NORTH ANNA 3 FSER

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ABBREVIATIONS

A&NS	alert and notification system
A2LA	American Association for Laboratory Accreditation
ac	alternating current
ACES	Automated Coastal Engineering System
ACI	American Concrete Institute
ACP	access control point
ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
ADB	ancillary diesel building
ADG	ancillary diesel generator
ADS	automatic depressurization system
AEA	Atomic Energy Act
AEOF	Alternate EOF
AF	amplitude function
AFT	as-found tolerance
AFU	air filtration unit AHEX
ALARA	as low as reasonably achievable
ANI	American Nuclear Insurers
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANSS	Advanced National Seismic System
AOO	anticipated operational occurrence
AOV	air-operated valve
API	American Petroleum Institute
AREOR	Annual Radiological Environmental Operating Report
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute
ASR	alkali-silica reactivity
ASTM	American Society of Testing and Materials
ATWS	anticipated transient without scram
B&V	Black & Veatch
BDBE	beyond-design-basis event
BE	best estimate
BL	bulletin
BPV	Boiler and Pressure Vessel
BPVC	Boiler and Pressure Vessel Code
BRE	bullet resisting enclosure
BTP	branch technical position
Btu	British thermal unit
BWR	boiling-water reactor
C	Celsius
cc	Cubic-centimeters

CAM	continuous air monitor
CAV	cumulative absolute velocity
CB	control building
CD-144	card deck-144 (format used in NCDC meteorological data)
CDA	critical digital asset
CDF	core damage frequency
CDI	conceptual design information
CEM	Coastal Engineering Manual
CENA	central and eastern North America
CEUS	central and eastern United States
CEUSSSC	Central and Eastern United States Seismic Source Characterization
CF	chemistry factor
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CHS	Charleston
CHV	Charlevoix
CIRC	circulating water system
CLSM	controlled low-strength material
cm	centimeter(s)
CMZ	Commerce fault zone
COCORP	Consortium for Continental Reflection Profiling
COL	combined license
COLA	combined license application
COOP	Cooperative Observation Program
CP	construction permit
CPS	condensate purification system
CPTs	cone penetrometer tests
CR	Coefficient Ratio-(SER Chapter 2)
CR	control room
CRD	control rod drive
CRHA	control room habitability area
CSTS	condensate storage and transfer system
CSAT	Cyber Security Assessment Team
CSDRS	certified seismic design response spectra
CSF	condensate storage facility
CSIRT	Cyber Security Incident Response Team
CSP	cyber security plan
CST	condensate storage tank
CVAP	Comprehensive Vibration Assessment Program
CVSZ	Central Virginia Seismic Zone
CWS	circulating water system
DAC	design acceptance criteria
DAW	dry active waste
DB	dry bulb
DBA	design-basis accident
DBE	design-basis event
DBT	design-basis threat
DBT	design basis tornado

DC	design certification
dc	direct current
DCA	Design certification application
DCD	design control document
DCF	damping correction factor
DCIS	distributed control and information system
DCR	design certification rule
DCRA	Design Centered Review Approach
DEM	digital elevation model
DG	diesel generator
DM	direct method
DMME	Virginia Department of Mines, Minerals and Energy
DOE	Department of Energy
Dominion	Dominion Virginia Power
DOT	Department of Transportation
DPV	depressurization valve
D-RAP	design reliability assurance program
DTE	Detroit Edison Company
DTPG	defined test plan group
DZO	depleted zinc oxide
EAB	exclusion area boundary
EAC	emergency alternating current
EAL	emergency action level
EAS	emergency alert system
ECC-AM	Extended Continental Crust – Atlantic Margin
ECCS	emergency core cooling system
ECGH	East Continent Gravity High
ECL	effluent concentration limit
ECRS	east continent rift system
ED	emergency director
EERI	Earthquake Engineering Research Institute
EDG	emergency diesel generator
EF	Enrico Fermi
ELAP	extended loss of alternating current power
EMD	emergency management division
EMDG	extensive damage mitigation guideline
EMI	electromagnetic interference
EMS	emergency medical service
ENS	emergency notification system
EOC	emergency operations center
EOF	emergency operations facility
EOL	end of life
EOP	emergency operating procedure
EP	emergency planning
EP	Emergency Preparedness
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 2005
EPG	emergency procedure guideline

EPIP	Emergency Plan Implementing Procedure
EPRI	Electric Power Research Institute
EPZ	emergency planning zone
EQ	environmental qualification
EQD	environmental qualification document
EQMEL	Environmental Qualification Master Equipment List
ER	environmental report
ERDS	emergency response data system
ERF	emergency response facility
ERO	emergency response organization
ESBWR	economic simplified boiling-water reactor
ESF	engineered safety feature
ESP	early site permit
ESP-003	North Anna 3 Early Site Permit
ETE	evacuation time estimate
ETS	emergency telecommunications system
ETSZ	Giles County Seismic Zone and Eastern Tennessee Seismic Zone
F	Fahrenheit
FAC	flow-accelerated corrosion
FAPCS	fuel and auxiliary pools cooling system
FATT	fracture appearance transition temperatures
FB	fuel building
FDA	Final Design Approval
FE	finite element
FEA	finite element analysis
FEIS	Final Environmental Impact Statement
FEM	finite element model
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFD	fitness for duty
FFS	free flow speed
FHA	fire hazards analysis
FHA	fuel handling accident
FIRS	foundation input response spectra
FIV	flow-induced vibration
FLEX	diverse and flexible coping strategy
FNPP	Fermi Nuclear Power Plant
FPS	fire protection system
FPWS	fire protection water system
FR	Federal Register
FRMAC	Federal Radiological Monitoring and Assessment Center
FRPP	fiberglass reinforced polyester pipe
FRS	floor response spectra
FS	factor of safety
FSAR	final safety analysis report
FSER	final safety evaluation report
ft	feet/foot
FTS	Federal Technology Services

FWSC	fire water service complex
g	acceleration of gravity
Ga	billion years ago
GALL	generic aging lessons learned
GCRP	Global Change Research Program
GDC	general design criterion/criteria
GDCS	gravity-driven cooling system
GE	General Electric
GEER	Geotechnical Extreme Events Reconnaissance
GEH	General Electric – Hitachi (Nuclear Energy)
GFTZ	Grenville Front Tectonic Zone
GI	generic issue
GIA	glacial isostatic adjustment
GL	generic letter
GLERL	Great Lakes Environmental Research Laboratory
GLIMPCE	Great Lakes International Multidisciplinary Program on Crustal Evolution
GMH	Great Meteor Hotspot
GMM	ground motion model
GMPE	ground motion prediction equation
GMRS	ground motion response spectrum
gpm	gallons per minute
GPS	global positioning system
GSI	generic safety issue
GSI	geological strength index
GTG	generic technical guidance
GTS	generic technical specification
GWMS	gaseous waste management system
hr	hour
HAB	hostile action based
HCLPF	high confidence of low probability of failure
HCU	hydraulic control unit
HEC	Hydrological Engineering Centers
HEC-HMS	Hydrological Engineering Centers-Hydrological Modeling System
HEPA	high-efficiency particulate air
HF	high frequency
HFE	human factors engineering
HFI	human factor issue
HMR	Hydrometeorological Report
HMS	Hydrological Modeling System
HPM	human performance monitoring
HPN	Health Physics Network
HPS	Health Physics Society
HRA	human reliability analysis
HUSWO	Hourly U.S. Weather Observations
HVAC	heating, ventilation, and air conditioning
HWCS	hydrogen water chemistry system
Hz	Hertz

I&C	instrumentation and control
IAS	International Accreditation Service
IBC	International Building Code
IBEB	Illinois Basin Extended Basement
IC	isolation condenser
IC/PCCS	isolation condenser/passive containment cooling system
ICS	isolation condenser system
IDLH	immediate danger to life and health
IE	inspection and enforcement
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFR	Interim finding report
IGLD	International Great Lakes Datum
ILAC	International Laboratory Accreditation Cooperation
IN	information notice
in.	inch(es)
INPO	Institute of Nuclear Power Operations
IPCS	integrated plant computer system
IR	intermediate range
ISFSI	independent spent fuel storage installation
ISG	interim staff guidance
ISHD	Integrated Surface Hourly Data
ISI	inservice inspection
ISRS	in-structure response spectra
IST	inservice testing
ITAAC	Inspections, tests, analyses, and acceptance criteria
ITC	International Transmission Company
ITP	initial test program
ITS	International Transmission Company
JFD	joint frequency distribution
JIC	joint public information center
JLD	Japan lesson-learned project directorate
JPIC	joint information center
ka	thousand years ago
Kd	Distribution Coefficients
KI	potassium iodide
km	kilometer(s)
kPa	kilopascals
kV	kilovolt
L-A-B	Laboratory Accreditation Bureau
LAN	local area network
LB	lower-bound
LBF	Long Branch fault
lb/ft2	pounds per square-foot
LCO	limiting condition for operation

LF	low frequency
LiDAR	light detection and ranging
LLNL	Lawrence Livermore National Laboratory
LLRW	low-level radioactive waste
LOA	Letters of Agreement
LOCA	loss-of-coolant accident
LOLA	loss of large area
LOOP	loss-of-offsite power
LOPP	loss of preferred power
Lpm	liter per minute
LPZ	low population zone
LR	lower-range
LSS	low strategic significance
LTOP	low temperature overpressure protection
LTR	licensing topical report
LTSP	limiting trip setpoint
LWMS	liquid waste management system
LWR	light water reactor
M	magnitude (earthquake)
Mmax	maximum magnitude
m	meter(s)
M&TE	measuring and test equipment
Ma	million years ago
MASR	minimum alternating stress ratio
MBtu	one million BTU
MC&A	material control and accounting
MCL	management counterpart link
MCPR	minimum critical power ratio
MCR	main control room
MCWB	mean coincident wet-bulb
MDCH	Michigan Department of Community Health
MDCT	mechanical draft cooling tower
MDEQ	Michigan Department of Environmental Quality
MEB	modified energy balance
MEI	maximally exposed individual
mi	material index
mi	mile(s)
MIDC	Midcontinent-Craton
MIS	marine isotope stage
MJ	megajoules
MMIS	man-machine interface system
MMP	Meteorological Monitoring Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOV	motor-operated valve
MPa	megapascals
MPaG	megapascals gauge
mph	miles per hour

MPSC	Michigan Public Service Commission
MR	maintenance rule
MRA	Mutual Recognition Arrangement
MRCSP	Midwest Regional Carbon Sequestration Partnership
Mrem	millirem
MRS	midcontinent rift system
MSM	modified subtraction method
MST	mitigative strategies table
MW	megawatt
NA3	North Anna 3
NAAQS	National Ambient Air Quality Standards
NACE	National Association of Corrosion Engineers
NAP	Northern Appalachian
NAPS	North Anna Nuclear Power Station (North Anna 3)
NAPS CDI	NA3 FSAR site specific info that replaces Conceptual Design information in DCD
NAPS COL	NA3 FSAR site specific info addressing a DCD COL Item
NAPS DEP	NA3 FSAR site specific info that departs from the DCD
NAPS ESP COL	ESP COL Action items identify an ESP COL Action Item
NAPS ESP COR	Corrections to ESP Information in FSAR.
NAPS ESP PC	ESP Permit Conditions that are addressed in FSAR.
NAPS ESP VAR	ESP Variance from design or terms of the ESP
NAPS SUP	Supplemental FSAR information that is plant-specific
NAVD	North American Vertical Datum
NCDC	National Climatic Data Center
NCS	nuclear criticality safety
ND	Nuclear Development
ND QAPD	Nuclear Development Quality Assurance Program document
N-DCIS	nonsafety-related distributed control and information system
NDCT	natural draft cooling tower
NDE	nondestructive examination
NDT	nil ductility temperature
NEDB	National Earthquake Database
NEHRP	National Earthquake Hazards Reduction Program
NEI	Nuclear Energy Institute
NEIC	National Earthquake Information Center
NERC	National Electric Reliability Council
NESC	National Electrical Safety Code
NFEMP	Nuclear Facilities Emergency Management Plan
NFPA	National Fire Protection Association
NGA	Next Generation Attenuation
NGVD	National Geodetic Vertical Datum
NIRMA	Nuclear Information and Records Management Association
NIST	National Institute of Standards and Technology
NMF	New Madrid fault
NMFS	New Madrid fault system
NMSZ	New Madrid Seismic Zone
NNE	north-northeast
NOAA	National Oceanic and Atmospheric Administration

NOC	Nuclear Operations Center
NPHS	normal power heat sink
NQA	nuclear quality assurance
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRO	Office of New Reactors
NS	non-seismic
NTTF	Near-Term Task Force
NUMARC	Nuclear Utilities Management and Resources Council
NWS	National Weather Service
OBE	operating-basis earthquake
OCA	owner controlled area
OCANS	owner controlled area notification system
ODCM	offsite dose calculation manual
OE	Owner's Engineer
OEM	original equipment manufacturer
OGS	offgas system
OIS	oxygen injection system
OM	Operation and Maintenance Code
ORE	occupational radiation exposure
ORO	offsite response organization
OSC	operational support center
OTV	optical televiewer
P&ID	piping and instrumentation diagram
P/T	pressure/temperature
PA	protected area
PA/PL	plant announcement (page)/party-line
PAA	protective action area
PABX	private automatic branch exchange
PAG	Protective Action Guide
PAM	post-accident monitoring
PAR	protective action recommendation
PAS	post-accident sampling
PASS	post-accident sampling system
PAT	power ascension test
PBSRS	performance-based surface response spectra
PCC	passive containment cooling
PCCS	passive containment cooling system
PCP	process control program
PCTMS	plant cooling tower makeup system
PEER	Pacific Earthquake Engineering Research
PERMS	process effluent radiation monitoring and sampling
PEZ	Paleozoic Extended Zone
PGA	peak ground acceleration
PGD	peak ground displacement
PGP	procedures generation package
PGV	peak ground velocity

PIP	plant investment protection
PMCL	protective measures counterpart link
PMF	probable maximum flood
PMH	probable maximum hurricane
PMP	probable maximum precipitation
PMT	probable maximum tsunami
PMWP	probable maximum winter precipitation
PMWS	probable maximum windstorm
PO	Purchase Orders
PORV	power-operated relief valve
POV	power-operated valve
ppb	parts per billion
PPS	preferred power supply
PRA	probabilistic risk assessment
PRMS	process radiation monitoring system
PSD	power spectral density
psf	pounds per square-foot
PSHA	probabilistic seismic hazard analysis
PSI	preservice inspection
psi	pounds per square inch
psia	pounds per square-inch absolute
psig	pound per square inch gauge
PSP	Physical Security Plan
PSS	process sampling system
PST	preservice testing
PSWS	plant service water system
PTLR	pressure and temperature limits report
PTS	plant-specific technical specifications
PWS	potable water system
PWSS	pretreated water supply system
QA	quality assurance
QAP	quality assurance program
QAPD	quality assurance program description
Q-DCIS	safety-related distributed control and information system
RAI	request for additional information
RAP	reliability assurance program
RAS	River Analysis System
RAT	reserve auxiliary transformer
RB	reactor building
RB/FB	reactor building & fuel building
RC	Recession Ratio
RCC	roller compacted concrete
RCCV	reinforced concrete containment vessel
RCCW	reactor closed-cooling water
RCCWS	reactor component cooling water system
R-COL	reference-COL
R-COLA	reference-COLA

RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RCTS	resonant column torsional shear
rem	roentgen equivalent man (a unit of radiation dose)
REMP	radiological environmental monitoring program
REP	radiological emergency preparedness
RERP	radiological emergency response preparedness
RET	radiological emergency team
RFI	radio frequency interference
RG	regulatory guide
RIS	regulatory issue summary
RLME	repeated large magnitude earthquake
RM	resolution method
RMS	radiation monitoring system
RO	reverse osmosis
RP	radiation protection
RPP	Radiation Protection Program
RQD	rock quality designations
RSCL	reactor safety counterpart link
RSW	reactor shield wall
RT	radiographic testing (or technique)
RTNDT	reference temperature nil ductility temperature
RTNSS	regulatory treatment of non-safety systems
RV	reactor vessel
RVSP	reactor vessel (materials) surveillance program
RWB	radwaste building
RWCU	reactor water cleanup
RWMS	radioactive waste management systems
RW-VS	radwaste building vent stack
s	second
SACTI	Seasonal/Annual Cooling Tower Impact
SAM	startup administrative manual
SAS	secondary alarm station
SASW	spectral analysis of surface wave
SAT	systems approach to training
SB	service building
SBO	station blackout
SCC	stress corrosion cracking
SCOR	soil column outcrop response
SCP	Safeguards Contingency Plan
SCRs	global study of earthquakes in stable continental regions
SDC	shutdown cooling
SDG	standby diesel generator
SDM	shutdown margin
SE	safety evaluation
SEC	Securities and Exchange Commission
SER	safety evaluation report
SFP	spent fuel pool

SFPC	spent fuel pool cooling
SGI	safeguards information
SL	stream gradient
SLC	standby liquid control
SLCS	standby liquid control system
SM	subtraction method
SNM	Special Nuclear Material
SNMPPP	Special Nuclear Material Physical Protection Plan
SOG	Seismic Owners Group
SPDS	safety parameter display system
SPT	standard penetration test
SR	surveillance requirement
SRI	select rod insert
SRM	staff requirements memorandum
SRO	senior reactor operator
SRP	Standard Review Plan
SRV/SV	safety relief valve/safety valve
SSAR	ESP site safety analysis report
SSC	structure, system, and component
SSCs	structures, systems and components
SSE	safe-shutdown earthquake
SSEMP	Safety, Security and Emergency Planning
SSEP	safety, security, and emergency preparedness
SSHAC	Senior Seismic Hazard Analysis Committee
SSI	soil-structure interaction
SSSI	structure-soil-structure interaction
SSW	south-southwest
Std	Standard
STS	standard technical specifications
SUNSI	Sensitive Unclassified Non-Safeguards Information
Sv	Sievert
SWMS	solid waste management system
SWS	station water system
SWST	station water storage tank
T&QP	Training and Qualification Plan
TAF	top of active fuel
TB	turbine building
TBS	turbine bypass system
TCCWS	turbine component cooling water system
TCP	traffic control point
TEDE	total effective dose equivalent
TG	Technical Guide
TGCS	turbine generator control system
TGSS	turbine gland seal system
THA	time-history accelerograph
TLD	thermoluminescent dosimeter
TMI	Three Mile Island
TMSS	turbine main steam system

TR	technical report
TS	technical specifications
TSC	technical support center
TSCR	truncated soil column response
TSTF	Technical Specifications Task Force
UAT	unit auxiliary transformer
UB	upper-bound
UC	unconfined compression
UHF	ultra-high frequency
UHRS	uniform hazard response spectra
UHS	ultimate heat sink
UPS	uninterruptible power supply
UR	upper-range
US	United States
USACE	U.S. Army Corps of Engineers
US-APWR	U.S. Advanced Pressurized Water Reactor
USCG	United Sates Coast Guard
USGS	United States Geological Survey
USI	unresolved safety issue
USNRC	United States Nuclear Regulatory Commission
UT	ultrasonic technique
UTM	Universal Transverse Mercator
V&V	verification and validation
V	volt
V/H	vertical-to-horizontal
Vac	volt alternating current
VBS	vehicle barrier system
Vdc	volt direct current
VEPCO	Virginia Electric and Power Company
VHRA	very high radiation area
Vp	compression wave velocity
Vpc	volt per cell
Vs	shear wave velocity
WB	wet bulb
WHTF	waste heat treatment facitlity
ZIS	zinc injection system

ABSTRACT

This final safety evaluation report[1] (FSER) documents the U.S. Nuclear Regulatory Commission (NRC or the Commission) staff's technical review of the combined license (COL) application (COLA) submitted by Dominion Virginia Power (Dominion) [2] (Dominion, or the applicant), for North Anna 3.

In a letter dated November 26, 2007, the Dominion submitted its application to the NRC for a COL to construct and operate a General Electric-Hitachi Economic Simplified Boiling-Water Reactor (ESBWR) pursuant to the requirements of Section 103 and 185(b) of the *Atomic Energy Act of 1954 as Amended (AEA),* Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications and Approval for Nuclear Power Plants," and the associated material licenses under 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material"; 10 CFR Part 40, "Domestic Licensing of Source Material"; and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material." This reactor will be identified as North Anna 3 and will be located on the existing North Anna Power Station site (North Anna site) in Louisa County, Virginia, approximately 40 miles north northwest of Richmond, Virginia.

As indicated in the applicant's November 26, 2007 submittal, the application incorporated by reference Revision 4 of the ESBWR Design Control Document (DCD) and Revision 9 of the North Anna 3 Early Site Permit (ESP) for the North Anna 3 site. The NRC issued the North Anna ESP (ESP-003) on November 27, 2007 based on Revision 9 of the ESP application (ADAMS Accession No. ML073180421).

By letter dated June 28, 2010, Dominion revised its application to incorporate by reference the Mitsubishi Heavy Industries', Ltd. United States – Advanced Pressurized Water Reactor (US-APWR). By letter dated April 25, 2013, Dominion notified the staff that it planned to revert back to ESBWR reactor technology for its North Anna 3 COLA. Dominion then submitted a revised application that incorporated by reference the ESBWR DCD, Revision 9 by letter dated December 18, 2013.

By letter dated June 24, 2014, Dominion submitted a revised application that incorporated by reference the ESBWR DCD, Revision 10. In a letter dated January 23, 2015, Dominion followed the design center approach and reviewed the Detroit Edison Company Fermi 3 COLA updates (ADAMS Accession Nos. ML14295A354 and ML14308A337) that reflected the changes to the Fermi 3 COLA incorporating by reference the codified version of the ESBWR design certification rule (DCR) which is contained in 10 CFR Part 52, Appendix E, "Design Certification Rule for the U.S. Economic Simplified Boiling Water Reactor." The ESBWR DCR was published on October 15, 2014 (79 FR 61944) and is effective as of November 14, 2014. The ESBWR DCR references Revision 10 of the ESBWR DCD.

This FSER presents the results of the staff's review of information submitted in conjunction with the North Anna 3 COLA, except those matters resolved as part of the referenced design certification rule. In Appendix A to this FSER, the staff has identified certain license conditions and inspections, tests, analyses and acceptance criteria (ITAAC) that the staff recommends the Commission impose, should the COL be issued to the applicant. In addition to the ITAAC in Appendix A, the ITAAC found in the

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[1] This FSER documents the NRC staff's position on all safety issues associated with the combined license application. The Advisory Committee on Reactor Safeguards (ACRS) independently reviewed those aspects of the application that concern safety, as well as the advanced safety evaluation report without open items (an earlier version of this document), and provided the results of its review to the Commission in a report dated November 15, 2016. This report is included as Appendix F to this SER.

ESBWR DCD Revision 10 Tier 1 material will also be incorporated into the COL should the COL be issued to the applicant.

On the basis of the staff's review[2] of the application, as documented in this FSER, the staff recommends that the Commission find the following with respect to the safety aspects of the COL application: 1) the applicable standards and requirements of the Atomic Energy Act and Commission regulations have been met, 2) required notifications to other agencies or bodies have been duly made, 3) there is reasonable assurance that the facility will be constructed and will operate in conformity with the license, the provisions of the Atomic Energy Act, and the Commission's regulations, 4) the applicant is technically and financially qualified to engage in the activities authorized, and 5) issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

[2] An environmental review was also performed of the COL application and its evaluation and conclusions are documented in NUREG-2105, "Final Supplemental Environmental Impact Statement for Combined License (COL) for North Anna 3."

1.0 INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

1.0 INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff overview of the North Anna 3 Combined License (COL) application (COLA), the COL applicants design, site plan, material licenses, application submittal information, financial qualifications and the staff review principals and regulations. This chapter of the SER is organized as follows:

- Section 1.1 provides an overview of the North Anna 3 COLA.
- Section 1.2 provides the regulatory basis for the COL licensing process.
- Section 1.3 provides an overview of the principal review matters in the COLA and where the staff's reviews of the ten parts of the COLA are documented.
- Section 1.4 documents the staff's review of Chapter 1 of the Final Safety Analysis Report (FSAR).
- Section 1.5 documents the staff's review of other regulatory considerations for Chapter 1.

1.1 Summary of Application

By letter dated November 26, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073320913), Dominion Virginia Power (Dominion) submitted its application to the NRC for a COL to construct and operate a General Electric-Hitachi Economic Simplified Boiling-Water Reactor (ESBWR) at North Anna Power Station site (North Anna site) pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certification, and Approvals for Nuclear Power Plants," and the associated material licenses under 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material," 10 CFR Part 40, "Domestic Licensing of Source Material," and 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

The ESBWR nuclear reactor design is a 4,500-megawatt thermal reactor that uses natural circulation for normal operations and has passive safety features. This reactor will be identified as North Anna 3 and will be located on Dominion's existing North Anna site in Louisa County, Virginia, approximately 40 miles north northwest of Richmond, Virginia. There are two existing nuclear reactors in operation at the North Anna site, as well as an Independent Spent Fuel Storage Installation (ISFSI). North Anna 3 will be located adjacent to and generally west of the existing units on the North Anna site.

As indicated in the applicant's November 26, 2007 submittal, the application incorporated by reference Revision 4 of the ESBWR Design Control Document (DCD) and Revision 9 of the North Anna 3 Early Site Permit (ESP) for the North Anna 3 site. The NRC issued the North Anna ESP (ESP-003) on November 27, 2007 based on Revision 9 of the ESP application (ADAMS Accession No. ML073180421).

By letter dated June 28, 2010, Dominion revised its application to incorporate by reference the Mitsubishi Heavy Industries', Ltd. United States – Advanced Pressurized Water Reactor

(US-APWR) technology to construct and operate at the North Anna 3 site. By letter dated April 25, 2013, Dominion notified the staff that it planned to revert back to ESBWR reactor technology for its North Anna 3 COLA. Dominion then submitted a revised application that incorporated by reference the ESBWR DCD, Revision 9 by letter dated December 18, 2013.

By letter dated June 24, 2014, Dominion submitted a revised application that incorporated by reference the ESBWR DCD, Revision 10. In a letter dated January 23, 2015, Dominion followed the design center approach and reviewed the recent Detroit Edison Company Fermi 3 COLA updates (ADAMS Accession Nos. ML14295A354 and ML14308A337) that reflected the changes to the Fermi 3 COLA incorporating by reference the codified version of the ESBWR design certification rule (DCR) which is contained in 10 CFR Part 52, Appendix E, “Design Certification Rule for the U.S. Economic Simplified Boiling Water Reactor.” The ESBWR DCR was published on October 15, 2014 (79 FR 61944) and is effective as of November 14, 2014. The ESBWR DCR references Revision 10 of the ESBWR DCD.

In developing the Final Safety Evaluation Report (FSER) for North Anna 3, the staff reviewed the ESBWR DCD, Revision 10 and the North Anna ESP to ensure that the combination of the information in the DCD and the information in the COLA represents the complete scope of information relating to a particular review topic.

There is a North Anna 3 FSER chapter that was issued without a corresponding ESBWR DCD chapter. Specifically, North Anna 3 FSER Chapter 20, “Requirements Resulting from Fukushima Near-Term Task Force Recommendations,” does not have a corresponding ESBWR DCD Chapter 20. The FSER Chapter 20 describes the staff’s evaluation and findings for the requirements resulting from the Fukushima Near-Term Task Force recommendations that are applicable to the North Anna 3 COL. The applicable recommendations address the following four topics:

- A re-evaluation of the seismic hazard (related to Recommendation 2.1).
- Mitigation strategies for beyond-design-basis external events (related to Recommendation 4.2).
- Spent fuel pool instrumentation (related to Recommendation 7.1).
- Emergency preparedness (EP) staffing and communications (related to Recommendation 9.3).

For more information on the staff’s review of the above four topics, please refer to Chapter 20 of this SER.

The North Anna 3 COLA is organized as follows:

- **Part 1 General and Administrative Information**

  Part 1 provides an introduction to the application and includes certain corporate information regarding Dominion pursuant to 10 CFR 50.33(a)–(d).

- **Part 2 Final Safety Analysis Report**

  Part 2 contains information pursuant to the requirements of 10 CFR 52.79 “Contents of applications; technical information in final safety analysis report,” and, in general, adheres to the content and format guidance in Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition).”

- **Part 3 Environmental Report**

  Part 3 contains environmental-related information pursuant to the requirements of 10 CFR 52.80, “Contents of applications; additional technical information,” and 10 CFR 51.50(c).

- **Part 4 Technical Specifications and Bases**

  Part 4 addresses how the ESBWR generic technical specifications (TS) and bases of the design are incorporated by reference into the North Anna 3 plant-specific TS and bases.

- **Part 5 Emergency Plan**

  Part 5 contains the North Anna 3 Emergency Plan with supporting information such as evacuation time estimates for the North Anna 3 plume exposure pathway and applicable offsite state and local emergency plans.

- **Part 6 [Not Used - reserved for Limited Work Authorization/site redress information]**

- **Part 7 Departures Report**

  Part 7 contains information from the applicant regarding departures, exemptions, and variances from the ESBWR DCD and the North Anna ESP accordingly. The departures, exemptions, and variances are all evaluated by the staff within their respective SER sections. However, the applicant has included one exemption request from 10 CFR 70.22(c); 70.32(c); 74.31, “Nuclear material control and accounting for special nuclear material of low strategic significance”; 74.41, “Nuclear material control and accounting for special nuclear material of moderate strategic significance”; and 74.51, “Nuclear material control and accounting for strategic special nuclear material.” The staff evaluated this exemption request in Section 1.5.5 of this SER chapter.

- **Part 8 Safeguards and Security Plans**

  Part 8 was submitted concurrent with the application to the NRC as separate licensing correspondence in order to fulfill the requirements of 10 CFR 52.79(a)(35) and 10 CFR 52.79(a)(36). Part 8 contains the North Anna 3 Security Plan and Safeguards Information (SGI) that is withheld from public disclosure pursuant to 10 CFR 73.21, “Protection of Safeguards Information: Performance Requirements.” The information in Part 8 consists of the Physical Security Plan, the Training and Qualification Plan, the Safeguards Contingency Plan, the Cyber Security Plan, the Mitigative Strategies Description and Plans, and the Special Nuclear Material Physical Protection Program. Portions of Part 8 contain Security-Related information and are withheld from public disclosure pursuant to 10 CFR 2.390, “Public inspections, exemptions, requests for withholding.”

- **Part 9 [Not used – Reserved for Withheld Information]**

- **Part 10 ITAAC**

  Part 10 contains the applicant’s Tier 1 information incorporated by reference from the ESBWR DCD. This part also contains the North Anna 3 Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). The entire set of North Anna 3 COL ITAAC are addressed in four parts: (1) Design Certification (DC), (2) Emergency Planning, (3) Physical Security, and (4) Site-Specific. In addition, Part 10 includes a list of proposed license conditions from the applicant.

1.2 Regulatory Basis

1.2.1 Applicable Regulations

10 CFR Part 52, Subpart C, “Combined Licenses,” establishes the requirements and procedures applicable to the Commission-issued COL for nuclear power facilities. The following requirements are of particular significance:

- 10 CFR 52.79, identifies the technical information required in the FSAR.
- 10 CFR 52.79(d) provides additional requirements for a COL referencing a standard certified design.
- 10 CFR 52.80, provides additional technical information outside of the FSAR (ITAAC and the environmental report).
- 10 CFR 52.81, “Standards for review of applications,” provides standards for reviewing the application.
- 10 CFR 52.83, “Finality of referenced NRC approvals; partial initial decision on site suitability,” provides for the finality of the referenced NRC approvals (e.g., standard DC approvals).
- 10 CFR 52.85, “Administrative review of applications; hearings,” provides requirements for administrative reviews and hearing.
- 10 CFR 52.87, “Referral to the Advisory Committee on Reactor Safeguards (ACRS),” provides for referral to the ACRS.

The staff reviewed this application according to the following requirements:

- 10 CFR Part 20, “Standards for Protection Against Radiation”
- 10 CFR Part 30
- 10 CFR Part 40

- 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”

- 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”

- 10 CFR Part 52

- 10 CFR Part 54, “Requirements for Renewal of Operating Licenses for Nuclear Power Plants”

- 10 CFR Part 55, “Operators’ Licenses”

- 10 CFR Part 70

- 10 CFR Part 73, “Physical Protection of Plants and Materials”

- 10 CFR Part 74, “Material Control and Accounting of Special Nuclear Material”

- 10 CFR Part 100, “Reactor Site Criteria”

- 10 CFR Part 140, “Financial Protection Requirements and Indemnity Agreements”

The staff evaluated the application against the guidance and acceptance criteria in the following:

- NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)”

- NUREG–1520, “Standard Review Plan for Fuel Cycle Facilities License Applications”

- NUREG–1555, Revision 1: “Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan (with Supplement 1 for Operating Reactor License Renewal)”

- NUREG–1556, “Consolidated Guidance About Materials Licenses”

- NUREG–1577, “Standard Review Plan on Power Reactor Licensee Financial Qualifications and Decommissioning Funding Assurance”

In addition, the staff considered the format and content guidance in RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” for the COLA.

1.2.2 Finality of Referenced NRC Approvals

The North Anna 3 COL references the codified version of the ESBWR DCD (ESBWR DCD, Revision 10). The regulatory basis of the information incorporated by reference is addressed in NUREG–1966, the FSER related to the certified ESBWR DCD (ADAMS Accession No. ML103470210) and NUREG–1966, Supplement 1 (ADAMS Accession No. ML14265A084). In addition, the North Anna 3 COLA references the North Anna ESP Site Safety Analysis Report (SSAR), Revision 9. The ESP was issued by the NRC on November 27, 2007. The staff documented its review of the North Anna 3 ESP SSAR in NUREG–1835 (ADAMS Accession

No. ML052710305), the staff FSER for the North Anna 3 ESP and NUREG–1835, Supplement 1 (ADAMS Accession No. ML063170371). In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the North Anna 3 COLA and the associated acceptance criteria, are given in NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," (SRP) (54 FR 31268).

Based on the finality afforded to referenced certified designs and ESPs, the scope of this COLA review, as it relates to the referenced certified design and ESP, is limited to items that fall outside the scope of the certified design (e.g., COL information items, design information replacing conceptual design information (CDI), and programmatic elements that are the responsibility of the COL) or the ESP. During its evaluation of the COLA, the staff confirmed that the complete set of information required to be addressed in the COLA was addressed in the DC or referenced ESP, the DC or ESP as supplemented by the COLA, or completely in the COLA. Following this confirmation, the staff's review of the COLA is limited to the COL-specific review items.

In accordance with 10 CFR 52.83, if the application for a COL references a DCD or ESP, the scope and nature of matters resolved for the application and any COL issued are governed by the applicable relevant provisions. For the ESBWR DCD, finality is specifically addressed in 10 CFR 52.63, "Finality of standard design certifications." In addition, if the application for a COL references an ESP, the scope and nature of matters resolved in the ESP for the application and any COL issued are governed by 10 CFR 52.39, "Finality of early site permit determinations."

The contents of the FSAR are specified in 10 CFR 52.79(a), which requires the information submitted in the FSAR to describe the facility; identify the design bases and the limits on its operation; and present a safety analysis of the structures, systems, and components (SSCs) of the facility as a whole. For a COLA that references a DC, Section 52.79(d) requires the DCD to be included in or incorporated by reference into the FSAR. Additionally, a COLA that references a DC must also contain the information and analysis required to be submitted within the scope of the COLA but is outside the scope of the DCD. This combined information addresses plant- and site-specific information and includes all COL action or information items; design information that replaces CDI; and programmatic information that was not reviewed and approved in connection with the DC rulemaking.

For a COLA that references an ESP, Section 52.79(b) requires; that the ESP SSAR to be included in or incorporated by reference into the FSAR, that information and analyses that demonstrate that the design of the facility fall within the North Anna site and design characteristics specified in the ESP, and that application must include any updates or changes related to any previously approved emergency plans.

The initial step in the staff's evaluation of the COLA is to confirm that the complete set of information required to be addressed in the COLA is also in the DC or ESP as supplemented by the COLA or completely included in the COLA. Following this confirmation, the staff's review of the COLA is limited to the COL review items. This FSER is based on the applicant's Revision 8 of the North Anna 3 FSAR, which incorporates by reference ESBWR DCD, Revision 10. In addition the changes to the North Anna 3 site-specific seismic hazard evaluation were confirmed by the staff in the North Anna 3 FSAR Revision 9, submitted in June 2016, which considered the latest seismic hazards information as described in this SER for North Anna 3, Chapter 3, Section 3.7, Section 3.8 and Chapter 2, Section 2.5.2. The results of the staff's technical evaluation of the ESBWR DCD application are in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design" (ADAMS Accession No. ML14100A304), and its Supplement 1 (ADAMS Accession No. ML14265A084).

The outcome of the ESBWR DC rulemaking was previously tracked as Open Item 1-1. This rulemaking has been completed and the application and the staff's safety evaluations have been updated accordingly. This Open Item is now considered closed.

1.2.3 Overview of the Design-Centered Review Approach

The design-centered review approach (DCRA) is described in Regulatory Issue Summary 2006-06, "New Reactor Standardization Needed to Support the Design-Centered Licensing Review Approach." The DCRA is endorsed by the Commission's Staff Requirements Memorandum SECY-06-0187, "Semiannual Update of the Status of New Reactor Licensing Activities and Future Planning for New Reactors," dated November 16, 2006. The DCRA is the Commission's policy intended to promote a standardization of COLAs; it is beyond the scope of information included in the DC. This policy directs the staff to perform one technical review for each standard issue outside the scope of the DC and to use this decision to support decisions on multiple COLAs. In this context, "standard" refers to essentially identical information and may include information provided by the applicant(s) to resolve plant-specific issues.
The first COLA submitted for the staff to review is designated in a design center as the referenced COL (R-COL) application, and the subsequent applications in the design center are designated as subsequent COL (S-COL) applications. The North Anna 3 COLA was originally designated as the R-COLA for the ESBWR design center, and the staff issued an SER with open items that documented a review of both standard and site-specific information. In a letter dated May 18, 2010, Dominion Energy, Inc. informed the NRC that it had changed reactor technology and had selected the US-APWR for its North Anna 3 COLA. As a result of Dominion's decision, for the Fermi 3 COLA, Detroit Edison responded to all of the open items in the staff's North Anna 3 SER that related to standard content on behalf of the ESBWR design center and consistent with its new position as the R-COL for the ESBWR design center.[1] Thus, the Final SER for the Fermi 3 COL documents the staff's review of both standard and site-specific information and is the first complete SER for a COLA in the ESBWR design center.

In a letter dated January 23, 2015, Dominion followed the design center approach and reviewed the recent Detroit Edison Company Fermi 3 COLA Revision 8 updates (ADAMS Accession Nos. ML14295A354 and ML14308A337) that reflected the changes to the Fermi 3 COLA incorporating by reference the codified version of the ESBWR DCD.

To ensure that the staff's findings on standard content that were documented in the Final SER for the Fermi 3 COLA are equally applicable to the North Anna 3 COLA, the staff undertook the following reviews:

[1] By letter dated April 25, 2013 (ADAMS Accession No. ML13120A016), the applicant for the North Anna 3 COL application informed the NRC that it had revised its technology selection and selected the General Electric (GEH) ESBWR nuclear technology for the North Anna 3 project. The applicant submitted a revised North Anna 3 COL application to the NRC on July 31, 2013 (ADAMS Accession No. ML13221A504). However, the Fermi COL application remains as the ESBWR design center R-COL.

- The staff compared the North Anna 3 COL FSAR, Revision 8, to the Fermi 3 COL FSAR Revision 8. In performing this comparison, the staff considered changes to the Fermi 3 COL FSAR (and other parts of the COLA, as applicable) resulting from requests for additional information (RAIs) and open and confirmatory items identified in the Fermi 3 SER with open items.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation (the Fermi 3 FSER) were endorsed.

- The staff verified that the site-specific differences are not relevant.

Where there were differences between the information provided by the Fermi 3 applicant and that provided by the North Anna 3 applicant regarding details in the application for the standard content material, the staff evaluated the differences and determined whether the standard content material of the Fermi 3 FSER was still applicable to the North Anna 3 application. These evaluations are in the SERs that reference the standard content. In various portions of this SER, the technical review of the related standard content material is identified by using italicized, double-indented formatting.

1.3 Principal Review Matters

The staff's evaluations related to the COLA review are addressed as follows:

- **Part 1 General and Administrative Information**

The staff's evaluation of the corporate information regarding Dominion that is pursuant to 10 CFR 50.33, "Contents of applications; general information," is in Section 1.5.1 of this SER.

- **Part 2 Final Safety Analysis Report**

The staff's evaluation of information in the North Anna 3 FSAR is in the corresponding sections of this SER.

- **Part 3 Environmental Report**

The staff's evaluation of environmental information pursuant to the requirements of 10 CFR 51.50(c) addressed in the environmental report is in the staff's Supplemental Environmental Impact Statement in NUREG–1917, "Supplemental Environmental Impact Statement for Combined License (COL) for North Anna Power Station Unit 3."

- **Part 4 Technical Specifications**

Chapter 16 of this SER contains the staff's evaluation of the North Anna 3 plant-specific TS (PTS), and the associated PTS bases.

- **Part 5 Emergency Plan**

Chapter 13 of this SER includes the staff's evaluation of the North Anna 3 Emergency Plan, including related ITAAC, and the Federal Emergency Management Agency's review of State and local emergency plans.

- **Part 6** **[Not Used - reserved for Limited Work Authorization/site redress information]**

- **Part 7** **Departures Report**

The staff's evaluation of departures and exemptions is provided in the applicable chapters of this SER (i.e., Chapters 1 through 19). In addition, the staff's review of one requested exemption is included in Section 1.5.4 of this SER. Any associated exemptions are granted separately from this SER.

- **Part 8** **Safeguards and Security Plans**

The information in Part 8 consists of the Physical Security Plan, the Training and Qualification Plan, the Safeguards Contingency Plan, the Cyber Security Plan, the Mitigative Strategies Description and Plans, and the Special Nuclear Material Physical Protection Program. Portions of Part 8 contain Security-Related information and are withheld from public disclosure pursuant to 10 CFR 2.390. The staff's evaluation of the sensitive information, withheld information in Part 8 occurs in the context of the specific subject being reviewed and is documented by the staff accordingly throughout the staff's SER.

The staff's evaluation of the North Anna 3 Security Plan and SGI is documented separately from this SER and is withheld from the public in accordance with 10 CFR 73.21. A non-sensitive summary of the staff's evaluation is in Section 13.6 of this SER.

The applicant has included withheld portions of the applicant's Cyber Security Plan as required by 10 CFR 73.54, "Protection of digital computer and communication systems and networks." The staff's evaluation of the cyber security-related plans is included in SER Section 13.8.

The applicant has provided withheld portions of the Mitigative Strategies Description and Plans for the loss of large areas of the plant due to explosions or fire, as required by 10 CFR 52.80(d). A summary of the staff's evaluation of this information is in Appendix 19A of this SER. The staff's complete evaluation is documented separately from this SER and is withheld from the public in accordance with 10 CFR 2.390. The applicant has provided withheld portions of the Special Nuclear Material Physical Protection Program as required by 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance." A summary of the staff's evaluation of this information is in SER Section 1.6.

- **Part 9** **[Not used – Reserved for Withheld Information]**

- **Part 10** **ITAAC and Proposed License Conditions**

Chapter 14 of this SER contains the staff's evaluation of the ITAAC, except for the Physical Security ITAAC in SER Section 13.6. In addition, Part 10 of the application includes a list of proposed license conditions that are evaluated by the staff throughout this SER. At the completion of the staff's North Anna 3 COLA review, the staff will identify all proposed license conditions and ITAAC for recommendation that the Commission should impose if a COL is issued to the applicant.

Organization of SER

The staff's SER is structured as follows:

- The SER adheres to the "finality" afforded to COLAs that incorporate by reference a standard certified design or ESP. As such, rather than repeat any technical evaluation of material incorporated by reference, this SER points to the corresponding review findings of NUREG–1966, NUREG–1811, "Final Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site," and NUREG–1917 "Supplemental Environmental Impact Statement for the Combined License (COL) for North Anna Power Station Unit 3). However, the referenced ESBWR DCD, ESP and the North Anna 3 COL FSAR are considered in the staff's safety evaluation—to the extent necessary—to ensure that the expected scope of information to be included in a COLA is adequately addressed in the DCD, ESP and/or in the COL FSAR.

- For sections that were completely incorporated by reference without any supplements or departures, the SER simply points to the ESBWR DCD and the related NUREG–1966 to confirm that all relevant review items are addressed in the ESBWR DCD and the staff's evaluation is documented in NUREG–1966.

- Staff made its safety determinations on specific COLA items based on the applicants FSAR revision and the DCD revision in which final staff conclusions were made. For example the staff SER with Open Items was based on FSAR Revision 2 and DCD Revision 5. Open items were closed and information confirmed based on FSAR Revision 8 and DCD Revision 10. The final FSAR Revision 9, submitted in June, 2016 included all changes based on staff review of final confirmatory items principally from the seismic re-evaluations changes and confirmed by the staff as discussed in the staff FSER for North Anna 3.

- For subject matter within the scope of the COLA that supplements or departs from the DCD, this SER generally follows a six-section organization as follows:

  - "Introduction," which provides a brief overview of the specific subject matter.

  - "Summary of Application," which identifies whether portions of the review have received finality and clearly identify the scope of the COL review.

  - "Regulatory Basis," which identifies the regulatory criteria for the information addressed by the COLA.

  - "Technical Evaluation," which focuses on the information addressed by the COLA.

  - "Post Combined License Activities," which identifies the proposed license conditions, the ITAAC, or the FSAR information commitments that are post COL activities.

  - "Conclusion," which summarizes how the technical evaluation resulted in a reasonable assurance determination by the staff on the basis that the relevant acceptance criteria have been met.

1.4 Staff Review of North Anna 3 COL FSAR Chapter 1:

1.4.1 Introduction

There are two types of information in Chapter 1 of the North Anna 3 COL FSAR:

- General information that enables the reviewer or reader to obtain a basic understanding of the overall facility without having to refer to the subsequent chapters. A review of the remainder of the application can then be completed with a better perspective and recognition of the relative safety significance of each individual item in the overall plant description.

- Specific information relating to qualifications of the applicant, construction impacts, and regulatory considerations that applies throughout the balance of the application (e.g., conformance with the acceptance criteria in the SRP).

This section of the Chapter 1 SER (1) identifies the information in Chapter 1 incorporated by reference, (2) summarizes all of the new information, and (3) documents the staff's evaluation of the sections addressing regulatory considerations.

1.4.2 Summary of Application

The information related to COL and supplemental (SUP) items included in Chapter 1 of the North Anna 3 COL FSAR includes either statements of fact or information recommended in RG 1.206. No staff technical evaluation was necessary where the statements were strictly background information. However, where technical evaluation of these COL/SUPs was necessary, the evaluation is not in this SER section, but in subsequent sections as referenced below.

<u>Section 1.1 – Introduction</u>

Section 1.1 of the North Anna 3 FSAR, Revision 8, incorporates by reference Section 1.1 of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.1, the applicant provides the following:

<u>COL Item:</u>

- NAPS COL 1.1-1-A

The applicant provides information regarding the site-specific values for the North Anna 3 power output.

<u>Supplemental Information:</u>

- NAPS SUP 1.1-1 and NAPS SUP 1.1-2

The applicant provides supplemental information that includes general information regarding format and content of the application. The applicant provides a description of incorporating by reference the North Anna ESPA (Early Site Permit Application) SSAR. The applicant also identifies systems and structures outside the scope of the ESBWR standard plant that are discussed in the applicable chapter (i.e., Chapters 2 through 20) of this SER.

- NAPS SUP 1.1-3

The applicant indicates that the Virginia Electric and Power Company was submitting the application to the NRC under Section 103 of the Atomic Energy Act of 1954, as amended, (the Act) to construct and operate a nuclear plant to be located on the existing North Anna site in Louisa County, Virginia.

- NAPS SUP 1.1-4

The applicant incorporates by reference the North Anna ESPA SSAR Section 2.1.1.1 to provide a description of the plant location.

- NAPS SUP 1.1-5

The applicant provides the anticipated schedule for the construction and operation of the North Anna 3 plant.

Conceptual Design Information:

- NAPS CDI

The applicant indicates that FSAR Figure 2.1-201 provides the orientation of the principal North Anna 3 plant structures.

Section 1.2 – General Plant Description

Section 1.2 of the North Anna 3 FSAR, Revision 8, incorporates by reference Section 1.2 of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.2, the applicant provides the following:

Departure Not Requiring NRC Approval:

- NAPS DEP 11.4-1

The applicant states that the radwaste building is configured to accommodate at least 10 years of packaged Class B and Class C waste and approximately 3 months of packaged Class A waste based on routine operations and anticipated operational occurrences. The applicant also provides the revised radwaste building elevation plans in Figures 1.2-21R to 1.2-25R, which contain security-related information and are therefore withheld under 10 CFR 2.390. This departure is discussed and reviewed in Chapter 11 of this SER.

Supplemental Information:

- STD SUP 1.2-1

The applicant provides a general statement regarding modular construction techniques to be used during ESBWR construction.

Conceptual Design Information:

- STD and NAPS CDI

The applicant provides CDI regarding the general plant descriptions of the main turbine, main condenser, plant service water system, hydrogen water chemistry system, zinc injection system, and freeze protection as well as other building structures. This information is discussed in the applicable chapter (i.e., Chapters 2 through 20) of this SER.

Section 1.3 – Comparison Tables

Section 1.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.3, "Comparison Tables", of the ESBWR DCD, Revision 10. In addition, in COL FSAR Section 1.3 the applicant provides the following:

Departure Requiring NRC Approval:

- NAPS DEP 3.7-1

The applicant has provided information for a departure regarding ground response spectra for seismic structural loads and floor response spectra in Table 1.3-4R "Comparison of Structural Design Characteristics." This departure is discussed and reviewed in Chapter 3 and Section 3.7 of this SER.

COL Item:

- NAPS COL 1.3-1-A

The applicant states that there are no updates to DCD Tier 2, Table 1.3-1 based on unit-specific information.

Section 1.4 – Identification of Agents and Contractors

Section 1.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.4, "Identification of Agents and Contractors", of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.4, the applicant provides the following:

Supplemental Information:

- NAPS SUP 1.4-1

The applicant provides additional information to identify Dominion (the applicant) as the licensee and operator of North Anna 3. Dominion also identifies GE-Hitachi Nuclear Energy Americas, LLC (GEH) as the primary contractor for the design of the unit, preparation of the COLA, and will support deployment of the ESBWR design on the North Anna 3 site. Dominion has identified Fluor Corporation (Flour) as the primary contractor for site engineering, along with construction of the turbine island and the nuclear island. Other contractors are listed for the environmental, geotechnical, and seismic hazard analysis support.

Section 1.5 Requirements for Further Technical Information

Section 1.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.5 of the ESBWR DCD, Revision 10.

Supplemental Information:

- CWR SUP 1.5-1

The applicant provides information regarding Post-Fukushima Near-Term Task Force Recommendations.

Section 1.6 – Material Incorporated by Reference

Section 1.6 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.6, "Material Incorporated By Reference," of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.6, the applicant provides the following:

Supplemental Information:

- NAPS SUP 1.6-1

Table 1.6-201 lists technical reports (TRs) not included in DCD Section 1.6 that are incorporated by reference in whole or in part into the North Anna 3 FSAR.

Section 1.7 – Drawings and Other Detailed Information

Section 1.7 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.7 of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.7, the applicant provides the following:

Departures Requiring NRC Approval:

- NAPS DEP 8.1-1

The applicant has provided information for a departure regarding the electrical power distribution system in FSAR Table 1.7-201. This departure is discussed and reviewed in Chapter 8 of this SER.

- NAPS DEP 12.3-1

The applicant has provided information for a departure regarding the liquid radwaste effluent discharge piping flow path in FSAR Table 1.7-202. This departure is discussed and reviewed in Chapters 11 and 12 of this SER.

Departure Not Requiring NRC Approval:

- NAPS DEP 11.4-1

The applicant has provided information for a departure regarding the long-term, temporary storage of Class B and C low-level radioactive waste in FSAR Table 1.7-202. This departure is discussed and reviewed in Chapter 11 of this SER.

Supplemental Information:

- NAPS SUP 1.7-1

FSAR Table 1.7-201 supplements DCD Table 1.7-2 for those portions of the electrical system configuration drawings outside the scope of the DCD. FSAR Table 1.7-202 supplements DCD Table 1.7-3 for those portions of the mechanical system configuration drawings outside the scope of the DCD. In addition, COL Item 1.7-1-H was deleted from the referenced DCD.

Section 1.8 – Interfaces with Standard Design and Early Site Permits

Section 1.8 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.8, “Interfaces with Standard Design,” of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.8, the applicant provides the following:

Supplemental Information:

- NAPS SUP 1.8-1

The applicant states that information in FSAR Chapter 2 demonstrates that the site characteristics fall within the ESBWR site parameters specified in the referenced certified design. The applicant also states that FSAR Chapter 2 provides information that the facility falls within the North Anna site characteristics and bounding design parameters for the referenced ESP.

- NAPS SUP 1.8-2

The applicant states that Section 1.10 identifies specific FSAR sections that address the COL information items from the referenced certified design, and the COL action items and Permit Conditions from the ESP.

- NAPS SUP 1.8-3

The applicant has provided FSAR Table 1.8-201 that identifies the site-specific departures taken from the referenced certified design. These departures are fully described in Part 7 of the COLA and listed in FSAR Table 1.8-201. These departures are evaluated in the respective Chapters of this SER.

- NAPS SUP 1.8-4

The applicant has provided FSAR Table 1.8-202 which identifies the requested variances from the referenced ESP. These variances are fully described in Part 7 of the COLA and evaluated in the respective Chapters of this SER.

- NAPS SUP 1.8-5

The applicant includes FSAR Table 1.8-203, which identifies systems that either adopt the CDI in the DCD as the actual system design information or replace the CDI in the DCD with site-specific design information. Information adopted from the DCD is evaluated by the NRC in NUREG–1966. Information replaced by site-specific design information is evaluated in the applicable chapters of this SER (i.e., Chapters 2 through 20).

- NAPS SUP 1.8-6

The FSAR states that the applicant reviewed site- and plant-specific information that included North Anna site meteorological data, site-specific population distribution, and plant-specific design information that replaced CDI described in the DCD with respect to the DC probabilistic risk assessment (PRA). FSAR Section 19.5 documents the conclusion that there is no significant change from the certified design PRA. The staff's evaluation is in Section 19.5 of this SER.

- NAPS SUP 1.8-7

The applicant states that there are no current plans for an independent North Anna 3 spent ISFSI.
Conceptual Design Information:

- STD CDI

The applicant states that DCD Tier 1 identifies significant interface requirements for those systems that are beyond the scope of the DCD.

Section 1.9 – Conformance with Standard Review Plan and Applicability of Codes and Standards

Section 1.9 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.9, "Conformance with Standard Review Plan and Applicability of Codes and Standards," of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.9, the applicant provides the following:

COL Item:

- NAPS COL 1.9-3-A

The applicant adds three FSAR tables. Table 1.9-201 evaluates conformance with the SRP sections and the Branch Technical Positions that were in effect 6 months before submitting the COLA. Table 1.9-202 evaluates conformance with Division 1, 4, 5, and 8 RGs in effect 6 months before submittal of the COLA. Table 1.9-203 evaluates conformance with FSAR content information and format guidance in RG 1.206.

Supplemental Information:

- NAPS SUP 1.9-1

The applicant provides FSAR Table 1.9-204, which identifies the industrial codes and standards applicable to those portions of the North Anna 3 design that are beyond the scope of the DCD and to the operational aspects of the facility.

- NAPS SUP 1.9-2

The applicant provides FSAR Table 1.9-205, which addresses operational experience information as described in the applicable NUREG and NUREG/CR reports, for those portions of the North Anna 3 design and operation that are beyond the scope of the ESBWR DCD. The comment column of Table 1.9-205 includes a reference to the applicable FSAR section that provides further discussion of the operational experience.

Departure Not Requiring NRC Approval:

- NAPS DEP 8.1-2

The applicant has provided information for a departure regarding their switchyard and lightning protection system as it relates to RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants." This departure is discussed in Chapter 8 of this SER.

- NAPS DEP 11.4-1

The applicant has provided information for a departure regarding the long-term, temporary storage of Class B and C low-level radioactive waste in FSAR Table 1.9-11R. This departure is discussed in Chapter 11 of this SER.

Section 1.10 – Summary of COL Items

Section 1.10 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.10, "Summary of COL Items," of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.10, the applicant provides the following:

Supplemental Information:

- NAPS SUP 1.10-1

The applicant includes FSAR Table 1.10-201, which lists the FSAR locations that address the individual COL items from the DCD and FSAR Table 1.10-202 which lists the FSAR locations that address the individual COL items and permit conditions from the ESP.

Section 1.11 – Technical Resolutions of Task Action Plan Items, New Generic Issues, New Generic Safety Issues, and Chernobyl Issues

Section 1.11 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 1.11, “Technical Resolutions of Task Action Plan Items, New Generic Issues, New Generic Safety Issues and Chernobyl Issues,” of the ESBWR DCD, Revision 10.

In addition, in COL FSAR Section 1.11, the applicant provides the following:

COL Items:

- NAPS COL 1.11-1-A

The applicant provides FSAR Table 1.11-201, which supplements DCD Table 1.11-1 to address the site-specific aspects of activities required by the action plan that the COL applicant must complete (i.e., Note 2) and environmental issues that are outside the scope of the DCD (i.e., Note 7). The staff’s technical evaluations of these topics are addressed in the environmental report in the staff’s Supplemental Environmental Impact Statement in NUREG–1917 and the relevant sections of this SER.

Supplemental Information:

- NAPS SUP 1.11-1 and NAPS SUP 1.11-2

The applicant adds FSAR Table 1.11-202, which supplements DCD Table 1.11-1 with references to FSAR locations that provide additional information on specific issues. In addition, the applicant adds references to new generic issues from NUREG–0933, “A Prioritization of Generic Safety Issues,” through Supplement 34.

Section 1.12 – Impact of Construction Activities on Units 1 and 2

The applicant includes a supplemental information section not provided in the referenced DCD, which addresses an evaluation of the impacts from North Anna 3 construction activities on North Anna 1 and 2.

In addition, in COL FSAR Section 1.12, the applicant provides the following:

COL Item:

- NAPS ESP COL 2.4-1

The applicant has provided information to address ESP COL Item 2.4-1. This item requires the COL applicant to provide for NRC review the layout of intake and discharge tunnels and the construction techniques to be used before construction activities begin. The staff reviewed this information in Chapter 2 of this SER.

Supplemental Information:

- NAPS SUP 1.12-1

The applicant provides FSAR Section 1.12, which summarizes the applicant's evaluation of the potential impact from the construction of North Anna 3 on North Anna 1 and 2 SSCs important to safety. Section 1.12 also describes the managerial and administrative controls used to provide assurance that North Anna 1 and 2 limiting conditions for operation (LCOs) will not be exceeded as a result of North Anna 3 construction activities. This evaluation involved the following sequential steps:

- Identification of potential construction activity hazards
- Identification of SSCs important to safety
- Identification of LCOs
- Identification of impacted SSCs and LCOs
- Identification of applicable managerial and administrative controls

Appendices 1A – 1D

The applicant has provided four appendices which contain information that the staff has identified and evaluated in Section 1.4.4 below.

1.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, NUREG-1811, and NUREG–1917. In addition, the relevant requirements of the Commission regulations for the information in FSAR Chapter 1, and the associated acceptance criteria, are in SRP Section 1.0.

The applicable regulatory requirements are as follows:

- 10 CFR 50.43(e), as it relates to requirements for approving applications for a DC, COL, manufacturing license, or operating license that proposes nuclear reactor designs that differ significantly from light-water reactor designs licensed before 1997 or that use simplified, inherent, passive, or other innovative means to accomplish their safety functions.

- 10 CFR 52.77 and 10 CFR 52.79, as they relate to general introductory matters.

- 10 CFR 52.79(a)(17), as it relates to compliance with technically relevant positions of the Three Mile Island (TMI) requirements.

- 10 CFR 52.79(a)(20), as it relates to proposed technical resolutions of those unresolved safety issues and medium- and high-priority generic safety issues that are identified in the current version of NUREG–0933 on the date up to 6 months before the docket date of the application and that are technically relevant to the design.

- 10 CFR 52.79(a)(31), as it relates to nuclear power plants that will be operated on multiunit sites and to an evaluation of potential hazards to the SSCs important to safety of operating units resulting from construction activities; in addition to providing a description of the managerial and administrative controls to be used to provide assurance that the LCO will not be exceeded as a result of construction activities at the multiunit sites.

- 10 CFR 52.79(a)(37), as it relates to the information necessary to demonstrate how operating experience insights are incorporated into the plant design.

- 10 CFR 52.79(a)(41), as it relates to an evaluation of the application against the applicable NRC review guidance in effect 6 months before the docket date of the application.

- 10 CFR 52.79(d)(2), which requires that for a COL referencing a standard DC, the FSAR must demonstrate that the interface requirements established for the design under 10 CFR 52.47, "Contents of applications; technical information," have been met.

- 10 CFR 52.97(a)(1)(iv), which states that an applicant is technically and financially qualified to engage in the activities authorized.

The related acceptance criteria are as follows:

- There are no specific SRP acceptance criteria associated with the general requirements.

- For regulatory considerations, acceptance is based on addressing the regulatory requirements discussed in FSAR Chapter 1 or in the FSAR section referenced in Chapter 1. The SRP acceptance criteria associated with the referenced section will be reviewed within the context of that review.

- For the performance of new safety features, the FSAR information should be sufficient to provide reasonable assurance that (1) the new safety features will perform as predicted in the applicant's FSAR; (2) the effects of system interactions are acceptable; and (3) the applicant's data are sufficient to validate analytical codes. The design qualification testing requirements may be met with either separate effects or integral system tests; prototype tests; or a combination of tests, analyses, and operating experience.

- For conformance with regulatory criteria, RG 1.206 states that an applicant should perform an evaluation for conformance with the RGs that were in effect 6 months before the submittal of the COLA.

1.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Chapter 1 of the certified ESBWR DCD. The staff also reviewed Chapter 1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic[2]. The staff's review confirms that information in the application and information incorporated by reference address the required information related to this chapter.

The staff notes that the information in the following sections of North Anna 3 FSAR Chapter 1 is for general informational purposes, and no specific technical or regulatory findings are made within the review scope of SER Chapter 1. The applicant's information in these sections are used as reference material to support the staff's technical reviews in Chapters 2 through 20 of this SER.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>Section 1.1 – Introduction</u>

In this section, the applicant briefly discusses the principal aspects of the overall application. There are no specific SRP acceptance criteria related to the general information in Section 1.1 and no specific regulatory findings. The applicant's information gives the reader a basic overview of the nuclear power plant and the construct of the North Anna 3 FSAR itself. The applicant also identifies systems and structures outside the scope of the ESBWR standard plant that are discussed in the applicable chapter (i.e., Chapters 2 through 20) of this SER. The staff finds that the applicant's information provided in FSAR Section 1.1 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.1.

<u>Section 1.2 – General Plant Description</u>

In this section, the applicant summarizes the principal characteristics of the site and describes the facility. There are no specific SRP acceptance criteria related to the general information in FSAR Section 1.2 and no specific regulatory findings. The applicant's information gives the reader a general plant description. The staff finds that the applicant's information provided in FSAR Section 1.2 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.2.

<u>*Departure Not Requiring NRC Approval:*</u>

- NAPS DEP 11.4-1

The staff notes the following for Departure NAPS DEP 11.4-1 identified in this section:

The applicant states that the radwaste building is configured to accommodate at least 10 years of packaged Class B and Class C waste and approximately 3 months of packaged Class A

[2] See *"Finality of Referenced NRC Approvals"* in this SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

waste based on routine operations and anticipated operational occurrences. The applicant also provides the revised radwaste building elevation plans in Figures 1.2-21R to 1.2-25R. This departure is discussed in Chapter 11 of this SER.

Conceptual Design Information:

- STD and NAPS CDI

The applicant provides CDI regarding the general plant descriptions of the main turbine, main condenser, plant service water system, hydrogen water chemistry system, zinc injection system, and freeze protection as well as other building structures. The CDI information presented in this section is discussed in the applicable chapter (i.e., Chapters 2 through 20) of this SER.

Section 1.3 – Comparison Table

In this section, the applicant provides information regarding a comparison with other facilities of a similar design and comparable power level. There are no specific SRP acceptance criteria related to the general information in Section 1.3 and no specific regulatory findings. The staff finds that the applicant's information provided in FSAR Section 1.3 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.3.

Departure Requiring NRC Approval:

- NAPS DEP 3.7-1

The applicant has provided information for a departure regarding ground response spectra for seismic structural loads and floor response spectra in Table 1.3-4R "Comparison of Structural Design Characteristics." This departure is discussed and reviewed in Section 3.7 of this SER.

COL Item:

- NAPS COL 1.3-1-A

The applicant provided North Anna 3 COL 1.3-1-A, which states that there are no updates to DCD Table 1.3-1 based on unit-specific information. The staff finds that the applicant's information satisfies COL Item 1.3-1-A, and the information in FSAR Section 1.3 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.3.

Section 1.4 – Identification of Agents and Contractors

This section identifies primary agents or contractors for the design, construction, and operation of the nuclear power plant. SRP Section 1.4 does not identify specific acceptance criteria related to the general information in Section 1.4 or specific regulatory findings. The quality assurance measure applied to these agents or contractors are specified in Chapter 17 of the FSAR. The staff finds that the applicant's information provided in FSAR Section 1.4 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.4.

Supplemental Information:

- NAPS SUP 1.4-1

The staff notes the following for NAPS SUP 1.4-1 identified in this section:

In accordance with RG 1.206, Regulatory Position C.I.1.4, "Identification of Agents and Contractors," the applicant's supplemental information identifies the primary agents for the design, construction, and operation of the proposed facility with the exception of contractors for the site engineering and for the construction of the Turbine Island and nuclear island. In addition, the applicant delineates the division of responsibility among the contractors cited in the FSAR.

North Anna 3 FSAR Chapter 17, "Quality Assurance [QA]," and the North Anna 3 Quality Assurance Program Description (QAPD) describe the Dominion QA Program and QA controls for contractors performing safety-related work activities associated with the North Anna 3 COLA. The staff's evaluation of Chapter 17 of the North Anna 3 FSAR is in Chapter 17 of this SER.

Section 1.5 – Requirements for Further Technical Information

In this section, an applicant who does not reference a certified design should provide information to demonstrate the performance of new safety features. The North Anna 3 application references the ESBWR DCD application. There are no specific SRP acceptance criteria related to the general information in Section 1.5 and no specific regulatory findings. The applicant incorporates by reference Section 1.5 of the ESBWR DCD. Per RG 1.206, Regulatory Position C.I.1.5, only an applicant who does not reference a certified design would need to provide additional information for this section. The staff finds that the applicant's information provided in FSAR Section 1.5 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.5.

Supplemental Information:

- CWR SUP 1.5-1

The applicant provides summary information regarding Post-Fukishima Near-Term Task Force Recommendations with respect to the ESBWR design and North Anna 3. The staff's evaluation of Fukishima Recommendations 2.1, 4.2, 7.1, and 9.3 for the North Anna 3 COLA are provided in Chapter 20 of the SER as stated in Section 1.1, Summary of Application, above.

Section 1.6 – Material Incorporated by Reference

In this section, an applicant provides a tabulation of all TRs that are incorporated by reference as part of the application. There are no specific SRP acceptance criteria related to the general information in Section 1.6 and no specific regulatory findings. The staff finds that the applicant's information provided in FSAR Section 1.6 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.6.

COL Item:

- NAPS SUP 1.6-1

In site-specific COL Item NAPS SUP 1.6-1, the applicant includes FSAR Table 1.6-201 which lists the TRs that are incorporated by reference in whole or in part into the FSAR that were not included in ESBWR DCD, Section 1.6. The incorporation of these TRs are discussed accordingly within the relevant Sections of this SER.

Section 1.7 – Drawings and Other Detailed Information

In this section, the applicant provides a tabulation of all instrument and control functional diagrams cross-referenced to the related application sections. There are no specific SRP acceptance criteria related to the general information in Section 1.7 and no specific regulatory findings. The staff finds that the applicant's information provided in FSAR Section 1.7 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.7.

Departures Requiring NRC Approval:

- NAPS DEP 8.1-1

The applicant has provided information for a departure regarding the electrical power distribution system in FSAR Table 1.7-201. This departure is discussed and reviewed in Chapter 8 of this SER.

- NAPS DEP 12.3-1

The applicant has provided information for a departure regarding the liquid radwaste effluent discharge piping flow path in FSAR Table 1.7-202. This departure is discussed and reviewed in Chapters 11 and 12 of this SER.

Departure Not Requiring NRC Approval:

- NAPS DEP 11.4-1

The applicant has provided information for a departure regarding the long-term, temporary storage of Class B and C low-level radioactive waste in FSAR Table 1.7-202. This departure is discussed in Chapter 11 of this SER.

Supplemental Information:

- NAPS SUP 1.7-1

NAPS SUP 1.7-1, includes FSAR Tables 1.7-201 and 1.7-202, which list the supplemental drawings of electrical system and mechanical system configurations, in addition to the information in ESBWR DCD, Tables 1.7-2 and 1.7-3.

Section 1.8 – Interfaces with Standard Design and Early Site Permits

In this section, an applicant who references a certified design has to satisfy interface requirements established for the certified design. There are no specific SRP acceptance criteria related to the general information in Section 1.8 and no specific regulatory findings. The staff finds that the applicant's information provided presented in FSAR Section 1.8 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.8.

The applicant provides the following supplemental information and CDI:

Supplemental Information:

- NAPS SUP 1.8-1

The applicant states that FSAR Chapter 2 provides information demonstrating that site characteristics fall within the ESBWR site parameters specified in the referenced certified design. The review of the site characteristics is in Chapter 2 of this SER.

- NAPS SUP 1.8-2

The applicant states that FSAR Section 1.10 identifies specific sections that address the COL information items from the referenced certified design and the COL action items. The review of the COL items listed in Table 1.10-201 is in the applicable chapter (i.e., Chapters 1 through 19) of this SER.

- NAPS SUP 1.8-3

The applicant identifies site-specific departures from the referenced certified design, which are fully described in Part 7 of the COLA. The applicant provides Table 1.8-201 to identify FSAR sections affected by the requested departures listed in Part 7 of the COLA. These departures are evaluated in their respective Chapters throughout this SER.

- NAPS SUP 1.8-4

The applicant has provided FSAR Table 1.8-202 which identifies the requested variances from the referenced ESP. These variances are fully described in Part 7 of the COLA and evaluated in their respective Chapters throughout this SER.

- NAPS SUP 1.8-5

The applicant provides FSAR Table 1.8-203, which identifies systems that either adopt the CDI in the DCD as the actual system design information or replace the CDI in the DCD with site-specific design information. The table also includes cross references to FSAR sections that address the CDI. The DCD CDI that the applicant replaced with site-specific design information is reviewed in the applicable chapters of this SER (i.e., Chapters 1 through 19).

- NAPS SUP 1.8-6

As stated above, the applicant's review of site- and plant-specific information is in FSAR Section 19.5. The staff's review of the applicant's PRA conclusion is evaluated in Section 19.5 of this SER.

- NAPS SUP 1.8-7

As stated above, the applicant does not provide information pertaining to the ISFSI because no North Anna 3 ISFSI is currently planned. Therefore, the staff is not reviewing information associated with this supplemental information item.

Conceptual Design Information:

- STD CDI

The applicant states that DCD Tier 1 identifies significant interface requirements for those systems that are beyond the scope of the DCD. As indicated above in the evaluation of Supplemental Information NAPS SUP 1.8-5, the system design information is in FSAR Table 1.8-203 and evaluated in the applicable chapters of this SER.

Section 1.9 – Conformance with Standard Review Plan and Applicability of Codes and Standards

This FSAR section provides the information required by 10 CFR 52.47(a)(9) showing conformance with the SRP and applicable codes and standards. The section summarizes deviations from each SRP section and regulatory criteria (i.e., Division 1, 4, 5, and 8 RGs; RG 1.206; and industrial codes and standards). In addition, this section provides information on the applicability of operational experience. The staff finds that the applicant's information provided in FSAR Section 1.9 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.9.

COL Item:

- NAPS COL 1.9-3-A

The applicant provides additional information in FSAR Tables 1.9-201 through 1.9-203 that evaluate the conformance of technical information in the North Anna 3 FSAR with the SRP and applicable regulatory criteria. The staff evaluated the information in Section 1.9 as part of the technical evaluations in Chapters 2 through 20 of this SER, as needed.

Supplemental Information:

- NAPS SUP 1.9-1

As stated earlier, the applicant provides additional information in FSAR Table 1.9-204 that lists the industrial codes and standards applicable to those portions of the North Anna 3 design that are beyond the scope of the ESBWR DCD and are applicable to the operational aspects of the facility. This table also identifies additional codes and standards referenced in various chapters of the COLA. The staff's technical evaluations of the additional industrial codes and standards are in the relevant chapters of this SER.

- NAPS SUP 1.9-2

In FSAR Table 1.9-205, the applicant provides additional information on the operational experience applicable to North Anna 3. The staff finds that the applicant has provided sufficient information to address conformance with the operational experience information, as described in applicable NUREG reports, for those portions of the North Anna 3 design and operation that are beyond the scope of the ESBWR DCD. The staff's technical evaluations of the applicable operational experience are in the relevant chapters of this SER.

Departures Not Requiring NRC Approval:

- NAPS DEP 8.1-2

The applicant has provided information for a departure regarding their switchyard and lightning protection system as it relates to RG 1.204. This departure is discussed in Chapter 8 of this SER.

- NAPS DEP 11.4-1

The applicant has provided information for a departure regarding the long-term, temporary storage of Class B and C low-level radioactive waste in FSAR Table 1.9-11R. This departure is discussed in Chapter 11 of this SER.

Section 1.10 – Summary of COL Items

The applicant's supplemental information in this section specifies NAPS SUP 1.10-1 which provides FSAR Table 1.10-201 and Table 1.10-202. These tables list the COL items from both the DCD and ESP along with the permit conditions from the ESP. The ESBWR DCD and the North Anna ESP describe the information for each COL item that the COL applicant needs to provide in the application that include site-specific information; information related to operational program descriptions; and other required information to support the construction and operation of an ESBWR standard design at the North Anna 3 site. FSAR Table 1.10-201 lists the COL items and the proper references to the FSAR sections that describe each item. The applicant's supplemental information also includes FSAR Table 1.10-202 which identifies where the COL items and permit conditions identified in the ESP are addressed in the FSAR. The COL items and permit conditions listed in both of these tables are reviewed in the applicable chapter (i.e., Chapter 2 through Chapter 19) of this SER. There are no specific SRP acceptance criteria related to the general information in Section 1.10 and no specific regulatory findings. The staff finds that the applicant's information provided in FSAR Section 1.10 is acceptable within the review scope of Chapter 1.

Section 1.11 – Technical Resolutions of Task Action Plan Items, New Generic Issues, New Generic Safety Issues, and Chernobyl Issues

In accordance with 10 CFR 52.79(a)(20), this FSAR section provides technical resolutions of unresolved safety issues (USIs); new generic issues (GI); medium- and high-priority generic safety issues (GSIs); human factor issues (HFIs); and Chernobyl issues identified in NUREG–0933 and its supplements.

COL Item:

- NAPS COL 1.11-1-A

In FSAR Section 1.11.1, the applicant provides Table 1.11-201 to supplement DCD Table 1.11-1 (Notes 2 and 7) and to address the site-specific aspects of activities required by the action plan that the COL applicant must complete (i.e., Note 2) and environmental issues that are outside the scope of the DCD (i.e., Note 7).

ESBWR DCD, Table 1.11-1 identifies Task Action Items (i.e., GI and USI) A-33, B-1, B-28, B-37 through B-43, and C-16 and the two new GIs: 184 requiring site-specific information and 199 which the applicant has included information in FSAR Section 3.7.1. These issues are mainly associated with the site-specific environmental concerns addressed in the site environmental report. The applicant provides the required information in Table 1.11-201 with appropriate references to various sections in Parts 2, 3, and 4 of the COLA. The staff's technical evaluations of these topics are addressed in the environmental reports of NUREG–1811 and NUREG–1917.

Supplemental Information:

- NAPS SUP 1.11-1 and NAPS SUP 1.11-2

In Table 1.11-202, the applicant provides supplemental information to DCD Table 1-11 on the issues in the TMI Action Plan that relate to staffing, qualifications, quality assurance, post-accident sampling, in-plant radiation monitoring, and shift staff HFI. The table identifies the FSAR sections where each issue is discussed. The staff's evaluations of these issues are in Chapters 12, 13, and 17 of this SER. In addition, the applicant provided references to new GIs 201, 202, and 203 to Table 1.11-201 as identified in NUREG–0933 through Supplement 24, December 2011.

The staff finds that the applicant's COL Item NAPS COL 1.11-1-A, and supplemental information NAPS SUP 1.11-1 and NAPS SUP 1.11-2 in FSAR Section 1.11 are acceptable and consistent with the guidance in the SRP and NUREG–0933 and the requirements of 10 CFR 52.79(a)(20). The staff finds that the applicant's information provided in FSAR Section 1.11 is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.9.3.

Section 1.12 – Impact of Construction Activities on Units 1 and 2

In this section of the SER, the applicant evaluates the potential hazards to the SSCs important to safety of the operating North Anna 1 and 2 that would result from future construction activities of North Anna 3. The applicant also describes the managerial and administrative controls to be used to provide assurance that the LCO will not be exceeded as a result of construction activities, in accordance with 10 CFR 52.79(a)(31). This section was pending the staff's review and previously identified as Open Item 1-2. The review has been completed and is presented below. This Open item is now considered closed.

COL Item:

- NAPS ESP COL 2.4-1

The applicant has provided information to address ESP COL Item 2.4-1. This item requires the COL applicant to provide for NRC review the layout of intake and discharge tunnels and the construction techniques to be used before construction activities begin. The applicant has provided a statement that they will provide this information for NRC review at least 60 days before the commencement of construction. The staff reviewed this information in Chapter 2, Section 2.4 of this SER and found that since the ESBWR is based on a passive-cooling design, that neither Lake Anna nor the piping to and from Lake Anna provide safety functions and, therefore, ESP COL Action Item 2.4-1 is no longer required. With respect to North Anna 3 construction activities affecting Units 1 and 2, the staff notes below that other mechanisms will be used by the licensee of the operating Units 1 and 2 to address these considerations and to ensure that potential impacts from the construction of a new North Anna 3 are precluded and/or mitigated.

Supplemental Information:

- NAPS SUP 1.12-1

The applicant provides FSAR Section 1.12 as supplemental information. Based on the Interim Staff Guidance (ISG) COL ISG-022, "Interim Staff Guidance on Impact of Construction (under a Combined License) of New Nuclear Power Plants Units on Operating Units at Multi-Unit Sites," the applicant should address the requirements of 10 CFR 52.79(a)(31) with respect to ISG-022.

The requirements in 10 CFR 52.79(a)(31) can be viewed as having two subparts:

1. The COL applicant must evaluate the potential hazards from constructing new plants on SSCs important to safety for existing operating plants located at the North Anna site (i.e., North Anna 1 and 2).

2. The COL applicant must evaluate the potential hazards from constructing new plants on SSCs important to safety for newly constructed plants that begin operation at the North Anna site. This subpart will not be applicable to North Anna 3.

The applicant has provided a construction impact evaluation plan that contains the following six elements discussed in the ISG:

- A discussion of the construction activity identification process and the impact evaluation criteria used to evaluate the construction activities that may pose potential hazards to the SSCs important to safety for operating unit(s).

- A table of those construction activities and the potential hazards that are identified using that construction impact evaluation plan, the SSCs important to safety for the operating unit potentially impacted by the construction activity, and proposed mitigation methods.

- Identification of the managerial and administrative controls, such as proposed license conditions that may involve construction schedule constraints or other restrictions on construction activities, that are credited to manage the safety/security interface and to preclude and/or mitigate the impacts of potential construction hazards to the SSCs important to safety for the operating unit(s).

- A discussion of the process for communications and interactions planned and credited between the construction organization and the operations organization to ensure appropriate coordination and authorization of construction activities and implementation of the prevention or mitigation activities as necessary.

- A memorandum of understanding or agreement (MOU or MOA) between the COL applicant and the operating unit(s) licensee as a mechanism for communications, interactions, and coordination to manage the impact of the construction activities.

- An implementation schedule corresponding to construction tasks or milestones to ensure the plan is reviewed on a recurring basis and maintained current as construction progresses.

In NAPS SUP 1.12-1, the applicant has provided the following FSAR information with respect to each of the above six elements:

- A discussion of the construction activity identification process and the impact evaluation criteria used to evaluate the construction activities that may pose potential hazards to the SSCs important to safety for operating unit(s).

The process and criteria used to evaluate potential North Anna 3 construction hazards associated with North Anna 1 and 2 SSCs important to safety are discussed in FSAR Section 1.12. Section 1.12.1 specifically outlines a series of sequential steps that are discussed in further detail in FSAR Sections 1.12.2 through 1.12.6. These steps include the identification of potential construction activity hazards, SSCs important to safety, LCOs, impacted SSCs and LCOs, and applicable managerial and administrative controls.

- A table of those construction activities and the potential hazards that are identified using that construction impact evaluation plan, the SSCs important to safety for the operating unit potentially impacted by the construction activity, and proposed mitigation methods.

Using the identification and evaluation process described above, the applicant developed FSAR Table 1.12-201, “Potential Hazards to Units 1 and 2 from Unit 3 Construction Activities,” which delineates the North Anna 3 construction activities; identifies the potential hazards using this evaluation; and describes the potentially impacted Unit 1 and 2. The applicant also developed FSAR Table 1.12-202, “Potential Consequences to Units 1 and 2 Due to Potential Hazards Resulting from Unit 3 Construction Activities,” which describes the potential hazards and consequences specifically related to Units 1 and 2 SSCs. In addition, the applicant developed FSAR Table 1.12-203, “Managerial and Administrative Controls for Unit 3 Construction Activity Hazards,” which delineates the proposed mitigation methods.

- Identification of the managerial and administrative controls such as the proposed license conditions that may involve construction schedule constraints or other restrictions on construction activities that are credited to manage the safety/security interface and to preclude and/or mitigate the impacts of potential construction hazards to the SSCs important to safety for the operating unit(s).

The managerial and administrative controls to manage the safety/security interface and to mitigate the impacts of potential North Anna 3 construction hazards to the Units 1 and 2 SSCs important to safety and security are discussed in Section 1.12.6, “Managerial and Administrative Controls,” and in FSAR Table 1.12-203, “Managerial and Administrative Controls for North Anna 3 Construction Activity Hazards.” FSAR Section 1.12.6 also states that there are additional controls established during construction as described and addressed in FSAR Section 13AA.1.9, “Management and Review of Construction Activities.”

- A discussion of the process for communications and interactions planned and credited between the construction organization and the operations organization to ensure appropriate coordination and authorization of construction activities and implementation of the prevention or mitigation activities as necessary.

FSAR Table 1.12-203 provides the managerial and administrative controls for preventative and mitigation activities that outline the planned interactions between Units 1 and 2 and North Anna 3. In addition, FSAR Subsection 13.AA.1.9 includes a description of the process for Units 1 and 2 and North Anna 3 communications and interactions to ensure organizational coordination and authorization requirements for construction activities with potential Units 1 and 2 impacts, as well as implementation plans for the mitigation controls identified.

- A memorandum of understanding or agreement (MOU or MOA) between the COL applicant and the operating unit(s) licensee as a mechanism for communications, interactions, and coordination to manage the impact of the construction activities.

The North Anna 3 COL applicant and the Units 1 and 2 operating licensee are the same entity. Therefore, an MOU or MOA is not considered necessary.

- An implementation schedule corresponding to construction tasks or milestones to ensure the plan is reviewed on a recurring basis and maintained current as construction progresses.

FSAR Section 1.12.6 describes the identification of specific hazards, impacted SSCs, and managerial and administrative controls including safety/security interfaces to be developed and implemented as work progresses on the site. FSAR Table 1.12-201 describes the work progression via identification of construction activities. FSAR Subsection 13.AA.1.9 states that assessments will be performed to facilitate an implementation schedule for the administrative and managerial controls that correspond with the scheduled construction activities. The applicant also describes periodic assessments involving both Units 1 and 2 and North Anna 3 organizations to identify Units 1 and 2 SSCs that could be reasonably expected to be impacted by scheduled construction activities.

In conclusion, based on a review of the information discussed above, the staff finds that the applicant’s Supplemental Information NAPS SUP 1.12-1 in FSAR Section 1.12 is acceptable and consistent with the six program elements of 10 CFR 52.79(a)(31) as expressed in COL ISG-022.

In addition, the staff notes that other mechanisms will be used by the licensee of the operating Units 1 and 2 to address these considerations and to ensure that potential impacts from the construction of a new North Anna 3 are precluded and/or mitigated. Examples include the 10 CFR 50.59 change process, the 10 CFR 50.65 risk assessment process, the 10 CFR 73.58

safety/security interface process, the technical specification change process, the EP change process, and the FSAR update process.

Appendix 1A – Response to TMI Matters

This FSAR Appendix supplements ESBWR DCD, Table 1A-1 with STD SUP 1A.1-1, which provides assessments of the TMI Action Plan items listed in 10 CFR 50.34(f). There are no specific SRP acceptance criteria related to the general information in FSAR Appendix 1A. The applicant provides supplemental information to DCD Table 1A-1 that addresses site-specific items related to construction, operations, and quality assurance. The detailed technical evaluations of these items are in Chapters 13 and 17 of this SER. The staff finds that the applicant's supplemental information provided in FSAR Appendix 1A is acceptable within the review scope of Chapter 1.

Appendix 1B – Plant Shielding To Provide Access to Areas and To Protect Safety Equipment for Post-Accident Operation [II.B.2]

The applicant has incorporated by reference this section of the DCD with no departures or supplements.

Appendix 1C – Industry Operating Experience

This FSAR Appendix supplements ESBWR Tables 1C-1 and 1C-2 with FSAR Tables 1C-201 and 1C-202. The DCD tables review industry operating experience issued in the Generic Letters (GL) and Bulletins (BL) that are potentially applicable to the ESBWR design or operation. These tables address GLs and BLs that were in effect/issued up to 6 months before a COLA submittal, and after the SRP revisions that are applicable to the FSAR. They also address GL 82-39 and Industry Experience (IE) BL 2005-02, which were identified in the DCD as the responsibility of the COL applicant. There are no specific SRP acceptance criteria related to the general information in Appendix 1C and no specific regulatory findings; however, the applicant provides its evaluation results in Table 1C-201. The applicant states that GL 82-39 is not applicable and is an administrative communication. The site has an approved procedure for handling SGI including how to mail such information to authorized recipients. IE Bulletin 2005-02 is discussed in the North Anna 3 COLA Part 5, Emergency Plan. The staff's evaluation of the Emergency Plan is in Section 13.3 of this SER.

Departure Not Requiring NRC Approval:

- NAPS DEP 11.4-1

In FSAR Table 1C-201, the applicant states under GL 81-38 that the radwaste building includes space for processing and storing low-level radioactive wastes. The radwaste building provides storage space for at least 10 years of packaged Class B and Class C wastes and approximately 3 months of packaged Class A waste. FSAR Section 11.4 provides additional information regarding the onsite storage of low-level radioactive wastes. This departure is discussed in Chapter 11 of this SER.

COL Items:

- STD COL 1C.1-1-A

In FSAR Table 1C-201, the applicant states that the site has an administrative procedure for handling SGI that meets the requirements of 10 CFR 73.21. This procedure also includes how to mail SGI to authorized recipients.

The staff finds that this response adequately addresses COL Item STD COL 1.C.1-1A, because the North Anna site has a procedure for handling SGI. However, the staff's review noted that ESBWR DCD Table 1C-1 conforms to the applicable GLs up to June 2006. The staff's review of the GLs in effect 6 months before the submittal date of the North Anna 3 COLA identified GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," as not listed in FSAR Table 1C-201. The staff's review finds that SER Section 8.2 evaluates the applicability of this GL to North Anna 3. According to SER Section 8.2, the applicant revised FSAR Section 17.6.4 to include the underground cable monitoring program regardless of the voltage. This FSAR section states that the condition monitoring underground or inaccessible cables is in the Maintenance Rule (MR) Program. The cable condition monitoring program incorporates lessons learned from industry operating experience (e.g., GL 2007-01); addresses regulatory guidance; and utilizes information from detailed design and procurement documents to determine the appropriate inspections, tests, and monitoring criteria for underground and inaccessible cables within the scope of the MR (10 CFR 50.65).

- STD COL 1C.1-2-A

In FSAR Table 1C-202, the applicant states that COLA Part 5 provides the North Anna 3 Emergency Plan. The staff finds that this response adequately addresses COL Item STD COL 1C.1-2-A. The staff's evaluation of the North Anna 3 Emergency Plan is in Section 13.3 of this SER.

STD SUP 1C-1 and NAPS SUP 1C-2, address GL 2007-01 and the staff has reviewed this information as discussed above.

In conclusion, the staff finds that the applicant's COL and supplemental information in FSAR Appendix 1.C is acceptable within the review scope of Chapter 1 and satisfies RG 1.206, Regulatory Position C.I.1.9.4.

Appendix 1D – Summary of Tier 2* Information

This FSAR Appendix supplements ESBWR DCD Table 1D-1 with NAPS SUP 1AA.1-1, which provides the incorporation of the North Anna ESP SSAR Chapter 1 for historical purposes. There are no specific SRP acceptance criteria related to the general information in FSAR Appendix 1D. The staff finds that the supplemental information submitted by the applicant is acceptable with the review scope of Chapter 1.

1.4.5 Post Combined License Activities

There are no post COL activities applicable to this Section.

1.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information; and no outstanding information is expected to be addressed in the COL FSAR related to these sections. Pursuant to 10 CFR 52.63(a)(5), all nuclear safety issues relating to these sections that were incorporated by reference have been resolved.

1.5 Additional Regulatory Requirements

1.5.1 Financial Qualifications

1.5.1.1 Introduction

By letter dated November 27, 2007, as supplemented on December 12, 2008, Virginia Electric and Power Company, doing business as Dominion, and Old Dominion Electric Cooperative (ODEC), submitted a COL application (Revision 1) for a proposed reactor at the North Anna site pursuant to 10 CFR Part 52, Subpart C, "Combined Licenses." In their submittal, Dominion and ODEC requested that the NRC issue a COL under Section 103 of the Act, for construction and operation of North Anna 3, which will be located in Louisa County, Virginia, approximately 40 miles north, northwest of Richmond.

Dominion and ODEC currently own NAPS, which includes the two existing nuclear units (Units 1 and 2) and an ISFSI at that site, as tenants in common, with respective undivided ownership interests of 88.4 and 11.6 percent. Dominion is the licensed operator of the existing facilities, with control of the North Anna site and authority to act as ODEC's agent. According to Revision 4 of the COLA, Dominion (hereafter, the applicant) has acquired sole title to the portion of the North Anna site on which North Anna 3 will be located, will own North Anna 3, and will construct and operate the proposed reactor.

The COLA incorporates by reference the GE-Hitachi Nuclear Energy Americas' ESBWR DCD, Revision 10. The codified version of the ESBWR DCR is contained in 10 CFR Part 52, Appendix E. The ESBWR DCR was published on October 15, 2014 (79 FR 61944) and is effective as of November 14, 2014. The ESBWR DCR references Revision 10 of the ESBWR DCD.

1.5.1.2 Regulatory Evaluation

The applicant's request for the NRC to issue a COL under Section 103 of the Act, as amended, for construction and operation of North Anna 3 is subject to, among other things, the requirements of the Act, as amended; Subpart C to 10 CFR Part 52; 10 CFR Part 50; and 10 CFR Part 140.

In its review, the staff used guidance in NUREG–1577, Revision 1, issued February 1999, to evaluate the financial qualifications of the applicant to construct, operate, and decommission the proposed facility.

In addressing foreign ownership, control, or domination (FOCD), the staff used guidance in the SRP, "Foreign Ownership, Control, or Domination of applicants for Reactor Licenses," dated

June 1999 (SRP on FOCD), to determine whether the applicant is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. The NRC published the SRP on FOCD in the *Federal Register* on September 28, 1999 (64 FR 52357–52359).

The staff also used guidance in NUREG–1307, Revision 15, “Report on Waste Burial Charges: Changes in Decommissioning Waste Disposal Costs at Low-Level Waste Burial Facilities,” to independently validate the licensee’s calculation of the minimum funding needed for decommissioning.

This safety evaluation documents the staff’s review and analysis of financial qualifications, decommissioning funding assurance, FOCD, and nuclear insurance and indemnity. In addition, this safety evaluation contains proprietary information that is withheld from public disclosure per 10 CFR 2.390 as commercially sensitive. Therefore, there will be both public and non-public versions of this safety evaluation with proprietary information marked with doubled brackets [[ ]].

1.5.1.3 Financial Qualifications

Pursuant to 10 CFR 52.77, “Contents of applications; technical information,” the application must contain all of the information required in 10 CFR 50.33, “Contents of applications; general information.”

<u>Construction Costs</u>

Pursuant to 10 CFR 50.33(f)(1):

> [T]he applicant shall submit information that demonstrates that the applicant possesses or has reasonable assurance of obtaining the funds necessary to cover estimated construction costs and related fuel cycle costs. The applicant shall submit estimates of the total construction costs of the facility and related fuel cycle costs, and shall indicate the source(s) of funds to cover these costs.

Under 10 CFR Part 50, Appendix C, “A Guide for the Financial Data and Related Information Required to Establish Financial Qualifications for Construction Permits and Combined Licenses,” Section I.A.1:

> [E]ach applicant's estimate of the total cost of the proposed facility should be broken down as follows and be accompanied by a statement describing the bases from which the estimate is derived:
>
> > (a) Total nuclear production plant costs; [and]
> >
> > (b) Transmission, distribution, and general plant costs; [and]
> >
> > (c) Nuclear fuel inventory cost for first core
> >
> > If the fuel is to be acquired by lease or other arrangement than purchase, the application should so state. The items to be included in these categories should be the same as those defined in the applicable electric plant and nuclear fuel inventory accounts prescribed by the Federal

Energy Regulatory Commission [FERC] or an explanation given as to any departure therefrom.

In Part 1 of the COLA (Revision 4), the applicant provided projected overnight costs for the construction of one ESBWR nuclear unit at the North Anna site. Under 10 CFR 2.390, this information was withheld as information that is commercially confidential.

PROJECTED PROJECT COST
NORTH ANNA POWER STATION UNIT 3
DOMINION VIRGINIA POWER
(In millions of 2013 $)[3]

	TOTAL
Total Nuclear Production Plant Costs	[[ ]]
Transmission, Distribution & General Plant Costs	[[ ]]
Nuclear Fuel Inventory & Cost for First Core	[[ ]]
TOTAL (OVERNIGHT COST)	**[[ ]]**
Interest & Escalation	[[ ]]
Total w/ Interest & Escalation	**[[ ]]**

According to the applicants, North Anna 3 is expected to operate at an estimated gross electrical power output of approximately 1,594 MWe installed (as shown in DCD Section 10.1). Therefore, the total overnight cost of [[ ]] million is equivalent to [[ ]]/kWe installed. The applicants describe, in part, the foregoing cost estimate to be based on assumptions set forth in the application and attributable to the GE Hitachi ESBWR design.

The staff finds the applicant's ESBWR overnight construction cost estimate to be a reasonable projection based on a number of studies[4] that have been conducted by governmental agencies, universities and other entities. In particular, the U.S. Energy Information Administration's (EIA) June 2012 report, "Annual Energy Outlook (AEO) 2012 with Projections to 2035," (DOE/EIA-0383(2012)), states that "…the overnight capital costs associated with building a nuclear power plant planned in 2012 are assumed to be $5,335 per kilowatt of capacity…" The staff applied an annual adjustment factor ranging from 3% to 10% to the EIA overnight capital cost estimate to account for inflation beyond 2012, and determined that the EIA projected 2015 overnight cost would range from $5,830 to $7,101/kWe installed. The construction cost estimate is expressed in terms of "overnight cost," which is a term commonly used in describing the cost of large capital projects[5] . As stated in the application, this overnight cost includes the engineering,

[3] Commercially sensitive data. The data in brackets is exempt from public disclosure under 10 CFR 2.390(a)(4).

[4] See, e.g., the 2003 the Massachusetts Institute of Technology (MIT) interdisciplinary study entitled The Future of Nuclear Power; the U.S. Department of Energy's (EIA 2012 AEO; the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development 2005 update on Projected Costs of Generating Electricity; and the Keystone Center 2007 report entitled Nuclear Power Joint Fact-Finding.

[5] overnight cost is the cost of a construction project if no interest was incurred during construction, as if the project was completed "overnight." An alternate definition is: the present value cost that would have to be paid as a lump sum up front to completely pay for a construction project. The overnight cost is frequently used when descr bing power plants.

procurement, and construction costs for the ESBWR plant, owner's costs, and contingencies, but excludes interest and escalation during the construction period. Owner's costs include site work and preparation, cooling water intake structures and cooling towers, import duties on components, insurance, spare parts, transmission interconnection, development costs, project management costs, owner's engineering, state and local permitting, legal fees, and staffing-related training. The applicant's overnight cost estimate of [[ ]]/kWe installed exceeds the most recent EIA 2012 range of overnight costs as adjusted for inflation. Accordingly, the staff finds Dominion's overnight cost estimate to be reasonable as presented in its COLA.

Sources of Construction Funds

Pursuant to 10 CFR Part 50, Appendix C, I.A.2:

> The application should include a brief statement of the applicant's general financial plan for financing the cost of the facility, identifying the source or sources upon which the applicant relies for the necessary construction funds, e.g., internal sources such as undistributed earnings and depreciation accruals, or external sources such as borrowings.

Dominion's Source of Construction Funds

According to the application, Dominion plans to finance the cost to construct North Anna 3 through a combination of debt and equity. The relative amount of debt and equity may depend on the availability of Federal loan guarantees under the provisions of the Energy Policy Act of 2005 (EPAct). If Federal loan guarantees are available on satisfactory terms, Dominion may be able to issue Federally guaranteed debt for a greater portion of the total financing need. If Federal loan guarantees are not available on satisfactory terms, Dominion may issue debt for a lesser portion of the total financing need. In either case, Dominion has sufficient capacity from a combination of internal and external funds for the equity and debt financing of the project through various means such as rate regulation under Virginia Code § 56-585.1.A.6, as described below, and also internal cash flows. The traditional capital markets will serve as the sources for the financing of North Anna 3.

Under Virginia Code § 56-585.1.A.6, a utility that constructs a nuclear generation facility has the right to recover the costs of the facility through a rate adjustment clause. This rate recovery includes projected construction work in progress (CWIP), and associated allowance for funds used during construction (AFUDC). Allowable costs include planning, development and construction costs, life-cycle costs, and costs of infrastructure associated therewith. Projected CWIP and AFUDC can be recovered prior to the date the facility begins commercial operation. As an incentive to undertake a nuclear generation facility, the statute allows an enhanced rate of return on common equity of 100 basis points above the utility's general rate of return on common equity.

This enhanced rate of return on common equity is applied to CWIP and the calculation of AFUDC during the facility construction phase. It is also applied to the nuclear facility from the date of the commencement of commercial operation and continuing for a period of 12 to 25 years, as the Virginia State Corporation Commission (VSCC) shall determine. After this period, the general rate of return is applied to the facility for the remainder of its service life.

In consideration of the foregoing, the staff finds that Dominion has demonstrated it possesses or has reasonable assurance of obtaining the funds necessary to cover estimated construction costs and related fuel cycle costs.

Financial Statements

Pursuant to 10 CFR Part 50, Appendix C, I.A.3:

> The application should also include the applicant's latest published annual financial report, together with any current interim financial statements that are pertinent. If an annual financial report is not published, the balance sheet and operating statement covering the latest complete accounting year together with all pertinent notes thereto and certification by a public accountant should be furnished.

Dominion's Financial Statements

Dominion files its financial statements with the Securities and Exchange Commission (SEC).

Dominion submitted, pursuant to Appendix C.I.A.3 to 10 CFR Part 50, annual financial statements. The staff did not identify anything in Dominion's financial statements that warranted further inquiry.

1.5.1.4 Operating License

Pursuant to 10 CFR 50.33(f)(3),

> If the application is for a combined license under subpart C of part 52 of this chapter, the applicant shall submit the information described in paragraphs (f)(1) and (f)(2) of this section.

Section 50.33(f) of 10 CFR provides that each application shall state:

> [e]xcept for an electric utility applicant for a license to operate a utilization facility of the type described in [10 CFR] § 50.21(b) or § 50.22, information sufficient to demonstrate to the Commission the financial qualification[s] of the applicant to carry out, in accordance with the regulations in this chapter, the activities for which the permit or license is sought.

Section 50.2, "Definitions," of 10 CFR states, in part, that an electric utility is:

> any entity that generates or distributes electricity and which recovers the cost of this electricity, either directly or indirectly, through rates established by the entity itself or by a separate regulatory authority.

According to the application, Dominion is an electric utility as defined in 10 CFR 50.2. Dominion generates and distributes electricity and recovers the cost of this electricity through cost-of-service based rates established by the VSCC, the North Carolina Utilities Commission (NCUC), and FERC.

Based on the foregoing, the staff finds that Dominion is not subject to a financial qualifications review pursuant to 10 CFR 50.33(f)(2).

1.5.1.5 Decommissioning Funding Assurance

Pursuant to the requirements of 10 CFR 50.33(k)(1), an applicant for a COL for a production or utilization facility will state information in the form of a report, as described in 10 CFR 50.75, "Reporting and recordkeeping for decommissioning planning," indicating how reasonable assurance will be provided that sufficient funds will be available to decommission the facility.

Under 10 CFR 50.75, the report must contain a certification that the applicant will provide financial assurance for decommissioning no later than 30 days after the Commission publishes notice in the *Federal Register* under 10 CFR 52.103(a), using one or more of the methods allowed under the regulation at 10 CFR 50.75(e). In addition, the amount of the financial assurance may be more, but not less, than the amount stated in the table in 10 CFR 50.75(c)(1), as adjusted under § 50.75(c)(2). Under 10 CFR 50.75(b)(4), a COL applicant need not obtain a financial instrument appropriate to the method to be used or submit a copy of the instrument to the Commission. (Once the COL is granted, the holder of a COL must submit an instrument as provided in § 50.75(e)(3)).

Decommissioning Funding Estimate

According to the COLA, Dominion certified that it will provide decommissioning funding assurance in the amount of $672,826,269 (2012 dollars). This value was derived using the methodology delineated in 10 CFR 50.75(b) and (c), and guidance in NUREG–1307, Revision 15. The staff independently calculated the minimum funding needed for North Anna 3 using the regulations and guidance described above, and obtained results similar to Dominion's. Accordingly, the staff finds that the amount provided by Dominion is acceptable.

Decommissioning Funding Mechanism

Pursuant to 10 CFR 50.75(b), a reactor licensee is required to provide decommissioning funding assurance by one or more of the methods described in 10 CFR 50.75(e), as determined to be acceptable to the NRC. According to the COLA, Dominion has chosen to provide decommissioning funding assurance for North Anna 3 using an external sinking fund. Dominion's external sinking fund will be in the form of a trust; will be established in writing and maintained at all times in the United States with an entity that is an appropriate State or Federal government agency, or an entity whose operations are regulated and examined by a State or Federal agency; and will include the provisions required by 10 CFR 50.75(h)(2). The staff finds that Dominion's use of an external sinking fund is acceptable since it will recover, either directly or indirectly, the estimated total cost of decommissioning through rates established by "cost of service" or similar ratemaking regulation. Therefore, the staff finds this method to be acceptable since it meets the requirements in 10 CFR 50.75(e)(1)(ii).

Certification Updates, Financial Instruments, and Annual Adjustment

According to the application, 2 years and 1 year before the scheduled date for initial loading of fuel, Dominion will submit a report updating this certification in accordance with 10 CFR 50.75(e)(3) and providing copies of the financial instruments to be used. In addition, no later than 30 days after the NRC publishes the notice in the *Federal Register* under 10 CFR

52.103(a), Dominion will submit a report containing a certification that the financial assurance for decommissioning is being provided in an amount specified in the most recent updated certification and will include a copy of the executed financial agreements obtained to satisfy the requirements of 10 CFR 50.75(e). Thereafter, the decommissioning funding amount will be adjusted annually using a rate at least equal to that stated in 10 CFR 50.75(c)(2). The staff finds Dominion's proposed plan as described above and in the application to be reasonable.

1.5.1.6 Antitrust

The EPAct removed the antitrust review authority contained in Section 105.c of the Act, regarding license applications for production or utilization facilities submitted under Sections 103 or 104b. of the Act after the date of enactment of the EPAct. Accordingly, the NRC is not authorized to conduct an antitrust review in connection with this COLA.

1.5.1.7 Foreign Ownership, Control, or Domination

Section 103 of the Act prohibits the Commission from issuing a license for a nuclear power plant to:

> an alien or any corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation or a foreign government.

10 CFR 50.38, "Ineligibility of certain applicants," is the regulatory provision that implements this statutory prohibition.

The staff reviewed the application pursuant to the guidance provided in the SRP on FOCD to determine whether the applicant is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government.

Dominion Foreign Ownership, Control, or Domination

According to the application, Dominion is not owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. Dominion was incorporated in 1909 as a Virginia public service corporation, with its principal business location in Richmond, Virginia. Dominion is a wholly owned subsidiary of Dominion Resources, Inc. (DRI), an investor-owned electric utility. The shares of common stock of DRI are publicly traded and widely held. The application also contained the names and addresses of the Dominion directors and principal officers, and stated that all are United States citizens.

The staff performed an independent analysis of the information provided in the application for Dominion and DRI, including open-source research, and found no evidence of FOCD. Based on this review, the staff does not know or have reason to believe that Dominion is owned, controlled, or dominated by a foreign interest. Therefore, Dominion conforms to the guidance provided in the SRP for FOCD and meets the requirements of 10 CFR 50.38.

1.5.1.8 Nuclear Insurance & Indemnity

This section of the SER addresses the applicant's offsite and onsite insurance requirements found in 10 CFR Part 140 and 10 CFR 50.54(w), respectively.

The provisions of the Price-Anderson Act (Section 170 of the Act) and the Commission's regulations in 10 CFR Part 140, require, in part, that each holder of a license issued pursuant to 10 CFR Part 52 have and maintain financial protection. Further, 10 CFR 50.54(w) establishes requirements for each power reactor licensee to obtain insurance or provide an equivalent amount of protection for the onsite costs of an accident. Under these regulations, Dominion is required to provide satisfactory documentation that it has obtained the amount of financial protection required by (1) 10 CFR 140.13, "Amount of financial protection required of certain holders of construction permits and combined licenses under 10 CFR part 52," (2) 10 CFR 140.11(a)(4), and (3) 10 CFR 50.54(w). In addition, each licensee required to have and maintain financial protection under 10 CFR 140.11(a)(4) shall provide evidence that it maintains a guarantee of payment of deferred premiums pursuant to 10 CFR 140.21, "Licensee guarantees of payment of deferred premiums." Finally, as required by 10 CFR 140.20, "Indemnity agreements and liens," the staff will amend Dominion's current indemnity agreement for existing NAPS 1 and 2 to include the addition of North Anna 3.

The regulation in 10 CFR 140.13 provides the amount of financial protection required by a 10 CFR Part 52 license holder who also holds a license under 10 CFR Part 70 during the period before the Commission makes the finding under 10 CFR 52.103(g) (i.e., a finding that the acceptance criteria in the license are met, which allows the licensee to initially load fuel and operate). Because the 10 CFR Part 70 license will be issued with the COL, Dominion must have and maintain $1,000,000 in financial protection from issuance of the COL until the 10 CFR 52.103(g) finding is made. In addition, as required by 10 CFR 140.11(a)(4), after the 10 CFR 52.103(g) finding is made, each licensee must have and maintain financial protection in an amount equal to the sum of primary financial protection ($375,000,000) and the amount available as secondary financial protection. Since the existing reactors (Units 1 and 2) at the North Anna site already have primary financial protection in the amount of $375,000,000, the current policy covering the North Anna site will be amended to include North Anna 3.

Because Dominion did not address the above requirements in its initial COLA submittal and supplements thereafter, the staff issued RAI 01-6 on May 18, 2016 to determine how Dominion will comply with these regulations ADAMS Accession No. ML16139A590). By letter dated June 9, 2016, Dominion responded to the RAI (ADAMS Accession No. ML16168A027). The RAI response included a letter of intent from American Nuclear Insurers (ANI) that documents its commitment to amend the nuclear liability insurance policy for North Anna 1 and 2 to include the primary financial protection coverage of $375,000,000 for North Anna 3. This coverage will be effective concurrent with the NRC's issuance of a COL to Dominion. Therefore, the staff concludes that the $375,000,000 coverage satisfies the $1,000,000 requirement of 10 CFR 140.13, and the primary financial protection requirement in 10 CFR 140.11(a)(4).

The staff notes that although licensees of large operating reactors under Parts 50 and 52 must have and maintain protection under 10 CFR 140.11(a)(4) upon NRC action authorizing operation, the timing provisions for reporting under 10 CFR 140.21 do not explicitly address the Part 52 process. Under the requirements in 10 CFR 140.11(a)(4) and 10 CFR 140.21, the coverage for secondary financial protection and the guarantee of payment of deferred premiums are only required for reactors authorized to load fuel and operate. Under the 10 CFR Part 52 COL process, the license authorizes operation only upon a Commission finding pursuant to 10 CFR 52.103(g). Therefore, these requirements apply as of the date the Commission makes such a finding. As such, Dominion's RAI response also included proposed license conditions to meet the requirements in 10 CFR 140.11(a)(4) and 10 CFR 140.21. While 10 CFR 50.54(w) by its terms applies upon a Commission finding under 10 CFR 52.103(g), Dominion also included a reporting requirement for 10 CFR 50.54(w) in its proposed condition.

Dominion proposed the following license condition to address the reporting of 10 CFR 140.11(a)(4) requirements for secondary financial protection, and the reporting of 50.54(w) requirements for onsite financial protection. The staff agreed with the proposed license condition but made some modifications. The staff's recommended license condition is stated below:

> Before the scheduled date for initial fuel load, and within ninety (90) days after the NRC publishes the notice of intended operation in the Federal Register, Dominion Virginia Power shall provide satisfactory documentary evidence to the Director of the Office of Nuclear Reactor Regulation, or designee, that it has obtained the appropriate amount of secondary financial protection pursuant to 10 CFR Part 140.11(a)(4) and the appropriate amount of financial protection pursuant to 10 CFR 50.54(w).

With the license condition as described above, the staff concludes that Dominion will satisfy the requirements of 10 CFR 140.11(a)(4) with respect to obtaining an appropriate amount of secondary financial protection and 10 CFR 50.54(w) with respect to obtaining the appropriate amount of financial protection. The staff notes that it will conform any license condition to the correct format if the Commission determines to issue the license. For example, the staff may change "the Director of the Office of Nuclear Reactor Regulation" to "the Director of the Office of New Reactors" and the like.

Dominion also proposed the following license condition to address the reporting of 10 CFR 140.21 for guarantee of payment of deferred premiums. The staff agreed with the proposed license condition but made some modifications. The staff's recommended license condition is stated below:

> Before the scheduled date of initial fuel load, and within ninety (90) days after the NRC publishes the notice of intended operation in the Federal Register, Dominion Virginia Power shall provide evidence to the NRC that it would have the ability to pay into the nuclear industry retrospective rating plan in the event of a nuclear incident and in the amount specified in 10 CFR Part 140.11(a)(4) for one calendar year using one of the following methods:
>
> (a) Surety bond,
> (b) Letter of credit,
> (c) Revolving credit/term loan arrangement,
> (d) Maintenance of escrow deposits of government securities, or
> (e) Annual certified financial statement showing either that a cash flow (i.e., cash available to a company after all operating expenses, taxes, interest charges, and dividends have been paid) can be generated and would be available for payment of retrospective premiums within three (3) months after submission of the statement, or a cash reserve or a combination of cash flow and cash reserve.
>
> Thereafter, Dominion Virginia Power shall provide evidence of the guarantees of payment of deferred premiums in accordance with the provisions specified in 10 CFR 140.21.

With the license condition as described above, the staff concludes that Dominion will satisfy the requirement in 10 CFR 140.21.

In consideration of the staff's evaluation and license conditions as described above, the staff concludes that Dominion will satisfy the provisions of the Price-Anderson Act (Section 170 of the Act) and the Commission's applicable regulations in 10 CFR Part 140, 10 CFR Part 52, and 10 CFR Part 50 for insurance and indemnity.

1.5.1.9 Conclusion

Based on the evaluation above, in consideration of the proposed license conditions, the staff finds reasonable assurance that Dominion is financially qualified to engage in the proposed activities regarding North Anna 3, and that Dominion satisfies the NRC requirements relating to financial qualification, decommissioning funding assurance, FOCD, and nuclear insurance and indemnity. The staff finds this acceptable since it conforms to the guidance in NUREG–1577, the SRP on FOCD, NUREG–1307, and meets the applicable regulations in 10 CFR Part 52, 10 CFR Part 50, and 10 CFR Part 140 as described above.

1.5.2 Nuclear Waste Policy Act

Section 302(b) of the Nuclear Waste Policy Act of 1982, as amended, states:

> The Commission, as it deems necessary or appropriate, may require as a precondition to the issuance or renewal of a license under Section 103 or 104 of the Atomic Energy Act of 1954 [42 U.S.C. 2133, 2134] that the applicant for such license shall have entered into an agreement with the Secretary for the disposal of high-level radioactive waste and spent nuclear fuel that may result from the use of such license.

In a letter dated March 26, 2009 (ADAMS Accession No. ML090840271) the staff issued RAI 01-3 requesting the applicant to identify the Department of Energy (DOE) contract number applicable to North Anna 3 for disposal of high-level radioactive waste and spent nuclear fuel. In a letter dated June 17, 2009 (ADAMS Accession No. ML091700117), the applicant stated that:

> The DOE contract number applicable to North Anna 3 for disposal of high-level radioactive waste and spent nuclear fuel is Contract No. DE-CR01-09RW09011.

Because Dominion has entered into a contract with the DOE for the disposal of high-level radioactive waste and spent nuclear fuel for North Anna 3, the staff accepts that Dominion has met the applicable requirements of Section 302(b) of the Nuclear Waste Policy Act of 1982. This RAI was previously tracked as an Open Item and is now closed.

1.5.3 Consultation with Department of Homeland Security and Notifications

In accordance with Section 657 of the EPAct, the NRC consulted with the Department of Homeland Security.

In April 2008, the NRC published notices of the application in the local newspapers: *The Richmond Times-Dispatch, The Daily Progress, The Free-Lance Star,* and *The Central Virginian.* As required by Section 182c. of the Act and 10 CFR 50.43(a), the NRC took the following actions. On April 20, 2016, the NRC notified the VSCC (ADAMS Accession No. ML16064A508), the NCUC (ADAMS Accession No. ML16064A507) and the Federal Energy Regulatory Commission (FERC) (ADAMS Accession No. ML16064A506) regarding the North Anna 3 COL application.

In addition, the staff also published a notice of the application in the *Federal Register* (FR) on April 27, May 4, May 11, and May 18, 2016 (81 FR 24900, 81 FR 26837, 81 FR 29308, and FR 31263).

Based on the staff's completion of notifications to regulatory agencies and the public notices described above, the staff concludes that, for the purposes of issuing a COL for North Anna 3, all required notifications to other agencies or bodies have been duly carried out.

1.5.4 Evaluation of Exemptions Associated with the Special Nuclear Material (SNM) Material Control and Accounting (MC&A) Program

In Revision 6 of their application, the applicant updated Part 7 to include exemption requests from 10 CFR 70.22(b), 70.32(c), 74.31, 74.41, and 74.51. The provisions of 10 CFR 70.22(b) require an application for a SNM license to include a full description of the applicant's program for MC&A of SNM under 10 CFR 74.31, 10 CFR 74.33, "Nuclear material control and accounting for uranium enrichment facilities authorized to produce special nuclear material of low strategic significance," 10 CFR 74.41; and 10 CFR 74.51.[6] The provisions of 10 CFR 70.32(c) require a license authorizing the use of SNM to include and be subject to a condition requiring the licensee to maintain and follow an SNM MC&A Program, a measurement control program, and other material control procedures that include corresponding record management requirements. However, 10 CFR 70.22(b), 70.32(c), 74.31, 74.41, and 74.51 contain exceptions for nuclear reactors licensed under 10 CFR Part 50. The regulations applicable to the MC&A of SNM for nuclear reactors licensed under 10 CFR Part 50 are in 10 CFR Part 74, Subpart B and 74.11 through 74.19, except for 74.17. The applicant states that the purpose of this exemption request is to seek similar exceptions for this COL under 10 CFR Part 52, so that the same regulations applicable to nuclear reactors licensed under 10 CFR Part 50 will apply to the SNM MC&A Program.

The applicant also states that that there is no technical or regulatory reason to treat nuclear reactors licensed under 10 CFR Part 52 differently from reactors licensed under 10 CFR Part 50, with respect to MC&A for SNM provisions in 10 CFR Part 74. The staff finds the applicant's justifications in Part 7 of the application acceptable in that nuclear reactors licensed under 10 CFR Part 52 should be treated the same as reactors licensed under 10 CFR Part 50 regarding MC&A for SNM.

For 10 CFR Part 52, an exemption request is evaluated under 10 CFR 52.7, "Specific exemptions," which incorporates the requirements of 10 CFR 50.12, "Specific exemptions," and states that the Commission may grant exemptions from the requirements of the regulations in 10 CFR 50.12 if (1) the exemption is authorized by law and will not present an undue risk to public health and safety and is consistent with common defense and security; and 2) special

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[6] Although it does not include an explicit exception for 10 CFR Part 50 reactors, 10 CFR 74.33 applies only to uranium enrichment facilities and thus is not directly impacted by this exemption request.

circumstances are present as specified in 10 CFR 50.12(a)(2). According to 10 CFR 50.12(a)(2)(ii), special circumstances are present whenever the application of the regulation in particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. In addition, the criteria in 10 CFR 50.12 encompass the criteria for an exemption in 10 CFR 70.17(a) and 10 CFR 74.7, the specific exemption requirements for 10 CFR Part 70 and 10 CFR Part 74, respectively. Therefore, by demonstrating that the exemption criteria in 10 CFR 50.12 are satisfied, these exemption requests also demonstrate that the exemption criteria in 10 CFR 52.7, 10 CFR 70.17(a), and 10 CFR 74.7 will be satisfied.

The staff reviewed the subject exemption requests that will allow the applicant to have similar exceptions for the COL under 10 CFR Part 52. The same regulations applied to nuclear reactors licensed under 10 CFR Part 50 (i.e., the regulations under Part 74 Subpart B) will apply to the SNM MC&A Program. The staff determined that (1) these requested exemptions are consistent with the Act and are authorized by law; (2) the exemptions will not present an undue risk to public health and safety; (3) these exemptions are consistent with common defense and security; and (4) special circumstances may exist so that the application of the regulations is not necessary to achieve the underlying purpose of the rule.

Because the staff finds that the applicant has satisfied the exemption criteria in 10 CFR 50.12, the staff considers these exemption requests to also satisfy the exemption criteria in 10 CFR 52.7, 70.17(a) and 74.7. Therefore, the staff finds that the exemptions from 10 CFR 70.22(b), 70.32(c), 74.31, 74.41 and 74.51 are justified.

1.5.5 Receipt, Possession, and Use of Source, Byproduct, and SNM Authorized by 10 CFR Part 52, Subpart C

1.5.5.1 Introduction

The reviews conducted for compliance with the requirements of 10 CFR Part 52 to support the issuance of the COLs encompass those requirements necessary to support granting 10 CFR Parts 30, 40, and 70 licenses. As a result, the 10 CFR Part 52 COL for North Anna 3 will be consistent with the licensing requirements in 10 CFR Parts 30, 40, and 70 for nuclear power plant licenses in accordance with 10 CFR Part 50.

In SECY-00-0092, “Combined License Review Process,” dated April 20, 2000, the Commission approved generic license conditions for 10 CFR Parts 30, 40, and 70. In addition, per the memorandum dated December 9, 2008, from the Director of the Division of New Reactor Licensing in the Office of New Reactors (ADAMS Accession No. ML083030065); holders of a COL under 10 CFR Part 52 will also be authorized to receive, possess, and use source, byproduct, and SNM in accordance with Commission regulations in 10 CFR Parts 30, 40, and 70 including 10 CFR Sections 30.33, “General requirements for issuance of specific licenses;” 40.32, “General requirements for issuance of specific licenses;” 70.23, “Requirements for the approval of applications;” and 70.31, “Issuance of licenses,” under their 10 CFR Part 52 COL. Licensees will be required to comply with all applicable regulations in 10 CFR Parts 30, 40, and 70, as well as the regulations in 10 CFR Parts 20, 50, and 52.

In order to meet these requirements, the applicant needed to supplement the COLA with a request to receive, possess, and use source, byproduct, and SNM accordingly and provide sufficient information to support compliance with the applicable portions of 10 CFR Parts 30, 40, and 70. In RAI 01-4 (ADAMS Accession No. ML091550016), the staff requested for Dominion to address these items and on September 25, 2009 (ADAMS Accession No. ML092730455) the applicant responded. The staff reviewed this information and detailed the privileges to be granted under 10 CFR Parts 30, 40 and 70 licenses in the proposed "License Conditions" section specified below. This RAI was previously tracked as an Open Item and is now closed.

1.5.5.2 Parts 30, 40, and 70 License Requests

Pursuant to 10 CFR 52.8, "Combining licenses; elimination of repetition," Part 1, "General and Administrative Information"; Section 2 (e), "Information Required by 10 CFR 50.33," of the North Anna 3 application, Dominion requested additional Parts 30, 40 and 70 licenses to be incorporated into the COL to receive, possess and use source, SNM, and byproduct material in connection with the operation of North Anna 3.

Pursuant to 10 CFR 52.8, this application also seeks licenses that would be incorporated into the COL to receive, possess, and use source, SNM, and byproduct material in connection with the operation of North Anna 3. Specifically, as the proposed operator of North Anna 3, Dominion seeks authority for the following:

- To receive, possess, and use at any time SNM as reactor fuel.

- To receive, possess, and use at any time any byproduct, source, and SNM, as sealed neutron sources for reactor startup, sealed sources for instrumentation, and radiation monitoring equipment calibration, and as fission detectors in amounts as required.

- To receive, possess, and use in the amounts as required any byproduct, source, or SNM without restriction to chemical or physical form, for a sample analysis or instrument and equipment calibration, or associated with radioactive apparatus or components.

- To possess, but not separate, such by-product and SNM as may be produced by the operation facility.

1.5.5.3 Parts 30, 40, 70 License Request Clarifications

In Part 10, Revision 7, the applicant has updated these proposed license requests. The staff notes that the initial license requests and conditions, stated above, have evolved based on the staff's review of information in the application. The full set of applicable license conditions for Parts 30, 40, and 70 to be proposed by the staff for North Anna 3 are listed below in Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions. In addition, the program elements to be in place to allow for receipt of byproduct and special materials before the 10 CFR 52.103(g) finding are discussed more specifically in the staff's review below and are also provided in the applicant's FSAR Table 13.4-201 "Operational Programs Required by NRC Regulations."

1.5.5.4 Exemptions from Part 70 License Request

In Part 7, Revision 6, of the application, the applicant has requested exemptions from 10 CFR 70.22(b), 70.32(c), 74.31, 74.41, and 74.51 as they relate the SNM Accountability. The staff's review for the SNM MC&A is provided below and discusses these exemptions. In addition, the evaluation of these exemption requests are summarized in SER Section 1.5.4.

1.5.5.5 Parts 30, 40, and 70 Materials and Use Clarifications

In order to clarify the specific types of byproducts, sources, and SNMs; the chemical or physical forms; and the maximum amount at any one time of the requested material licenses under 10 CFR Parts 30, 40, and 70, the applicant has provided supplemental information in FSAR Section 12.2 to identify additional byproduct, source, and SNM materials beyond what has been described in the ESBWR DCD. The information in the section has been reviewed by the staff below, and was found to be acceptable.

10 CFR Part 30 Materials

With respect to the amount of 10 CFR Part 30 materials specified by the applicant between the issuance of the COL and before the 10 CFR 52.103(g) finding, the applicant has provided FSAR Table 12.2-206 which indicates that the quantity of any sealed calibration and referenced sources of byproduct material with the atomic numbers 1 through 93 would not exceed 100 millicuries for a single source and 5 curies total. In addition, the maximum for americium-241 would not exceed 300 millicuries for a single source and a total of 500 millicuries. The applicant has also provided STD SUP 12.2-1 in Subsection 12.2.1.1.2 to state that the Californium-252 (Cf) Cf-252 reactor startup source is a sealed source and each source capsule contains 0.5 to 0.822 mg of Cf-252. Six sources are required, resulting in a total of 3 to 5 mg Cf-252.

The applicant stated that this information remains in effect between the issuance of the COL and the 10 CFR 52.103(g) finding. The applicant included this information as Table 12.2-206 in FSAR Chapter 12. Further clarifications of the licensing for the receipt, possession, and use of 10 CFR Part 30 materials are outlined below in Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions.

10 CFR Part 40 Materials

In FSAR Section 12.2, the applicant states that no 10 CFR Part 40 specifically licensed material, including natural uranium, depleted uranium, and uranium hexafluoride will be received, possessed, or used during the period prior to implementation of the Emergency Plan (in preparation for initial fuel load following the 52.103(g) finding.) Accordingly, the license conditions described below only grant licenses for Parts 30 and 70 materials between the issuance of the COL and the 10 CFR 52.103(g) finding. Further clarifications of the licensing for the receipt, possession, and use of 10 CFR Part 40 materials after a 10 CFR 52.103(g) finding are outlined below in Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions.

10 CFR Part 70 Materials (non-fuel)

In FSAR Section 12.2, the applicant states that the radioactive materials identified in the table below represent nominal values of known non-fuel SNM specifically required for use at North Anna 3. Table 1-1 includes the following data from Table 12.2-207 of the North Anna 3 COL FSAR:

Table 1-1 Non-Fuel Special Nuclear Material for Use

(a) Element and Mass Number	(b) Chemical or Physical Form	(c) Maximum Amount
U-234 (approx. 78%) U-235 (approx. 22%)	Local Power Range Monitor Assemblies – Each assembly includes four fission chambers (64 assemblies and 4 spares)	0.0104 grams of uranium per assembly. Total of approx. 0.71 grams.
U-234 (approx. 78%) U-235 (approx. 22%)	Startup Range Nuclear Monitor Assemblies – Fission chambers (12 installed assemblies and 1 spare)	0.0129 grams of uranium per assembly. Total approx. 0.17 grams.

Further clarifications of the licensing for the receipt, possession, and use of 10 CFR Part 70 materials as a non-fuel are outlined below in Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions.

10 CFR Part 70 Materials (fuel)

The receipt, possession, and use of 10 CFR Part 70 SNMs as fuel are fully described in accordance with the limitations for storage and in the amounts necessary for reactor operation in the applicant's FSAR, as supplemented and amended. Further clarifications of the licensing for the receipt, possession, and use of 10 CFR Part 70 materials as fuel are outlined below in the license conditions.

1.5.5.6 Parts 30, 40, and 70 License Conditions

Based on the discussions above and the reviews outlined below, the staff proposes to include the following license conditions for the North Anna 3 COL as they relate to authorization pursuant to the regulations in 10 CFR Parts 30, 40, and 70:

- License Condition (1-1) – Subject to the conditions and requirements incorporated herein, the Commission hereby licenses Dominion:

  (a) (i) Pursuant to the Act and 10 CFR Part 70, to receive and possess at any time SNM as reactor fuel in accordance with the limitations for storage and in the amounts necessary for reactor operation, as described in the FSAR as supplemented and amended;

  (ii) Pursuant to the Act and 10 CFR Part 70, to use SNM as reactor fuel, after a Commission finding under 10 CFR 52.103(g) has been made, in accordance with the limitations for storage and in amounts necessary for reactor operation, described in the FSAR, as supplemented and amended;

(b) (i) Pursuant to the Act and 10 CFR Parts 30 and 70, to receive, possess, and use, at any time before a Commission finding under 10 CFR 52.103(g), such byproduct and SNM as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts, as necessary;

(ii) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use, after a Commission finding under 10 CFR 52.103(g) any byproduct, source, and SNM as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as necessary;

(c) (i) Pursuant to the Act and 10 CFR Parts 30 and 70, to receive, possess, and use, before Commission finding under 10 CFR 52.103(g), in amounts not exceeding those specified in 10 CFR 30.35(d) and 10 CFR 70.25(d) required for establishing decommissioning financial assurance, any byproduct or SNM that is (1) in unsealed form; (2) on foils or plated surfaces, or (3) sealed in glass, for sample analysis or instrument calibration or other activity associated with radioactive apparatus or components;

(ii) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use, after a Commission finding under 10 CFR 52.103(g), in amounts as necessary, any byproduct, source, or SNM without restriction as to chemical or physical form, for sample analysis or instrument calibration or other activity associated with radioactive apparatus or components but not uranium hexafluoride; and

(d) Pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such byproduct and SNMs as may be produced by the operation of the facility.

- License Condition (1-2) – Prior to initial receipt of SNM onsite, the licensee shall implement the SNM Material Control and Accounting Program. No later than 12 months after issuance of the COL, the licensee shall submit to the Director of Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the SNM MC&A Program. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the SNM MC&A Program has been fully implemented.

- License Condition (1-3) – The fire protection measures in accordance with RG 1.189, “Fire Protection for Nuclear Power Plants,” for designated storage building areas (including adjacent fire areas that could affect the storage area) shall be implemented before initial receipt of byproduct or SNMs that are not fuel (excluding exempt quantities as described in 10 CFR 30.18, “Exempt quantities”).

- License Condition (1-4) – The fire protection measures in accordance with RG 1.189 for areas associated with new fuel (including all fuel handling, fuel storage, and adjacent fire areas that could affect the new fuel) shall be implemented before receipt of fuel onsite.

- License Condition (1-5) – Prior to the receipt of fuel onsite, a formal letter of agreement shall be in place with the local fire department specifying the nature of arrangements in support of the Fire Protection Program (FPP).

- License Condition (1-6) – All FPP features shall be implemented before initial fuel load.

1.5.5.7 Operational Programs to Support 10 CFR Parts 30, 40, and 70

The staff notes that North Anna 3 COL FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations," provides milestones and commitments for the implementation of various operational programs. Important milestones for the portions of operational programs applicable to radioactive materials that support the issuance of licenses and requirements relative to 10 CFR Parts 30, 40, and 70 are included in the following programs:

- Item 8: Fire Protection Program
- Item 10: Radiation Protection (RP) Program
- Item 11: Non-Licensed Plant Staff Training Program
- Item 15: Security Program
- Item 23: SNM Control and Accounting Program

1.5.5.8 Part 70 License Staff Review

The applicant's compliance with several applicable 10 CFR Part 70 requirements regarding RP, nuclear criticality safety (NCS), and environmental protection are already encompassed by the design information incorporated by reference from the ESBWR DCD. In addition, the staff evaluated the applicant's compliance with these requirements as part of the DC review. Other applicable 10 CFR Part 70 requirements to be addressed by the COL applicant are outlined below. In order to satisfy NRC regulations and requirements for licensing under 10 CFR Part 70 so as to receive, possess, and use SNM as fuel and non-fuel, the applicant addressed the following areas for review per the guidance in NUREG–1520 and the SRP:

- General Information – Applicant identifications, location, licenses sought, financial qualifications, exemption requests, site layout, population, geography, nearby facilities, meteorology, hydrology, geology, and seismicity

- Organization and Administration – Structure, management, functions, qualifications, experience, communications, and turnover of the construction to operation

- Radiation Protection

- Criticality Safety

- Fire Safety

- EP

- Effluent Controls and Monitoring Programs

- SNM MC&A–Exemptions, MC&A, and Fixed Site Security Review

- Physical Security

General Information

The legal identities of the applicant and the site location are described by the applicant in Part 1, Sections 1, 2(a-d), and Part 2, Subsection 1.1.2.2. The license action types requested by the applicant are described in Part 1, Section 2(e). However, the staff has further clarified the 10 CFR Parts 30, 40, and 70 licenses to be granted in the license conditions listed above in Section 1.5.5.6. Financial qualifications are in Part 1, Section 2(f), which the staff reviewed in SER Section 1.5.1. The exemption requests for 10 CFR Part 70 licensing are in Part 7 of the application, which the staff reviewed in Section 1.5.4. The facility layout, property boundaries, geography, and population are described in FSAR Section 2.1. Locations of nearby facilities are described in FSAR Section 2.2. Meteorology is described in FSAR Section 2.3, and site hydrology is described in FSAR Section 2.4. Site geology and seismicity are described in FSAR Section 2.5. These sections also incorporate information from the North Anna ESP Standard SSAR. Based on the above information, the staff finds that the applicant has satisfactorily addressed general information.

Organization Information

The applicant's organizational structure and charts are in FSAR Section 13.1 and Appendix 17AA. This information includes functional descriptions of the organizational groups—including those responsible for managing the design, construction, operations, and modifications of the facility; in addition to responsibilities, reporting hierarchy, and communications. FSAR Subsection 13.1.1.4 discusses the education and experience qualifications for managers, supervisors, and technicians. FSAR Appendix 13AA describes the activities required to transition the unit from the construction phase to the operation phase. Based on the above information, the staff finds that the applicant has satisfactorily addressed organizational information.

Radiation Protection

The staff's safety review under 10 CFR Part 52 for RP programs and systems for the construction and operation of North Anna 3 is in SER Chapter 12. The staff finds the applicant's RP programs and systems acceptable for construction and operation.

In FSAR Table 13.4-201, the applicant states that the following four commitments will be implemented for the RP Program at North Anna 3:

- Prior to initial receipt of byproduct, source, or SNMs (excluding Exempt Quantities as described in 10 CFR 30.18) for those elements of the RP Program necessary to support such receipt.

- Prior to fuel receipt for those elements of the RP Program necessary to support receipt and storage of fuel onsite.

- Prior to fuel load for those elements of the RP Program that are necessary to support fuel load and plant operation.

- Prior to first shipment of radioactive waste for those elements of the RP Program that are necessary to support shipment of radioactive waste.

The above commitments correspond to the four milestones for the RP Program that is specified in Nuclear Energy Institute (NEI) Template 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program Description." NEI 07-03A is incorporated by reference by the applicant in Chapter 12, Appendix 12BB, of the North Anna 3 FSAR. By letter dated March 18, 2009 (ADAMS Accession No. ML090510379), the staff determined that NEI 07-03A provides an acceptable template for assuring that the RP program meets applicable NRC regulations and guidance. Therefore, the staff finds these commitments acceptable. With respect to the RP review of 10 CFR Part 70 licenses, the staff performed the following review:

The regulatory basis for this review of the North Anna 3 RP Program applicable to the fresh fuel assemblies for the first reactor core prior to commencement of operation is contained in 10 CFR Parts 19, "Notices, Instructions, and Reports to Workers: Inspections and Investigations," 20, and 70. The purpose of this review is to determine whether Dominion's proposed RP program is adequate to protect the radiological health and safety of workers, the public, and the environment during fresh fuel handling and storage operations under 10 CFR Part 70. This review is necessary in anticipation of the operation of the North Anna 3 ESBWR.

The applicable acceptance criteria for the NRC's 10 CFR Part 70 review of the North Anna 3 RP Program are outlined in Section 4.4 of NUREG–1520, Revision 1, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility* (SRP). While some portions of the acceptance criteria in NUREG–1520, Section 4.4 are relevant to this incremental review, other portions are not. For example, certain RGs and other documents referenced in NUREG–1520, Section 4.4 are specific to fuel cycle facilities and are not applicable to reactor reviews. Also, reactors are not one of the engagements for which an Integrated Safety Analysis is required as per 10 CFR 70.60, "Applicability."

Operations pertaining to 10 CFR Part 70 include uncrating, handling, and inspection of fuel assemblies and storing them in the new fuel and spent fuel storage pool prior to loading into the reactor. As the fuel assemblies are effectively contained/sealed material with little associated external radiation, the radiological risks associated with this operation are considered minimal. Other forms (not fuel) of SNM on site include small amounts in fission chambers used for monitoring and wire sources used for startup operations. Similarly, because that is also contained/sealed material, the radiological risks associated with the materials are considered minimal.

The review documented here is not applicable in determining the acceptability of the described program with respect to operations under 10 CFR Part 52. The radiation protection methods and estimated occupational radiation exposures to operation and construction personnel during normal and anticipated operational occurrences will be reviewed with respect to issuance of the combined construction permit and operating license (COL) in Chapter 12 of the Advanced SER for the North Anna 3 COL Application. The staff will have to verify the resolution of all relevant issues when the North Anna 3 final SER is available in order to complete its 10 CFR Part 70 review.

In general, the NUREG–1520 acceptance criteria require descriptions to ensure the following topics will be adequately addressed at the facility: RP program implementation; radiation exposures as low as reasonably achievable (ALARA); RP organization and qualifications;

written procedures; training; ventilation and respiratory protection programs; radiation survey and monitoring programs; radiological risk associated with accidents; and additional programs normally impacting the RP function. The applicant's FSAR Section 12.5 provides a description of the operational RP program. The program incorporates by reference NEI Template 07-03A, Revision 0 (NEI, 2009a), with site-specific supplements or substitutions included elsewhere in the FSAR or ESBWR DCD (GE-Hitachi, 2014), as the operational RP Program description. NEI 07-03A is the final accepted version of the NRC reviewed NEI-07-03, Revision 7. The staff completed the review and safety evaluation of NEI 07-03, Revision 7, as documented in "Safety Evaluation Regarding the Nuclear Energy Institute Technical Report 07-03 "Generic FSAR Template Guidance for Radiation Protection Program Description, Revision 7". Table 13.4-201 (item 10) in the applicant's FSAR indicates that all necessary aspects of its RP program will be implemented prior to its receipt of any by-product, source, SNM (except as described in 10 CFR 30.18), or fuel.

The generic RP program template commits an applicant to NRC regulatory requirements and guidance and to acceptance criteria listed in RG 1.206 and SRP Section 12.5. While the SRP is not as prescriptive regarding the required information for a radiological protection program as NUREG–1520, the staff believes that a program established to address 10 CFR Part 52 operations would adequately address 10 CFR Part 70 operations as well. The staff reviewed NEI 07-03A, as well as the modifications and supplements to that information described in the FSAR and found that it adequately addressed the topics of evaluation in Section 4 of the NUREG–1520 (Radiation Protection) with the exceptions of ALARA, ventilation, and radiological risk associated with accidents.

With respect to ALARA, the applicant states in Appendix 12AA and Appendix 12BB of its FSAR that it incorporates NEI 07-08A (NEI, 2009b), "Generic FSAR Template Guidance for Ensuring That Occupational Radiation Exposures are As Low As Is Reasonably Achievable (ALARA), Revision 0," with modifications or supplements as noted in the section. Similar to NEI 07-03A, the staff previously reviewed NEI 07-08, Revision 3, and found it acceptable as documented via letter. The template, in conjunction with template NEI 07-03A, generally describes operational policies, regulatory compliance, and operational considerations applicable to the ALARA program. Compliance with the template, when considering the minimal risks associated with storage and handling fresh fuel under 10 CFR Part 70, is adequate to assure operations will be ALARA. The applicant's RP program to achieve occupational doses ALARA also addresses regulatory requirements for RP found in 10 CFR Part 20.

Regarding ventilation, the materials of interest for this license are expected to be contained and pose little airborne potential or risk of internal exposure. For this reason, staff found it unnecessary to evaluate the facility's ventilation systems.

The Integrated Safety Analysis requirements for control of radiological risk discussed in Section 4.4.8 of NUREG–1520 are not applicable to North Anna 3 because the operations proposed are excluded from the list of engagements in 10 CFR 70.60 for which 10 CFR Part 70, Subpart H, applies. The applicant did submit an emergency plan that addresses response to accident situations involving potential radiological exposures. As stated previously, it is expected that the unirradiated uranium contained in the fuel poses little radiological risk for the operations pertaining to 10 CFR Part 70.

The staff finds that Dominion will establish and maintain an acceptable RP program for North Anna 3 that addresses operations under 10 CFR Part 70, which includes:

- An effective documented program to ensure that occupational radiological exposures are ALARA;
- An organization with adequate qualification requirements for RP personnel;
- Approved, written RP procedures and RWPs for RP activities;
- RP training for all personnel who have access to radiologically restricted areas;
- A program to control airborne concentrations of radioactive material with engineering controls and respiratory protection.
- A radiation survey and monitoring program that includes requirements for controlling radiological contamination within the facility and monitoring of external and internal radiation exposures; and,
- Other programs to correct upsets at the facility, maintain records, and generate reports in accordance with 10 CFR Parts 20 and 70.

The staff concludes that the applicant's RP program for North Anna 3, with respect to the initial fresh fuel elements for the first reactor core and other forms of SNM as described in its COL application, complies with regulatory requirements in 10 CFR Parts 19, 20, and 70, adequately addresses the applicable acceptance criteria in Section 4.4 of NUREG–1520, Revision 1, and is, therefore, acceptable to the staff.

Criticality Safety

The assessment of criticality safety of fresh and spent fuel storage and handling is based, in part, on the information in the ESBWR DCD. The applicant has incorporated by reference Sections 9.1.1 and 9.1.2 of the ESBWR DCD. The ESBWR DCD, Tier 2, Subsection 9.1.1.7, "Safety Evaluation," for criticality control designates DCD COL Item 9.1-4-A for the applicant to describe the programs that address criticality safety of fuel handling operations. The staff's safety review of fuel handling is in SER Section 9.1.4. The staff has found that the applicant has satisfactorily addressed fuel handling operations, including criticality safety.

In addition, in SER Section 1.5.5.9 below, the staff finds that the applicant's request for a 10 CFR Part 70 SNM license did not involve an authorization to possess enriched uranium or plutonium for uranium hexafluoride in excess of 50 kilograms in a single container or 1,000 kilograms total; or in excess of 2 curies of plutonium in an unsealed form or on foils or plated sources. Therefore, a criticality alarm system is not required and implementation of the emergency plan before receipt of the SNM is also not required.

With respect to additional review of 10 CFR Part 70 licenses, the staff performed the following review. The regulatory basis for the review of North Anna 3 NCS is contained in 10 CFR 70.22, "Contents of applications;" 10 CFR 70.23; and 10 CFR 70.52, "Reports of accidental criticality." The purpose of this review is to determine whether the Dominion's North Anna 3 proposed NCS program is adequate to protect the radiological health and safety of workers, the public, and the environment during fresh fuel handling and storage operations under 10 CFR Part 70. This review is necessary in anticipation of the operation of the North Anna 3 ESBWR.

The acceptance criteria for NRC's 10 CFR Part 70 review of North Anna 3's NCS program are outlined in Section 5.4 of NUREG–1520. However, staff determined that few of the acceptance criteria in NUREG–1520 were applicable to the 10 CFR Part 70 operations proposed at North Anna 3 and, therefore, limited the review to that necessary to assure compliance with the applicable 10 CFR Part 70 requirements noted previously.

Dominion has submitted a COLA for an ESBWR design to be designated North Anna 3. This review is to focus on criticality safety for the receipt, possession, inspection, and storage of SNM in the form of fresh fuel assemblies as applicable under 10 CFR Part 70. Other forms of SNM are specified in Table 12.2-207 of the COLA (primarily fission chambers) and constitute less than 1 gram total of SNM which was considered negligible relative to NCS concerns. The operations relevant to the 10 CFR Part 70 portion of the license include the uncrating and inspection of the fuel assemblies and storing them in the new fuel racks and spent fuel storage pool prior to loading into the reactor. The applicant has prepared the FSAR to be consistent with guidance in the SRP. Consistent with the format of that guidance, Section 9.1 of the FSAR discusses criticality safety of fresh and spent fuel storage and handling, including movement of light and heavy loads (fuel assemblies).

Acceptance criteria for a 10 CFR Part 70 review are in Section 5.4 of NUREG–1520. However, the staff determined that few of those acceptance criteria are applicable to the proposed reactor operations. The staff therefore limited the review to what was necessary to assure compliance with the applicable 10 CFR Part 70 requirements noted previously.

The staff evaluation of criticality concerns relating to fresh and spent fuel storage for the standard ESBWR design is set forth in ESBWR FSER Sections 9.1.1, and 9.1.2.

Finally, staff determined that reporting compliant with 10 CFR 70.52 would be self-evident and no elaboration in the application should be required to assure compliance with those regulations. The information submitted by the applicant and reviewed by the staff assures the applicant's equipment, facilities and procedures will be adequate to assure subcriticality of the fresh fuel consistent with 10 CFR 70.23(a)(3) and (4), thus adequately protecting health and minimizing danger to life or property.

Fire Safety

The staff's safety review under 10 CFR Part 52 for the FPPs) and systems for the licensing and operation of North Anna 3 was completed and is contained in Chapter 9 SER, Subsection 9.5.1. In FSAR Table 13.4-201 the applicant has made three commitments to adhere to the FPP: 1) prior to initial receipt of byproduct, source, or SNM (excluding exempt quantities as described in 10 CFR 30.18) for portions of the FPP applicable to radioactive material; 2) prior to fuel receipt for the elements of the FPP necessary to support receipt and storage of fuel onsite, and; 3) prior to fuel load for the elements of the FPP necessary to support fuel load and plant operation. The staff found these commitments contribute to the reasonable assurance that adequate fire protection will be provided and maintained to meet the criteria of 10 CFR 70.23.

With respect to the fire safety review of 10 CFR Part 70 licenses, the staff performed the following review:

The purpose of this review is to determine, with reasonable assurance, that North Anna 3 has (1) designed a facility that provides adequate protection against fires and explosions that could affect the safety of licensed materials and thus present an increased radiological risk; (2) considered the radiological consequences of fires; and (3) instituted suitable safety controls to protect workers, the public, and the environment.

The regulatory basis for the fire safety review includes the general and additional contents of the application, as required by 10 CFR 70.22. In addition, the fire safety review must provide reasonable assurance of compliance with 10 CFR 70.23(a)(3) and 10 CFR 70.23(a)(4). The acceptance criteria that the NRC uses for reviews of fire safety of licensed material are outlined in Sections 7.4.3.1 through 7.4.3.5 of NUREG–1520.

The facility and its original fire protection systems are designed and will be constructed to industrial standards currently in effect. The licensee commits to meeting the prevailing codes whenever facilities are expanded or modified. Facilities are generally concrete, noncombustible masonry, or metal construction. Lightning protection is incorporated into the facility design. Facility exit routes are posted throughout and are unimpeded by physical security requirements. In addition, workers are trained in evacuation and periodic drills are conducted to verify the adequacy of egress.

Within the fuel building (FB), which is a seismic Category I structure, new fuel bundles are brought in through the rail car bay, uncrated, raised to the refueling floor, and transferred for storage on racks in the buffer pool within the reactor building, also a seismic Category I structure. The process itself utilizes methods and materials that have no fire safety concerns. The fire protection equipment in the fuel handling area of the FB includes fire detection, portable fire extinguishers, and hose stations for manual firefighting.

Site procedures for the maintenance and surveillance testing of the above-listed equipment, including fire pump, fire mains, standpipes, and hoses, have been developed and will be performed as described in the FPP and in accordance with applicable codes and standards. In addition, the compensatory actions described in the FPP will be used should any of the listed fire equipment become unavailable.

The staff has proposed the following license conditions regarding the FPP which requires:

- The fire protection measures in accordance with RG 1.189 for designated storage building areas (including adjacent fire areas that could affect the storage area) be implemented before initial receipt of byproduct or SNMs that are not fuel (excluding exempt quantities as described in 10 CFR 30.18).

- The fire protection measures in accordance with RG 1.189 for areas associated with new fuel (including all fuel handling, fuel storage, and adjacent fire areas that could affect the new fuel) be implemented before receipt of fuel onsite.

- Prior to the receipt of fuel onsite, a formal letter of agreement shall be in place with the local fire department specifying the nature of arrangements in support of the FPP.

- All FPP features be implemented before initial fuel load.

These license conditions are included in Subsection 1.5.4.6, Parts 30, 40, and 70 License Conditions, above.

Effective handling of fire emergencies is accomplished by trained and qualified emergency responders. The fire response organization is staffed and equipped for firefighting activities. The fire brigade is composed of a fire brigade leader and at least four fire brigade members. The fire brigade does not include the Shift Manager or other members of the minimum shift crew necessary for safe shutdown of the unit, nor any personnel required for other essential functions during a fire emergency or members of the fire brigade for Units 1 and 2. Additional support is available when needed through an agreement with the local fire department.

Training ensures that the fire brigade's capability to combat fires is established and maintained. The training program consists of initial (classroom and field) training and recurrent training which includes periodic instruction, fire drills, and annual fire brigade training.

Firefighting equipment is provided throughout the plant. Fire emergency procedures and pre-fire plans specify actions to be taken by the individual discovering the fire and by the emergency responders. Discussion of this pre-fire plan is included in the periodic classroom instruction's training program provided for the emergency responders.

Combustibles are controlled to reduce the severity of a fire which might occur in a given area and to minimize the amount and type of material available for combustion. The use and application of combustible materials at North Anna 3 are controlled utilizing the following methods:

- Instructions/guidelines provided during general employee training/orientation programs;
- A chemical control program;
- Periodic plant housekeeping inspections/tours by management and/or the plant fire protection organization;
- Design/modification review and installation process; and
- Administrative procedures (e.g., Transient Combustible Control Program).

The use of ignition sources such as welding, flame cutting, brazing, grinding, and soldering within safety-related areas are controlled through the approval and issuance of an ignition source permit. Permits are reviewed and approved by appropriate plant personnel. The ignition source permit is valid for 24 hours during plant operation and for the duration of one job during plant shutdown. Job area inspection will be performed and documented at the start of each shift that ignition source activities are being performed.

The Fire Hazards Analysis (FHA) is part of the FPP. The FHA results are documented on a fire area basis, broken down into separate discussions of classical fire protection features and safe shutdown analysis for each fire area. The FHA is required to be updated, prior to receipt of the new fuel, as part of the License Condition previously mentioned. The FHA includes the following:

- A summary of the evaluation performed to determine the adequacy of the fire protection features for each fire area; and

- A discussion of the ability to achieve safe shutdown in case of a fire in each fire area.

The fire hazards and safe shutdown evaluation were performed by qualified nuclear, mechanical, electrical, and fire protection engineers. FHA and Pre-Fire Plans conform to the applicable guidance provided in National Fire Protection Association (NFPA) 801, “Standard for Fire Protection for Facilities Handling Radioactive Materials” (NFPA, 2003) and NFPA 804, “Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants” (NFPA, 2006).

The staff concluded that the licensee’s capabilities meet the criteria in Chapter 7 of NUREG–1520. The staff determined that the licensee’s equipment, facilities, and procedures provide reasonable assurance that adequate fire protection will be provided and maintained to meet the criteria of 10 CFR 70.23.

Emergency Preparedness

The staff’s evaluation of the applicant’s request for a 10 CFR Part 70 license, with regard to EP, is provided below in SER Section 1.5.5.9, “Parts 30 and 40 License Staff Review.” In this review, the staff also evaluated the applicant’s request for 10 CFR Parts 30 and 40 licenses in regards to EP. In regards to the 10 CFR Part 70 license request, the staff found that the applicant has met the emergency planning-related requirements of 10 CFR 70.22(i)(1) for SNM (fuel and non-fuel), such that prior to implementation of the North Anna 3 Emergency Plan (i.e., during the period of time between issuance of the COL and implementation of the North Anna 3 Emergency Plan, which will occur prior to the Commission’s 10 CFR 52.103(g) finding), an emergency plan that meets 10 CFR 70.22(i)(3) is not required.

Effluent Controls and Monitoring Programs

The staff’s complete reviews of environmental protection for the licensing and operation of North Anna 3 under 10 CFR Part 51 are in NUREG–1811 and NUREG–1917.

With respect to the applicant’s request for a 10 CFR Part 70 license, the staff performed the following review: The regulatory basis for the review of the North Anna 3 program applicable to the fresh fuel assemblies for the first reactor core before beginning operation is in 10 CFR Part 20, Subpart D and 10 CFR 70.22 and 70.23. The North Anna 3 facility will also use fission chamber detectors containing SNM for the reactor startup and neutron flux monitoring during reactor operations. The staff evaluated the use and handling of these fission chamber detectors for compliance with the applicable requirements in 10 CFR Parts 20 and 70.

The acceptance criteria for the NRC review of the portion of the North Anna 3 application for a 10 CFR Part 70 license described above are outlined in Section 9.4 of NUREG–1520, Revision 1. Although most portions of the acceptance criteria in Section 9.4 of NUREG–1520 are directly applicable to this review, other portions are not because of the scope of the proposed activities. For example, a review of an applicant’s Integrated Safety Analysis of accidents is conducted for fuel cycle facilities but not for reactors. In addition, certain regulatory guides and other documents referenced in Section 9.4 of NUREG–1520 are specific to fuel cycle facilities.

The radiological impacts assessment is based, in part, on information in the ESBWR DCD, Revision 10. The DCD is incorporated by reference into Revision 6 of the North Anna 3 FSAR, which was prepared to be consistent with the guidance in the SRP. This staff review focused on the incremental impact, if any, of the North Anna 3 application for the receipt, possession, inspection, and storage of SNM in the form of fresh fuel assemblies for the first reactor core loading, as applicable under 10 CFR Part 70. This review also evaluated the receipt, storage, use, and disposal of fission chamber detectors containing SNM. These detectors will be used for the reactor start up and neutron flux monitoring during reactor operations.

The staff reviewed FSAR Sections 11.4, 11.5, 12.1, 12.2, and 13.1, in addition to FSAR Table 13.4-201. These sections describe the RP and waste management program to be used for the entire facility, which includes the proposed activities that are within the scope of this review. The staff noted that several elements of Dominion's effluent controls and monitoring programs will be in place before the onsite receipt of fuel or initial fuel loading. These elements include but are not limited to the radiological environmental monitoring program, waste management program, offsite dose calculation manual, and the process and effluent monitoring and sampling program. The staff also noted that the incremental effects related to the fresh fuel assemblies for the first core loading, and the use of fission chamber detectors, do not change Dominion's ALARA goals or controls for liquid or air effluents. These goals include an analysis of the total effective dose equivalent to the maximally exposed individual member of the public who would receive the greatest radiation dose. Population dose estimates are also unaffected. Dominion's monitoring of liquid and air discharges, including monitoring locations and samples, will not be affected by receipt of fresh fuel.

As stated in FSAR Section 1.4.2.2 and Table 13.1-201, Dominion's plant personnel includes those involved in the proposed activities who will be qualified to meet the requirements in American National Standard Institute (ANSI)/American Nuclear Society 3.1-1993, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants," as endorsed by RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants." FSAR Appendix 13BB, Training Program, references the NRC-approved NEI guidance NEI 06-13A, "Technical Report on a Template for an Industry Training Program Description." The staff recognizes that compliance with these documents is an acceptable method for ensuring that the facility's staff will have adequate education and training to engage in the proposed activities. The staff finds that the quality control procedures related to the collection and analyses of environmental monitoring samples will not be affected by the receipt of fresh fuel. ALARA reviews and reports to management will not be affected by activities involving the fresh fuel assemblies or the fission chamber detectors. Because the fresh fuel assemblies and fission chamber detectors contain SNM in the form of encapsulated material (i.e., not dispersible), they result in a low risk of environmental releases. Dominion's implementation of the effluent controls and monitoring programs as described in the North Anna 3 FSAR are commensurate with the activities and impacts associated with fresh fuel handling and storage and provide reasonable assurance that any releases or waste generated during the proposed activities will be adequately handled to protect the public health and safety.

Dominion has provided adequate measures including (1) environmental and effluent monitoring, (2) effluent controls to maintain public doses ALARA as part of the RP Program, and (3) waste management programs. The staff concludes, with reasonable assurance, that Dominion's conformance to the application and license conditions is adequate to protect public health and safety and complies with the regulatory requirements imposed by the Commission in 10 CFR

Parts 20 and 70. The staff finds that Dominion's effluent controls and monitoring programs, including sampling locations and frequency, staff training and qualifications, waste minimization practices, and proposed action levels for the proposed activities as described in the COLA adequately address the applicable acceptance criteria in Subsection 9.4.3.2 of NUREG–1520, Revision 1, and is therefore acceptable.

Special Nuclear Materials Material Control and Accounting Review

The staff conducted a review of the applicant's MC&A Program description. The purpose of this review was to determine whether the applicant had provided a description of an MC&A Program that would be capable of satisfying the regulatory requirements in 10 CFR Part 74, Subpart B. The staff's full evaluation has been provided in a non-publicly available Safety Related Information (SRI) Safeguards Evaluation Report (ADAMS Accession No. ML14262A315). The information below summarizes the conclusions made by the staff:

In accordance with 10 CFR 70.22(b), current applicants requesting a license to possess SNM must submit a full description of their program for the control and accounting of SNM in the applicant's possession and to show compliance with 10 CFR 74.31, 74.33, 74.41, or 74.51, as applicable. Also in accordance with 10 CFR 70.32(c), applicants requesting a license to possess SNM are subject to a license condition to maintain and follow a program for controlling and accounting for source material and SNM. Decreases in the program's effectiveness will be submitted as an amendment pursuant to 10 CFR 70.34. However, the requirements in 10 CFR 70.22(b) and 70.32(c) contain an exclusion for licensees governed by 10 CFR Part 50, including existing nuclear power plants. Moreover, the Dominion North Anna 3 COLA was submitted and accepted as a licensing action for a nuclear power plant under 10 CFR Part 52 instead of 10 CFR Part 50.

The 10 CFR Part 70 and 74 exclusions described above do not include 10 CFR Part 52 applicants, even though for purposes of the requirement, the applicants are the same facility type. For both 10 CFR Parts 50 and 52 applicants, 10 CFR Part 74, Subpart B (excluding 74.17) contains the appropriate MC&A performance requirements. An adequate applicant submittal would describe the licensee program elements that would meet the 10 CFR Part 74 requirements. Additionally, because the primary roles of the MC&A Program are to control and account for SNM, the licensee program elements would have to be developed and implemented before receiving SNM and be maintained as long as any SNM was onsite.

Since there was not any specific regulatory guidance related to MC&A licensing submittals by 10 CFR Parts 50 or 52 applicants, a process was developed that would be acceptable for this applicant and for other 10 CFR Part 52 applicants referencing the same design ESBWR. An ANSI publication, N15.8-2009, which specifically discusses MC&A methods for nuclear power plants, was identified as a resource for the applicant to use. The goal was for the applicant's MC&A description to provide assurance that the implemented program would meet the performance requirements of 10 CFR Part 74, Subpart B, excluding 74.17.

As a result it was determined that:

> (a) The applicant would provide a description of the MC&A Program and its related elements. The form and format submitted by the applicant would be informed by ANSI N15.8-2009;

(b) The applicant would request an exemption from 10 CFR 70.22(b), 70.32(c), and 10 CFR 74.31, 74.41, and 74.51, the purpose being to seek an exception for this application so that the same requirements would be applied to this program as to other reactors licensed under 10 CFR Part 50;

(c) The applicant would provide information relevant to the nuclear material they propose to possess (i.e. Category I-formula quantity, Category II-moderate strategic significance, Category III-low strategic significance);

(d) The MC&A Program will be an operational program, meaning that a formal process of ITAAC should not be necessary if the program and its implementation are fully described in the application;

(e) A licensing condition would be proposed that would require the implementation of the MC&A Program prior to the receipt of SNM on site.

MC&A Program Description

In the submittal dated July 31, 2013, the applicant's proposed Appendix 13CC titled, "Special Nuclear Material (SNM) Material Control and Accounting Program Description", provided a narrative of the MC&A Program that would be developed for the North Anna facility. The review of the applicant's proposed SNM MC&A Program in Appendix 13CC encompassed requirements in 70.22(a)(4); 74.11, "Reports of loss or theft or attempted theft or unauthorized production of special nuclear material"; 74.13, "Material status reports"; 74.15, "Nuclear material transaction reports"; and 74.19, "Recordkeeping."

The staff concluded that the scope and detail of the submittal provided reasonable assurance of program acceptability. The approaches, procedures, and commitments as outlined in the MC&A program description are likely to meet the 10 CFR Part 74, Subpart B, excluding 74.17, regulatory requirements.

Exemption Requests from 70.22(b), 70.32(c), 74.31, 74.41, and 74.51

In order for the applicant to have the same requirements applied to their SNM MC&A Program as are applied to other reactors licensed under 10 CFR Part 50, the applicant submitted requests for exemption from 10 CFR 70.22(b), 70.32(c), 74.31, 74.41, and 74.51 that are detailed in Part 7 of the application. The staff finds that these exemptions are justified and should be granted. The staff's reviews of these exemption requests are in SER Section 1.5.4.

Nuclear Material Category

The applicant's declaration that (1) the facility would be Category III as defined by the regulations and (2) the purpose of the facility was to engage in commercial power operations using small quantities of non-fuel SNM in support of that activity, provided assurance that the correct regulatory requirements for MC&A were being addressed in the submittal. For the purposes of this MC&A review, this portion of the submittal is acceptable.

MC&A Program Description and Operation Programs

Section 13 of the FSAR should address the addition of the MC&A Program to the COL application. During the review of the applicant's submittal of July 2013, it was noted that the applicant agrees with this approach. In Part 2 of the FSAR, the applicant has included a proposed Appendix 13CC, which discusses material control and SNM MC&A procedures. In addition, in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations", was revised to include item 23, SNM Material Control and Accounting Program." The table listed the implementation milestone as "prior to receipt of SNM" and the implementation requirement as "license condition." The staff agrees with the applicant's proposals, in particular that MC&A will be an operational program and that the development of MC&A procedures are formally annotated.

SNM MC&A License Condition

The staff included the following license condition previously for other applicants, as it relates to the MC&A requirements in 10 CFR Part 74. The following condition should be added to the applicant's license:

- **License Condition** - Prior to initial receipt of special nuclear materials (SNM) onsite, the licensee shall implement the SNM Material Control and Accounting program. No later than 12 months after issuance of the Combined Operating License, the licensee shall submit to the Director of Office of New Reactors (NRO) a schedule that supports planning for and conduct of NRC inspections of the SNM Material Control and Accounting program. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the SNM Material Control and Accounting program has been fully implemented.

This license condition is included in the Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions, above.

Conclusion

The staff reviewed Dominion's submitted description of the proposed MC&A Program for SNM for the North Anna 3 facility, the category of material to be possessed, and a licensing exemption request. The staff concluded that the scope and detail of the submittal provided reasonable assurance of program acceptability. The approaches, procedures, and commitments as outlined in the MC&A Program description are likely to meet the 10 CFR Part 74, Subpart B, excluding 74.17, regulatory requirements. The staff also concluded that the exemption request from certain Parts of 10 CFR Parts 70 and 74 met the criteria for exemptions as stated 10 CFR 70.17(a), 74.7, and 52.7, thus making the applicant subject to the same MC&A requirements as the existing commercial reactor fleet. Furthermore, the staff agreed that making the MC&A Program an operational program and proposing a license condition covering the implementation of the MC&A Program is consistent with the policy established in SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." The staff concludes that this MC&A description and approach is sufficient and is acceptable as described.

Fixed Site and Transportation Security for SNM in Regards to the 10 CFR 73.67 Review

This portion of the 10 CFR Part 70 materials review pertains to 10 CFR 73.67. The full technical evaluation on these topics can be found in ADAMS Access No. ML16061A038. The staff reviewed the application to determine if all fixed-site and in-transit physical protection guidance and requirements for SNM of low strategic significance were met as appropriate. The following sections represent a summary of the specific areas of the review and the staff's conclusions.

Introduction and Background

In developing the FSER for North Anna 3, the staff reviewed the ESBWR DCD to ensure that the combination of the information in the DCD and the information in the COLA represents the complete scope of information relating to a particular review topic. The staff finds that the applicant plans to bring SNM of low strategic significance in the form of new fuel assemblies on-site before the protected area is declared operational in accordance with 10 CFR 73.55(a) will be acceptable because the fresh fuel will be subject to the applicable portions of 10 CFR 73.67 and the applicable post September 11, 2001, security order measures for SNM of low strategic significance, and the applicant's plans are adequate for these purposes, as discussed below.

Regulatory Guidance and Evaluation

Fixed site and in-transit physical protection requirements:

- 10 CFR 73.67
- RG 5.59, "Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance (1983)."
- NRC RIS 2005-22, "Requirements for the Physical Protection During Transportation of Special Nuclear Material of Moderate and Low Strategic Significance: 10 CFR Part 73 vs. Regulatory Guide 5.59 (1983)."

Technical Evaluation

A technical evaluation of the North Anna 3 COL FSAR against applicable 10 CFR 73.67 fixed site and in- transit: 1) general performance objectives, 2) general requirements, and 3) physical protection requirements for SNM of low strategic significance, was performed. In addition, the post September 11, 2001, security order measures for SNM of low strategic significance were sent to the applicant to be addressed. The letter conveying those order measures was sent on August 27, 2015 (ADAMS Accession No. ML15224B618) and the SGI containing order measures were sent under separate cover (Safeguards Local Area Network Electronic Safe (SLES) ADAMS Accession No. NS113220). Subsequently, the applicant submitted a letter dated October 9, 2015, which provided a reviewer's aid matrix that covered the applicable 10 CFR 73.67 requirements. The reviewer's aid matrix pointed out the text of the application that described the intent of meeting each element of the applicable portions of 10 CFR 73.67 (ADAMS Accession No. ML15288A072). In addition, the applicant submitted, in the same letter dated October 9, 2015, a revised Special Nuclear Material Physical Protection Program (SNMPPP) description and a response to the post September 11, 2001, security order measures for SNM of low strategic significance. The revised SNMPPP was labeled as: Revision 2, draft dated October 8, 2015, and is noted by the applicant, in the letter dated October 9, 2015, that it will be included in the next revision of the FSAR submitted to the NRC.

Fixed Site General Performance Objectives

The applicable physical protection requirements specified in 10 CFR 73.67, had general performance objectives described. The staff found that the applicant met the specified requirements.

Fixed Site General Requirements

The applicable requirements specified in 10 CFR 73.67, had general requirements. The staff found that the applicant met the specified requirements.

Fixed Cite Physical Protection Requirements

The applicable requirements specified in 10 CFR 73.67, had fixed site physical protection requirements for SNM of low strategic significance. The staff found that the applicant met the specified requirements.

In-transit General Performance Objectives

The applicable requirements specified in 10 CFR 73.67, had general performance objectives described. The staff found that the applicant met the specified requirements.

In-transit General Requirements

The applicable requirements specified in 10 CFR 73.67, had general requirements. The staff found that the applicant met the specified requirements.

In-transit Physical Protection Requirements

The applicable requirements specified in 10 CFR 73.67, had in-transit physical protection requirements described. The staff found that the applicant met the specified requirements.

Post September 22, 2011 Security Order Measures for SNM of Low Strategic Significance

Applicable Requirement: "General Performance Objectives and Requirements," described in the post September, 11, 2001, security order for SNM of low strategic significance, dated 2003 and titled, "Interim Compensatory Measures for Category-3 Fuel Cycle Facilities," has an analysis required. The applicant considered the order and assessed that only parts C and D of those order must be addressed. The discussion of the analysis that justified only Part C and D of the order needed to be addressed was within a letter sent to the NRC dated October 9, 2015, specifically in "Enclosure 2, Response to NRC RAI, Question 01.05-04, Part 2" (ADAMS Accession No. ML15288A072). In addition, in Section 1 "Scope" of the SNMPPP there is a statement reflecting that Sections A and B of the order were not applicable for particular reasons. Therefore, the analysis requirement presented in the beginning of the order, is met.

Conclusion

The staff reviewed North Anna 3 COLA and finds that the applicable requirements specified in 10 CFR 73.67 and the post September 11, 2001, security order measures for SNM of low strategic significance, are met.

Physical Protection Program in FSAR Section 13.6 in Regards to the 10 CFR 73.55 Review

Part 8 of the application contains the North Anna 3 security plan that is referenced in Part 2, FSAR Chapter 13, Section 13.6. This information includes the Physical Security Plan that contains SGI as defined by 10 CFR 73.21; its disclosure to unauthorized individuals is prohibited in Section 147 of the AEA. The staff's safety review of this information under 10 CFR Part 52 for the licensing and operation of North Anna 3 is in SER Chapter 13, Subsection 13.6. Because of information security requirements, the staff's evaluation of the physical security protection program is presented in the publicly available SER Section 13.6, but does not contain the same level of details as the SGI version. Those persons with the correct access authorization and a need to know basis may view the SGI version of the North Anna 3 COLA.

Per 10 CFR 73.55, "Requirements for physical security protection of licensed activities in nuclear power reactors against radiological sabotage," the staff reviewed the applicant's proposed security plan in Part 2 of FSAR Chapter 13, Subsection 13.6 and Part 8 of the application. The staff finds that the applicant has satisfied the regulatory requirements and provided the required information relating to physical security. The staff concludes that the applicant has provided the necessary programmatic elements in the physical security plan, the training and qualification plan, and the safeguards contingency plan, which provide a high assurance that activities involving SNM are not inimical to common defense and security and do not constitute an unreasonable risk to public health and safety.

1.5.5.9 Parts 30 and 40 License Staff Review

In order to satisfy NRC regulations and requirements for the receipt, possession, and use of byproduct and/or source materials, the applicant needed to address the following main areas for review per the guidance in NUREG–1556, Volume 7, Section 8:

- General Information – License action type, legal identities, address, points of contact.
- Materials to be possessed and used.
- Financial assurance and recordkeeping.
- Individuals responsible for the radiation safety program and training and experience, etc.
- Training for workers in restricted areas.
- Facilities and equipment.
- Radiation Safety Program.
- Waste management.
- Physical security.
- EP.

General Information

The 10 CFR Parts 30 and 40 licenses requested by the applicant are described above in Subsection 1.5.5.3, Parts 30, 40 and 70 License Request Clarifications, and in Subsection 1.5.5.6, Parts 30, 40, and 70 License Conditions. The legal identities, addresses, and points of contact are described in Part 1 of Section 2(a-d). The staff finds that the applicant has adequately addressed this information.

Materials To Be Possessed and Used

The possession and proposed uses of 10 CFR Parts 30 and 40 materials are described above in the Subsection 1.5.5.5, Parts 30, 40, and 70 Materials and Use Clarifications, in addition to the Subsection on 1.5.5.3, Parts 30, 40, and 70 License Request Clarifications. The staff finds that the applicant has adequately identified the possession and proposed uses of materials.

Financial Assurance and Recordkeeping for Decommissioning

In the application, the applicant describes this information in Part 1, Section 2(k), including Attachment E, "Decommissioning Funding Assurance Report," This information is discussed and reviewed in Section 1.5.1 of this SER. In addition, the QAPD in FSAR Appendix 17AA describes the decommissioning record keeping processes. The QAPD is reviewed in SER Chapter 17. The staff finds that the applicant has adequately addressed these items.

Individuals Responsible for the Radiation Safety Program: Qualifications, Training, and Experience

The RP Program for North Anna 3 is described in FSAR Section 12.5, Appendices 12AA and 12BB. In SER Chapter 12, the staff finds the applicant's programs acceptable. In regards to RP managers, supervisors, and technicians, FSAR Section 13.1 describes the job and function for these positions. In addition, qualifications and training for these positions are described in FSAR Sections 13.1 and 13.2. The staff reviewed this information in SER Chapter 13 and finds it acceptable.

Training for Workers in Restricted Areas

The RP Program for North Anna 3 is described in FSAR Section 12.5, Appendices 12AA and 12BB. In SER Chapter 12, the staff finds the applicant's programs acceptable. The training criteria for workers in restricted areas are described in FSAR Section 13.2. The staff reviewed this information in SER Chapter 13 and finds it acceptable.

Facilities and Equipment

The physical arrangement and design features for RP is described in FSAR Section 12.3. In addition, in FSAR Sections 12.5, Appendices 12AA and 12BB describe the programs, facilities, instrumentation, and equipment provided to support the implementation of the RP Program. The staff reviewed this information in SER Chapter 12 and finds it acceptable.

Radiation Safety Program

The applicant describes the Operational RP Program in FSAR Section 12.5. The staff finds the applicant's RP Program acceptable in SER Chapter 12. Qualifications, training, and experience for managers, supervisors, and technicians are described in FSAR Sections 13.1 and 13.2. The staff reviewed this information in SER Chapter 13. Radiation control procedures and the maintenance of radiation records will be established by the applicant's QAPD, as presented in FSAR Appendix 17AA. The QAPD is reviewed in SER Chapter 17. In addition, FSAR Table 13.4-201 provides the applicant's commitments to implement the RP programs. The staff reviewed this information in SER Chapters 12 and 13 and finds it acceptable. The staff finds that the applicant has adequately addressed these items.

Waste Management

The radioactive waste management system includes the liquid waste management system (LWMS, Section 11.2); gaseous waste management system (GWMS, Section 11.3); solid waste management system (SWMS, Section 11.4); and process effluent radiation monitoring and sampling systems (PERMS, Section 11.5) as described in the FSAR. The staff evaluated these systems and associated programs and information supplied by the applicant. The staff concludes that the information pertaining to the applicant's waste management systems and programs in Chapter 11 is acceptable.

Physical Security

The applicant's physical security program is described in FSAR Section 13.6. The staff reviewed the Physical Security Program in SER Section 13.6 and finds it acceptable.

Emergency Preparedness (10 CFR Parts 30, 40, and 70 (SNM, Fuel and Non-Fuel) Materials)

The following regulations address emergency planning requirements associated with issuance of licenses to receive, possess, and use source, byproduct, or SNM:

- 10 CFR 30.32(i)(1) requires that each application to possess radioactive materials in unsealed form, on foils or plated sources, or sealed in glass in excess of the quantities in 10 CFR 30.72, "Schedule C—Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release," must contain either: (1) an evaluation showing that the maximum dose to a person offsite due to a release of radioactive materials would not exceed 1 rem effective dose equivalent or 5 rems to the thyroid; or (2) an emergency plan for responding to a release of radioactive material, that provides the information identified in 10 CFR 30.32(i)(3).

- 10 CFR 40.31(j)(1) requires that each application to possess uranium hexafluoride in excess of 50 kilograms in a single container or 1000 kilograms total must contain either: (1) an evaluation showing that the maximum intake of uranium by a member of the public due to a release would not exceed 2 milligrams; or (2) an emergency plan for responding to the radiological hazards of an accidental release of source material and to any associated chemical hazards directly incident thereto, that provides the information identified in 10 CFR 40.31(j)(3).

- 10 CFR 70.22(i)(1) requires that each application to possess enriched uranium or plutonium for which a criticality accident alarm system is required, uranium hexafluoride in excess of 50 kilograms in a single container or 1000 kilograms total, or in excess of 2 curies of plutonium in unsealed form or on foils or plated sources, must contain either: (1) an evaluation showing that the maximum dose to a member of the public offsite due to a release of radioactive materials would not exceed 1 rem effective dose equivalent or an intake of 2 milligrams of soluble uranium; or (2) an emergency plan for responding to the radiological hazards of an accidental release of SNM and to any associated chemical hazards directly incident thereto, that provides the information identified in 10 CFR 70.22(i)(3).

In COLA Part 1, Section 1, “Introduction,” the applicant stated that Dominion applies for a COL of North Anna 3, as well as such other licenses as would be required to possess and use byproduct, source, and SNM in connection with the operation of North Anna 3. Pursuant to Section (a) of 10 CFR 52.8, the applicant further stated in COLA Part 1, Section 2(e), “Class of License, Use of Facility, Period of Time for which the License is Sought, and Other Licenses Issued or Applied for in Connection with the Proposed Facility,” that the application also seeks licenses to receive, possess and use source, byproduct, and SNM in connection with operation of North Anna 3.[7] Finally, in COLA Part 10, Section 3.3, “License Conditions for Byproduct, Source and Special Nuclear Material,” the applicant proposed four license conditions for byproduct, source, and SNM, which reflect the respective requirements in 10 CFR Parts 30, 40, and 70.[8] The staff’s proposed license conditions for the North Anna 3 COL, as they relate to authorization pursuant to the regulations in 10 CFR Parts 30, 40, and 70, are provided above in SER Section 1.5.5.6, “Parts 30, 40, and 70 License Conditions.”

The staff previously examined byproduct, source, and SNM associated with the ESBWR standard design, and discussed these materials in Section 12.3.3.1, “Contained Sources,” of NUREG–1966, Volume 3 (Chapters 9-15) (ADAMS Accession No. ML14099A532). The discussion identified COL Information Item 12.2-4-A, and stated that the addition of this COL information item ensures that any radiation sources containing byproduct, source, or SNM will either be described in the DCD or by the COL applicant, as specified in SRP Section 12.2, “Radiation Sources.”

DCD Tier 2, Section 12.2, “Plant Sources,” describes radiation sources associated with the ESBWR design, and DCD Tier 2, Section 12.2.4, “COL Information,” includes COL Information Item 12.2-4-A, which states that “[t]he COL applicant will address any additional contained radiation sources (including sources for instrumentation and radiography) not identified in [DCD Tier 2] Subsection 12.2.1.5.” In COLA Part 2, FSAR Section 12.2, “Plant Sources,” the COL applicant described the various types and quantities of radiation sources that may be used on the site, and incorporated by reference DCD Tier 2 Section 12.2 (with various departures and/or supplements). In addition, FSAR Section 12.2.1.1.2, “Other Radioactive Sources,” describes the Cf-252 reactor startup source (identified as STD SUP 12.2-1), which supplements the radioactive sources identified in DCD Tier 2, Section 12.2.1.1.2, “Other Radioactive Sources.”

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[7] See also, 10 CFR 52.77 and its referenced Section (e) of 10 CFR 50.33, which requires the applicant to list other licenses, except operator’s licenses, issued or applied for in connection with the proposed facility.
[8] SECY-00-0092 dated April 20, 2000, and the associated September 5, 2000, Staff Requirements Memorandum address the form and content of the generic COL, issued pursuant to 10 CFR Part 52, which includes generic (standard) license conditions for 10 CFR Parts 30, 40, and 70 materials.

The applicant replaced DCD Tier 2 [Sub]section 12.2.1.5 with FSAR Section 12.2.1.5, "Other Contained Sources," which addresses COL Information Item 12.2-4-A (identified as COL Item CWR COL 12.2-4-A[9]) by describing additional contained (byproduct, source, or SNM) sources that may be maintained on the North Anna 3 site, and includes specific limitations (listed below) for these byproduct, source, and SNM that would apply during the period of time prior to the implementation of the Emergency Plan (i.e., between issuance of the COL and implementation of the North Anna 3 Emergency Plan, which will occur prior to the Commission's 10 CFR 52.103(g) finding). Specifically, the applicant stated that prior to the implementation of the North Anna 3 Emergency Plan, no emergency plan will be necessary because:

1. No byproduct material will be received, possessed, or used in a physical form that is "in unsealed form, on foils or plated sources, or sealed in glass," that exceeds the quantities in Schedule C in 10 CFR 30.72;

2. No 10 CFR [Part] 40 specifically licensed material, including natural uranium, depleted uranium, and uranium hexafluoride, will be received, possessed, or used during this period; and

3. The SNM to be received, possessed, or used does not involve enriched uranium for which a criticality accident alarm system is required, uranium hexafluoride in excess of 50 kilograms in a single container or 1000 kilograms total, or in excess of 2 curies of plutonium in unsealed form or on foils or plated sources.

The North Anna 3 Emergency Plan is included in COLA Part 5, "Emergency Plan," and the staff's evaluation of the Emergency Plan is addressed in SER Section 13.3, "Emergency Planning." The resolution of DCD COL Information Item 12.2-4-A is addressed in SER Section 12.2, "Radiation Sources."

In its December 18, 2013, letter (ADAMS Accession No. ML14013A113), the applicant provided the results of its review and disposition of RAIs and responses that are associated with the updated COLA content in the December 2013 COLA submission. These review results addressed whether an emergency plan that meets the requirements in 10 CFR 30.32(i)(3), 10 CFR 40.31(j)(3), or 10 CFR 70.22(i)(3) is required, in relation to the requested 10 CFR Parts 30, 40, and 70 (SNM, fuel and non-fuel) materials license applications, respectively. Specifically, in Enclosure 25, Attachment 1, of the December 18, 2013, letter, the applicant stated that the materials to be possessed and proposed uses are described in COLA Part 1, Section 2(e), and FSAR Chapter 12, including the portions of ESBWR DCD Chapter 12 incorporated by reference.

In Enclosure 25, Attachment 2, of the December 18, 2013, letter, the applicant further stated that an emergency plan that meets 10 CFR 70.22(i)(3) is not required because the request for a 10 CFR Part 70 license does not involve authorization to possess enriched uranium for which a criticality accident alarm system is required, uranium hexafluoride in excess of 50 kilograms in a single container or 1000 kilograms total, or in excess of 2 curies of plutonium in unsealed form or on foils or plated surfaces.

[9] As defined in FSAR Table 1.1-201, "Left Margin Annotations," CWR COL.X.Y-#-A identifies FSAR information that addresses a DCD COL Item and is similar to information presented in the R-COL application (i.e., Fermi 3 Reference COL application) for the same ESBWR DCD.

The staff reviewed the DCD and COLA information (described above) against the applicable requirements in 10 CFR 30.32(i)(1), 10 CFR 40.31(j)(1), and 10 CFR 70.22(i)(1), and concludes that the applicant's identified quantities of byproduct, source, and SNM do not exceed the respective threshold quantities that would require an emergency plan – that meets the respective requirements in 10 CFR 30.32(i)(3), 10 CFR 40.31(j)(3), and 10 CFR 70.22(i)(3) – prior to the implementation of the North Anna 3 Emergency Plan.

When the 10 CFR 52.103(g) finding is made, the North Anna 3 Emergency Plan will have been fully implemented, as reflected in the implementation milestones in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations" (i.e., Item 14, "Emergency Planning") and SER Section 13.3.4.19, "Implementation Milestones." In addition, completion of the emergency planning ITAAC in SER Table 13.3-1, "NAPS Unit 3 ITAAC," which address full implementation of the North Anna 3 Emergency Plan, is required prior to the Commission's 10 CFR 52.103(g) finding.

Therefore, the staff finds that the applicant has met the requirements of 10 CFR 30.32(i)(1), 10 CFR 40.31(j)(1), and 10 CFR 70.22(i)(1), such that prior to implementation of the North Anna 3 Emergency Plan, an emergency plan that meets 10 CFR 30.32(i)(3), 10 CFR 40.31(j)(3), or 10 CFR 70.22(i)(3) is not required.

1.5.5.10 Part 37 Staff Review

On March 19, 2013, a new 10 CFR Part 37, "Physical Protection of Category 1 and Category 2 Quantities of Radioactive Material," rule was published in the FR. The NRC amended its regulations to establish security requirements for the use and transport of Category 1 and Category 2 quantities of radioactive material. The NRC considers these quantities to be risk significant and, therefore, to warrant additional protection. Category 1 and Category 2 thresholds are based on the quantities established by the International Atomic Energy Agency (IAEA) in its Code of Conduct on the Safety and Security of Radioactive Sources, which the NRC endorses. The objective of the 10 CFR Part 37 rule is to provide reasonable assurance of preventing the theft or diversion of Category 1 and Category 2 quantities of radioactive material. The regulations also include security requirements for the transportation of irradiated reactor fuel that weighs 100 grams or less in net weight of irradiated fuel. The 10 CFR Part 37 rule affects any licensee that possesses an aggregated Category 1 or Category 2 quantity of radioactive material, any licensee that transports these materials using ground transportation, and any licensee that transports small quantities of irradiated reactor fuel. The 10 CFR Part 37 rule compliance date was March 19, 2014.

Upon further review by the staff, it was determined that the regulations of 10 CFR Part 37 do not require COL applicants to address 10 CFR Part 37. After COL issuance, a COL licensee becomes subject to the requirements of this regulation upon taking possession of an aggregated Category 1 or Category 2 quantity of radioactive material.

1.5.5.11 Conclusion

Based on the reviews discussed above, the staff finds that the applicant has used a combination of the information in the referenced ESBWR DCD and the information in the COLA, including supplemental COL information, in order to demonstrate compliance with the requirements of 10 CFR Part 52. The applicant's compliance with 10 CFR Part 52 licensing encompasses the necessary requirements to support granting 10 CFR Parts 30, 40, and 70 licenses consistent with operating licenses for nuclear power plants licensed in accordance with 10 CFR Part 50. The staff used the guidance in the SRP, NUREG–1520, and NUREG–1566.

The privileges to be granted under the 10 CFR Parts 30, 40, and 70 licenses are detailed by the staff in the proposed License Conditions specified above in Section 1.5.5.6. Therefore, the applicant for the North Anna 3 COL will also be authorized to receive, possess, and use source, byproduct, and SNM in accordance with the Commission's regulations in 10 CFR Parts 30, 40, and 70; including 10 CFR Sections 30.33, 40.32, 70.23, and 70.31. The applicant complies with all applicable regulations of 10 CFR Parts 30, 40, and 70; as well as the regulations in 10 CFR Parts 20, 50, 51 and 52.

References

1. 10 CFR 140.11, "Amounts of financial protection for certain reactors."

2. 10 CFR 140.13, "Amount of financial protection required of certain holders of construction permits and combined licenses under 10 CFR part 52."

3. 10 CFR 140.20, "Indemnity agreements and liens."

4. 10 CFR 140.21, "Licensee guarantees of payment of deferred premiums."

5. 10 CFR 2.390, "Public inspections, exemptions, and request for withholding."

6. 10 CFR 30.18, "Exempt quantities."

7. 10 CFR 30.32, "Application for specific licenses."

8. 10 CFR 30.72, "Schedule C-Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release."

9. 10 CFR 40.31, "General domestic licenses for byproduct material."

10. 10 CFR 40.32, "General requirements for issuance of specific issues."

11. 10 CFR 50.12, "Specific exemptions."

12. 10 CFR 50.2, "Definitions."

13. 10 CFR 50.33, "Contents of applications; general information."

14. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

15. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

16. 10 CFR 50.38, "Ineligibility of certain applicants."

17. 10 CFR 50.43, "Additional standards and provisions affecting class 103 licenses and certifications for commercial power."

18. 10 CFR 50.54, "Conditions of licenses."

19. 10 CFR 50.59, "Changes, tests and experiments."

20. 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants."

21. 10 CFR 50.75, "Reporting and recordkeeping for decommissioning plan."

22. 10 CFR 51.50, "Environmental report-construction permit, early site permit, or combined license stage."

23. 10 CFR 52.103, "Operation under a combined license."

24. 10 CFR 52.39, "Finality of early site permit determinations."

25. 10 CFR 52.47, "Contents of applications; technical information."

26. 10 CFR 52.63, "Finality of standard design certification."

27. 10 CFR 52.7, "Specific exemptions."

28. 10 CFR 52.77, "Contents of applications; general information."

29. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

30. 10 CFR 52.8, "Combining licenses; elimination of repetition."

31. 10 CFR 52.80, "Contents of applications; additional technical information."

32. 10 CFR 52.81, "Standards for review of applications."

33. 10 CFR 52.83, "Finality of referenced NRC approvals; partial initial decision on site suitability."

34. 10 CFR 52.85, "Administrative review of applications; hearings."

35. 10 CFR 52.87, "Referral to the Advisory Committee on Reactor Safeguards (ACRS)."

36. 10 CFR 52.97, "Issuance of combined licenses."

37. 10 CFR 70.17, "Specific exemptions."

38. 10 CFR 70.22, "Contents of applications."

39. 10 CFR 70.23, "Requirements for the approval of applications."

40. 10 CFR 70.25, "Financial assurance and recordkeeping for decommissioning."

41. 10 CFR 70.31, "Issuance of licenses."

42. 10 CFR 70.32, "Conditions of licenses."

43. 10 CFR 70.34, "Amendment of licenses."

44. 10 CFR 70.52, "Reports on accident criticality."

45. 10 CFR 70.60, "Applicability."

46. 10 CFR 73.21, "Protection of safeguards information: performance requirements."

47. 10 CFR 73.54, "Protection of digital computer and communication systems and networks."

48. 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage."

49. 10 CFR 73.58, "Safety/security interface requirements for nuclear power reactors."

50. 10 CFR 73.67, "Licensee fixed site and in-transit requirements for the physical protection of special nuclear material of moderate and low strategic significance."

51. 10 CFR 74.11, "Reports of loss or theft or attempted theft or unauthorized production of special nuclear material."

52. 10 CFR 74.13, "Material status reports."

53. 10 CFR 74.15, "Nuclear material transaction reports."

54. 10 CFR 74.19, "Recordkeeping."

55. 10 CFR 74.31, "Nuclear material control and accounting for special nuclear material of low strategic significance."

56. 10 CFR 74.33, "Nuclear material control and accounting for uranium enrichment facilities authorized to produce special nuclear material of low strategic significance."

57. 10 CFR 74.41, "Nuclear material control and accounting for special nuclear material of moderate strategic significance."

58. 10 CFR 74.51, "Nuclear material control and accounting for strategic special nuclear material."

59. 10 CFR 74.7, "Specific exemptions."

60. 10 CFR Part 100, "Reactor Site Criteria."

61. 10 CFR Part 140, "Financial Protection Requirements and Indemnity Agreements."

62. 10 CFR Part 19, "Notices Instructions and Reports to workers: Inspection and Investigation."

63. 10 CFR Part 20, "Standards for Protection Against Radiation."

64. 10 CFR Part 30, "Rules of General Applicability to Domestic Licensing of Byproduct Material."

65. 10 CFR Part 37, "Physical Protection of Category 1 And Category 2 Quantities of Radioactive Material."

66. 10 CFR Part 40, "Domestic Licensing of Source Material."

67. 10 CFR Part 50 Appendix C, "A Guide for the Financial Data and Related Information Required To Establish Financial Qualifications for Construction Permits and Combined Licenses."

68. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

69. 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

70. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

71. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

72. 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."FR Part 52, Subpart C, "Combined Licenses."

73. 10 CFR Part 55, "Operators' Licenses."

74. 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

75. 10 CFR Part 73, "Physical Protection of Plants and Materials."

76. 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material."

77. 10 CFR Part 74, Subpart B, "General Reporting and Recordkeeping Requirements."

78. ANSI N15.8-2009, "Nuclear Material Control Systems for Nuclear Power Plants." 2009.

79. ANSI/ANS-3.1-1993, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plant."

80. DOE/EIA-0383(2012) (U.S. Department of Energy/U.S. Energy Information Administration's), "Annual Energy Outlook 2012 with Projections to 2035."

81. *Federal Register*, 79 FR 52357-52359, "Final Standard Review Plan on Foreign Ownership, Control and Domination," September 28, 1999.

82. *Federal Register*, 79 FR 61944, "Final Rule: Economic Simplified Boiling-Water Reactor Design Certification," October 15, 2014.

83. *Federal Register*, 81 FR 24900, "North Anna Unit 3 combined license (COL) application from Dominion Virginia Power (Dominion)," April 27, 2016.

84. *Federal Register*, 81 FR 26837, "North Anna Unit 3 combined license (COL) application from Dominion Virginia Power (Dominion)," May 4, 2016.

85. *Federal Register*, 81 FR 29308, "North Anna Unit 3 combined license (COL) application from Dominion Virginia Power (Dominion)," May 11, 2016.

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88. Keystone Center report entitled Nuclear Power Joint Fact-Finding, 2007.

89. MIT (Massachusetts Institute of Technology), Interdisciplinary study entitled The Future of Nuclear Power, 2003.

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93. NEI 07-08, Revision 3, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)," November 2008 (ADAMS Accession No. ML083380351).

94. NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)," October 2009 (ADAMS Accession No. ML093220178).

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96. NFPA 804, "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants," 2006.

97. NRC BL 2005-02, "Emergency Preparedness and Response Actions for Security-Based Events," July 18, 2005 (ADAMS Accession No. ML051740058).

98. NRC GL 1981-38, "Storage of Low-Level Radioactive Wastes at Power Reactor Sites," November 10, 1981 (ADAMS Accession No. ML031110064).

99. NRC GL 1982-39, "Problems with the Submittals of 10 CFR 73.21 Safeguards Information for Licensing Review," December 22, 1982 (ADAMS Accession No. ML031080554).

100. NRC GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," February 7, 2007 (ADAMS Accession No. ML070360665).

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102. NRC RG 1.189, Revision 2, "Fire Protection for Operating Nuclear Power Plants," October 2009 (ADAMS Accession No. ML092580550).

103. NRC RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants," November 2005 (ADAMS Accession No. ML052290422).

104. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

105. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

106. NRC RG 5.59, "Standard Format and Content for a Licensee Physical Security Plan for the Protection of Special Nuclear Material of Moderate or Low Strategic Significance (1983)," (ADAMS Accession No. ML16272A096).

107. NRC RG 5.69, "Guidance for the Application of Radiological Sabotage Design-Basis Threat in the Design, Development, and Implementation of a Physical Security Protection Program that Meets 10 CFR 73.55 Requirements," September 2007 (Revised May 2010: ADAMS Accession No. ML101410631).

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110. NRC SECY-00-0092, "Combined License Review Process," April 20, 2000 (ADAMS Accession No. ML003680823), and the related SRM, dated September 5, 2000 (ADAMS Accession No. ML003747332).

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112. NRC SECY-06-0187, "Semiannual Update of the Status of New Reactor Licensing Activities and Future Planning for New Reactors," August 25, 2006 (ADAMS Accession No. ML063200352).

113. NRC Staff NUREG–0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

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120. NRC Staff NUREG-1556, Volume 7, "Program-Specific Guidance about Academic, Research and Development, and Other Licenses of Limited Scope Including Gas Chromatographs and X-Ray Fluorescence Analyzers," December 1999. (ADAMS Accession No. ML010370258).

121. NRC Staff NUREG-1566, "Consolidated Guidance About Materials Licenses," December 1999 (ADAMS Accession No, ML010370258).

122. NRC Staff NUREG-1577, "Standard Review Plan on Power Reactor Licensee Financial Qualifications and Decommissioning Funding Assurance," February 1999 (ADAMS Accession No. ML13093A394).

123. NRC Staff NUREG-1811 NRC 2006a, "Draft Environmental Impact Statement for an Early Site Permit (ESP) for the North Anna ESP Site, Supplement 1."

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127. NRC Staff NUREG-1917, "Supplemental Environmental Impact Statement for Combined License (COL) for North Anna Power Station Unit 3."

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129. U.S Public Law 109-58, "Energy Policy Act of 2005," August 8, 2005, 119 Stat. 594.

130. U.S Public Law 97-425, "Nuclear Waste Policy Act of 1982," January 7, 1983, 96 Stat. 2201.

131. U.S. Code- 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

132. Virginia Code § 56-585.1.A.6.

2 SITE CHARACTERISTICS

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2.0 North Anna 3 Site

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR) which addresses the geological, seismological, hydrological, and meteorological characteristics of the site and vicinity, in conjunction with present and projected population distributions and land use and site activities and controls.

2.0.1 Introduction

The site characteristics are reviewed by the staff to determine whether the applicant has accurately described the site characteristics and site parameters together with site-related design parameters and design characteristics in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The review is focused on the site characteristics and site-related design characteristics needed to enable the staff to reach a safety conclusion on the siting of North Anna 3. The North Anna 3 combined license application (COLA) references the Economic Simplified Boiling-Water Reactor (ESBWR) Design Control Document (DCD), referenced in Appendix E to 10 CFR Part 52 as well as the North Anna 3 early site permit (ESP), specifically ESP-003, the ESP for the North Anna 3 site, issued pursuant to 10 CFR 52.24, "Issuance of early site permit." For a COLA referencing a design certification (DC) and an ESP, the staff's review focuses on the applicant's demonstration that the site characteristics and site-related design parameters specified in the ESP fall within the site parameters and design characteristics specified in the DC.

2.0.2 Summary of Application

Section 2.0, "Site Characteristics," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 2.0 of the ESBWR DCD, Revision 10. In addition, North Anna 3 FSAR Section 2.0 incorporates by reference ESP-003. The staff review of the North Anna 3 site ESP Application includes the site safety analysis report (SSAR), Revision 9 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062580096)), which describes the applicant's safety assessment of the site, as required by 10 CFR 52.17, "Contents of application; technical information." The staff documented its review of the North Anna 3 ESP SSAR in NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site" (ADAMS Accession No. ML052710305), the staff Final Safety Evaluation Report (FSER) for the North Anna 3 ESP and NUREG-1835 Supplement 1 (ADAMS Accession No. ML063170371).

In addition, in FSAR Section 2.0, the applicant provided the following information:

COL Items:

- NAPS COL 2.0-1-A Site Characteristics Demonstration

The applicant provided Table 2.0-201 in response to this COL item. Part 1 of Table 2.0-201 identifies each DCD site parameter value and the corresponding ESP and North Anna 3 site characteristic values. In addition, Part 1 provides an evaluation, as applicable, of whether (1) ESP site characteristic values fall within DCD site parameter values; (2) North Anna 3 site characteristic values fall within DCD site parameter values; and (3) North Anna 3 site characteristic values fall within ESP site characteristic values.

- NAPS COL 2.0-2-A - 2.0-30-A Standard Review Plan Conformance

The applicant provided detailed information related to North Anna 3 site characteristics in FSAR Sections 2.1 through 2.5, which incorporate by reference the corresponding ESP SSAR sections. In addition, the applicant provided Table 2.0-2R, which brings forward the ESBWR DCD Table 2.0-2, "Limits Imposed on Acceptance Criteria in Section II of Standard Review Plan (SRP) by ESBWR Design," and identifies specific COL items to be addressed in subsequent FSAR sections. In Table 2.0-2R, the COL Item from the DCD is replaced with information responding to the specific North Anna 3 COL item and identifying the FSAR section that addresses the SRP section invoked by the respective COL item.

Supplemental Information:

- NAPS SUP 2.0-1 Site Specific Parameter Values not in DCD

The applicant provided Part 2 of Table 2.0-201 as supplemental information. Part 2 of Table 2.0-201 identifies those ESP site characteristics and design parameters for which there is no corresponding DCD site parameter value. Part 2 also evaluates whether the North Anna 3 site characteristic or facility design value falls within the ESP site characteristic or ESP design parameter value.

- NAPS SUP 2.0-2 Site Specific Parameter Values not in DCD or ESP

The applicant provided Part 3 of Table 2.0-201 as supplemental information. Part 3 of Table 2.0-201 identifies those site characteristics and design parameters listed in SSAR Table 1.9-1, for which there is not already a comparison to a corresponding DCD or ESP value in the first two parts of Table 2.0-201. Part 3 also evaluates whether the North Anna 3 site characteristic or facility design value falls within the SSAR Table 1.9-1 site characteristic or design parameter value which has been incorporated by reference into the North Anna 3 FSAR.

Early Site Permit Variance:

The following variance from the ESP SSAR is discussed in Section 2, "Variances," of Part 7 to the COLA:

- NAPS ESP VAR 2.0-7 Coordinates/Removal of abandoned mat foundations

This variance is discussed in the Variances Section of the Departures Report (Part 7) of the COLA and contains two parts as discussed below:

The COL applicant requested a variance from one of the coordinate systems that define the "ESP Plant Parameter Envelope" shown in the ESP, Appendix A, Figure 1, which lists the coordinates of the site in State NAD 83 South Zone, as well as in the North Anna 3 site Grid coordinates. In the variance, the COL applicant requested to use the values given in North Anna 3 COL FSAR Figure 2.0-205 as "COORDINATES (STATE PLANE NAD 83 VA SOUTH ZONE)," to replace those in the ESP given as "Coordinates (State NAD 83 South Zone)." The review of this part of the variance request is discussed below in Section 2.4.1.

The COL applicant requested a variance from ESP, Appendix A, Figure 1, Note 2, which states, “Abandoned Unit 3 and 4 Reactor Building Mat Foundations are to be removed.” The applicant requests to not remove the abandoned mat foundations for the originally planned North Anna Units 3 and 4 unless a Unit 3 Seismic Category I or II structure would be located above an abandoned foundation. The review of this part of the variance request is discussed below.

2.0.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, “Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling Water Reactor” and in NUREG-1835. In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the site characteristics, and the associated acceptance criteria, are given in Section 2.0 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” the SRP.

The acceptance criteria for the additional information presented in the FSAR beyond that presented in the staff FSER related to the ESBWR DCD and the North Anna 3 site ESP are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100, Reactor Site Criteria”:

The applicable regulatory requirements are the following:

- 10 CFR 52.79(a)(1)(i)-(vi) provides the site-related contents of a COLA.

- 10 CFR 52.79(b) applies to a COL referencing an ESP as the COL relates to information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

- 10 CFR 52.79(d)(1) applies to a COL referencing a DC as the COL relates to information sufficient to demonstrate that the characteristics of the site fall within the site parameters specified in the DC.

The related acceptance criteria are the following:

- The acceptance criteria associated with specific site characteristics/parameters and site-related design characteristics/parameters are contained in the related sections of SRP Chapter 2 or other referenced SRP sections.

For a COLA referencing an ESP and a DC, acceptance is based on the applicant’s demonstration that the site characteristics and site-related design parameters specified in the ESP fall within the site parameters and design characteristics specified in the DC. If the actual site characteristics do not fall within the certified standard design site parameters, the COL applicant should provide sufficient justification (e.g., by request for a variance from the ESP) that the proposed facility is acceptable at the proposed site.

2.0.4 Technical Evaluation

The staff reviewed Section 2.0 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD, Revision 10 and the North Anna 3 site ESP SSAR, Revision 9, to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and North Anna 3 site ESP appropriately represents the complete scope of information relating to this review topic.[1]

The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to this introductory section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items:

- NAPS COL 2.0-1-A — Site Characteristics Demonstration

The ESBWR DCD site parameter values for the standard plant are identified in DCD Tier 2, Table 2.0-1 and DCD Tier 1, Table 5.1-1.

- NAPS COL 2.0-2-A - 2.0-30-A — Standard Review Plan Conformance

Information on North Anna 3 site characteristics is provided in Section 2.1 through Section 2.5 of this SER. This information addresses NRC guidance in NUREG 0800 as identified in Table 2.0-2R. In the "COL Information" column, the COL item from the DCD is replaced with information responding to the COL item and identifying the FSAR section which addresses the SRP section invoked by the COL item.

The staff reviewed the COL information in North Anna 3 COL FSAR Section 2.0, "Site Characteristics," describing the characteristics and site-related design parameters for the North Anna 3 site. The appropriateness of the site characteristic values presented by the applicant for the North Anna 3 site is reviewed by the staff in Section 2.1 through 2.5 of this SER. The applicant compared its site-specific characteristics to the DCD site parameters from DCD Tier 2, Table 2.0-1 and DCD Tier 1, Table 5.1-1 in North Anna 3 COL FSAR Table 2.0-2R and Table 2.0-201.

The staff reviewed the applicant's comparison of site-specific characteristics against the ESBWR DCD and North Anna 3 site ESP for site-specific design parameters and finds the applicant provided in its FSAR Tables 2.0-2R, and 2.0-201 the applicable North Anna 3 site and design specific information that show that the COL design parameters are bounded or are addressed further in specific FSAR sections as noted and therefore is acceptable.

Supplemental Information:

- NAPS SUP 2.0-1 — Site Specific Parameter Values not in DCD

In North Anna 3 FSAR Table 2.0-201 Part 2 the applicant provided an evaluation of ESP site characteristics and design parameters for which there is no corresponding DCD site parameter and provided a reference as to where these parameters were evaluated in the North Anna 3 ESP or addressed in the North Anna 3 FSAR as applicable.

[1] See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.
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- NAPS SUP 2.0-2 Site Specific Parameter Values not in DCD or ESP

In North Anna 3 FSAR Table 2.0-201 Part 3 the applicant provided an evaluation of site-specific design parameters that were not included as part of the North Anna DCD or ESP. These parameters are described in the North Anna 3 ESP SSAR Table 1.9-1 which was incorporated by reference into the North Anna 3 FSAR and are not specifically evaluated by the staff.

The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this introductory section.

- NAPS ESP VAR 2.0-7 Coordinates/Removal of abandoned mat foundations

The COL applicant requested a variance from one of the coordinate systems that define the "ESP Plant Parameter Envelope" shown in the ESP, Appendix A, Figure 1, which lists the coordinates of the site in State NAD 83 South Zone, as well as in the North Anna 3 site Grid coordinates. In the variance, the COL applicant requested to use the values given in North Anna 3 COL FSAR Figure 2.0-205 as "COORDINATES (STATE PLANE NAD 83 VA SOUTH ZONE)," to replace those in the ESP given as "Coordinates (State NAD 83 South Zone)." The review of this part of the variance request is discussed below in Section 2.4.1.

The COL applicant requested a variance from ESP, Appendix A, Figure 1, Note 2, which states, "Abandoned Unit 3 and 4 Reactor Building Mat Foundations are to be removed." In the variance request, the COL applicant states that North Anna Unit 3 Site characteristics are such that removal of abandoned mat foundations is not necessary because the arrangement of a single ESBWR unit selected for this site allows the power block Seismic Category I and II structures to be located away from the abandoned mat foundations.

According to the layout of the ESBWR plant design at the North Anna Unit 3 site, COL site investigation results and the excavation and backfill plan of the applicant, all Seismic Category I structures will be founded on new concrete fill with underlying sound rock, and all safety-related or Seismic Category I or II structures will be away from the abandoned foundations. In view of the plant design layout, and insofar as the requested variance would allow the applicant to leave the abandoned Unit 3 and 4 Reactor Building Mat Foundations in place, the staff finds the variance acceptable because the abandoned foundations will have no adverse effect on Seismic Category I or II structures at the North Anna Unit 3 site.

The requested variance, however, also indicates that the applicant would "not remove the abandoned mat foundations . . . unless a Unit 3 Seismic Category I or II structure would be located above an abandoned foundation." In this regard, FSAR Figure 2.4-201 shows the site layout, and shows Unit 3 Seismic Category I and II structures in locations where they will not be adversely affected by the abandoned mat foundations. Changes to the site layout in FSAR Figure 2.4-201 are subject to control under the provisions of 10 CFR 50.59, and this control is sufficient to ensure that Dominion will account for any effect the abandoned mat foundations might have with respect to Unit 3 Seismic Category I and II structures as a result of an change to the site layout. Accordingly, the staff finds the requested variance acceptable in regard to removal of the abandoned mat foundations.

2.0.5 Post Combined License Activities

There are no post COL activities associated with this section.

2.0.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966 and NUREG-1835. The staff reviewed the application and checked the referenced DCD and the North Anna 3 site ESP. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design," Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference are resolved.

In addition, the staff compared the additional COL information in the application, and the applicant's supplemental COL information to the relevant NRC regulations, the guidance in Section 2.0 of NUREG–0800, and other NRC regulatory guides (RGs). The staff concludes that North Anna 3 COL FSAR, Section 2.0 is acceptable and meets NRC regulatory requirements in 10 CFR 52.79(a)(1)(i) - (vi), 10 CFR 52.79(d)(1), 10 CFR Part 100, and Section 2.0 of NUREG-0800.

Conclusions related to the staff's evaluation of information contained in North Anna Power Station (NAPS) COL 2.0-2-A - 2.0-30-A are provided in Sections 2.1 through 2.5 of this SER.

2.1 Geography and Demography

Section 2.1 of the North Anna 3 FSAR, Revision 8, discusses the site characteristics that could affect the safe design and siting of the plant and includes information about the site boundaries and location of the site with respect to prominent natural and man-made features.

The descriptions of the site area and reactor location are used to assess the acceptability of the reactor site. This review covers the following specific areas: (1) specification of reactor location with respect to latitude and longitude, political subdivisions; and prominent natural and man-made features of the area; (2) site area map to determine the distance from the reactor to the boundary lines of the exclusion area, including consideration of the location, distance, and orientation of plant structures with respect to highways, railroads, and waterways that traverse or lie adjacent to the exclusion area; and (3) any additional information requirements prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52. The purpose of the review is to ascertain the accuracy of the applicant's description for use in independent evaluations of the exclusion area authority and control, the surrounding population, and nearby manmade hazards.

2.1.1 Introduction

Section 2.1, "Geography and Demography," of the North Anna 3 COL FSAR addresses site-specific information related to the site location and description, exclusion area authority and control, and population distribution.

2.1.2 Summary of Application

Section 2.1 of the North Anna 3 COL FSAR incorporates by reference the ESP SSAR Section 2.1.1 and includes supplemental information.

COL Items:

- NAPS COL 2.0-2-A Site Location and Description

The proposed location for North Anna 3 is located within the existing North Anna Power Station site (North Anna site) located in Louisa County, Virginia, adjacent to North Anna 1 and 2. The North Anna 3 FSAR specifies the latitude, longitude, and coordinates for the North Anna 3 site.

- NAPS ESP COL 2.1-1 Coordinates of the Unit 3 Reactor Building

The applicant provided supplemental information on the site location and the site area pertaining to ownership and control; and the coordinates of the North Anna 3 Reactor Building (RB) to address ESP COL Action Item 2.1-1.

- NAPS COL 2.0-3-A Exclusion Area Authority and Control

The North Anna 3 Exclusion Area Boundary (EAB) is the perimeter of a 5,000ftradius circle from the center of the abandoned North Anna 3 containment. This is the same as the exclusion area for the existing units.

- NAPS ESP COL 2.1-2

The applicant provided supplemental information to satisfy the requirements of NAPS ESP COL Action Item 2.1-2.

- NAPS ESP Permit Condition 3.E(1)

The applicant provided supplemental information to address NAPS ESP Permit Condition 3.E(1). The information emphasizes that the applicant maintains current control of the North Anna site and exclusion area under an existing agreement with Old Dominion Electric Co-operative (ODEC), so no approvals are required by State law for shared control of the exclusion area. As the owners of the North Anna site, Dominion and ODEC possess the right to implement the site redress plan.

- NAPS COL 2.0-4-A Population Distribution

The permanent population data presented in this section are primarily derived using the 1990 Census and 2000 Census data as the basis.

2.1.3 Regulatory Basis

The acceptance criteria associated with the relevant requirements of the Commission regulations for the site characteristics are given in Section 2.0 of NUREG-0800.

The regulatory basis for incorporating information by reference into the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, sufficient information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP. The regulatory basis for the information presented in the ESP SSAR is addressed in the staff FSER related to the ESP SSAR (i.e., NUREG-1835).

The applicable regulatory requirements for identifying the site location and description are as follows:

- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 52, as they relate to inclusion in the Safety Analysis Report (SAR) of a detailed description and safety assessment of the site on which the facility is to be located, with appropriate attention to features affecting facility design (10 CFR 50.34(a)(1)) and 10 CFR 52.79(a)(1)).

- 10 CFR Part 100, as it relates to the following: (1) defining an exclusion area and setting forth requirements regarding activities in that area (10 CFR 100.3, "Definitions"); (2) addressing and evaluating factors that are used to determine the acceptability of the site as identified in 10 CFR 100.20(b); (3) determining an exclusion area where certain dose limits would not be exceeded in the event of a postulated fission product release, as identified in 10 CFR 50.34(a)(1) as it relates to site evaluation factors identified in 10 CFR Part 100; and (4) requiring that the site location and the engineered features included as safeguards against the hazardous consequences of an accident, should one occur, should ensure a low risk of public exposure.

- 10 CFR 100.20(a) and 10 CFR 100.20(b) as they relate to population densities.

- The acceptance criteria presented in the ESP SSAR are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100.

The related acceptance criteria are:

- Specification of Location:

  The information submitted by the applicant is adequate and meets the requirements of 10 CFR 50.34(a)(1) and 10 CFR 52.79(a)(1) if it describes highways, railroads, and waterways that traverse the exclusion area in sufficient detail to allow the reviewer to determine that the applicant has met the requirements in 10 CFR 100.3.

- Site Area Map:

  The information submitted by the applicant is adequate and meets the requirements of 10 CFR 50.34(a)(1) and 10 CFR 52.79(a)(1) if it describes the site location, including the exclusion area and the location of the plant within the area, in sufficient detail to enable the reviewer to evaluate the applicant's analysis of a postulated fission product release, thereby allowing the reviewer to determine (in Sections 2.1.2 and 2.1.3 of NUREG-0800, and Chapter 15) that the applicant has met the requirements of 10 CFR 50.34(a)(1) and 10 CFR Part 100.

- Establishment of Authority:

  The information submitted by the applicant is adequate and meets the requirements of 10 CFR 50.33, "Contents of applications; general information," 10 CFR 50.34(a)(1), 10 CFR 52.79, "Contents of application; technical information in final safety analysis report," and

10 CFR Part 100 if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority within the designated exclusion area.

- Exclusion or Removal of Personnel and Property:

  The information submitted by the applicant is adequate and meets the requirements of 10 CFR 50.33, 10 CFR 50.34(a) (1), 10 CFR 52.79, and 10 CFR Part 100 if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority for the exclusion or removal of personnel or property from the exclusion area.

- Proposed and Permitted Activities:

  The information submitted by the applicant is adequate and meets the requirements of 10 CFR 50.33, 10 CFR 50.34(a)(1), 10 CFR 52.79, and 10 CFR Part 100 if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority over all activities within the designated exclusion area.

- Population Data:

  The population data supplied by the applicant in the SAR is acceptable under the following conditions: (1) the SAR contains population data from the latest census and projected population at the year of plant approval and 5 years thereafter, in the geographical format given in Section 2.1.3 of RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, LWR Edition," and in accordance with RG 1.206, "Combined License Applications for Nuclear Power Plants," (2) the SAR describes the methodology and sources used to obtain the population data, including the projections; (3) the SAR includes information on transient populations in the site vicinity.

- Exclusion Area:

  The exclusion area should either not contain any residents, or such residents should be subject to ready removal if necessary.

- Low-Population Zone (LPZ):

  The specified LPZ is acceptable if it is determined that appropriate protective measures could be taken on behalf of the enclosed populace in the event of a serious accident.

- Nearest Population Center Boundary:

  The nearest boundary of the closest population center containing 25,000 or more residents is at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. Population Density: If the population density exceeds the guidelines in Regulatory Position C.4 of RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations," the applicant must give special attention to the consideration of alternative sites with lower population densities.

- Population Density:

If the population density exceeds the guidelines in Regulatory Position C.4 of RG 4.7, the applicant must give special attention to the consideration of alternative sites with lower population densities.

2.1.4 Technical Evaluation

As documented in NUREG-1966, the staff reviewed and approved Section 2.1 of the certified ESBWR DCD, Revision 9. The staff reviewed Section 2.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESP SSAR, Revision 9 and the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 COL FSAR, the ESP SSAR, and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1]

The staff's review confirmed that the information contained in the application address the relevant information related to this section. The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items:

- NAPS COL 2.0-2-A Site Location and Description

The applicant incorporated by reference ESP SSAR Section 2.1.1 to resolve DCD COL Item 2.0-2-A, related to the site location and description, including political subdivisions, natural and man-made features, population, highways, railways, waterways, and other significant features of the area included under Section 2.1 of the COL FSAR.

The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to site location and description.

- NAPS ESP COL 2.1-1 Location Coordinates for the Unit 3

The applicant provided the following supplemental information regarding the site location:

> The site layout and boundary for the proposed North Anna 3, shown in Figure 2.1-201 of the COL FSAR, remains within the ESP proposed facility boundary as shown in Figure 2.0-205 of the COL FSAR. The center of the North Anna 3 RB is approximately 450 meters (m) (1,476 feet (ft)) southwest of the center of the Unit 2 Containment Building.
>
> The staff has independently estimated and verified the following latitude and longitude and universal transverse Mercator (UTM) coordinates of the proposed North Anna 3 site in the FSAR as summarized in the table below.

UTM coordinates (meters)	Latitude/longitude (degree/minute/second)
Zone 18, North American Datum (NAD) 83; 4,216,007 meters north; 254,783 meters east	38 03 31.01 north; 77 47 41.8 west

On the basis of the staff's review of the information addressed in the North Anna 3 COL FSAR, the staff's confirmatory review of pertinent information generally available in the literature and in the information provided by the applicant with regard to the site location is considered adequate and acceptable.

- NAPS COL 2.0-3-A Site Specific Exclusion Area Authority and Control

The applicant incorporated by reference ESP SSAR Section 2.1.2 to address DCD COL Item2.0-3-A. The staff finds the information incorporated by reference in the ESP acceptable because the information provided and reviewed in the ESP are still relevant and applicable to this COLA.

- NAPS ESP Permit Condition 3.E(1)

The applicant supplemented Section 2.1.2.1 of the ESP SSAR with the information to address the authority of the COL applicant, as described below.

Since Dominion submitted the ESP application, the Commonwealth of Virginia has passed legislation re-regulating the electric power industry in Virginia. ODEC has sold to Dominion its interest in the portion of NAPS on which Unit 3 will be located. Further ODEC will not jointly own entire site.

In order to resolve NAPS ESP Permit Condition 3.E(1), the applicant stated that Dominion currently controls the NAPS site and exclusion area under Dominion's existing agreement with ODEC, and no approvals are required by state law to share control of the exclusion area.

As a part of resolving NAPS ESP Permit Condition 3.E(1), the applicant supplemented the information by stating that as the owners of NAPS, Dominion possesses the right to implement the site redress plan under its agreement with ODEC.

Lastly, the applicant states that recreational use of the lake is consistent with lake access and control practices in effect for Units 1 and 2 and will be maintained for North Anna 3.

The staff reviewed the applicant's supplemental information regarding exclusion area authority. On the basis of this supplemental information, the staff concluded that the applicant has resolved NAPS ESP Permit Condition 3.E(1), pertaining to exclusion area authority and control and the site redress plan.

- NAPS ESP COL 2.1-2

The applicant supplemented the third paragraph in the ESP SSAR by addressing arrangements with appropriate agencies for emergencies.

To resolve NAPS ESP COL Action Item 2.1-2, the applicant supplemented the ESP SSAR with a description of the arrangements made with the appropriate agencies for emergencies. The information states that under the Commonwealth of Virginia's Radiological Emergency Response Plan (COVRERP), the Virginia Department of Game and Inland Fisheries (VDGIF) is responsible for warning people in boats and assisting with the traffic control of boats on Lake Anna in the vicinity of NAPS. This arrangement is documented in the COVRERP Appendix 1.

ESP COL Action Item 2.1-2 requires the applicant to address arrangements for controlling the portions of Lake Anna and the waste heat treatment facility (WHTF) that are within the exclusion area.

Since the supplemental information from the applicant addressed arrangements for controlling only Lake Anna on July 15, 2008, the staff issued a Request for Additional Information (RAI) 02.01.02-1 (ADAMS Accession No. ML081970390), which requested additional information on controls for portions of the WHTF within the exclusion area. The applicant responded to RAI 02.01.02-1 on August 28, 2008 (ADAMS Accession No. ML082460847), by stating that Lake Anna consists of both the WHTF and North Anna Reservoir, which are both partially within the NAPS exclusion area, and the VDGIF is responsible for controlling the portions of the North Anna Reservoir and the WHTF that are within the exclusion area. Therefore, RAI 02.01.02-1 is resolved and closed. Based on the staff's review of the supplemental information provided, the staff concludes that the applicant has appropriately resolved ESP COL Action Item 2.1.2.

- NAPS COL 2.0-4-A Site Specific Population

NAPS COL 2.0-4-A resolves DCD COL Item 2.0-4-A by addressing the provision of site-specific information related to population distribution of the site environs. The applicant incorporated by reference ESP SSAR Section 2.1.3 to resolve DCD COL Item 2.0-4-A, related to the population distribution included under Section 2.1 of the North Anna 3 COL FSAR.

The staff reviewed Section 2.1.3 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to population distribution.

Under the provisions of 10 CFR 52.79(b), the staff accepted the information incorporated by reference to ESP SSAR Section 2.1.3. Therefore, the staff did not perform any technical evaluation of this FSAR section.

2.1.5 Post Combined License Activities

There are no post COL activities related to this section.

2.1.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff's review confirmed that the applicant has addressed the relevant information and there is no outstanding information expected to be addressed in the COL FSAR related to this subsection.

As discussed above, the applicant has provided an acceptable description of current and projected population densities in and around the site. The staff reviewed the information provided and, for the reasons given above, concluded that the population data provided is acceptable and meets the requirements of 10 CFR 50.34(a)(1), 10 CFR 52.79(a)(1), 10 CFR 100.20(a), 10 CFR 100.20(b), 10 CFR Part 100, and 10 CFR 100.3. In addition to the COL actions addressed above, the staff further concluded that the applicant had provided sufficient details in the ESP SSAR Section 2.1.3 about the population distribution to allow the staff to evaluate, as documented in Section 2.1.3 of NUREG-1835, whether the applicant meets the relevant requirements of 10 CFR 52.79(a)(1) and 10 CFR Part 100. This conclusion is based on the applicant's acceptable description and safety assessment of the site that contains present and projected population densities, which are within the guidelines of Regulatory Position C.4 of RG 4.7 and properly specified the distance from the LPZ population center. The applicant also calculated the radiological consequences of design-basis accidents at the outer boundary of the LPZ (SRP Chapter 15). The applicant provided reasonable assurance that appropriate protective measures can be taken within the LPZ to protect the population in the event of a radiological emergency. This information incorporated by reference, addressed NAPS COL

Item 2.0-4-A. In conclusion, the applicant has provided sufficient information to satisfy 10 CFR Parts 50, 52, and 100.

2.2 Nearby Industrial, Transportation, and Military Facilities

This section provides information on the site characteristics that could affect the safe design and siting of the plant. The information is addressed in three subsections: Section 2.2.1 provides information on locations and routes; Section 2.2.2 describes nearby industrial transportation facilities (airports, airways, roadways, railways, etc.) and military facilities; and Section 2.2.3 evaluates potential hazards.

2.2.1 Locations and Routes

The locations of and separation distances from transportation facilities and routes, including airports and airways, roadways, railways, and navigable bodies of water are addressed in ESP SSAR Sections 2.2.1 and 2.2.2, which are incorporated by reference. The staff's review of this information is in the following SER Section 2.2.2.

2.2.2 Descriptions

2.2.2.1 Introduction

The description of locations and routes refers to potential external hazards or hazardous materials that are present or may reasonably be expected to be present during the projected lifetime of the proposed plant. The purpose is to evaluate the sufficiency of information concerning the presence and magnitude of potential external hazards so that the reviews and evaluations described in SRP Sections 2.2.3, 3.5.1.5, and 3.5.1.6 can be performed. The review covers the following specific areas: (1) the locations of and separation distances to transportation facilities and routes, including airports and airways, roadways, railways, pipelines, and navigable bodies of water; (2) the presence of military and industrial facilities such as fixed manufacturing, processing, and storage facilities; and (3) any additional information requirements prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.2.2.2 Summary of Application

Section 2.2.2 of the FSAR addresses the need for locations and route descriptions and descriptions of nearby industrial and military facilities. The applicant addressed the information as follows:

COL Items:

- NAPS COL 2.0-5-A

NAPS COL 2.0-5-A resolves DCD COL Item 2.0-5-A by providing information about industrial, military, and transportation facilities and routes to establish the presence and magnitude of potential external hazards. The site-specific information needed to address DCD COL Item 2.0-5-A in the North Anna 3 FSAR is incorporated by reference to ESP SSAR Section 2.2.1-2.2.2.

- NAPS ESP COL 2.2-1

In accordance with RG 1.206 and relevant sections of 10 CFR Parts 50 and 100, the applicant provided supplemental information to address ESP COL Action Item 2.2.-1. The supplemental information identified and addressed the potential hazard facilities and routes within 5 miles of NAPS, three (3) airports within 10 miles of NAPS, and other significant facilities beyond 5 miles of NAPS. In addition, it is stated that no hazardous industrial facilities have been added at the industrial development near the North Anna 3 EAB.

2.2.2.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

The applicable regulatory requirements for identifying locations and routes are:

- 10 CFR 100.20(b), which requires that the nature and proximity of human-related hazards (e.g., airports, dams, transportation routes, and military and chemical facilities) be evaluated to establish site parameters used to determine whether the plant's design can accommodate commonly occurring hazards, and whether the risk of other hazards is very low.

- 10 CFR 52.79(a)(1)(iv), as it relates to the factors to be considered in the evaluation of sites that require the location and description of industrial, military, or transportation facilities and routes.

- 10 CFR 52.79(a)(1)(vi), as it relates to compliance with 10 CFR Part 100.

The acceptance criteria in the ESP SSAR are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100.

The related acceptance criteria are:

- Data in the SAR that adequately describe the locations of and distances from the plant of nearby industrial, military, and transportation facilities; and that the data are in agreement with data obtained from other sources, when available.

- Descriptions of the nature and extent of activities conducted at the site and in its vicinity, including the products and materials likely to be processed, stored, used, or transported; and that they are adequate to permit identification of the possible hazards cited in Section III of Section 2.2.1-2.2.2 of NUREG-0800.

- Sufficient statistical data with respect to hazardous materials that establish a basis for evaluating the potential hazards to the plant or plants considered at the site.

2.2.2.4 Technical Evaluation

The staff reviewed Section 2.2.2 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR, Revision 9. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to identification of potential hazards in the vicinity of the site.

The staff's technical evaluation of this application is limited to reviewing the supplemental information pertaining to NAPS COL Item 2.0.5-A and NAPS ESP COL Action Item 2.2-1.

The staff reviewed the resolution to DCD COL Item 2.0-5-A related to identification of potential hazards in the vicinity of the site, including nearby industrial, transportation, and military facilities and NAPS ESP COL Action Item 2.2-1 as follows:

<u>Industrial Facilities</u>

In order to resolve ESP COL Action Item 2.2-1, the applicant stated that since submitting the ESP SSAR, no hazardous industrial facilities have been added to the 620-acre industrial development near the North Anna 3 exclusion area boundary (EAB). The industrial site poses no hazard to North Anna 3.

<u>Airports</u>

This section of the ESP SSAR is supplemented with information that identifies an additional airport in the vicinity of North Anna 3.

A third airport (Seven Gables) within 10 miles of the North Anna 3 site opened in 2007. Seven Gables is a private landing strip with an unlighted 457 m (1,500 ft) turf runway approximately 12.4 km (7.7 miles) north-northwest of the site. This airport is not licensed for commercial use and is based with three small aircraft. The airport's location is shown along with other nearby airports in FSAR Figure 2.2-201. Flight operation information is in FSAR Table 2.2-201.

<u>Airways</u>

The supplemental information in this section of the ESP SSAR identifies an additional military training flight airway in the vicinity of NAPS.

One additional airway, VR1755, is identified and shown along with others in FSAR Figure 2.2-201. The center line of this airway is more than 8 miles from North Anna 3. Given that the U.S. Department of Navy projected a total of 306 flight operations for the 2007/2008 year for three of four military training routes, the applicant states that the assumed 6,000 flights per year in the ESP SSAR remain bounding.

2.2.2.5 Post Combined License Activities

There are no post-COL activities related to this subsection.

2.2.2.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff's review confirmed that the applicant has addressed the relevant information, and there is no outstanding information expected to be addressed in the COL FSAR related to this subsection. As set forth above, the applicant presented and substantiated information that identified potential hazards in the site vicinity. The staff reviewed the information in the ESP SSAR and supplemented in the FSAR and, for the reasons given above, concluded that the applicant had provided information that identified potential hazards in accordance with the requirements of 10 CFR 52.79(a)(1)(iv) and 10 CFR 52.79(a)(1)(vi) for compliance evaluation. The nature and extent of activities involving potentially hazardous materials that are conducted at nearby industrial, military, and transportation facilities have been evaluated to identify those activities that have the potential for adversely affecting plant safety-related structures. Based on an evaluation of information in the ESP SSAR and FSAR, as well as information that the staff had independently obtained, the staff concluded that all potentially hazardous activities on the site and in the vicinity of the plant have been identified. The hazards associated with these activities have been reviewed and are discussed in Sections 2.2.3, 3.5.1.5, and 3.5.1.6 of this SER. This information addresses NAPS ESP COL Action Item 2.2-1. In conclusion, the applicant has provided sufficient information to satisfy 10 CFR Parts 50, 52, and 100.

2.2.3 Evaluation of Potential Accidents

2.2.3.1 Introduction

The evaluation of potential accidents considers the applicant's probability analyses of potential accidents involving hazardous materials or activities on the site and in the vicinity of the proposed site to confirm that appropriate data and analytical models have been used. This review covers the following specific areas: (1) hazards associated with nearby industrial activities such as manufacturing, processing, or storage facilities; (2) hazards associated with nearby military activities such as military bases, training areas, or aircraft flights; and (3) hazards associated with nearby transportation routes (aircraft routes, highways, railways, navigable waters, and pipelines). Each hazard review area includes consideration of the following principal types of hazards: (1) toxic vapors or gases and their potential for incapacitating nuclear plant control room operators; (2) overpressure resulting from explosions or detonations involving materials such as munitions, industrial explosives, or explosive vapor clouds resulting from the atmospheric release of gases (such as propane and natural gas or any other gas) with a potential for ignition and explosion; (3) missile effects attributable to mechanical impacts such as aircraft impacts, explosion debris, and impacts from waterborne items such as barges; and (4) thermal effects attributable to fires.

2.2.3.2 Summary of Application

This section of the COL FSAR addresses the need to evaluate potential accidents. The applicant addressed the information as follows:

COL Items:

- NAPS COL 2.0-6-A Evaluation of Potential Accidents

NAPS COL 2.0-6-A resolves DCD COL Item 2.0-6-A by addressing the provision for evaluating potential accidents. The site-specific information needed to address DCD COL Item 2.0-6-A in North Anna 3 FSAR is incorporated by reference to ESP SSAR Section 2.2.3. In addition, as a part of NAPS COL 2.0-6-A, an evaluation of potential hazard due to gasoline delivery truck is supplemented. On-site and off-site toxic chemicals, aircraft hazards, explosive hazards (hydrogen) and fire hazards are also addressed.

- NAPS ESP COL 2.2-2 Interactions Between the Existing and New Unit

The applicant provided updated site-specific supplemental information to address ESP COL Action Item 2.2-2.

2.2.3.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

The regulatory basis for the information presented in the ESP SSAR is addressed in the FSER related to the ESP SSAR (i.e., NUREG-1835).

The applicable regulatory requirements for identifying and evaluating potential accidents are:

- 10 CFR 52.79(a)(1)(iv) as it relates to the factors to be considered in the evaluation of sites, which require the location and description of industrial, military, or transportation facilities and routes.

- 10 CFR 52.79(a)(1)(vi), as it relates to compliance with 10 CFR Part 100.

The acceptance criteria presented in the ESP SSAR are based on meeting the relevant requirements of 10 CFR Parts 52 and 100.

The related acceptance criteria are:

- Event Probability: The identification of design-basis events resulting from the presence of hazardous materials or activities in the vicinity of the plant or plants of specified type is acceptable if all postulated types of accidents are included for which the expected rate of occurrence of potential exposures resulting in radiological dose in excess of the 10 CFR 50.34(a)(1) limits, as it relates to the requirements of 10 CFR Part 100, is estimated to exceed the NRC staff's objective of an order of magnitude of 10^{-7} per year.

- Design-Basis Events: The effects of design-basis events have been adequately considered, in accordance with 10 CFR 100.20(b), if analyses of the effects of those accidents on the safety-related features of the plant or plants of specified type have been performed and measures have been taken (e.g., hardening, fire protection) to mitigate the consequences of such events.

2.2.3.4 Technical Evaluation

The staff reviewed Section 2.2.3 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the evaluation of potential accidents. The staff's technical evaluation of this application is limited to reviewing the supplemental information pertaining to NAPS COL Item 2.0-6-A, and NAPS ESP COL Action items. The staff reviewed the resolution to DCD COL Item 2.0-6-A, related to the evaluation of potential accidents to be covered under ESP COL Action Item 2.2-2 addressed as follows:

COL Items:

- NAPS COL 2.0-6-A Evaluation of Potential Accidents

The applicant incorporated by reference ESP SSAR Section 2.2.3 to address DCD COL Item 2.0-6-A. In addition, as a part of NAPS COL 2.0-6-A, potential impacts due to gasoline delivery trucks are evaluated and presented as supplement information in new Section 2.2.3.1.1.

- NAPS ESP COL 2.2-2 Interactions between Existing Units and the New Unit

The applicant supplemented its application with a new section to ESP SSAR Section 2.2.3.1 on the evaluation of potential hazards of onsite chemicals to resolve ESP COL Action Item 2.2-2.

The chemicals stored onsite at Units 1 and 2 and to be stored at North Anna 3 are identified in FSAR Table 2.2-202. This table identifies the storage locations and quantities of each chemical. Properties relative to the hazards from each chemical and the results of the screening analyses are in FSAR Table 2.2-203. FSAR Table 2.2-204 provides the safe-separation distances for flammable and explosive chemicals and compares those distances to the actual distance to the nearest safety-related North Anna 3 structure, system, or component (SSC).

Explosions

The applicant evaluated hydrogen (gas and liquid) and Nalco H-130 (for Unit 3), and acetone, ammonium hydroxide, hydrazine and Nalco H-130, hydrogen, Carboline 2, and gasoline from delivery truck (for Units 1 and 2) for potential explosions resulting in blast overpressure using 1 psi overpressure as a criterion for adversely affecting plant operations or preventing the safe shutdown of the plant. In accordance with RG 1.91, "Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes Near Nuclear Power Plants," peak-positive incident overpressures below 1 psi are not considered to cause significant damage.

The applicant determined a minimum safe-standoff distance from an in-vessel, confined vapor explosion by conservatively considering a volume of chemical vapor equal to the empty volume of the largest storage vessel that was available for combustion, with an explosion yield factor of 100 percent.

The applicant addressed the potential detonation and deflagration in a plume due to a flammable vapor cloud from the release of chemicals. This evaluation assumed a dispersion downwind toward the NAPS, with a delayed ignition. The typical vapor dispersion assumed a wind speed of 1 meter per second with an atmospheric stability class F, and a 77 degree Fahrenheit (°F) ambient air temperature, a relative humidity of 50 percent, a cloud cover of 50 percent, and an atmospheric pressure condition. However, meteorological sensitivity analysis with variation of wind speed, atmospheric stability and ambient air temperature is also performed to determine potential limiting impact. This dispersion analysis was conducted using the ALOHA model with a spectrum of meteorological conditions (stability class, wind speed, time of day, and cloud cover) to ensure the worst-case is captured. The meteorological sensitivity analysis includes the stable meteorological class, F, at a wind speed of 1 meter per second. The ALOHA computer model (ALOHA, 2007) was used to evaluate the dispersion and detonation of the vapor clouds. Each chemical was analyzed by assuming the maximum volume of the storage vessel leaked to form a 1-centimeter thick puddle, giving significant surface area to maximize evaporation and the formation of a vapor cloud.

The staff noted that there are two 10,000 gallon underground gasoline storage tanks onsite at the North Anna site as listed in FSAR Revision 1 Table 2.2-202 at existing North Anna 1 and 2. The applicant did not address the hazards posed by these tanks from either a confined vapor explosion or a flammable vapor cloud explosion. On June 3, 2004, the staff requested additional information in RAI 2.2.3-1 (ADAMS Accession No. ML050660242), the applicant to address the potential hazards of these tanks due to fuel storage and onsite delivery of fuel to the tanks. The response to RAI 2.2.3-1 provided in Dominion letter NA3-08-118 (ML082980061) documented that a vapor cloud explosion from underground gasoline tank was not a credible event. The applicant provided the information in an FSAR update and calculated the probability of 7.8×10^{-7} for an explosion from a gasoline tanker truck delivery resulting in an overpressure of 1 psi at the nearest North Anna 3 safety-related structure. However, in the FSAR Revision 8, the applicant performed the impact evaluation and determined the impacts by calculating the minimum safe distance of 227.7 m (747 ft) to 1 psi overpressure due to potential unconfined vapor cloud explosion, and 82.9 m (272 ft) due to confined vapor explosion from the gasoline delivery truck. Both the calculated minimum distances are lower than the actual distance to the nearest North Anna 3 safety-related structure. The staff performed independent confirmatory calculations and found the minimum safe distance determined by the applicant comparable to the staff's calculated distance. Therefore, staff considers the applicant analysis, assumptions, and conclusions are reasonable and acceptable in meeting the requirements and regulatory guidance. The applicant performed deterministic analysis by calculating the minimum safe distances to 1 psi overpressure, instead of screening out the potential accident based on originally calculated low probability basis. Therefore, the applicant requested that the original probability calculations addressed are no longer considered to be applicable or required. The staff considers this acceptable. The staff considers RAI 2.2.3-1 resolved and closed.

The minimum safe separation distances for flammable and explosive materials in relation to the actual distance to the nearest North Anna 3 safety related-structure are presented in the FSAR Table 2.2-204. The results indicate that a fire or explosion from identified hazardous chemicals and materials stored or transported at Units 1, 2, and 3 would not adversely affect the safe operation or shutdown of North Anna 3, with an exception of liquid hydrogen stored at North Anna 3 and a 13,000 gallon liquid hydrogen delivery truck.

North Anna 3 COLA FSAR Table 2.2-204 indicates that for the 6,000 gallon liquid hydrogen tank, the minimum safe distance to reach an over pressure of 1 psi due to source explosion is estimated to be 612 m (2,009 ft), which is greater than the actual distance to the safety-related structure of 228.6 m (750 ft). Therefore, the applicant performed further analysis using Appendix B of the Electric Power Research Institute (EPRI) Guideline NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations, " to determine the minimum safe distance of 150.9 m (495 ft) from source explosion and of 206.3 m (677 ft) from vapor cloud explosion. Since these two distances are less than the distance to the nearest safety-related structure distance of 228.6 m (750 ft), the applicant concluded that the storage of liquid hydrogen would not adversely affect the safe operation of North Anna 3. The staff reviewed the EPRI methodology and the applicant's approach and assumptions, and requested additional information on July 18, 2014, in RAI 2.2.3-10 (ADAMS Accession No. ML14283A550). In a letter dated September 3, 2014 (ADAMS Accession No. ML14251A060), the applicant responded and staff reviewed the information. The staff requested further supplemental information to complete the review as some information provided was unclear and inconsistent. In a letter dated February 16, 2015 (ADAMS Accession No. ML15051A288), the applicant provided information and associated inspections, tests, analyses, and acceptance criteria (ITAAC) and revision to the North Anna 3 FSAR. The revision to the response by the applicant included an ITAAC for verifying the minimum static lateral load capacity of 3 psi for the radwaste building (RW). Based on the review of the information provided and future ITAAC consideration, the staff considers the applicant approach reasonable and acceptable in meeting the requirements and guidance. Therefore this RAI 2.2.3-10 is resolved and closed.

For the 13,000 gallon liquid hydrogen delivery truck, the applicant determined minimum safe distance is greater than the actual distance of 228.6 m (750 ft) to the nearest SSC. For this reason, the applicant stated in the FSAR that a probability analysis was performed and the probability of accident involving a 13,000 gallon delivery truck is estimated to be less than 10^{-6} per year. The applicant stated that this is sufficiently low, and this scenario need not be considered as a design-basis event. Because no detailed information or calculations were provided, in RAI 2.2.3-10 the staff requested additional information regarding the calculation method, input data, assumptions and results along with the justification of this approach taken, and revisions to the FSAR Section as appropriate. In letters dated September 3, 2014 (ADAMS Accession No. ML14251A060) and February 16, 2015 (ADAMS Accession No. ML15051A288), a detailed and sufficient response of the screening analysis and approach along with committed proposed future revision to the FSAR section is provided by the applicant. The staff reviewed the response provided by the applicant, and confirmed that the calculation methods followed those found in RG 1.91, Revision 2, and that conservative input data and assumptions were used. The staff used data provided in the applicant's references as well as independent data on truck accident rates from the U.S. Department of Transportation to confirm that the applicant's results were reasonable. The applicant performed a screening analysis in accordance with the guidance in RG 1.91, Revision 2, that provides reasonable assurance that the risk of damage to safety-related structures, systems or components caused by an explosion from the 13,000 gallon liquid hydrogen delivery truck is sufficiently low, as defined in RG 1.91, Revision 2, such that further evaluation of the risk is not necessary. Therefore, staff considers the applicant's approach reasonable and acceptable. For the reasons described above, RAI 2.2.3-10 pertaining to the 13,000 gallon delivery truck is resolved and closed. In response to RAI 2.2.3-10, the applicant has proposed revisions to future FSAR Sections 2.2.3 and 3.7.2.8.2 and FSAR Tables 2.2-203, 2.2-204, 2.2.-205, and added a new Table 2.2-206 and revised COLA Part 10, Section 2.4.16 and associated ITAAC. The staff verified that the appropriate COLA revisions are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.2-01 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff performed independent calculations for the chemicals addressed by the applicant, and the staff's calculations confirmed the applicant's results. Therefore, the staff concluded that the applicant's assumptions and methodology are reasonable and acceptable.

Toxic Chemicals

The applicant identified the onsite storage of chemicals for North Anna 3 in FSAR, Revision 0, Table 2.2-203 and considered the potential for impacting control room habitability. In FSAR Section 2.2.3.1.3, the applicant stated that the effects of toxic vapors or gases and their potential for incapacitating North Anna 3 control room operators were evaluated. In FSAR, Revision 0, Section 6.4 under NAPS COL 6.4-2-A, the applicant conclusively stated, "The results of the analysis, when compared to the toxicity limits given in RG 1.78, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," show hazardous concentrations of toxic gas in the control room are not reached." In that version of the application, the applicant did not provide the bases and methodology for calculating the toxic chemical concentrations at the intake of the control room; the potential toxic chemical concentrations inside the control room with potential air flow rates; the modeling assumptions and inputs for accidental chemical release scenarios; and evaporation characteristics, dispersion and transport mechanisms, and resulting concentrations. The staff requested this information in RAIs 2.2.3-2 and 2.2.3-3 (ADAMS Accession No. ML082250417). The applicant's response in a letter dated December 29, 2008 (ADAMS Accession No. ML083660043), identified two chemicals requiring control room habitability analyses, which were reviewed by the staff and further evaluated in Section 6.4 of this SER. The applicant identified in FSAR, Revision 0, eight additional chemicals that are stored onsite, but the applicant provided no rationale as to why those chemicals are not a hazard to the control room. Therefore, the staff issued a subsequent RAI 2.2.3-5 (ADAMS Accession No. ML090680312) requesting the applicant to provide a rationale for screening out those chemicals. In a letter dated May 27, 2009 (ADAMS Accession No. ML091490217), the applicant provided rationale by discussing the nature of the chemicals and addressed screening out of chemicals from further analysis. The staff reviewed and found the applicant's response reasonable and acceptable as it satisfies the NRC guidance provided in RG 1.78. Therefore RAI 2.2.3-5 is resolved and closed. As a follow-up to the applicant's response to RAI 2.2.3-2 and 2.2.3-3, the staff on March 26, 2009, issued RAI 2.2.3-7 (ADAMS Accession No. ML090840271) requesting a revised response regarding the modeling data and assumptions details for its analysis and conclusions. This RAI was superseded by RAI 2.2.3-8, and the applicant in a letter dated January 10, 2011 (ADAMS Accession No. ML110110613), provided response addressing ALOHA model methodology, assumptions and input data used. The staff considers that this information is adequate and acceptable for staff's confirmatory analysis. The staff performed confirmatory calculations and concluded that the applicant's results are comparable. The staff therefore considers the applicant's response acceptable, and RAI 2.2.3-7 and 2.2.3-8 are resolved and closed.

The staff noted that the quantity of sodium hydroxide in FSAR Table 2.2-202 (180 gallons for North Anna 3 and 700 gallons for Units 1 and 2) was not analyzed for toxicity, whereas Units 1 and 2 UFSAR Version 42 (Table 6.4-1) identifies a sodium hydroxide quantity of 55 gallons, which was analyzed for toxicity. The staff requested on August 12, 2008, clarification in RAI 2.2.3-4 *(*ADAMS Accession No. ML082250417). The applicant's response, dated October 20, 2008 (ADAMS Accession No. ML082980061) stated that the existing Unit 1 and 2 analyses were overly conservative, and assumed that all sodium hydroxide is volatile. However, based on the low volatility of sodium hydroxide, no significant concentrations would accumulate even with the higher quantities. The staff performed confirmatory calculations and concluded that the applicant's results are comparable; the staff therefore considers the applicant's response acceptable. Therefore, RAI 2.2.3-4 is resolved and closed. The staff also requested on March 9, 2009, additional information in RAI 2.2.3-6 (ADAMS Accession No. ML090680312), to provided rationale for screening sodium hydroxide on the basis of vapor pressure of 10 torr. The applicant in a letter dated May 27, 2009 (ADAMS Accession No. ML091490217), provided response and rationale by comparing United States Environmental Protection Agency (EPA) suggested threshold value of 10 torr to the NRC guidance value provided in RG 1.78, which the staff considers reasonable and acceptable as it satisfies the NRC guidance. This RAI 2.2.3-6 is resolved and closed.

In Enclosure 6 to a letter dated December 18, 2013 (ADAMS Accession No. ML14013A113), the applicant provided a response to RAI 2.2.3-8 and enclosed the list of onsite chemicals and the Control Room Toxic Gas concentrations, which are included in FSAR Table 2.2-205. In addition to these chemicals, potential releases from gasoline delivery trucks have been analyzed and included in the table. The applicant used immediate danger to life and health (IDLH) of 500 PPM for gasoline instead of 300 PPM that is based Time Weighted Average. Therefore, the staff requested the applicant in RAI 2.2.3-10 (ADAMS Accession No. ML14283A550), to revise the analysis using the IDLH of 300 ppm. The applicant performed the analysis and provided the results in a response letter (ADAMS Accession No. ML15051A288) dated February 16, 2015.

The staff considers that the applicant's response adequately addresses the control room concentration of gasoline, which is determined by the applicant to be lower than IDLH concentration of 300 ppm. The staff therefore finds the response acceptable. The applicant also provided proposed revisions to FSAR Section 2.2.3.3 and FSAR Table 2.2-205. The staff verified that the appropriate COLA revisions are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.2-02 from the staff's advanced SER for North Anna 3 is resolved and closed.

Each of the hazardous chemicals analyzed, with exception of nitrogen, oxygen, carbon dioxide, an 8,500 gallon gasoline delivery truck, and a 13,000 gallon liquid hydrogen delivery truck, had distances to their respective toxic or asphyxiating limit less than the distance to the control room. However, the control room concentrations for nitrogen, oxygen, carbon dioxide, gasoline, and liquid hydrogen were determined and reported to be below the asphyxiating or toxic limits for each hazardous chemical in FSAR Table 2.2-205. Since, the concentration of these chemicals exceeded their respective IDLH concentrations at the intake to the control room, these chemicals are further considered and evaluated in Section 6.4 of the SER in addressing for the control room habitability.

Airways

The staff evaluation for North Anna 3 airways is contained in the SER related to the ESP SSAR (NUREG-1835). Supplemental information contained in North Anna 3 FSAR Section 2.2.3.2.2 pertaining to effective plant areas for North Anna 3 was reviewed by the staff. However, the staff finds that this modification did not change any conclusions made by the staff in the ESP SER. Consequently, the staff finds that the modification in the COL FSAR, Revision 8, is acceptable and would not change the original conclusion that the two accident probabilities are within the NUREG-0800 guideline of less than 10^{-7} per year.

External Fires

The staff evaluation for North Anna 3 external fires is contained in the FSER related to the ESP SSAR (NUREG-1835). Supplemental information contained in North Anna 3 FSAR Section 2.2.3.4 included information regarding North Anna 3 external fires. The applicant performed an analysis of a wildfire near North Anna 3 using methodology discussed in the SER for the ESP, to determine the incident heat flux on North Anna 3. On the basis of a calculated heat flux with conservative assumptions to include wildfire at plant elevation, closest to the Unit 3 control building (CB) and fuel building (FB), the staff considers the applicant's analysis reasonable and the conclusion acceptable.

Collision with North Anna 3 Intake Structure

FSAR Section 2.2.3.5 states that the North Anna 3 intake structure is located on Lake Anna in a cove behind a cofferdam that is northeast of the North Anna 3 power block area, shown in FSAR Section 2.1-201. Lake Anna has small pleasure boats used solely for recreation; there are no large boats or barges on the lake. The area around the North Anna 3 intake structure is managed by Dominion as a part of the exclusion area. The cofferdam prevents a potential collision between a boat on Lake Anna and the North Anna 3 intake structure. Even if there is such a collision, the North Anna 3 intake structure is not a safety-related structure, and therefore the staff concluded that such a collision would not affect the safety of the plant.

Liquid Spills near the Intake Structure

FSAR Section 2.2.3.6 states that although small quantities of motor oil and gasoline may be spilled from the pleasure boats in Lake Anna, such spills would not affect the safe operation or shutdown of North Anna 3. The staff finds the applicant's assessment that minor spills into the lake will not affect safe operation or shutdown of the proposed unit is reasonable and therefore acceptable.

2.2.3.5 Post Combined License Activities

There are no post COL activities related to this subsection.

2.2.3.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff's review confirmed that the applicant has addressed the relevant information and no outstanding information is expected to be addressed in the COL FSAR related to this subsection.

As set forth above, the applicant identified potential accidents related to the presence of hazardous materials or activities in the site vicinity that could affect a nuclear power plant or plants of the specified type that might be constructed on the proposed site. The applicant also appropriately determined those events that should be considered as design-basis events and demonstrated that the plant is adequately protected and can be operated with an acceptable degree of safety, with regard to design-basis accidents. The staff reviewed the information in the ESP SSAR and supplemented in the FSAR and for the reasons given above, concluded that the applicant has provided information that identified potential hazards, and also has established that the construction and operation of North Anna 3 on the proposed site location is acceptable and meets the requirements of 10 CFR 52.79(a)(1)(iv) and 10 CFR 52.79(a)(1)(vi) for compliance with respect to determining the acceptability of the site. The information addresses COL Item 2.0.6-A and NAPS ESP COL Action Item 2.2-2. In conclusion, the applicant has provided sufficient information to satisfy 10 CFR Parts 50, 52, and 100.

2.3 <u>Meteorology</u>

To ensure that a nuclear power plant or plants can be designed, constructed, and operated on a COL applicant's proposed site in compliance with the NRC regulations, the staff evaluates regional and local climatological information, including climate extremes and severe weather occurrences that may affect the design and siting of a nuclear plant. The staff evaluates regional and local climatological information, including climate extremes and severe weather occurrences that may affect the design and siting of a nuclear plant. The staff also reviews the applicant's onsite meteorological monitoring program and information on the atmospheric dispersion characteristics of a nuclear power plant site to determine whether the radioactive effluents from postulated accidental releases, as well as routine operational releases, are within Commission guidelines.

The staff has prepared Sections 2.3.1 through 2.3.5 of this SER in accordance with the review procedures described in NUREG-0800, using information presented in Sections 2.0 and 2.3 of the North Anna 3 COL FSAR, Revision 8, which references ESBWR DCD, Revision 10, responses to staff RAIs, and applicable sections of NUREG-0800.

2.3.1 Regional Climatology

2.3.1.1 Introduction

North Anna 3 COL FSAR, Revision 9, Section 2.3.1, "Regional Climatology," of the North Anna 3 COL FSAR addresses averages and extremes of climatic conditions and regional meteorological phenomena that could affect the safe design and siting of the plant, including information describing the general climate of the region, seasonal and annual frequencies of severe weather phenomena, and other meteorological conditions to be used for design- and operating-basis considerations.

2.3.1.2 Summary of Application

North Anna 3 COL FSAR, Revision 9, Section 2.3.1, "Regional Climatology," incorporates by reference Section 2.3.1 of the ESBWR DCD, Revision 10, "Regional Climatology," and Section 2.3.1 of the North Anna 3 ESP SSAR, Revision 9, "Regional Climatology".

In addition, the North Anna 3 COL FSAR Section 2.3.1, the COL applicant provided the following:

COL Item:

- NAPS COL 2.0-7-A

The COL applicant provided information in NAPS COL 2.0-7-A to address site-specific information relating to regional climatology, site-specific meteorology, and the onsite meteorological measurements program.

Early Site Permit Variance:

- NAPS ESP VAR 2.3-1

The COL applicant proposed variance NAPS ESP VAR 2.3-1 from the ESP SSAR. This variance recalculated North Anna 3 tornado site characteristic values to replace corresponding values presented in the ESP SSAR.

2.3.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in the FSERs related to the ESBWR DCD and the North Anna 3 ESP.

In addition, the acceptance criteria associated with the relevant requirements of the NRC regulations for regional climatology are given in Section 2.3.1 of NUREG-0800.

The acceptance criteria for the additional regional climatic information presented in the FSAR beyond that presented in the ESP SSAR (i.e., NAPS COL 2.0-7-A and NAPS ESP VAR 2.3-1) are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c)(2) and 10 CFR 100.21(d), as it relates to the consideration given to the regional meteorological characteristics of the site.

The climatological and meteorological information assembled in compliance with the above regulatory requirements are necessary to determine a proposed facility's compliance with the following requirements in Appendix A, "General Design Criteria for Nuclear Power Plants," of 10 CFR Part 50:

- General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," which requires that SSCs important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

- GDC 4, "Environmental and Dynamic Effects Design Bases," which requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, included loss-of-coolant accidents.

The related acceptance criteria from Section 2.3.1 of NUREG-0800 are as follows:

- The description of the general climate of the region should be based on standard climatic summaries compiled by the National Oceanic and Atmospheric Administration (NOAA).

- Data on severe weather phenomena should be based on standard meteorological records from nearby representative National Weather Service (NWS), military, or other stations recognized as standard installations that have long periods of data on record. The applicability of these data to represent site conditions during the expected period of reactor operation should be substantiated.

- The tornado parameters should be based on RG 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1. Alternatively, a COL applicant may specify any tornado parameters that are appropriately justified, provided that a technical evaluation of site-specific data is conducted.

- The extreme (straight-line) 100-year return period 3-second gust wind speed site characteristics should be based on appropriate standards, with suitable corrections for local conditions.

- In accordance with RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants," Revision 2, the ultimate heat sink (UHS) meteorological conditions resulting in maximum evaporation and drift losses should be the worst 30-day average combination of controlling parameters (e.g., dewpoint, depression, wind speed, and solar radiation). The meteorological conditions resulting in minimum water cooling should be the worst combination of controlling parameters, including diurnal variations, where appropriate, for the critical time period(s) unique to the specific design of the sink. (Not applicable to a passive containment system design [such as the Passive Containment Cooling System used by the ESBWR design] that does not utilize a cooling tower or cooling pond).

- The 100-year ground-level snowpack or snowfall, whichever is greater, should be based on data recorded at nearby representative climatic stations or obtained from appropriate standards with suitable corrections for local conditions. The weight of the 48-hour probably maximum winter precipitation (PMWP) should be determined in accordance with reports published by NOAA's Hydrometeorological Design Studies Center.

- Ambient temperature and humidity statistics should be derived from data recorded at nearby representative climatic stations or obtained from appropriate standards with suitable corrections for local conditions.

- High air pollution potential information should be based on EPA studies.

- All other meteorological and air quality conditions identified by the COL applicant as design and operating bases should be documented and substantiated.

The information should be consistent with acceptable practices, data from NOAA, industry standards, and NRC RGs.

Interim Staff Guidance (ISG) document DC/COL-ISG-7, "Interim Staff Guidance on Assessment of Normal and Extreme Winter Precipitation Loads on the Roofs of Seismic Category I Structures" (74 FR 31470) (ADAMS Accession No. ML091490565), was issued subsequent to the publication of Section 2.3.1 in NUREG-0800. The ISG clarifies the Staff's position that the COL applicant should identify winter precipitation events as site characteristics and site parameters for determining normal and extreme winter precipitation loads on the roofs of seismic Category I structures.

To the extent that the data are applicable to the acceptance criteria outlined above, the applicant has applied the following NRC-endorsed meteorological information selection methodologies and techniques:

- RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants," Revision 1, which provides criteria for an acceptable onsite meteorological measurements program, which can be used to monitor regional meteorology site characteristics.

- RG 1.76, Revision 1, which provides criteria for selecting the design-basis tornado parameters.

- RG 1.206, which describes the type of regional meteorological data that should be presented in FSAR Section 2.3.1.

- RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," which provides criteria for selecting the design basis hurricane parameters.

2.3.1.4 Technical Evaluation

The staff reviewed Section 2.3.1 of the North Anna 3 COL FSAR and checked the referenced North Anna 3 ESP SSAR, Revision 9. The staff's review confirmed that the information in the North Anna 3 COLA and incorporated by reference to Section 2.3.1 of the North Anna 3 ESP

SSAR, addresses the relevant information related to the regional meteorology. The staff's technical evaluation of the information incorporated by reference to the North Anna 3 ESP SSAR related to regional climatology is documented in the corresponding SER (i.e., NUREG-1835).

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item:

- NAPS COL 2.0-7-A

The staff reviewed NAPS COL 2.0-7-A related to the provision of regional climatology. The staff found that the COL applicant had appropriately supplied site-specific regional climatological information by incorporating by reference Revision 9 to the North Anna 3 ESP SSAR Section 2.3.1, except as discussed below.

Early Site Permit Variance:

- NAPS ESP VAR 2.3-1

The staff reviewed NAPS ESP VAR 2.3-1 related to from the ESP SSAR. This variance recalculated North Anna 3 tornado site characteristic values as evaluated below by the staff under Section "Tornado Characteristics."

Evaluation of Site Parameters and Site Characteristics

Section 2.0 of the North Anna 3 COL FSAR evaluates whether the North Anna 3 site characteristics fall within the ESBWR DCD site parameter values. A comparison of ESBWR DCD climatic site parameters with the North Anna 3 climatic site characteristics is in North Anna 3 COL FSAR Table 2.0-201, "Evaluation of Site/Design Parameters and Characteristics." Unless otherwise noted in North Anna 3 COL FSAR Table 2.0-201, the North Anna 3 site characteristic values are acceptable to the staff because NUREG-0800, Section 2.3.1, states that a COLA referencing an ESP need not include a reinvestigation of the site characteristics that were previously accepted in the referenced ESP. The staff found that the COL applicant had appropriately compared the ESBWR DCD site parameter values with the North Anna 3 site characteristics, except as discussed below.

Design Basis Dry and Wet Bulb Temperatures

The ESBWR DCD site parameters for ambient air temperature are as follows:

- Ambient Design Air Temperature (0 percent exceedance maximum dry bulb and mean coincident wet bulb): These site parameter values represent a maximum dry bulb temperature that exists for 2 hours or more, combined with the maximum wet bulb temperature that exists in that population of dry bulb temperatures.

- Ambient Design Air Temperature (0 percent exceedance minimum dry bulb): This site parameter value represents a minimum dry bulb temperature that exists within a set of hourly data for duration of 2 hours or more.

- Ambient Design Air Temperature (0 percent exceedance maximum non-coincident wet bulb): This site parameter value represents a maximum wet bulb temperature that exists within a set of hourly data for duration of 2 hours or more.

- Ambient Design Air Temperature (1 percent annual exceedance maximum dry bulb and mean coincident wet bulb): These site parameter values represent a 1-percent annual exceedance dry bulb temperature combined with the corresponding wet bulb temperature that exists in that population of dry bulb temperatures.

- Ambient Design Air Temperature (1 percent annual exceedance minimum dry bulb): The minimum normal value is the 99-percent annual exceedance temperature.

- Ambient Design Air Temperature (1 percent annual exceedance maximum non-coincident wet bulb): The maximum normal value is the 1-percent annual exceedance non-coincident wet bulb temperature.

- Ambient Design Air Temperature (2 percent annual exceedance maximum dry bulb and mean coincident wet bulb): These site parameter values represent a 2-percent annual exceedance dry bulb temperature combined with the corresponding wet bulb temperature that exists in that population of dry bulb temperatures.

- Ambient Design Air Temperature (2 percent annual exceedance minimum dry bulb): The minimum normal value is the 98-percent annual exceedance temperature.

- Ambient Design Air Temperature (2 percent annual exceedance maximum non-coincident wet bulb): The maximum normal value is the 2-percent annual exceedance non-coincident wet bulb temperature.

North Anna 3 COL FSAR Table 2.0-201 compares the ESBWR ambient design temperature site parameters against the corresponding 100-year return period temperatures estimated near the North Anna 3 site. 10 CFR 52.79(a)(1)(iii) states that COLAs must identify the meteorological characteristics of the proposed site with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated. Temperatures based on a 100-year return period are considered to provide sufficient margin for the limited accuracy, quantity, and period of time in which historical data have been accumulated.

As shown in North Anna 3 COL FSAR Table 2.0-201, all of the COL applicant's site characteristics for ambient design air temperature are bounded by the ESBWR DCD site parameters. These temperatures include the 100-year return period dry bulb temperatures with the mean coincident wet bulb temperatures and the 100-year return period noncoincident wet bulb temperatures. The COL applicant derived a 100-year return period, maximum coincident wet bulb temperature value of 76 °F by extrapolating a curve of Richmond's dry bulb temperatures, plotted with their maximum observed coincident wet bulb temperatures, to the 100-year return period maximum dry bulb temperature value of 109 °F. The staff performed an independent evaluation of the site characteristic temperatures that resulted in generally similar temperatures. Although the staff's calculation determined the 100-year return period coincident wet bulb temperature to be higher than the COL applicant's, both the staff's and COL applicant's dry bulb and coincident wet bulb temperatures are well within bounds of the ESBWR DCD site parameter value of 80.0 °F for the coincident wet bulb temperature. RAI 02.03.01-6 requested that the COL applicant provide a 100-year return period minimum dry bulb temperature for comparison against the US-APWR [Advanced Pressurized Water Reactor] site parameter temperature (in previous revisions of the North Anna 3 COL FSAR when the reference DCD was the US-APWR). The COL applicant responded by committing to include a justification for the use of a 0 percent exceedance minimum dry bulb temperature instead of the 100-year return period temperature. North Anna 3 COL FSAR Table 2.0-201 included a 0 percent annual exceedance minimum temperature of -21 °F for comparison against the US-APWR (now ESBWR) site characteristic 0 percent annual exceedance minimum temperature. The 0 percent annual exceedance temperature is used as the North Anna 3 site characteristic minimum dry bulb temperature because it bounds the calculated 100-year return period minimum dry bulb temperature of -19 °F. The -21 °F temperature was recorded at the Louisa Cooperative observation site, which is located about 10 miles WSW of the North Anna 3 site, whereas the 100-year return period temperature is an extrapolation of data from Richmond, VA. Both the 100-year return period temperature and 0 percent exceedance temperature presented by the COL applicant bound the Staff's independently calculated 100-year return period minimum dry bulb temperature, and are, therefore, acceptable to the staff. The staff reviewed the changes proposed in the response to RAI 02.03.01-6 and finds them to be acceptable. Therefore, the staff has determined that RAI 02.03.01-6 is resolved and closed.

Using a combination of National Climatic Data Center (Hourly data from Richmond, VA (1978-2009)), and climate data from the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the staff was able to verify the COL applicant's site characteristic temperatures presented in North Anna 3 COL FSAR, Table 2.0-201. The staff, therefore, accepts them as correct.

Extreme Winds

Section 2.3.1.3.1 of the North Anna 3 FSAR includes a description of extreme wind, including estimates of 10^{-7} per year hurricane wind speeds. Using the guidance in RG 1.221, the applicant chose a 3-second gust hurricane wind speed value of 62 m/s (140 mph). This wind speed represents the maximum nominal 3-second gust wind speed at 10 m (33 ft) above ground over open terrain having a probability of exceedance of 10^{-7} per year. The staff, using the guidance provided in RG1.221, confirmed the hurricane wind speed value chosen by the applicant.

Section 2.3.1.3.1 of the North Anna 3 FSAR also presents a basic wind speed value of 40 m/s (90 mph) for Unit 3 nonsafety-related structures not included in the certified design. The applicant used the American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standard 7-05, "Minimum Design Loads for Buildings and Other Structures," to determine the value. The value was confirmed by the staff through the use of ASCE/SEI Standard 7-05.

The applicant presents a 50-year wind speed site characteristic of 42.9 m/s (96 mph) in Table 2.0-201 for "Other Seismic NS Standard Plant Structures." This site characteristic value is the same as the ESP and Unit 3 site characteristic value for a 100-year wind speed. The 100-year wind speed site characteristic value is higher than a 50-year wind speed. This is a conservative assumption and is therefore acceptable to the staff.

The applicant specified exposure Category D in Table 2.0-201 for Unit 3 as part of the extreme wind site characteristics for Seismic Category I, II, and radwaste building structures. ASCE/SEI Standard 7-05 describes Exposure Category D as having flat, unobstructed area and water surfaces that prevail in the upwind direction for a distance greater than 5,000 ft (1,525 m) or 20 times the building height, whichever is greater. The use of Exposure Category D results in the most severe design wind pressures and is therefore a conservative assumption and is acceptable to the staff. Hurricane wind speed effect on safety systems and structures is evaluated in Chapter 3 Section 3.3 and Chapter 19 Appendix 19A of this SER.

Tornado Characteristics

Revision 3 of the North Anna 3 COL FSAR presented tornado site characteristics that differed from those presented in the North Anna 3 ESP. The tornado site characteristics approved in the North Anna 3 ESP were based on RG 1.76, Revision 0. The most recent guidance provided for determining tornado site characteristics is RG 1.76, Revision 1. This updated guidance effectively lowered the wind speeds based on the Enhanced Fujita scale. In RAI 02.03.01-5, the staff asked the COL applicant to include in the North Anna 3 COL FSAR either a request for a variance (NAPS ESP VAR 2.3-1) related to the ESP tornado site characteristic values, or request an amendment to the North Anna 3 ESP.

In response to RAI 02.03.01-5, the COL applicant proposed an update to Part 7, "Departures Report," of the North Anna 3 COL that includes a variance in accordance with 10 CFR 52.79(b)(2), CFR 52.93(b) and 10 CFR 52.39(d). The staff has determined that the COL applicant's updated tornado site characteristics are appropriate for the North Anna 3 site. Additional staff evaluation of this variance is below. The staff has confirmed that the COL applicant included this variance request in Part 7 of the COLA and therefore determines that RAI 02.03.01-5 is resolved.

The COL applicant chose tornado site characteristics based on RG 1.76, Revision 1. RG 1.76, Revision 1 provides design-basis tornado characteristics for three tornado intensity regions throughout the United States, each with a 10^{-7} per year probability of occurrence. The proposed COL site is located in Tornado Intensity Region II where severe tornadoes have been observed. The COL applicant proposed the following tornado site characteristics, which are listed in North Anna 3 COL FSAR Table 2.0-201 and North Anna 3 COL FSAR Table 2.3-225:

- Maximum wind speed 200 mph
- Maximum translational speed 40 mph
- Maximum rotational speed 160 mph
- Radius of maximum rotational speed 150 ft.
- Pressure drop 0.9 psi
- Rate of pressure drop 0.4 psi/sec

Because the COL applicant has identified design-basis tornado site characteristics based on RG 1.76, Revision 1, the staff concludes that the COL applicant's tornado site characteristics are acceptable. As shown in North Anna 3 COL FSAR Table 2.0-201, the North Anna 3 COL tornado site characteristics are bounded by the ESBWR DCD site parameter values.

Precipitation Extremes

The staff also reviewed the COL applicant's additional information related to winter precipitation roof loading provided in North Anna 3 COL FSAR Section 2.3.1.3.4. The staff issued DC/COL-ISG-7, which clarifies the Staff's position on identifying winter precipitation events as site characteristics and site parameters for determining normal and extreme winter precipitation loads on the roofs of seismic Category I structures. The ISG revises the previously issued staff guidance as discussed in Section 2.3.1 in NUREG-0800.

The ISG states that normal and extreme winter precipitation events should be identified in Section 2.3.1 of NUREG-0800, as COL site characteristics to compare against site parameters related to normal and extreme winter precipitation loads on the roofs of seismic Category I structures. The normal winter precipitation roof load is a function of the normal winter precipitation event; whereas, the extreme winter precipitation roof loads are based on the weight of the antecedent snowpack resulting from the normal winter precipitation event plus the larger resultant weight from either: (1) the extreme frozen winter precipitation event; or (2) the extreme liquid winter precipitation event. The extreme frozen winter precipitation event is assumed to accumulate on the roof on top of the antecedent normal winter precipitation event; whereas, the extreme liquid winter precipitation event may or may not accumulate on the roof, depending on the geometry of the roof and the type of drainage provided. The ISG further states:

- The normal winter precipitation event should be the highest ground-level weight (in pounds per square foot (lb/ft^2)) among: (1) the 100-year return period snowpack; (2) the historical maximum snowpack; (3) the 100-year return period two-day snowfall event; or (4) the historical maximum two-day snowfall event in the site region.

- The extreme frozen winter precipitation event should be the higher ground-level weight (in lb/ft^2) between: (1) the 100-year return period two-day snowfall event; and (2) the historical maximum two-day snowfall event in the site region.

- The extreme liquid winter precipitation event is defined as the theoretically greatest depth of precipitation (in inches of water) for a 48-hour period that is physically possible over a 25.9-square-kilometer (km) (10-square-mile (mi)) area at a particular geographical location during those months with the historically highest snowpack.

The COL applicant identified the maximum snowfall events for the area surrounding the North Anna 3 site to be 25.5 inches. This was measured at two different stations; Piedmont Research Station on January 8, 1996, and Fredericksburg on January 28, 1922. The COL applicant presented the normal winter precipitation roof load of 30.5 lb/ft^2. The staff notes that the normal winter precipitation roof load resulting from the 100-year return period snowpack (30.5 lb/ft^2) is less than the ESBWR design basis normal winter precipitation roof load site parameter value of 50 lb/ft^2. The COL applicant also presented its extreme winter precipitation ground load of 141.3 lb/ft^2. This value is based on the sum of the site characteristic normal winter precipitation event plus the liquid 48-hr PMWP. The staff notes that this extreme winter precipitation ground snow load is less than the ESBWR site parameter value of 162 lb/ft^2. The staff performed an independent evaluation following the methodology provided in DC/COL-ISG-7 and determined that the COL applicant's snow load calculations are conservative and acceptable.

A comparison between the ESBWR site parameter and the North Anna 3 site characteristic for snow load is presented in North Anna 3 COL FSAR Table 2.0-201. The COL applicant's site characteristic for snow load is conservatively bounded by the ESBWR DCD site parameter.

2.3.1.5 Post Combined License Activities

There are no post-COL activities to this section.

2.3.1.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff finds that the COLA includes all the information relevant to this subsection and the staff confirmed that there is no outstanding information that remains to be addressed in the COL FSAR related to this section.

The staff concluded that the information pertaining to North Anna 3 COL FSAR Section 2.3.1 is within the scope of the ESP SSAR and adequately incorporates by reference Section 2.3.1 of the ESP SSAR. The information is therefore acceptable to the staff. The staff evaluated additional information related to NAPS ESP VAR 2.3-1 as discussed in “Tornado Characteristics,” above. The staff found this information to be correct and acceptable for the North Anna 3 site. In addition, the staff compared the additional COL information in the application to the relevant NRC regulations and acceptance criteria defined in Section 2.3.1of NUREG-0800. The staff concluded that the COL applicant is in compliance with the relevant requirements of 10 CFR Parts 52 and 100. The staff finds that COL item 2.0-7-A has been adequately addressed by the applicant and can be considered closed.

2.3.2 Local Meteorology

2.3.2.1 Introduction

North Anna 3, “Local Meteorology,” addresses the local (site) meteorological characteristics, the assessment of the potential influence of the proposed plant and its facilities on local meteorological conditions and the impact of these modifications on plant design and operations, and a topographical description of the site and its environs.

2.3.2.2 Summary of Application

Section 2.3.2, “Local Meteorology,” of the North Anna 3 COL FSAR, Revision 9, incorporates by reference Section 2.3.2 of the ESBWR DCD, Revision 10 and Section 2.3.2 of the North Anna 3 ESP SSAR.

In addition, in North Anna 3 COL FSAR Section 2.3, the COL applicant provided the following:

COL Items:

- NAPS COL 2.0-8-A

The COL applicant provided information in NAPS COL 2.0-8-A to address site-specific information relating to regional climatology, site-specific meteorology, and the onsite meteorological measurements program.

- NAPS ESP COL 2.3-1

The staff reviewed the resolution to NAPS ESP COL 2.3-1, related to the potential impact on the design or operation of the proposed unit(s) of any cooling tower-induced local increase in: (1) ambient air temperature; (2) ambient air moisture content; or (3) moisture and salt deposition. The COL applicant responded to this COL item by providing supplemental information on the potential impact of the North Anna 3 cooling towers on North Anna 3 plant design and operation due to salt deposition, fogging, icing, and local ambient air temperature increases.

2.3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in the FSER related to the DCD.

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for local meteorology are given in Section 2.3.2 of NUREG-0800.

The applicable regulatory requirements for identifying local meteorology are:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c)(2), and 10 CFR 100.21(d) as it relates to the consideration given to the local meteorological characteristics of the site.

The related acceptance criteria from Section 2.3.2 of NUREG-0800 are as follows:

- Local summaries of meteorological data based on onsite measurements in accordance with RG 1.23, Revision 1, and NWS station summaries or other standard installation summaries from appropriate nearby locations (e.g., within 80 km (50 mi)) should be presented as specified in RG 1.206, Section 2.3.2.1.

- A complete topographical description of the site and environs out to a distance of 80 km (50 mi) from the plant, as described in RG 1.206, Section 2.3.2.2, should be provided.

- A discussion and evaluation of the influence of the plant and its facilities on the local meteorological and air quality conditions should be provided. COL applicants should also identify potential changes in the normal and extreme values, resulting from plant construction and operation. The acceptability of the information is determined through comparison with standard assessments.

- The description of local site airflow should include wind roses and annual joint frequency distributions (JDF) of wind speed and wind direction by atmospheric stability for all measurement levels using the criteria provided in RG 1.23, Revision 1.

2.3.2.4 Technical Evaluation

The staff reviewed Section 2.3.2 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR, Revision 9. The staff's review confirmed that the information contained in the North Anna 3 COLA and incorporated by reference to Section 2.3.2 of the ESP SSAR addresses the relevant information related to the local meteorology. The staff's technical evaluation of the information incorporated by reference to the ESP SSAR related to local meteorology is documented in NUREG-1835.

The staff's technical evaluation of this application subsection is limited to reviewing: (1) the resolution of COL item NAPS COL 2.0-8-A, and (2) the resolution of COL Action Item NAPS ESP COL 2.3-1.

COL Items:

- NAPS COL 2.0-8-A

- NAPS ESP COL 2.3-1

The staff reviewed the resolution to NAPS COL 2.0-8-A and NAPS ESP COL 2.3-1 related to local meteorology. The staff found that the COL applicant had appropriately supplied site-specific local meteorological information by incorporating by reference Revision 9 to the North Anna ESP SSAR Section 2.3.2. The staff's review of the COL applicant's supplemental information regarding the North Anna 3 cooling tower impact on North Anna 3 plant design and operation is discussed below.

Potential Influence of the Plant and the Facilities on Local Meteorology

The COL applicant states that the cooling towers are positioned at a location that attempts to reduce or eliminate the potential for plume interference effects on the same-unit and adjacent-unit components and systems that are important to safety. The COL applicant provided a discussion of the effects of salt and moisture deposition on the North Anna 3 transformers, switchyard equipment, or transmission lines. The COL applicant provided an electronic copy of the input and output files from the Seasonal/Annual Cooling Tower Impact (SACTI) computer model. The staff reviewed the model input files to assure that the COL applicant made conservative assumptions. The SACTI results indicate that a highest deposition rate of salt accumulation would result in 0.00015 milligrams per cubic centimeter per month (mg/cm^2-month) near the North Anna 3 transformers during the winter months. This accumulation rate is below the lower end of the "Light Contamination Level" range of 0.03 – 0.08 mg/cm^2 defined by the Institute of Electrical and Electronic Engineers (IEEE) standard[2]. The staff has independently verified the source cited by the COL applicant. The staff agrees that total accumulation reaching amounts that require mitigation is highly unlikely due to local precipitation removing any salt deposits before it reaches a level of concern.

The COL applicant states that the plume from the CIRC hybrid cooling towers is unlikely to affect any heating, ventilation, and air conditioning systems due to the location of the CB being over 1600 ft away. This assures sufficient mixing between the exhaust plume and the surrounding air to minimize any significant increases in wet bulb or dry bulb temperature above local ambient values. The staff agrees with this assessment and finds that the COL applicant has given adequate consideration to whether cooling towers may adversely impact local temperatures, humidity, and other hazards posed by cooling towers.

2.3.2.5 Post Combined License Activities

There are no post COL activities associated with this subsection.

2.3.2.6 Conclusion

The staff reviewed the application and checked the referenced North Anna ESP SSAR. The staff finds that the COLA includes all the required information relevant to this section, and the staff confirmed that there is no outstanding information that remains to be addressed in the COL FSAR related to this Section.

The staff concluded that the information pertaining to North Anna 3 COL FSAR, Section 2.3.2 is within the scope of the ESP and adequately incorporates by reference Section 2.3.2 of the ESP SSAR. Therefore the information is acceptable to the staff. In addition, the staff compared the additional COL information in the application to the relevant NRC regulations and acceptance

[2] IEEE Guide for Application of Power Apparatus Bushings, IEEE Standard C.57.19.100-1995, Aug 1995.

criteria defined in Section 2.3.2 of NUREG-0800 and concluded that the COL applicant is in compliance with the relevant requirements of 10 CFR Parts 52 and 100. COL item NAPS COL 2.0-8-A and COL Action Item NAPS ESP COL 2.3-1 have been adequately addressed by the COL applicant and can be considered closed.

2.3.3 Onsite Meteorological Measurement Programs

2.3.3.1 Introduction

The North Anna 3 onsite meteorological measurement program addresses the need for onsite meteorological monitoring and the resulting data. The staff review covers the following specific areas: (1) meteorological instrumentation, including siting of sensors, sensor type and performance specifications, methods and equipment for recording sensor output, the quality assurance program for sensors and recorders, data acquisition and reduction procedures, and special considerations for complex terrain sites; and (2) the resulting onsite meteorological database, including consideration of the period of record and amenability of the data for use in characterizing atmospheric dispersion conditions.

2.3.3.2 Summary of Application

Section 2.3 of the North Anna 3 COL FSAR, Revision 9, incorporates by reference Section 2.3.3 of the ESBWR DCD, Revision10 and Section 2.3.3 of the North Anna 3 ESP SSAR, Revision 9.

COL Item:

- NAPS COL 2.0-9-A

The COL applicant provided information in NAPS COL 2.0-9-A to address site-specific information relating to regional climatology, site-specific meteorology, and the onsite meteorological measurements program

2.3.3.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

The regulatory basis for the information presented in the ESP SSAR is addressed in the FSER related to the ESP SSAR (i.e., NUREG-1835).

The acceptance criteria for the adequacy of distances from the North Anna 3 to the onsite meteorological measurements program are in RG 1.23. NUREG-0800, Section 2.3.3, states that guidance on a suitable onsite meteorological monitoring program is in RG 1.23, Revision 1.

2.3.3.4 Technical Evaluation

The staff reviewed Section 2.3.3 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR. The staff's review confirmed that the information contained in the North Anna 3

COLA and incorporated by reference to Section 2.3.3 of the ESP SSAR, Revision 9, addresses the relevant information related to the onsite meteorological measurements program. The staff's technical evaluation of the information incorporated by reference to the ESP SSAR related to the onsite meteorological measurements program is documented in the corresponding SER (i.e., NUREG-1835).

The staff's technical evaluation of this application subsection is limited to reviewing the resolution of COL Item NAPS COL 2.0-9-A. There are no site parameters or site characteristics associated with this FSAR subsection.

COL Item:

- NAPS COL 2.0-9-A

The staff reviewed the resolution to NAPS COL 2.0-9-A related to the onsite meteorological measurements program. The staff found that the COL applicant had appropriately supplied site-specific onsite meteorological measurements program information by incorporating by reference North Anna 3 ESP SSAR Section 2.3.3.

The staff also reviewed the information provided by the COL applicant in North Anna 3 COL FSAR Section 2.3.3.1.2, concerning the distance between the onsite meteorological towers and the North Anna 3 structures. The COL applicant stated that the highest building at the North Anna 3 site is the Turbine Building (TB) at 52 m (170.6 ft). The primary and backup meteorological towers are approximately 733.4 m (2,406 ft) and 744 m (2,440 ft), respectively, from the plant facility boundary. Because the primary and backup meteorological towers are more than 10 building heights away from the tallest building at the North Anna 3 site, the COL applicant concluded that the North Anna 3 TB does not influence the meteorological measurements. The staff concurred with this assessment because the COL applicant had met the RG 1.23, Revision 1 guidance. RG 1.23, Revision 1 states that obstructions to wind measurements should be at a distance of at least 10 times their height from the wind sensors. The staff noted that the tallest cooling tower is the CWS hybrid cooling tower, which, at 55 m (180 ft), is slightly taller than the TB, but is located further from the primary and backup meteorological towers. Therefore, the staff concluded that the building wake from the cooling tower structures would not influence the meteorological measurements.

2.3.3.5 Post Combined License Activities

Part 10 of the COLA describes proposed COL conditions, including ITAAC. Part 10, Table 2.3-1 of the COLA contains the emergency planning (EP) ITAAC. The following EP ITAAC involve demonstrating that the operational onsite meteorological monitoring program appropriately supports the North Anna 3 emergency plan:

- EP Program Element 6.3: The means exist to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions.

- EP Program Element 6.4: The means exist to acquire and evaluate meteorological information.

- The North Anna 3 EP, including EP ITAAC are addressed in SER Section 13.3, "Emergency Planning."

2.3.3.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff finds that the COLA includes all the information relevant to this subsection, and the staff confirmed that there is no outstanding information that remains to be addressed in the COL FSAR related to this subsection.

The staff concluded that the information pertaining to North Anna 3 COL FSAR Section 2.3.3 is within the scope of the ESP SSAR and adequately incorporates by reference Section 2.3.3 of the North Anna 3 ESP SSAR. The information is therefore acceptable to the staff. In addition, the staff has compared the additional COL information within the application to the relevant NRC regulations and acceptance criteria defined in NUREG-0800, Section 2.3.3, and concludes that the COL applicant is in compliance with the 10 CFR Parts 52 and 100 as described in RG 1.23 and SRP Section 2.3.3. Therefore, NAPS COL Item 2.0-9-A has been adequately addressed by the COL applicant and can be considered closed.

2.3.4 Short-Term Diffusion Estimates (Related to RG 1.206, Section C.III.1, Chapter 2, C.I.2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases")

2.3.4.1 Introduction

The short-term diffusion estimates are used to determine the amount of airborne radioactive materials expected to reach a specific location during an accident situation. The diffusion estimates address the requirement for conservative atmospheric dispersion (relative concentration) factor (χ/Q value) estimates at the EAB, the outer boundary of the LPZ, and at the control room for postulated design-basis accidental radioactive airborne releases. The staff's review covers the following specific areas: (1) atmospheric dispersion models to calculate atmospheric dispersion factors for postulated accidental radioactive releases; (2) meteorological data and other assumptions used as input to atmospheric dispersion models; (3) derivation of diffusion parameters (e.g., σ_y and $o_{z.}$); (4) cumulative frequency distributions of χ/Q values; (5) determination of conservative χ/Q values used to assess the consequences of postulated design-basis atmospheric radioactive releases to the EAB, LPZ, and control room; and (6) any additional information requirements prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.3.4.2 Summary of Application

North Anna 3 COL FSAR, Revision 9, Section 2.3.4 addresses site-specific information on short-term atmospheric dispersion estimates for accident releases. The COL applicant addressed the information as follows:

COL Item:

- NAPS COL 2.0-10-A

This COL item states that the COL applicant should provide conservative factors as described in Section 2.3.4 of NUREG-0800.

- NAPS ESP COL 2.3-2

This COL action item states that the COL applicant should assess dispersion of airborne radioactive materials to the control room. The COL applicant responded to this COL action item by providing details regarding the source and receptor information needed to determine χ/Q values at the ESBWR control room. The χ/Q values calculated through the use of the ARCON96 computer program are provided in North Anna 3 COL FSAR Table 2.0-201. Tables 2.3-201 through 2.3-204, Table 2.3-206, and Table 2.3-207.

2.3.4.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

The regulatory basis for the information presented in the ESP SSAR is addressed in the FSER related to the ESP SSAR (i.e., NUREG-1835).

The acceptance criteria for the additional accidental atmospheric dispersion estimates presented in the North Anna 3 COL FSAR, beyond those presented in the ESP SSAR, are based on meeting the relevant requirements of 10 CFR Part 50. The staff considered the following regulatory requirements in reviewing the COL applicant's discussion of control room atmospheric dispersion analyses:

- 10 CFR Part 50, Appendix A, GDC 19, "Control Room," as it relates to the meteorological considerations used to evaluate the personnel exposures inside the control room during radiological accident conditions.

- 10 CFR Part 50, Appendix E, Paragraph IV.E.8, as it relates to providing an onsite technical support center (TSC) from which effective direction can be given and effective control can be exercised during an emergency.

The related acceptance criteria from Section 2.3.4 of NUREG-0800 are as follows:

- A description of the atmospheric dispersion models used to calculate χ/Q values for accidental releases of radioactive materials into the atmosphere.

- Meteorological data used for the evaluation (as input to the dispersion models), which represent annual cycles of hourly values of wind direction, wind speed, and atmospheric stability for each mode of accidental release.

- A discussion of atmospheric diffusion parameters, such as lateral and vertical plume spread (σ_y and $o_{z.}$) as a function of distance, topography, and atmospheric conditions, should be related to measured meteorological data.

- Hourly cumulative frequency distributions of χ/Q values from the effluent release point(s) to the EAB and LPZ should be constructed to describe the probabilities of these χ/Q values being exceeded.

- Atmospheric dispersion factors used for the assessment of consequences related to atmospheric radioactive releases to the control room for design-basis and other accidents should be provided.

- For control room habitability analysis, a site plan drawn to scale should be included showing true North and potential atmospheric accidental release pathways, control room intake, and unfiltered inleakage pathways.

Section 15.0.3 of NUREG-0800 specifies (in part) that an application meets 10 CFR Part 50, Appendix E, TSC radiological habitability requirements if the total calculated radiological consequences for postulated accidents fall within the exposure acceptance criteria specified for the control room.

The following RGs are applicable to this section:

- RG 1.78, Revision 1;

- RG 1.145, “Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,” Revision 1; and

- RG 1.194, “Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants.”

2.3.4.4 Technical Evaluation

The staff reviewed North Anna 3 COL FSAR Section 2.3.4 and checked the referenced ESP SSAR, Revision 9. The staff’s review confirmed that the information contained in the North Anna 3 COLA and incorporated by reference to Section 2.3.4 of the ESP SSAR, addresses the relevant information related to short-term atmospheric diffusion estimates for accident releases. The staff’s technical evaluation of the information incorporated by reference to the ESP SSAR related to long-term atmospheric dispersion estimates for routine releases is documented in the corresponding FSER (i.e., NUREG-1835).

The staff’s technical evaluation of this subsection is limited to reviewing: (1) the resolution of COL item NAPS COL 2.0-10-A; (2) the resolution of COL Action Item NAPS ESP COL 2.3-2; and (3) whether the North Anna 3 short-term atmospheric diffusion site characteristics fall within the ESBWR DCD short-term atmospheric diffusion site parameter values.

EAB and LPZ χ/Q Values

The staff found the continued use of the North Anna 3 ESP SSAR accident EAB and LPZ χ/Q values acceptable for the following reasons:

- Section 2.3.4 of NUREG-0800, states that a COLA referencing an ESP need not include a re-investigation of the site characteristics that have been previously accepted in the referenced ESP.

- The North Anna 3 site layout shown in North Anna 3 COL FSAR Figure 2.0-205, "Unit 3 Power Block Building Locations Within the ESP Proposed Facility Boundary," is the same layout shown in North Anna 3 ESP Figure 1.2-4 and the definitions of the North Anna 3 COL FSAR EAB and LPZ are the same as the North Anna 3 ESP definitions. Consequently, the downwind distances used in the North Anna 3 ESP SSAR to calculate the EAB and LPZ χ/Q site characteristic values are applicable to the North Anna 3 COLA.

Other input assumptions used to derive the North Anna 3 ESP SSAR EAB and LPZ accident χ/Q site characteristic values remain bounding for North Anna 3. For example, all release points are as ground level releases and the COL applicant did not take credit for building wake effects. Ignoring building wake effects for a ground-level release decreases the amount of atmospheric turbulence assumed to be in the vicinity of the release point, resulting in higher (more conservative) χ/Q values.

The staff concluded that the input assumptions used to model the North Anna 3 ESP SSAR accident EAB and LPZ χ/Q values bound the actual North Anna 3 plant and site characteristics and the use of one set of accident χ/Q values to model all potential accident release points is appropriate. Therefore, the staff finds that the COL applicant's use of the North Anna 3 ESP SSAR EAB and LPZ χ/Q values for North Anna 3 is appropriate.

Control Room and TSC χ/Q Values for North Anna 3 Releases

The COL applicant used the computer code ARCON96 (NUREG/CR-6331, "Atmospheric Relative Concentrations in Building Wakes") to estimate χ/Q values at the control room for potential accidental releases of radioactive material. The ARCON96 model implements the methodology outlined in RG 1.194.

The ARCON96 code estimates χ/Q values for various time-averaged periods ranging from 2 hours to 30 days. The meteorological input to ARCON96 consists of hourly values of wind speed, wind direction, and atmospheric stability class. The χ/Q values calculated through ARCON96 are based on the theoretical assumption that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. A straight-line trajectory is assumed between the release points and receptors. The diffusion coefficients account for enhanced dispersion under low wind speed conditions and in building wakes.

The hourly meteorological data are used to calculate hourly relative concentrations. The hourly relative concentrations are then combined to estimate concentrations ranging in duration from 2 hours to 30 days. Cumulative frequency distributions are prepared from the average relative concentrations and the relative concentrations that are exceeded no more than 5 percent of the time for each averaging period is determined.

The meteorological input to ARCON96 used by the COL applicant consisted of wind speed, wind direction, and atmospheric stability data based on hourly onsite data from a 3-year period from January 1, 1996 through December 31, 1998. The wind data were obtained from the 10-m and 48.4 m levels of the onsite meteorological tower, and the stability data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 48.4-m and 10-m levels on the onsite meteorological tower.

The following sources were used as the necessary input to ARCON96:

Onsite Hourly Meteorological Data: ----------- January 1, 1996 – December 31, 1998
ESBWR DCD Figure 2A-1:-----------------------Site Plan with Release and Intake Locations
ESBWR DCD Table 2A-1 to 2A-4:------------- CR and TSC Source/Receptor Data
North Anna 3 COL FSAR Figure 2.1-201:----Plant Layout on the North Anna 3 Site

North Anna 3 COL FSAR Section 2.4.2.3 states that for North Anna 3 Units 3, the plant orientation is rotated 23.54 degrees clockwise from true north. ARCON96 modeling was conducted by the COL applicant to evaluate impacts at the Control Room emergency intakes.

North Anna 3 COL FSAR Table 2.3-201 through 2.3-207 lists the atmospheric dispersion estimates that the COL applicant derived from its ARCON96 modeling run results. In accordance with the ESBWR DCD, North Anna 3 COL FSAR Table 2.0-201 compared the site-specific control room χ/Q values to the corresponding site parameters provided in the DCD. This comparison showed that the ESBWR control room values conservatively bounded the site-specific values.

RAI 02.03.04-2 requested the COL applicant provide a copy of the ARCON96 input and output files used to determine the control room and TSC χ/Q values. As part of the response to RAI 02.03.04-2 dated January 10, 2011 (ADAMS Accession No. ML110140131), the COL applicant committed to updating the FSAR to include a comparison of the site χ/Q values against Revision 3 of the US-APWR DCD. The staff confirmed the COL applicant's atmospheric dispersion estimates for the 1996-1998 data by running the ARCON96 computer model and obtaining similar results (i.e., values on average within ± 2.5 percent). Both the staff and COL applicant used a ground-level release assumption for each of the release/receptor combinations as well as other conservative assumptions. In light of the foregoing, the staff accepts the control room χ/Q values presented by the COL applicant and determines that RAI 02.03.04-2 is resolved and closed. The licensee later submitted ARCON96 input and output files to support the control room and TSC χ/Q values for the ESBWR DCD.

2.3.4.5 Post Combined License Activities

There are no post COL activities associated with this subsection.

2.3.4.6 Conclusion

The staff reviewed the application and checked the referenced DCD and the North Anna 3 ESP SSAR. The staff finds that the COLA includes all the required information related to short-term diffusion estimates, and the staff confirmed that there is no outstanding information that remains to be addressed in the North Anna 3 COL FSAR related to this subsection. The staff's technical evaluation of the information incorporated by reference to the ESP SSAR related to local meteorology is documented in NUREG-1835.

In addition, the staff has compared the additional COL information in the application to the relevant regulations and acceptance criteria defined in NUREG-0800, Section 2.3.4. The staff concludes that the COL applicant is in compliance with the relevant requirements of 10 CFR Parts 50, 52, and 100.

2.3.5 Long-Term Diffusion Estimates (Related to RG 1.206, Section C.III.2, Chapter 2, C.I.2.3.5, "Long Term Atmospheric Dispersion Estimates for Routine Releases")

2.3.5.1 Introduction

The long-term diffusion estimates are used to determine the amount of airborne radioactive materials expected to reach a specific location during normal operations. The diffusion estimates address the requirement concerning atmospheric dispersion and dry deposition estimates for routine releases of radiological effluents to the atmosphere. The review covers the following specific areas: (1) atmospheric dispersion and deposition models used to calculate concentrations in air and amount of material deposited as a result of routine releases of radioactive material to the atmosphere; (2) meteorological data and other assumptions used as input to the atmospheric dispersion models; (3) derivation of diffusion parameters (e.g., σ_z); (4) atmospheric dispersion (relative concentration) factors (χ/Q values) and deposition factors (D/Q values) used for assessment of consequences of routine airborne radioactive releases; (5) points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations; and (6) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.3.5.2 Summary of Application

North Anna 3 COL FSAR, Section 2.3.5 addresses site-specific information on long-term atmospheric dispersion estimates for routine releases. The COL applicant addressed the information as follows:

<u>*COL Items:*</u>

- NAPS COL 2.0-11-A

This COL information item states that the COL applicant should characterize the atmospheric transport and diffusion conditions necessary for estimating radiological consequences of the routine release of radioactive materials to the atmosphere, and provide realistic estimates of annual average χ/Q values and D/Q values as described in Section 2.3.5 of NUREG-0800.

- NAPS ESP COL 2.3-3

This COL item states that the COL applicant should verify specific release point characteristics and specific locations of receptors of interest used to generate the ESP SSAR long-term (routine release) atmospheric dispersion site characteristics. The COL applicant responded to this COL action item by recalculating site-specific, long-term χ/Q and D/Q values at specific receptors of interest using: (1) the land-use census results reported in the Dominion North Anna 3 2006 Annual Radiological Environmental Operating Report (AREOR), and (2) ESBWR-specific vent building height and building cross-sectional area data. These new North Anna 3 long-term χ/Q and D/Q values at specific receptors of interest are in North Anna 3 COL FSAR Table 2.3-16R. The COL applicant recalculated long-term χ/Q and D/Q values at the site boundary; however, χ/Q and D/Q values from the ESP SSAR are used because the COL applicant had determined that the ESP SSAR values for the site boundary are bounding.

Early Site Permit Variances:

- NAPS ESP VAR 2.0-1a

The COL applicant proposed variance NAPS ESP VAR 2.0-1a from the ESP SSAR. This variance recalculated North Anna 3 maximum long-term (routine release) χ/Q and D/Q values for the RW ventilation stack to replace corresponding values presented in the ESP SSAR.

2.3.5.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP, provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP.

The regulatory basis for the information presented in the ESP SSAR is addressed in the FSER related to the ESP SSAR (i.e., NUREG-1835).

The acceptance criteria for the additional long-term atmospheric dispersion estimates presented in North Anna 3 COL FSAR Section 2.3.5, beyond those presented in the ESP SSAR, are based on meeting the relevant requirements of 10 CFR Parts 20, "Standards for Protection Against Radiation," 50, and 100. The staff considered the following regulatory requirements in reviewing the COL applicant's discussion of long-term atmospheric dispersion and deposition estimates:

- 10 CFR Part 20, Subpart D, as it relates to establishing atmospheric dispersion site characteristics for demonstrating compliance with dose limits for individual members of the public.
- 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents – nuclear power reactors," and Sections II.B, II.C, and II.D of Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," of 10 CFR Part 50, as they relate to establishing atmospheric dispersion site characteristics for operation to meet the requirements that radioactive material in effluents released to unrestricted areas be kept as low as is reasonably achievable.
- 10 CFR 100.21(c)(1), as it relates to establishing atmospheric dispersion site characteristics such that radiological effluent release limits associated with normal operation can be met for any individual located offsite.

The related acceptance criteria from Section 2.3.5 of NUREG-0800 are as follows:

- A detailed description of the atmospheric dispersion and deposition models used by the COL applicant to calculate annual average concentrations in air and amount of material deposited as a result of routine releases or radioactive materials to the atmosphere.
- A discussion of atmospheric diffusion parameters, such as vertical plume spread ($\sigma_{z.}$) as a function of distance, topography, and atmospheric conditions.

- Meteorological data summaries (onsite and regional) used as input to the dispersion and deposition models.

- Points of routine release of radioactive material to the atmosphere, including the characteristics (e.g., location, release mode) of each release point.

- The specific location of potential receptors of interest (e.g., nearest vegetable garden, nearest resident, nearest milk animal, and nearest meat cow in each 22½ degree direction sector within a 5-mi [8-km] radius of the site).

- The χ/Q and D/Q values to be used for assessment of the consequences of routine airborne radiological releases as described in and Section 2.3.5.2 of RG 1.206: (1) Maximum annual average χ/Q values and D/Q values at or beyond the site boundary and at specified locations of potential receptors of interest utilizing appropriate meteorological data for each routine venting location; and (2) estimates of annual average χ/Q values and D/Q values for 16 radial sectors to a distance of 50 mi (80 km) from the plant using appropriate meteorological data.

The following RGs are applicable to this section:

- RG 1.23, Revision 1;

- RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1;

- RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1; and

- RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," Revision 1.

2.3.5.4 Technical Evaluation

The staff reviewed North Anna 3 COL FSAR Section 2.3.5 and checked the referenced ESP SSAR, Revision 9. The staff's review confirmed that the information contained in the North Anna 3 COLA and incorporated by reference to Section 2.3.5 of the ESP SSAR, addresses the relevant information related to long-term atmospheric dispersion and deposition estimates for routine releases. The staff's technical evaluation of the information incorporated by reference to the ESP SSAR related to long-term atmospheric dispersion estimates for routine releases is documented in the corresponding FSER (i.e., NUREG-1835).

The staff's technical evaluation of this subsection is limited to reviewing: (1) the resolution of COL Item NAPS COL 2.3-3, (2) the resolution of COL Action Item NAPS ESP COL 2.3-3, (3) variance NAPS ESP VAR 2.0-1 (Long-Term Dispersion Value (D/Q) Estimate), and (4) whether the North Anna 3 long-term atmospheric dispersion and deposition site characteristics fall within the ESBWR DCD long-term atmospheric dispersion and deposition site parameter values.

Atmospheric Dispersion Model

The COL applicant used the NRC-sponsored computer code XOQDOQ (described in NUREG/CR-2919, "XOQDOQ Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations") to estimate χ/Q and D/Q values resulting from routine releases. The XOQDOQ model implements the constant mean wind direction model methodology outlined in RG 1.111, Revision 1.

The XOQDOQ model is a straight-line Gaussian plume model based on the theoretical assumption that material released to the atmosphere will be normally distributed (Gaussian) about the plume centerline. In predictions of χ/Q and D/Q values for long time periods (i.e., annual averages), the plume's horizontal distribution is assumed to be evenly distributed within the downwind direction sector (e.g., "sector averaging"). A straight-line trajectory is assumed between the release point and all receptors.

Release Characteristics and Receptors

The COL applicant modeled two ground-level release points and two mixed-mode release points. Releases from the TB and the RB assumed a minimum building cross-sectional area of 3,098 m^2, a building height of 46.1 m, and release heights of 71.3 m (TB) and 52.77 m (RB). Releases from the RW assume a building minimum building cross-sectional area of 3,098 m^2, a building height of 46.1 m, and a release height of 0.0 m. Releases from the CIRC Cooling Tower assume a height of 0.0 m for both building height and release height and a minimum cross-sectional area of 0.0 m^2. The COL applicant assumed a mixed-mode release for releases from the RB ventilation stack and the TB ventilation stack. Ground-level releases are used to model routine releases from the RW and the CIRC Cooling Tower.

The staff found that the ESBWR DCD assumed a ground-level release for releases from the RW, while mixed-mode releases were considered for releases from the RB/ FB stack and the TB stack based on the criteria set forth in RG 1.111. Revision 8 of the North Anna 3 FSAR stated that the vent stacks on the RB/FB, TB, and RW are all modeled as mixed-mode releases. On September 9, 2014, the staff issued RAI 02.03.05-5, which asked the applicant to update the FSAR to include a justification for modeling the RW vent stack (RW-VS) as a mixed-mode release or update the FSAR to implement the ground-level source configuration guidance provided in RG 1.111 for the RW-VS releases. The applicant submitted a response to RAI 02.03.05-5 on October 17, 2014 (ADAMS Accession No. ML14295A659), which updated the FSAR to reflect the RW-VS source as a ground-level release. The RAI response also updated FSAR Section 2.3.5.1, Table 2.3-16R, Tables 2.3-208 through 2.3-215, and Table 2.0-201. The staff confirmed the applicant's changes to the release point characteristics by comparing the release details against the ESBWR DCD. The staff performed an independent confirmatory analysis of the release sources using the XOQDOQ model and the provided onsite meteorological database. The staff has confirmed the assumptions and revised χ/Q and D/Q values provided in the RAI response. Therefore, the staff considers RAI 02.03.05-5 to be closed. The staff verified that the appropriate changes are incorporated into FSAR Section 2.3.5, Revision 9, and, therefore, Confirmatory Item 2.3.5-1 from the staff's advanced SER for North Anna 3 is resolved and closed. The use of mixed-mode releases and ground-level releases is acceptable to the staff because it follows the guidance provided in RG 1.111, Revision 1, and the methodology used in the ESBWR DCD.

The distance to the receptors of interest (i.e., the EAB, nearest residence, nearest vegetable garden, and nearest meat animal) were presented in North Anna 3 COL FSAR Table 2.3-15R. For the evaluation of each of the receptors (with the exception of the EAB), the COL applicant conservatively assumed that the location of the closest receptor is the distance to each of the receptors. The closest receptor was determined to be a residence in the NW direction at a distance of 1.2 km. Therefore, for the purposes of the atmospheric dispersion calculations, each receptor was assigned a distance of 1.2 km for each radial direction. For releases from the CIRC Cooling Tower, which lies outside of the plant facility boundary, distances from the CIRC Cooling Tower to the EAB in each sector were used to calculate separate χ/Q and D/Q values. Because the COL applicant chose to use the closest distance for each of the receptors, these assumptions are conservative and are therefore acceptable to the staff.

Meteorological Data Input

The meteorological input to XOQDOQ used by the COL applicant consisted of a JFD of wind speed, wind direction, and atmospheric stability based on hourly onsite data from a 3-year period from January 1, 1996 through December 31, 1998. The wind data were obtained from the 10-m level of the onsite meteorological tower, and the stability data were derived from the vertical temperature difference (delta-temperature) measurements taken between the 48.4-m and 10-m levels on the onsite meteorological tower. As discussed in SER Section 2.3.3, the staff considers the January 1, 1996 through December 31, 1998 onsite meteorological database suitable for input to the XOQDOQ model.

Diffusion Parameters

The COL applicant chose to implement the diffusion parameter assumptions outlined in RG 1.111, Revision 1 for the XOQDOQ model runs. The staff evaluated the applicability of the XOQDOQ diffusion parameters and concluded that no unique topographic features preclude the use of the XOQDOQ model for the North Anna 3 site. Therefore, the staff finds that the COL applicant's use of diffusion parameter assumptions, as outlined in RG 1.111, Revision 1 is acceptable.

Resulting Relative Concentration and Relative Deposition Factors

North Anna 3 COL FSAR Table 2.3-16R, "XOQDOQ Predicted Maximum χ/Q and D/Q Values at Specific Points of Interest," lists the maximum long-term atmospheric dispersion and deposition estimates for the special receptors of interest that the COL applicant derived from its XOQDOQ modeling results. North Anna 3 COL FSAR Table 2.3-208 through 2.3-223 lists the COL applicant's long-term atmospheric dispersion and deposition estimates for 16 radial sectors from the site boundary, to a distance of 50 mi from the proposed facility.

The χ/Q values presented in North Anna 3 COL FSAR Table 2.3-16R reflect several plume radioactive decay and deposition scenarios. Section C.3 of RG 1.111, Revision 1 states that radioactive decay and dry deposition should be considered in radiological impact evaluations of potential annual radiation doses to the public, resulting from routine releases of radioactive materials in gaseous effluents. Section C.3.a of RG 1.111, Revision 1 states that an overall half-life of 2.26 days is acceptable for evaluating the radioactive decay of short-lived noble gases and an overall half-life of 8 days is acceptable for evaluating the radioactive decay for all iodine's released to the atmosphere. Definitions for the χ/Q categories listed in the headings of North Anna 3 COL FSAR Table 2.3-16R are as follows:

- Undepleted/No Decay χ/Q values are χ/Q values used to evaluate ground-level concentrations of long-lived noble gases, tritium, and carbon-14. The plume is assumed to travel downwind, without undergoing dry deposition or radioactive decay.

- Undepleted/2.26-Day Decay χ/Q values are χ/Q values used to evaluate ground-level concentrations of short-lived noble gases. The plume is assumed to travel downwind, without undergoing dry deposition, but is decayed, assuming a half-life of 2.26 days, based on the half-life of xenon-133.

- Depleted/8.00-Day Decay χ/Q values are χ/Q values used to evaluate ground-level concentrations of radioiodine and particulates. The plume is assumed to travel downwind, with dry deposition, and is decayed, assuming a half-life of 8.00 days, based on the half-life of iodine-131.

Using the information provided by the COL applicant, including the 10-m level JFDs of wind speed, wind direction, and atmospheric stability presented received during the North Anna 3 ESP SSAR review, the staff confirmed the COL applicant's χ/Q and D/Q values by running the XOQDOQ computer code. Although the staff's χ/Q and D/Q values differed from the COL applicants, the values presented in the North Anna 3 COL FSAR were consistently more conservative than those calculated by the staff. The applicant provided information related to NAPS ESP VAR 2.0-1, which requests the use the North Anna 3 maximum long-term deposition value (D/Q) estimate provided in North Anna 3 FSAR Table 2.3-16R for the maximum annual average meat animal D/Q value in the South direction for releases from the RW ventilation stack rather than the corresponding ESP value in FSER Supplement 1, Appendix A and in ESP SSAR Table 2.3-16. Both the COL applicant and the staff calculated χ/Q and D/Q (including those provided as part of NAPS ESP VAR 2.0-1) values were within bounds of the ESBWR DCD χ/Q and D/Q site parameter values, and are, therefore, acceptable to the staff.

2.3.5.5 Post Combined License Activities

There are no post-COL activities related to this section.

2.3.5.6 Conclusion

The staff reviewed the application including NAPS COL 2.3-3 and checked the referenced DCD and the North Anna 3 ESP SSAR. The staff finds that the COLA includes all the required information relating to long-term diffusion estimates, and the staff confirmed that there is no outstanding information that remains to be addressed in the North Anna 3 COL FSAR related to this subsection. The staff evaluated additional information related to NAPS ESP VAR 2.0-1 as discussed in "Resulting Relative Concentration and Relative Deposition Factors," above. The staff found this information to be correct and acceptable for use in the FSAR. The staff's technical evaluation of the information incorporated by reference to the ESP SSAR related to local meteorology is documented in NUREG-1835.

ESBWR DCD, Section 2.3.6.5 states that a COL applicant shall characterize the atmospheric transport and diffusion conditions necessary for estimating radiological consequences of the routine release of radioactive materials to the atmosphere, and provide realistic estimates of annual average χ/Q values and D/Q values as described in Section 2.3.5 in NUREG-0800. Based on the meteorological data provided by the COL applicant and an atmospheric dispersion model that is appropriate for the characteristics of the site and release points, the staff concludes that representative atmospheric dispersion and deposition factors have been calculated for 16 radial sectors from the site boundary to a distance of 50 mi (80 km), as well as for specific locations of potential receptors of interest. The characterization of atmospheric dispersion and deposition conditions are acceptable to meet the criteria described in RG 1.111, Revision 1 and are appropriate for the evaluation to demonstrate compliance with the numerical guides for doses in Subpart D of 10 CFR Part 20 and Appendix I to 10 CFR Part 50. The staff finds that the COL applicant has provided sufficient information to meet the requirements of the ESBWR DCD.

2.4 <u>Hydrology</u>

This section of the SER addresses the North Anna 3 COL FSAR, Revision 9, site-specific hydrological site parameters and site characteristics identified in Chapter 5 of Tier 1 and Chapter 2 of Tier 2 of the ESBWR DCD, Revision 10.

2.4.1 Hydrologic Description

2.4.1.1 Introduction

The hydrologic description of the nuclear power plant site includes the interface of the plant with the hydrosphere, hydrological causal mechanisms, surface and groundwater uses, hydrologic data, and alternate conceptual models. The review covers the following specific areas: (1) interface of the plant with the hydrosphere including descriptions of site location, major hydrological features in the site vicinity, surface- and groundwater related characteristics, and the proposed water supply to the plant; (2) hydrological causal mechanisms that may require special plant design bases or operating limitations with regard to floods and water supply requirements; (3) current and likely future surface and groundwater uses by the plant and water users in the vicinity of the site that may impact safety of the plant; (4) available spatial and temporal data relevant for the site review; (5) alternate conceptual models of the hydrology of the site that reasonably bound hydrological conditions at the site; (6) potential effects of seismic and nonseismic data on the postulated design bases and how they relate to the hydrology in the vicinity of the site and the site region; and, (7) any additional information requirements prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.1.2 Summary of Application

North Anna 3 COL FSAR Section 2.4.1, "Hydrologic Description," describes the site from the standpoint of hydrologic considerations. This section also provides topographic and regional maps showing proposed changes to the site's natural drainage features and major hydrological features.

The COL applicant addressed the ESBWR DCD and ESP information as follows:

<u>COL Item:</u>

- NAPS COL Item 2.0-12-A — Hydraulic Description, COL Applicant to provide information in accordance with SRP 2.4.1

The COL applicant incorporated by reference ESP SSAR Section 2.4.1 to address COL Item 2.0-12-A.

The COL applicant provided updated site-specific information to supplement ESP SSAR, Section 2.4.1.1, "Site and Facilities," by stating that the design plant grade elevation is 88.39 m (290.0 ft) North American Vertical Datum 1988 (NAVD88) and that the layout will affect a few small wetlands and the upper portion of two small unnamed streams that flow into Lake Anna northwest of the powerblock. In these areas, drainage will be directed into drainage swales and a stormwater management system and then rejoined with the two small streams.

- NAPS ESP COL 2.4-1 Intake and Discharge Tunnels Layout

The NAPS ESP COL 2.4-1 item provides a site-specific layout of intake and discharge tunnels for plant service water (SW) and circulating water systems.

- NAPS ESP COL 2.4-2 Shut Down Water Level

The NAPS ESP COL 2.4-2 item describes the Lake Anna required shutdown water level.

- NAPS ESP COL 2.4-6 UHS Reservoir Design

The NAPS ESP COL 2.4-6 item provides the basis for emergency cooling capability.

- NAPS ESP COL 2.4-7 UHS Storage Basins Sufficient for 30-Day Emergency Cooling Water Needs

The NAPS ESP COL 2.4-7 item provides the North Anna 3 UHS for the passive ESBWR design.

- NAPS ESP COL 2.4-8 Use of Lake Anna or the Waste Heat Treatment Facility (WHTF) for Safety-Related Water Withdrawals

The NAPS ESP COL 2.4-8 item describes that the Isolation Condenser/Passive Containment Cooling System (IC/PCCS) pools have their own water in place during North Anna 3 operation for safety-related cooling in the event that use of the UHS is required.

Early Site Permit Condition:

ESP Permit Condition 3.E(2), Second New Unit Shall Use A Dry Cooling System.

Early Site Permit Variance:

The following variances from the ESP SSAR is discussed in Section 2, “Variances,” of Part 7 to the COLA:

- NAPS ESP VAR 2.4-4 Lake Level Increase

The COL applicant requested VAR 2.4-4 to the ESP SSAR to use a higher value for the normal elevation of Lake Anna. The COL applicant supplemented ESP SSAR Section 2.4.1.3, “Existing and Proposed Water Control Structures,” by stating that, with the addition of North Anna 3, the normal pool elevation will be increased by 7.6 cm (3 in) to a level of 76.01 m (249.39 ft) NAVD88.

In addition, the COL applicant supplemented North Anna 3 COL FSAR Section 2.4.1 with a statement that the flood surcharge capacity of Lake Anna is 4.50 m (14.75 ft) above the normal pool elevation and included information on Lake Anna storage allocations in North Anna 3 COL FSAR Table 2.4-1R.

- NAPS ESP VAR 2.0-7 Coordinates/Removal of abandoned mat foundations

This variance is discussed in the Variances Section of the Departures Report (Part 7) of the COLA and contains two parts as discussed below:

The COL applicant requested a variance from one of the coordinate systems that define the "ESP Plant Parameter Envelope" shown in the ESP, Appendix A, Figure 1 which lists the coordinates of the site in State NAD 83 South Zone, as well as in the North Anna 3 site Grid coordinates. In the variance, the COL applicant requested to use the values given in North Anna 3 COL FSAR Figure 2.0-205 as "COORDINATES (STATE PLANE NAD 83 VA SOUTH ZONE)," to replace those in the ESP given as "Coordinates (State NAD 83 South Zone)." The review of this part of the variance (site Grid coordinates) request is discussed below.

The COL applicant in addition requested a variance from ESP, Appendix A, Figure 1, Note 2, which states, "Abandoned Unit 3 and 4 Reactor Building Mat Foundations are to be removed." The applicant requests to not remove the abandoned mat foundations for the originally planned North Anna Units 3 and 4 unless a Unit 3 Seismic Category I or II structure would be located above an abandoned foundation. The review of this part of the variance request is discussed above in Section 2.0.

2.4.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835 the FSER related to the North Anna 3 ESP. In addition, guidance relevant to the Commission's regulations for the hydrologic descriptions, and the associated acceptance criteria, with the relevant requirements of the NRC regulations for site hydrology are described in Section 2.4.1 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 site hydrologic information presented in the FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item 2.0-12-A and NAPS ESP VAR 2.4-4), are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

The hydrological information assembled in compliance with the above regulatory requirements are necessary to determine a proposed facility's compliance with the following requirements in Appendix A of 10 CFR Part 50:

- GDC 2, which requires that SSCs important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

The related acceptance criteria from Section 2.4.1 of NUREG-0800 SRP are as follows:

- Interface of the Plant with the Hydrosphere: The application should provide a description of hydrology in the vicinity of the site and site regions and of how the plant interfaces with the hydrosphere.

- Hydrological Causal Mechanisms: The application should provide a description of hydrological causal mechanisms that affect the safety of the plant.

- Surface and Ground Water Uses: The application should provide a description of surface and ground water uses in the vicinity of the site that affect the safety related water supply to the plant.

- Data: The application should provide a complete description of all spatial and temporal datasets used by the applicant in support of its conclusions regarding safety of the plant.

- Alternate Conceptual Models: The application should provide a description of alternate conceptual models of site hydrology.

- Consideration of Other Site-Related Evaluation Criteria: The application should demonstrate that the potential effects of site-related proximity and of seismic and non-seismic information as they relate to hydrologic description in the vicinity of the proposed plant site and site regions are appropriately taken into account.

The description of hydrologic characteristics should correspond to those of the United States Geological Survey (USGS), Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), or appropriate State and river basin agencies.

In addition, the hydrologic characteristics should be consistent with appropriate sections from: RG 1.27, RG 1.29, “Seismic Design Classification,” RG 1.59, “Flood Design Basis for Nuclear Power Plants,” as supplemented by best current practices, and RG 1.102, “Flood Protection for Nuclear Power Plants.”

2.4.1.4 Technical Evaluation

As documented in Section 2.4.1 of NUREG-1966 and Section 2.4.1 of NUREG-1835, the staff reviewed and approved information related to hydrologic description for the certified ESBWR DCD, Revision 10, and Section 2.4.1 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.1 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic. The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to “Hydrologic Description.”

The staff’s review of the additional information and ESP variances contained in the North Anna 3 COL FSAR is as follows.

The staff’s technical review of this application includes the supplemental information pertaining to NAPS COL 2.0-12-A and NAPS ESP VAR 2.4-4. This review also includes staff evaluation of additional items discussed in the ESP and the North Anna 3 COL FSAR, as described below.

COL Items:

- NAPS COL 2.0-12-A Hydraulic Description

The COL applicant's updated design plant grade elevation for North Anna 3 is 88.39 m (290.0 ft) NAVD88 which is 6.36 m (20.86 ft) above the flood elevation site characteristic (82.03 m [269.14 ft] NAVD88). The COL applicant provided North Anna 3 COL FSAR Figure 2.1-201 showing the layout of the external structures and components of North Anna 3.

The COL applicant stated that small changes to natural drainage features would be required to accommodate North Anna 3, including a few small wetlands and the upper ends of two intermittent streams that discharge to Lake Anna. Drainage from filled areas will be directed into swales before entering the streams. North Anna 3 COL FSAR Section 2.4.2.3 discusses drainage during the local probable maximum precipitation (PMP). The staff finds that the additional information is consistent with the information in the ESP SSAR, which has already been accepted by the staff as documented in the North Anna ESP FSER (NUREG-1835).

- NAPS ESP COL 2.4-1 Intake and Discharge Tunnels Layout

ESP COL Action Item 2.4-1 considers the layout of intake and discharge tunnels for plant SW and circulating water systems. North Anna 3 COL FSAR Section 1.12 discusses hazards to existing units from construction, and it is stated that piping plans for intake and discharge structures will be provided to NRC 60 days prior to construction of the piping.

Based on the description of the UHS in ESBWR DCD Section 9.2.5 and North Anna 3 COL FSAR Section 9.2.5, staff have determined that intake and discharge piping does not provide safety-related functions. The maximum flood and the maximum groundwater elevations are below the ESBWR DCD site parameters for hydrologic characteristics; therefore, ESP COL Action Item 2.4-1 is considered closed.

- NAPS ESP COL 2.4-2 Shut Down Water Level

Although Appendix C of the North Anna ESP discusses Action Item 2.4-2 in ESP FSER Section 2.4.1, the COL applicant chose to discuss this item in North Anna 3 COL FSAR Section 2.4.14. This report follows the North Anna 3 COL FSAR convention, and staff's review of NAPS ESP COL 2.4-2 can be found in Section 2.4.14.

- NAPS ESP COL 2.4-6 UHS Reservoir Design

- NAPS ESP COL 2.4-7 UHS Storage Basins Sufficient for 30-Day Emergency Cooling Water Needs

- NAPS ESP COL 2.4-8 Use of Lake Anna or the Waste Heat Treatment Facility (WHTF) for Safety-Related Water Withdrawals

ESBWR DCD Section 9.2.5 and North Anna 3 COL FSAR Section 9.2.5 describe the UHS. The UHS is provided by the IC/PCCS pools, with makeup from the equipment storage pool and Reactor Well sufficient during the initial 72 hours of an accident. ESBWR DCD Section 9.2.5 states that a separate safety-related reservoir is not required. The Fire Protection System, described in ESBWR Section 9.5.1, provides onsite makeup to the UHS from 72 hours to 7 days through a connection to safety-related components of the Fuel and Auxiliary Pools Cooling System, described in ESBWR DCD Section 9.1.3. ESBWR DCD Section 9.2.5 states that the makeup water source beyond 7 days post-accident is not required to be safety-related.

The COL applicant supplemented North Anna 3 COL FSAR Section 2.4.8 to state that Lake Anna and the WHTF are not used for safety-related cooling.

Based on the description of the UHS, staff have determined that no underground reservoirs are included in the design of the ESBWR UHS and no external source of safety-related makeup water is required for the UHS. Accordingly, ESP COL Action Items 2.4-6, 2.4-7, and 2.4-8 are considered closed.

Early Site Permit Condition:

- ESP Permit Condition 3.E(2) Second New Unit Shall Use A Dry Cooling System

In North Anna 3 COL FSAR Table 1.10-202, the COL applicant states that Permit Condition 3 is not applicable to North Anna 3.

The North Anna 3 COL FSAR describes the construction of a single new unit. Therefore, ESP Permit 3.E(2), which states that a second new unit shall use a dry cooling tower system to remove waste heat from the working fluid passed through the turbine/generator set during normal operations, does not apply to this licensing action.

Early Site Permit Variance:

- NAPS ESP VAR 2.4-4 Lake Level Increase

With the addition of North Anna 3, the normal pool elevation is to be held at 76.01 m (249.39 ft) NAVD88, which is 0.08 m (0.25 ft) higher than prior to the addition of North Anna 3. The higher water level is to improve water availability to downstream users during drought conditions. The COL applicant analyzed the effect of the lake level increase on the maximum elevation from the probable maximum flood (PMF) in North Anna 3 COL FSAR Section 2.4.3 and the effect on water balance and minimum water level in North Anna 3 COL FSAR Section 2.4.11. The staff's review of NAPS ESP VAR 2.4-4 can be found in those sections.

- NAPS ESP VAR 2.0-7 Coordinates/Removal of abandoned mat foundations

The COL applicant requested a variance from one of the coordinate systems presented in the ESP, Appendix A, Figure 1 which lists the coordinates of the site in State NAD 83 South Zone as well as in the North Anna 3 Grid coordinates. In the variance, the COL applicant stated that there is an error associated with the coordinates of the proposed facility boundaries, which are coordinated of the eight points that define "ESP Plant Parameter Envelope." The applicant requested to use the values given in North Anna 3 COL FSAR Figure 2.0-205 as "COORDINATES (STATE PLANE NAD 83 VA SOUTH ZONE)," to replace those in the ESP given as "Coordinates (State NAD 83 South Zone)." The coordinates provided in the North Anna Grid coordinates in the ESP, Appendix A, Figure 1 remained unchanged; therefore, this variance request corrects an administrative error and is acceptable.

The COL applicant requested a variance from ESP, Appendix A, Figure 1, Note 2 that states, “Abandoned Unit 3 and 4 Reactor Building Mat Foundations are to be removed.” The applicant requests to not remove the abandoned mat foundations for the originally planned North Anna Units 3 and 4 unless a Unit 3 Seismic Category I or II structure would be located above on an abandoned foundations. The review of this part of the variance request is discussed above in Section 2.0.

2.4.1.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.1.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff’s review confirmed that the COL applicant has addressed the relevant information and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.1 of NUREG–0800, and NRC RGs. The staff’s review concludes that the applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed NAPS COL 2.0-12-A as it relates to the hydrologic description.

As set forth above, the COL applicant has presented and substantiated information relative to the hydrologic description in the vicinity of the site and site regions important to the design and siting of this plant. The staff reviewed the available information provided. For the reasons given above, the staff concluded that the identification and consideration of the hydrology in the vicinity of the site and site regions are acceptable and meet the requirements of GDC 2, 10 CFR Part 50, 10 CFR 52.79, and 10 CFR 100.20(c), with respect to determining the acceptability of the site for the ESBWR design.

The staff finds that the COL applicant has considered the appropriate site phenomena for establishing the design bases for SSCs important to safety. The staff accepted the methodologies used to determine the hydrologic description in the vicinity of the site and site regions reflected in site characteristics documented in the ESP FSER. Accordingly, the staff concluded that the use of these methodologies results in site characteristics containing sufficient margins for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concluded that the identified site characteristics meet the requirements of 10 CFR 52.79 and 10 CFR 100.20(c), with respect to establishing the design basis for SSCs important to safety.

2.4.2 Floods

2.4.2.1 Introduction

This section discusses the historical flooding at the proposed site or in the region of the site. The information summarizes and identifies the individual types of flood-producing phenomena, and combinations of flood-producing phenomena, considered in establishing the flood design bases for safety-related plant features. The discussion also covers the potential effects of local intense precipitation. The flood history and the potential for flooding are reviewed for the sources and events described below. Factors affecting potential runoff (such as urbanization, forest fire, changes in agricultural use, erosion, and sediment deposition) are considered in the review. In addition to describing flood history, this section also determines the local intense precipitation on the site used to estimate localized flooding and sheet flow. Local intense precipitation is reported as a site characteristic used in site grading design.

2.4.2.2 Summary of Application

North Anna 3 COL FSAR, Revision 9, Section 2.4.2, "Floods," describes the site from the standpoint of flooding considerations.

The COL applicant addressed the ESBWR DCD and ESP information as follows:

COL Items:

- NAPS COL Item 2.0-13-A — Floods, COL Applicant to provide information in accordance with SRP 2.4.2

The COL applicant incorporated by reference ESP SSAR Section 2.4.2 to address NAPS COL 2.0-13-A. The COL applicant also supplemented the site-specific information of ESP SSAR Section 2.4.2.2, "Flood Design Consideration," indicating that the design plant grade elevation of 89.39 m (290 ft) NAVD88 for safety-related SSCs is below the localized sheet flow levels at specific locations of the site due to the local intense precipitation event. As indicated in the discussion in SER Section 2.4.2, the staff issued RAI 02.04.02-8 (ADAMS Accession Number No. ML110970719) dated April 07, 2011, and RAI 02.04.02-10 through 02.04.02-15 dated December 11, 2014 (ADAMS Accession No. ML14345B075), which asked for clarification of the design sheet flow levels due to the local precipitation event. The applicant's response (ADAMS Accession Nos. ML11124A154, ML15022A199, and ML16229A451) dated May 03, 2011, January 19, 2015, and June 12, 2015, respectively, stated that the local PMP sheet flow flood elevation is above the plant grade elevation in three specific areas of the site. As detailed in SER Section 2.4.10, the applicant committed to providing flood protection features for the impacted site areas.

- NAPS ESP COL 2.4-3

Appendix C of the North Anna ESP states that NAPS ESP COL 2.4-3 is not used. Therefore, a sequential gap exists between NAPS ESP COL 2.4-2, which is discussed in North Anna 3 COL FSAR Section 2.4.14, and NAPS ESP COL 2.4-4, which is discussed in North Anna 3 COL FSAR Section 2.4.2.

- NAPS ESP COL 2.4-4 and 2.4-5

The COL applicant provided updated site-specific information to supplement ESP SSAR Section 2.4.2.3, "Effects of Local Intense Precipitation," to address ESP COL Action Items 2.4-4 and 2.4-5. The applicant provided four figures, with the first (North Anna 3 COL FSAR Figure 2.4-201) showing the site layout and sub-basin drainage areas, the second (North Anna 3 COL FSAR Figure 2.4-202) showing the site's PMP duration-intensity curve, the third (North Anna 3 COL FSAR Figure 2.4-203) showing the location of ditch cross sections used for the HEC-RAS model analysis (ADAMS Accession No. ML16229A451), and the fourth (North Anna 3 COL FSAR Figure 2.4-221) showing the location of supercritical flow and hydraulic jumps from the HEC-RAS model analysis.

2.4.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, guidance relevant to the Commission's regulations for flooding descriptions, and the associated acceptance criteria, with the relevant requirements of the NRC regulations are described in Section 2.4.2 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 site floods information presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Items 2.0-13-A, and NAPS ESP COL 2.4-3, 2.4-4 and 2.4-5), are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

The following related acceptance criteria are summarized from SRP Section 2.4.2:

Local Flooding on the Site and Drainage Design: The application should include an estimate of local intense precipitation or local PMP and a determination of the capacity of site drainage facilities (including drainage from the roofs of buildings and site ponding).

- Stream Flooding: The application should include documentation of the potential sources of flood and flood response characteristics.

- Surges: The application should include the complete history of storm surges in the vicinity of the site.

- Seiches: The application should include the complete history of seiches in the vicinity of the site.

- Tsunami: The application should include the complete history of tsunami in the vicinity of the site.

- Seismically Induced Dam Failures (or Breaches): The application should include the flooding hazard at the plant site resulting from seismically induced dam failure upstream of the site location.

- Flooding Caused by Landslides: The application should include the flooding hazard at the plant site from flood waves induced by landslides and backwater effects due to stream blockage from landslides.

- Effects of Ice Formation in Water Bodies: The application should include information concerning potential flooding at the plant site due to flood waves resulting from the collapse of an ice dam or backwater effects due to stream blockage due to an ice dam or an ice jam downstream of the plant site.

- Combined Events Criteria: The application should include information concerning design basis flooding at the plant site, including consideration of appropriate combinations of individual flooding mechanisms in addition to the most severe effects from individual mechanisms themselves.

- Consideration of Other Site-Related Evaluation Criteria: The application should demonstrate that the potential effects of site-related proximity, seismic, and nonseismic information as they relate to hydrologic description in the vicinity of the proposed plant site and site regions are appropriately taken into account.

In addition, the hydrologic characteristics should be consistent with appropriate sections in RGs 1.27, 1.29, 1.59, as supplemented by best current practices and in RG 1.102.

2.4.2.4 Technical Evaluation

As documented in Section 2.4.2 of NUREG-1966 and Section 2.4.2 of NUREG-1835, the staff reviewed and approved information related to floods for the certified ESBWR DCD, Revision 10, and Section 2.4.2 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.2 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic. The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Floods."

In addition the staff reviewed Section 2.4.2 of the North Anna 3 COL FSAR, Revision 9, related to flood history, flood design, and the effects of the PMP as follows:

COL Items:

- NAPS COL 2.0-13-A Floods

The staff reviewed the resolution to NAPS COL 2.0-13-A, related to historical flooding at the proposed site or in the region of the site, and included in North Anna 3 COL FSAR Section 2.4.2. The staff's technical review of this application was limited to reviewing the supplemental information pertaining to NAPS COL 2.0-13-A and ESP COL Action Items 2.4-4 and 2.4-5, as addressed below:

The staff reviewed the North Anna 3 COL FSAR, Revision 9, the applicant's responses to RAI 02.04.02-10 through 02.04.02-15, and checked the referenced ESP SSAR. The staff's review confirmed that the information contained in the application and in the responses to RAIs, and incorporated by reference addresses the relevant information related to this section. Based on a review of the North Anna 3 site grading plan, the design plant grade elevation is 88.39 m (290.0 ft) NAVD88. As discussed in the ESP FSER, the flooding site characteristic is produced by the PMF in Lake Anna's watershed, the simultaneous failure of upstream storage reservoirs, and coincident wave action, which produces a water surface elevation of 82.03 m (269.14 ft) NAVD88. However, for the North Anna 3 COLA, the applicant provided supplemental information from the analysis of local intense precipitation that produces localized sheet flow levels that are above site grade. According to the COL applicant's analysis, the sheet flow level resulting from the local intense precipitation is a maximum of 0.15 m (0.5 ft) above the design plant grade.

The staff checked ESP FSER Section 2.4.2.3 and supplemented the ESP safety evaluation with an independent confirmation of the applicant's steady-state HEC-RAS numerical modeling analysis of site drainage during local intense precipitation. The ESBWR DCD site parameter Maximum Flood (or Tsunami) Level is 1 ft below plant grade. The design plant grade elevation is 88.39 m (290.0 ft) NAVD88. As stated above, the maximum sheet flow flood level at the site, during a local intense precipitation event, is 88.54 m (290.5 ft) NAVD88 which is (0.15 m) 0.5 ft above the design plant grade. By definition, sheet flow due to local intense precipitation will always be above plant grade; therefore, the ESBWR DCD site parameter Maximum Flood (or Tsunami) Level does not apply to localized sheet flow. However, local intense precipitation-generated sheet flow is included in determination of the design-basis event and any necessary flood protection as discussed below.

- NAPS ESP COL 2.4-4 and 2.4-5

The COL applicant provided to the staff the input files of the numerical model HEC-RAS that were used to analyze runoff from local intense precipitation for site drainage of North Anna 3 with the ESBWR reactor. HEC-RAS is a numerical model developed by the USACE, Hydrologic Engineering Center (USACE 2010a). The model is widely used within the engineering community and is accepted as a standard engineering-practice tool for the analysis of flooding. Figure 2.4.2-1 shows the site drainage plan provided by the COL applicant in the North Anna 3 COL FSAR and includes additional identifying information. The staff determined that the site drainage plan satisfies the requirements of ESP COL Action Item 2.4-4 and ESP COL Action Item 2.4-5. The staff also reviewed the supplemental information provided in North Anna 3 COL FSAR Section 2.4.2 and the HEC-RAS hydraulic model provided by the COL applicant, and also conducted sensitivity tests on the hydraulic model.

Information Submitted by Applicant:

In North Anna 3 COL FSAR Section 2.4.2.2 the COL applicant provides supplemental information on the local intense precipitation flooding which is reported as being a maximum of 0.15 m (0.5 ft) above the design plant grade of 88.39 m (290.0 ft) NAVD88. In addition to the design plant grade and elevations of safety-related buildings (corresponding to the floor and entrance elevations), the COL applicant stated that the ground level elevations outside the buildings is 88.24 m (289.5 ft) NAVD88.

The site drainage plan consists of three drainage channels (labeled east ditch, south ditch, and west ditch in Figure 2.4.2-1), a stormwater management pond, and an outfall channel. Figure 2.4.2-1 also shows the layout of drainage basins used in the estimation of local intense precipitation-generated runoff. For the analysis of local intense precipitation flooding, the culverts were assumed to be blocked where the ditches passed under the plant access roads. In the HEC-RAS model of the drainage system, the roads crossing the ditches were treated as broad-crested weirs. As noted in Figure 2.4.2-1, these weirs are located in the south and west ditches. The east ditch has no weirs. Figure 2.4.2-2 shows the layout of HEC-RAS cross sections with respect to the ditches, stormwater management pond, and outfall channel. Figure 2.4.2-2 also shows the locations of blocked culverts, which were simulated as inline weirs.

Because channel linings consist of rip-rap (stone used for erosion protection), the COL applicant set up the HEC-RAS hydraulic model using Manning's roughness values of 0.035 for all cross sections. The COL applicant generally used a contraction coefficient of 0.1 and an expansion coefficient of 0.3 for most cross sections, which assume a gradual transition between adjacent cross sections. However, for cross sections 900 in the east ditch, 500, 390, and 100 in the outfall, and 490 to 195 in the south ditch (Figure 2.4.2-2), the COL applicant used a contraction coefficient of 0.3 and an expansion coefficient of 0.5. The COL applicant did not explain how these values were determined. Therefore, in RAI 02.04.02-13, the staff requested that the COL applicant provide a description of the basis for selection of expansion and contraction coefficients. The COL applicant's response dated January 19, 2015 (ADAMS Accession No. ML15022A199), and the staff's independent confirmatory evaluation are described in the staff's technical evaluation section of this SER below.

The staff found in its examination of the HEC-RAS input files provided by the COL applicant that the downstream boundary condition assigned by the COL applicant to the HEC-RAS model was the water surface elevation of Lake Anna, which the COL applicant assigned a constant elevation of 80.77 m (265 ft) NAVD88.

The precipitation intensity used by the COL applicant for the local intense precipitation analysis was taken from ESP SSAR Table 2.4.3, which is shown in Table 2.4.2-1. The COL applicant divided the drainage area into subbasin areas (Table 2.4.2-2) for use in estimating precipitation runoff and distribution of runoff to the drainage channel system.

Table 2.4.2-1 Local intense precipitation depths for durations less than 6 hours and over a 2.59-km^2 (1-mi^2) area. (Derived from ESP SSAR Table 2.4-3)

Duration	Precipitation Depth (in)	Precipitation Depth (cm)
6-hr	27.9	70.9
1-hr	18.3	46.5
30-min	13.7	34.8
15-min	9.6	24.4
5-min	6.1	15.5

The COL applicant estimated discharge from local intense precipitation using the rational method, combined with the areas of the drainage basins and assumptions about the runoff coefficient (representing precipitation infiltration). The COL applicant's subbasin areas were provided in Table 2.4.2-2. The COL applicant assumed that vegetated areas have a runoff coefficient of 0.9 and that other areas have a runoff coefficient of 1.0, reflecting their imperviousness resulting in composite runoff coefficients ranging from 0.93 to 1.0. The COL applicant computed the time of concentration of a subbasin to determine the appropriate rainfall intensity for use in calculating subbasin discharges from local intense precipitation. The COL applicant estimated the time of concentration for each of the subbasins using the methods of the US Natural Resource Conservation Service (1986). To account for non-linear response to large storms, the COL applicant also included a 25 percent reduction of the times of concentration based on guidance from USACE (1994). Table 2.4.2-1 provided the duration-intensity data for local intense precipitation at the North Anna 3 site. Table 2.4.2-2 provided characteristics of the subbasins provided by the COL applicant including the cumulative drainage area along each reach, the runoff coefficients, the times of concentration, the precipitation intensities corresponding to the times of concentration, and the discharge estimates for cumulative drainage areas. Generally, the times of concentration and discharges increased with increasing cumulative drainage area. The COL applicant-provided information supplemental to the North Anna 3 COL FSAR provided detail of the methods used to calculate the time of concentration, precipitation intensity, and runoff. However, the staff determined that the North Anna 3 COL FSAR contained little discussion of the methods and results for computation of subbasin discharges. Therefore, in RAI 02.04.02-11, the staff requested that the COL applicant provide a description of the estimation of subbasin discharges including the estimation of flow type lengths, Manning's roughness coefficients, and times of concentration. The COL applicant's response dated January 19, 2015 (ADAMS Accession No. ML15022A199), and the staff's evaluation are described in the staff's technical evaluation section below.

Table 2.4.2-2. Subbasin characteristics used to estimate discharge during the local intense precipitation. (Derived from COL FSAR Tables 2.4-201, 2.4-202, and 2.4-203.)

Subbasin	Areas m^2 (ft^2)	Contributing Subbasins	Cumulative Area ha (ac)	Runoff Coefficient	Time of Concentration (min)	Precipitation Intensity cm/hr (in/hr)	Discharge m^3/s (cfs)
B	35,193 (378,813)	All	24.38 (60.24)	0.98	20.4	31.7	52.99 (1871.4)
W1	35,513 (382,258)	W1,W2,W3,S1,S2	13.59 (33.58)	0.98	20.4	31.7	29.54 (1043.2)
W2	27,129 (292,011)	W2,W3,S1,S2	10.04 (24.81)	0.97	19.8	32.0	21.81 (770.1)
W3	45,388 (488,556)	W3	4.54 (11.22)	0.93	11.2	48.0	14.18 (500.9)
S1	8,367 (90,065)	S1,S2	2.79 (6.89)	1.00	17.4	34.5	6.73 (237.7)
S2	19,524 (210,152)	S2	1.95 (4.82)	1.00	14.8	39.0	5.32 (188.0)
E1	23,820 (256,391)	E1,E2,E3	5.29 (13.08)	0.99	8.1	49.0	17.97 (634.5)
E2	16,261 (175,035)	E2,E3	2.91 (7.19)	1.00	7.2	65.5	13.33 (470.9)
E3	12,822 (138,011)	E3	1.28 (3.17)	1.00	6.2	68.5	6.15 (217.1)
U1&2	19,754 (212,630)	N/A	N/A	N/A	N/A	N/A	N/A

N/A – not available

According to the COL applicant's HEC-RAS model analysis, the highest predicted water surface elevation of 89.70 m (294.3 ft) NAVD88 occurred at the upstream end of the west ditch (ADAMS Accession No. ML16229A451). However, this portion of the west ditch is upstream of the powerblock, and it is tributary to the drainage system surrounding the powerblock (Figure 2.4.2-1). In the drainage channels surrounding the powerblock, the highest predicted water surface elevations occurred at the upstream ends of the south and east ditches. These computed water surface elevations were 87.92 m (288.45 ft) NAVD88 (south ditch) and 87.84 m (288.2 ft) NAVD88 (east ditch) and were on opposite sides of the Administration Building (Figure 2.4.2-1). Consequently, the maximum water surface elevation computed by the COL applicant in the site drainage ditches adjacent to the powerblock was in the south ditch. Note that in the North Anna 3 COL FSAR, the COL applicant rounded the water surface elevations to one-tenth of a foot and reported the maximum elevation as 87.90 m (288.4 ft) NAVD88, 0.18 m (0.6 ft) below the North Anna 3 ESBWR DCD's Maximum Flood (or Tsunami) Level site parameter value of 88.09 m (289.0 ft) NAVD88 (North Anna 3 COL FSAR Table 2.0-1).

The COL applicant assumed that the roads crossing the west and south ditches and the outfall from the stormwater management pond were completely blocked and functioned as weirs during the flooding from local intense precipitation (Figures 2.4.2-1 and 2.4.2-2). As found in the COL applicant's HEC-RAS input files, inline weirs were designated as broad-crested weirs with discharge coefficients specified as either 2.6 or 2.4. Because the COL applicant did not provide a justification for choosing the lower of these two discharge coefficient values, in RAI 02.04.02-14, the staff requested that the COL applicant provide a discussion of the basis for selecting weir discharge coefficients. The COL applicant's response dated January 19, 2015 (ADAMS Accession No. ML15022A199), and the staff's evaluation are described in the staff's technical evaluation section below in this SER.

According to North Anna 3 COL FSAR, Revision 9, Figures 2.4-201 and 2.4-203, the discharge from the west ditch was combined with the outflow from the stormwater management pond. However, according to the geometry of the HEC-RAS model provided by the COL applicant, the staff discovered that the discharge from the west ditch entered the stormwater management pond. Therefore, in RAI 02.04.02-12, the staff requested that the COL applicant provide an explanation for the disagreement between the North Anna 3 COL FSAR figures and the HEC-RAS input files and any necessary corrections. The COL applicant's response dated January 19, 2015 (ADAMS Accession No. ML15022A199), and the staff's evaluation are described in the staff's technical evaluation section below in this SER.

A drainage divide is located between the North Anna 3 stormwater management pond and the existing Unit 2 site at an elevation of 82.91 m (272.0 ft) NAVD88. As indicated in Figure 2.4.2-1, the stormwater management pond received flow from the east and west ditches. Discharge was routed from the stormwater management pond by overtopping the main access road, which was simulated in the HEC-RAS model as a broad-crested weir. The maximum water surface elevation computed by the COL applicant in the stormwater management pond was 82.84 m (271.8 ft) NAVD88 resulting in a freeboard of 0.06 m (0.2 ft). The COL applicant concluded that flows in North Anna 3 site would not affect the existing Units 1 and 2. Although the staff found references to Subbasin U1&2 in North Anna 3 COL FSAR Tables 2.4-201 and 2.4-202 (Table 2.4.2-2), the COL applicant did not adequately explain how Subbasin U1&2 derived flow from the existing Units 1 and 2 area. In RAI 02.04.02-10, the staff requested that the COL applicant provide additional details regarding how the rational method was applied to estimate peak discharges, particularly from Subbasin U1&2 (ML14345B075). The COL applicant's response dated January 19, 2015 (ADAMS Accession No. ML15022A199), and the staff's evaluation are described in the staff's technical evaluation section below in this SER.

Based on the staff's examination of the COL applicant's HEC-RAS analysis results, supercritical flow was found to occur in the east and west ditches during flooding from local intense precipitation. In these locations, the water velocities ranged from 2.1 m/s (7.0 fps) to 4.5 m/s (14.7 fps) with Figure 2.4.2-3 showing the locations of supercritical flow based on the HEC-RAS analysis. In North Anna 3 COL FSAR Section 2.4.2.3, the COL applicant stated that:

- The locations where supercritical flow regimes were predicted to occur would be protected against possible erosive forces arising from large velocities and potential hydraulic jumps using linings and hardened surface protections;

- Grading near safety-related SSCs will slope away from the structures so that ground and roof runoff during a local intense precipitation event will sheet flow towards drainage ditches;

- During the construction phase for North Anna 3, the construction and as-built drawings will be checked against site topography, surface type, and channel linings that were used for the for local intense precipitation analysis and the associated HEC-RAS modeling;

- During operation of North Anna 3 the drainage system will be monitored to ensure consistency with the assumptions used in the flood analysis for local intense precipitation and associated HEC-RAS modeling analysis;

- Drainage facilities will be inspected during construction at least once every two weeks; and

- Site inspections will be done quarterly to inspect areas with erosion potential.

During review of the COL applicant's local intense precipitation flood analysis, the staff noted that the COL applicant analyzed runoff from building roofs in the powerblock area as sheet flow. The staff located additional details of the analysis in the COL applicant's Calculation Package 25161-G-012. From the information provided by the COL applicant on the sheet flow analysis, the staff could not determine how the COL applicant partitioned roof runoff from adjacent roofs and direct precipitation in passageways between safety-related buildings. It was also unclear to the staff if the COL applicant's approach to sheet flow analysis was consistent with guidance provided in ANSI/ANS-2.8-1992, Section 11.4 (ANS 1992). Therefore, in RAI 02.04.02-15, the staff requested that the COL applicant provide: (1) a discussion of the effects of roof drainage and direct precipitation during local intense precipitation on flood water surface elevations along passageways between buildings and structures important for safety; (2) a comparison of these flood water surface elevations or depths to the elevations of any penetrations or openings housing safety-related SSCs; and, (3) an update to the FSAR to include this information. The COL applicant's responses dated January 19, 2015 and June 12, 2015 (ADAMS Accession Nos. ML15022A199 and ML16229A451, respectively), as well as the staff's evaluation are described in the staff's technical evaluation section below in this SER.

In response to staff's RAI 02.04.02-10 through 02.04.02-15, the COL applicant proposed updating the North Anna 3 COL FSAR in a future revision (ADAMS Accession Nos. ML15022A199 and ML16229A451). The staff verified that the appropriate updates are incorporated into the FSAR, Revision 9, and, therefore Confirmatory Items 2.4.2-1 to 2.4.2-6 from the staff's advanced SER for North Anna 3 are resolved and closed.

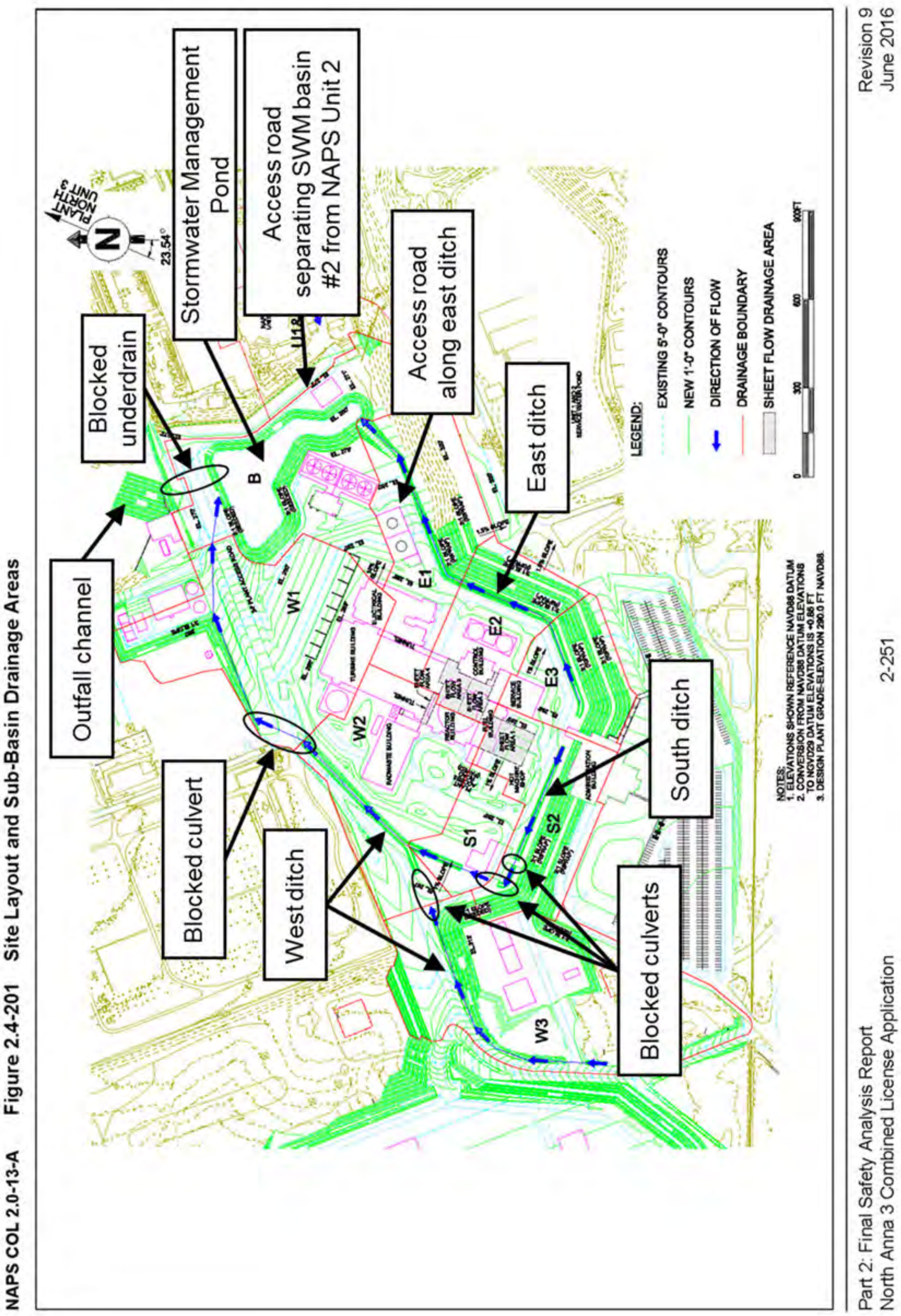

Figure 2.4.2-1. Site map with locations of drainage basins and primary hydraulic features of the drainage system flooding analysis from local intense precipitation (after North Anna 3 COL FSAR Figure 2.4-201)

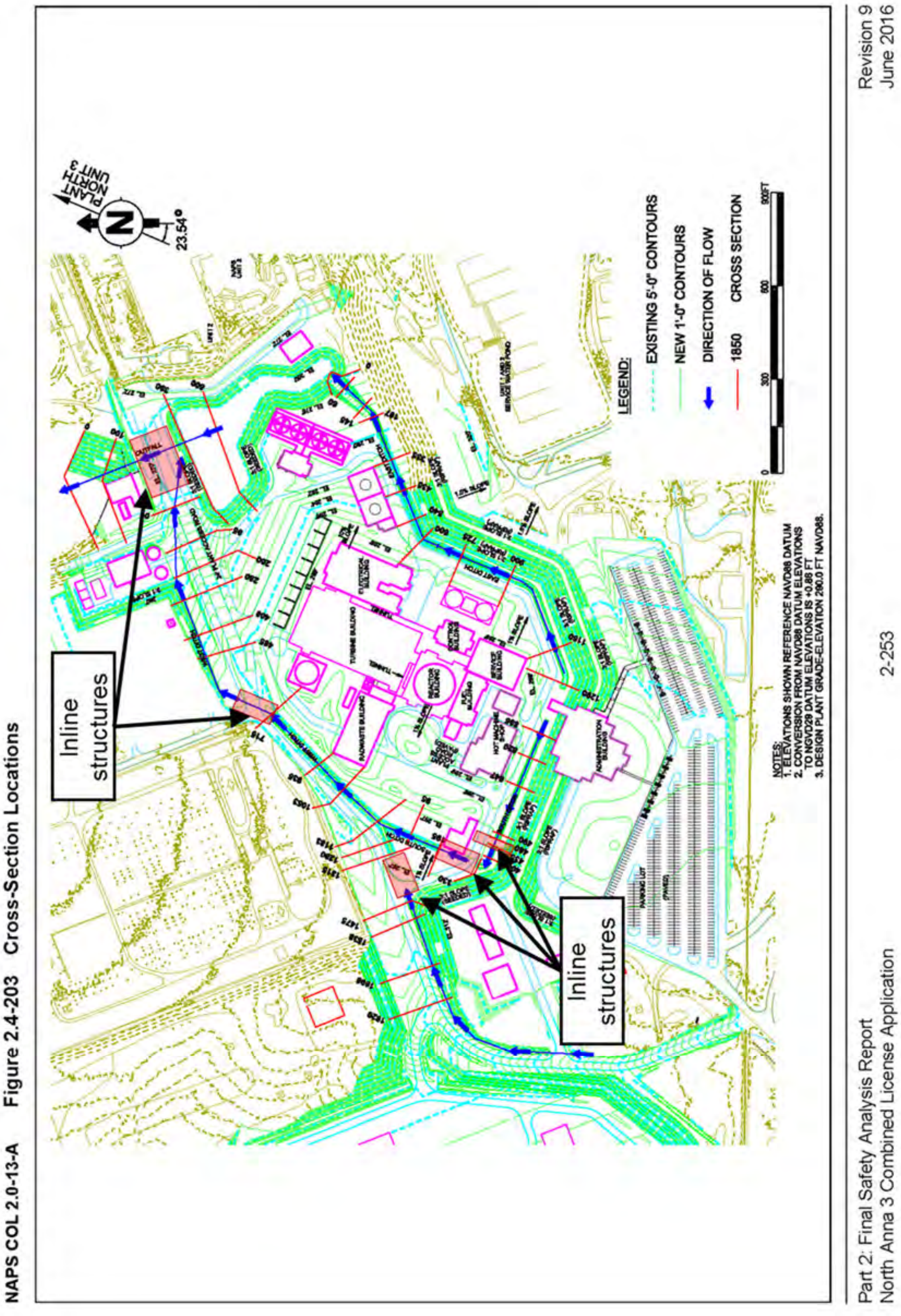

Figure 2.4.2-2. Site map with locations of the inline control structures that correspond to blocked culverts (after North Anna 3 COL FSAR Figure 2.4-203)

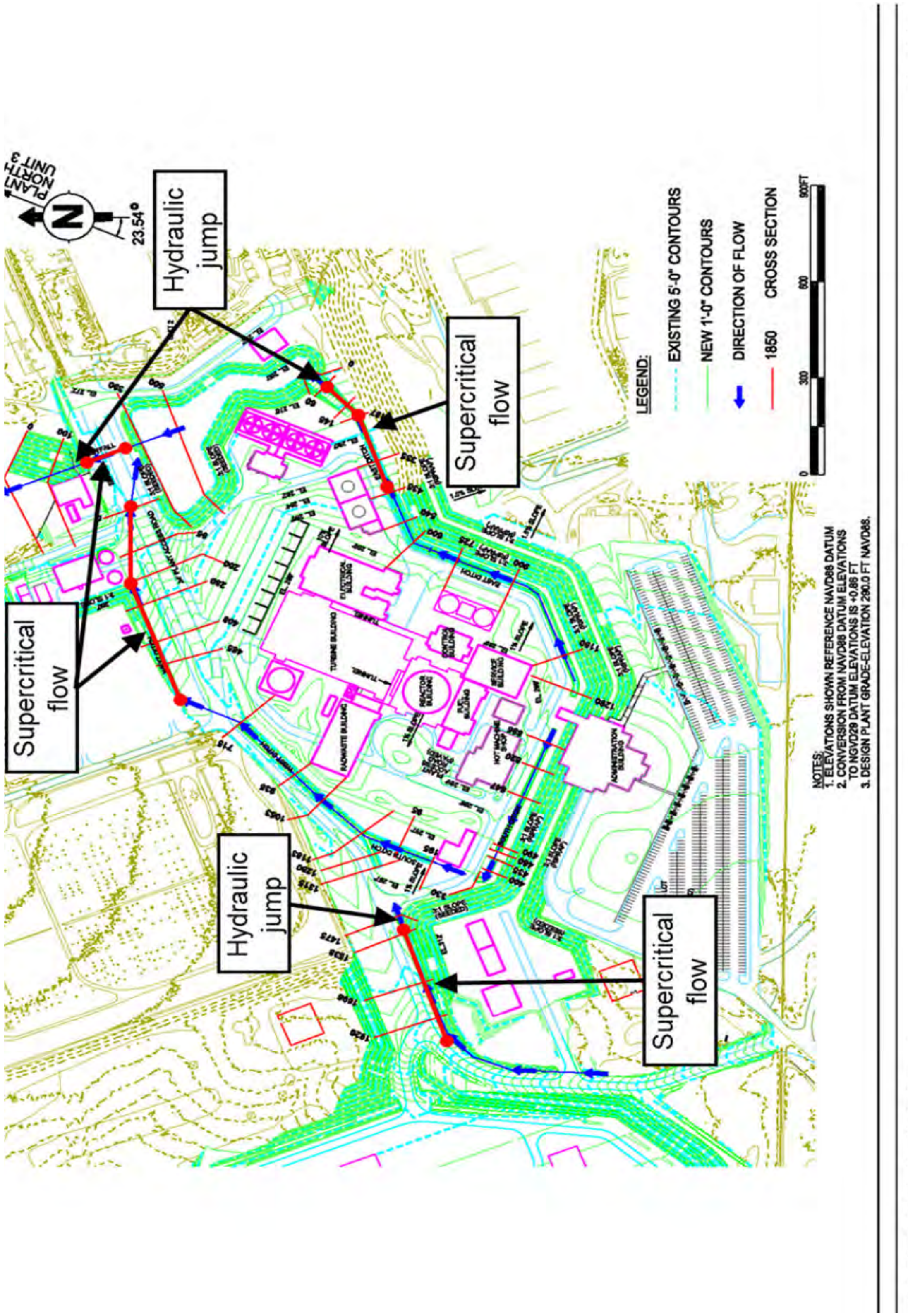

Figure 2.4.2-3. Site map with locations of supercritical flow and of hydraulic jumps from the applicant's HEC-RAS model and North Anna 3 COL FSAR Figure 2.4-221 (after North Anna 3 COL FSAR Figure 2.4-203)

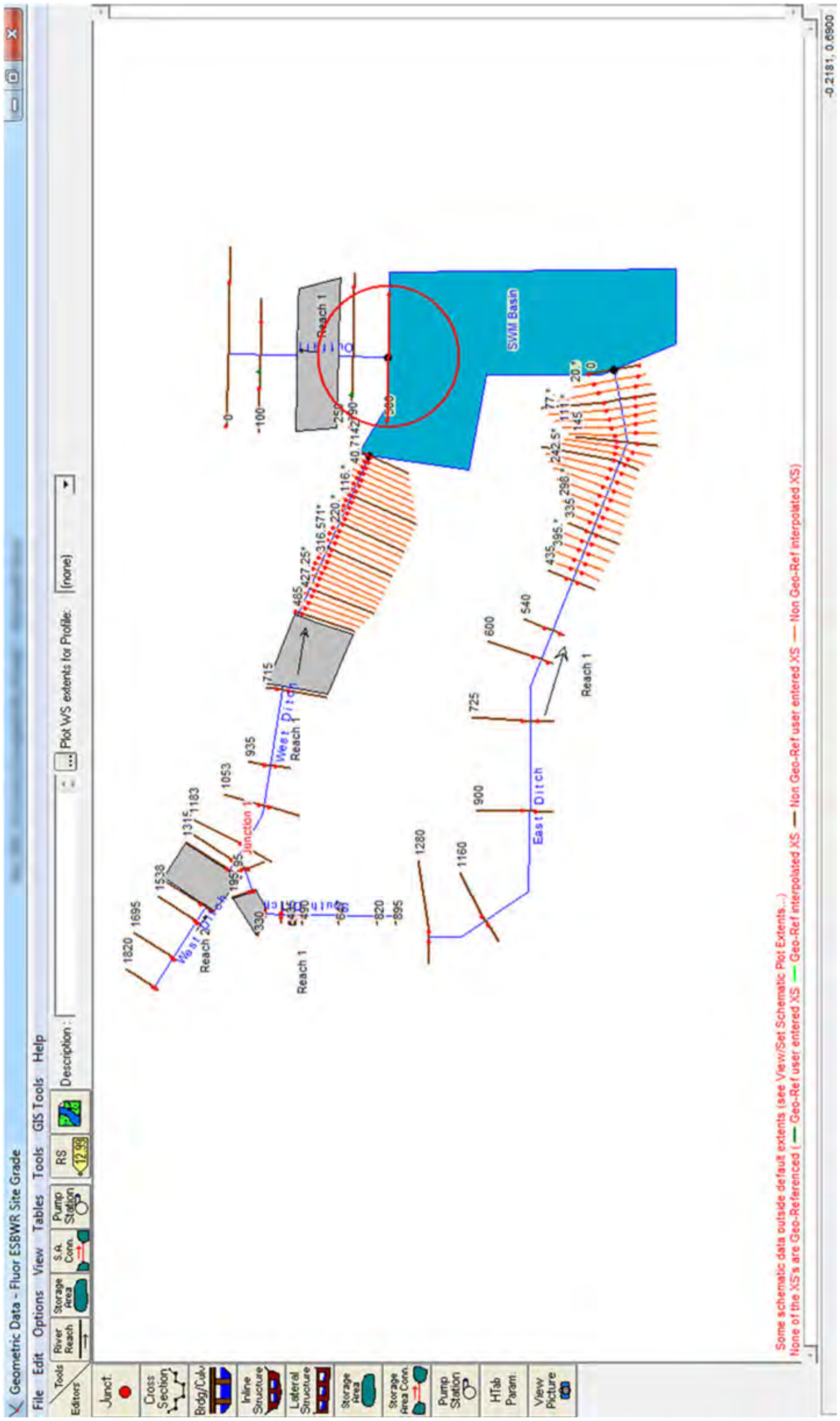

Figure 2.4.2-4. HEC-RAS schematic of the channel geometry derived from input files provided by the COL applicant

The Staff's Technical Evaluation

The staff reviewed the application and verified information discussed in this section.

The North Anna 3 COL FSAR states that the design plant grade for the safety-related SSCs for North Anna 3 is 88.39 m (290.0 ft) NAVD88. The maximum flood level reported in North Anna 3 COL FSAR from local intense precipitation sheet flow was 88.54 m (290.5 ft) NAVD88 which is 0.15 m (0.5 ft) above the design plant grade. The staff's examination of the HEC-RAS model provided by the applicant showed that the maximum flood level in the drainage ditches adjacent to the powerblock was 87.92 m (288.45 ft) NAVD88, reported in the North Anna 3 COL FSAR to the nearest tenth foot, or 87.90 m (288.4 ft) NAVD88.

In RAI 02.04.02-8, the staff requested that the COL applicant provide clarification as to why the reported design basis flood elevation was lower than the maximum flood elevation resulting from the local PMP. The COL applicant provided a response dated May 3, 2011 (ADAMS Accession No. ML11124A154), which clarified the issue. The staff noted that the information provided in the response is included in the current revision of the North Anna 3 COL FSAR. Accordingly, the staff considers RAI 02.04.02-8, resolved and closed.

The staff checked the COL applicant's precipitation depths and durations for the local intense precipitation (Table 2.4.2-1) and confirmed that they matched the values of the ESP (Dominion 2006). The staff also compared the 1-hour and 5-minute precipitation intensities (46.5 cm/hr [18.3 in/hr] and 15.5 cm/5 min [6.1 in/5 min], respectively) provided by the COL applicant against the ESBWR DCD and found that they were below the ESBWR DCD site parameter values of 49.3 cm/hr (19.4 in/hr) and 15.7 cm/5 min (6.2 in/5 min) for roof design. Therefore, the staff concluded that the ESBWR standard plant site parameters for precipitation bound the site-specific local intense precipitation.

The staff independently checked and confirmed the subbasin areas (Table 2.4.2-2) reported in the North Anna 3 COL FSAR. Although the staff did not obtain the exact subbasin areas as reported by the COL applicant, the staff's estimates were within 2 percent of the COL applicant's available area estimates. The staff considers this difference reasonable. The subbasin areas were used by the COL applicant to estimate runoff using the rational method. The COL applicant's use of the rational method to estimate runoff during the local intense precipitation is a conservative method because it assumes steady-state runoff using maximum precipitation depths over precipitation periods corresponding to the time of concentration. This approach results in the assumption that the whole subbasin was contributing runoff at the furthest downstream point. The staff determined that the rational method produced conservative estimates of discharge for use in steady-state analyses provided that the conservative times of concentration and precipitation data are used.

The staff noted that the North Anna 3 COL FSAR does not discuss North Anna 1 and 2 discharges, which was mentioned only in North Anna 3 COL FSAR Tables 2.4-201 and 2.4-202 (combined into Table 2.4.2-2). No value was provided in the FSAR for discharge from Subbasin U1&2 into the stormwater management pond; however, using the HEC-RAS input files provided by the applicant, the staff estimated that a discharge of 5.48 m^3/s (193.7 cfs) was used. In RAI 02.04.02-10, the staff requested that the COL applicant provide additional details regarding how the rational method was applied to estimate peak discharges, particularly from North Anna 1 and 2 Subbasin. In response to RAI 02.04.02-10 (ADAMS Accession No. ML15022A199), the COL applicant stated that a peak discharge specifically for Unit 1 and Unit 2 Subbasin was not calculated because it contributes flow to Subbasin B and was included in the calculation for Subbasin B (ADAMS Accession No. ML15022A199). The COL applicant provided proposed updated North Anna 3 COL FSAR text in the North Anna 3 COL FSAR, Revision 9, and the staff confirmed its inclusion. The staff reviewed the COL applicant's response and determined that the area of Subbasin B, including that of Subbasin U1&2 would be higher than that of North Anna 1 and 2 Subbasin itself and therefore the peak discharge estimated for Subbasin B would be slightly less than the peak discharge estimated for Subbasin U1&2 only. Therefore, it remained possible that the discharge for the outfall segment of the local drainage network could be slightly greater if North Anna 1 and 2 Subbasin were to be treated separately. However, the staff determined that the increase in discharge to be minor because the North Anna 1 and 2 Subbasin discharge occurs directly to the stormwater pond and would not significantly affect water-surface elevations in the powerblock area. Therefore, the staff determined that the COL applicant's response was adequate and RAI 02.04.02-10, was resolved and closed. The verified that all appropriate text changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff independently computed the times of concentration using Figure 2.4.2-1 for areas, distances, and slopes, and by using WinTR-55 software (SCS 1986, NRCS 2009). The TR-55 methodology includes three types of flow: overland (sheet) flow, concentrated flow, and channel flow. For sheet flow, the staff used Manning's roughness coefficients as provided in NRCS (2003). As indicated in the North Anna 3 COL FSAR, there are two land cover types: graveled areas and grass covered areas. For sheet flow over graveled areas, NRCS (2003) recommends a Manning's roughness of 0.02, while for sheet flow through dense-grass coverage a value of 0.24 is recommended. The WinTR-55 software provides drop-down lists for selection of surface type (as described by Manning's roughness values). For sheet flow, a 0.02 value for graveled areas is not provided in WinTR-55, so the staff used the next largest available value of 0.05. The staff assumed a 1 percent surface slope as indicated in Figure 2.4.2-1, though the staff expects that between buildings surface slopes would be smaller. Estimating the distance that sheet flow will occur is problematic without detailed information. The staff used a distance of 30.48 m (100 ft), which is the maximum distance that sheet flow could occur according to NRCS (2003). Comparing the staff-computed values with those provided by the applicant showed that for the east drainage areas the times of concentration are similar, though the staff's estimates are short by 1 to 2 minutes. However, the staff-computed times of concentration for the west and south drainage areas are shorter than those computed by the COL applicant, for example 10.4 min versus 20.4 min. Examination of additional information pertaining to the COL applicant's computation of times of concentration indicates the COL applicant used higher Manning's roughness coefficients for sheet flow and smaller slopes than used by the staff. The staff noted that in Subbasin S2, the applicant's estimated time of concentration for sheet flow accounts for over 60 percent of the subbasin's response time. Consequently, the COL applicant's basis for estimating sheet flow was needed.

The staff independently developed an exponential curve fit to estimate precipitation intensities for intermediate durations using the COL applicant's precipitation duration-depth data for 1-hr, 30-min, 15-min, and 5-min durations. The staff then used the independently estimated times of concentrations to compute precipitation intensities and discharges for the contributing areas. The staff used the same runoff coefficients for the Rational Method as those estimated by the COL applicant. The staff-computed discharges are higher than those estimated by the COL applicant because of higher estimated precipitation intensities. In RAI 02.04.02-11 (ADAMS Accession No. ML14345B075) dated December 11, 2014, the staff requested that the COL applicant provide a description of the assumptions made in estimation of subbasin discharges and include a discussion of the estimation of flow type lengths, Manning's roughness coefficients, times of concentration, and discharges.

In response to RAI 02.04.02-11 dated January 19, 2015 (ADAMS Accession No. ML15022A199), the COL applicant described the process used to estimate times of concentration for each subbasin. The COL applicant also described the basis for selection of Manning's roughness coefficients and the use of USACE guidance to reduce values of times of concentration for PMF events. The COL applicant provided proposed updated North Anna 3 COL FSAR text in the North Anna 3 COL FSAR, Revision 9, and the staff confirmed its inclusion. The staff reviewed the COL applicant's response and determined that the COL applicant appropriately followed current engineering practices and guidance applicable to PMF computations. The staff's higher estimates of discharges were related to differences in Manning's roughness coefficients and slopes. The staff determined that the COL applicant has appropriately used these parameters for the site-specific conditions. Therefore, the staff determined that the COL applicant's response was adequate and RAI 02.04.02-11 was resolved and closed. The staff verified that the appropriate text changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-2 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff received an updated set of HEC-RAS model input files from the COL applicant for the local intense precipitation flooding analysis (ADAMS Accession No. ML14013A113). The updated model files reflected the current North Anna 3 site design for the ESBWR.
The staff examined the COL applicant-provided HEC-RAS files and found the input consistent with the site plan shown in North Anna 3 COL FSAR Figure 2.4.2-203 (shown in Figure 2.4.2-1). In addition to the elevations computed by the HEC-RAS model, the staff examined the output from the COL applicant's analysis for supercritical flow. Locations with supercritical flow are noted in Figure 2.4.2-3. A transition from supercritical to subcritical flow regime is expected to produce a hydraulic jump. The staff examined the results from the COL applicant's HEC-RAS analysis for hydraulic jumps and found that the COL applicant correctly identified locations within the drainage ditches where supercritical to subcritical transitions would be predicted.

The staff noted that the downstream boundary condition in the HEC-RAS model is 80.77 m (265.0 ft) and noted that the boundary value was set 0.26 m (0.86 ft) higher than the maximum flood storage elevation in Lake Anna. The staff determined that the COL applicant used a conservative boundary condition which would result in conservative flood water surface elevations near safety-related SSCs during a local intense precipitation event.

The staff noted that the applicant's HEC-RAS input file geometry was inconsistent with the connectivity of the west ditch for the storm water management pond. In RAI 02.04.02-12, the staff requested that the COL applicant explain the apparent disagreement between the HEC-RAS input files and North Anna 3 COL FSAR Figures 2.4.201 and 2.4.203 which illustrate the connection of the west ditch to the stormwater management pond. In response to RAI 02.04.02-12 (ADAMS Accession No. ML15022A199), the COL applicant stated that as the west ditch approaches the stormwater management pond, water will flow in three directions: a portion will flow north into an area adjacent to the intake channel, another portion will flow south into the stormwater management pond, and a third portion will continue flowing along the west ditch towards the stormwater management pond outlet and into Lake Anna. The COL applicant chose to direct all flow from the west ditch into the stormwater management pond because the calculated water surface elevation would then be conservatively higher in Subbasin B. The COL applicant proposed updating North Anna 3 COL FSAR Figures 2.4-201 and 2.4-203 to correctly depict the discharge from the west ditch into the stormwater management pond, consistent with the HEC-RAS model setup. The staff determined that the COL applicant's response was adequate and verified that the appropriate updates to Figures 2.4-201 and 2.4-203 are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-3 from the staff's advanced SER for North Anna 3 is resolved and closed.

The HEC-RAS model requires specification of contraction and expansion coefficients. Typical contraction and expansion coefficient values are 0.1 and 0.3, respectively, for gradual transitions, 0.3 and 0.5 for typical bridge sections, respectively, and a maximum of 0.6 and 1.0 for abrupt transitions, respectively (USACE, 2010). The staff noted in the review of the COL applicant's HEC-RAS model that several cross sections were specified with contraction and expansion coefficients at the default value of 0.1 and 0.3, respectively, but others had values of 0.3 and 0.5, respectively. While staff acknowledged that these higher values are conservative, there was no discussion in the North Anna 3 COL FSAR concerning the selection of the higher values. In RAI 02.04.02-13, the staff requested that the COL applicant provide a discussion of the basis for selection of contraction and expansion coefficient values of 0.3 and 0.5, respectively. In response to RAI 02.04.02-13 (ADAMS Accession No. ML15022A199), the COL applicant explained that contraction and expansion coefficient values of 0.3 and 0.5, respectively, were specified at cross sections located upstream and downstream of inline weirs where flow transitioning was expected to be less gradual and act more similarly to flow transitions near bridges. The COL applicant provided proposed updated North Anna 3 COL FSAR text in the North Anna 3 COL FSAR, Revision 9, and the staff confirmed its inclusion. In the COL applicant's HEC-RAS model input geometry, the staff identified and confirmed the presence of inline weirs that were used in place of culverts and were used to represent fully blocked culverts. The staff reviewed the COL applicant's justification for using contraction and expansion coefficient values of 0.3 and 0.5, respectively, at these locations and determined the values and associated justification adequate. Therefore, the staff determined that the COL applicant's response was adequate and verified that the appropriate text changes are incorporated in the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-4 from the staff's advanced SER for North Anna 3 is resolved and closed.

During the review of the inline weirs used in the COL applicant's HEC-RAS model, the staff noted that weir coefficients in the model were set to either 2.6 or 2.4. The staff found no discussion of the basis for these values in the North Anna 3 COL FSAR. Therefore, in RAI 02.04.02-14, the staff requested that the COL applicant provide a discussion of the basis and the method used to specify the weir coefficients used in the HEC-RAS model. In response to RAI 02.04.02-14 (ADAMS Accession No. ML15022A199), the COL applicant described the basis for selection of the weir coefficients. The COL applicant stated that all inline weirs in the HEC-RAS model acted as broad-crested weirs and that the selected weir coefficient values of 2.4 and 2.6 were fairly low values for broad-crested weirs. These low values would produce higher water-surface elevations over the weirs, which would result in more conservative water-surface elevations in the ditches. The staff reviewed the typical weir coefficient values used in currently accepted engineering practice (Chow 1959) and determined that the COL applicant's conclusion was reasonable. The COL applicant stated that a weir coefficient of 2.4 was used for weirs at the outfall and at a south ditch cross section to account for additional hydraulic loss because of the presence of security barriers at these locations. The COL applicant used an iterative calculation to estimate the weir coefficient value of 2.4 at these locations. The COL applicant provided proposed updated North Anna 3 COL FSAR text in the North Anna 3 COL FSAR, Revision 9, and the staff confirmed its inclusion. The staff reviewed the COL applicant's method for estimating the weir coefficient at locations that have security barriers and concluded that the applicant has appropriately analyzed the flow at these locations. Therefore, the staff determined that the COL applicant's response was adequate and verified that appropriate text changes are incorporated in the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-5 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff checked the reference (Chow 1959) used by the applicant to select the Manning's roughness coefficient value. In the North Anna 3 COL FSAR, the applicant explained that the channel linings consist of riprap and used a Manning's roughness coefficient of 0.035 for all cross sections. According to Chow (1959), this value is for a channel with a gravel bottom with riprap sides. A slightly higher value might be expected if the channel was completely lined with riprap rather than just on its sides. The COL applicant set Manning's roughness coefficients for all cross sections in the HEC-RAS model input to 0.035, which represents a channel lined with riprap. To test the effect of a slightly higher Manning's roughness coefficient, the staff examined the effect on water surface elevations using a value of 0.040 for Manning's roughness coefficient. The staff determined that the water-surface elevation increased 0.06 m (0.2 ft) in the east ditch compared to that from the COL applicant's estimate, while for the south ditch the water surface elevation was the same as the COL applicant's estimate. Because these changes in water-surface elevations are minor and remained significantly below the design plant grade, the staff concluded that the COL applicant's use of a Manning's roughness coefficient value of 0.035 was acceptable.

The staff noted that the COL applicant's Calculation Package 25161-G-012 included an analysis of runoff and flood water depths between buildings during a local intense precipitation event. In this calculation, the COL applicant determined that a depth up to 12.7 cm (5 in) could be expected to occur in at least one location (between the Hot Machine Shop and Auxiliary Diesel Building). The staff also noted that the North Anna 3 COL FSAR did not include a discussion of drainage and flood discharge between buildings. The staff consider the guidance provided by ANSI/ANS-2.8-1992 Section 11.4 for consideration of roof drainage during local intense precipitation events an important aspect of the safety analysis. The North Anna 3 COL FSAR Revision 7 did not provide a description of this aspect of local intense precipitation flooding. Therefore, in RAI 02.04.02-15, the staff requested that the COL applicant provide the following:

- A discussion of the effects of roof drainage and direct precipitation on water-surface elevations or depths along passageways between buildings and structures important for safety;

- A comparison of these estimated water-surface elevations with the elevations of any penetrations or openings housing safety-related SSCs; and

- Appropriate updates to the North Anna 3 COL FSAR.

In response to RAI 02.04.02-15 (ADAMS Accession No. ML15022A199), the COL applicant provided details of the analysis in Calculation Package 25161-G-012.

The staff's review of the COL applicant's response revealed that some narrow alleyways between buildings in the powerblock area may not have been fully analyzed. In a revised response to RAI 02.04.02-15 (ADAMS Accession No. ML16229A451), the COL applicant provided an updated analysis of runoff between buildings during a local intense precipitation event. The COL applicant assumed that all roof drains will be clogged during a local intense precipitation event. The COL applicant also stated that scuppers in the parapets of the Reactor, Fuel, Control, Turbine, and Service Buildings will be sized to pass the peak discharge from the local intense precipitation and will be designed to prevent clogging. The COL applicant described its analysis (ADAMS Accession No. ML16229A451) of sheet flow within four key areas of relatively narrow passages within the powerblock:

- Area 1, the area located between the Hot Machine Shop and the Ancillary Diesel Building, south of the FB;

- Area 2, the area south of the CB, north of the Service Building, and east of the RB;
- Area 3, the area between the north end of the CB, the southeast corner or the TB, and east of the RB; and
- Area 4, the alleyway north of the RB and south of the TB.

The COL applicant estimated the drainage area that would contribute runoff to these four areas, including adjacent building roof areas. The COL applicant stated that building scuppers would be designed to direct roof drainage in specific directions. The COL applicant used the rational equation to estimate the peak sheet flow discharge for each of the four areas using a runoff coefficient of 1.0 and using a 5-minute time of concentration that results in a local intense precipitation intensity of 185.9 cm (73.2 in) /hr. The COL applicant estimated peak sheet flow discharges for Areas 1 through 4 as 0.83, 0.52, 0.60, and 0.10 m^3/s (29.3, 18.3, 21.2, and 3.7 cfs), respectively.

For Area 1, the COL applicant estimated a sheet-flow depth of 0.12 m (0.4 ft) using an estimated flow width of 9.14 m (30 ft), a channel slope of 0.4 percent, and a Manning's roughness coefficient of 0.02 to represent shallow flow over a paved surface. Therefore, the COL applicant estimated that the maximum flood water-surface elevation in this area to be 88.36 m (289.9 ft) NAVD88 (i.e., the site grade of 88.24 m [289.5 ft] NAVD88 plus a maximum sheet-flow depth of 0.12 m [0.4 ft]).

Similarly, for Area 2, the COL applicant estimated a maximum flow depth of 0.24 m (0.8 ft) that, when added to the site grade resulted in a maximum flood water-surface elevation of 88.48 m (290.3 ft) NAVD88. In addition, the COL applicant also estimated the sheet-flow water-surface elevation on top of the access tunnel roof because the access tunnel roof is 15.2 cm (6 in) above the site grade and therefore water will discharge as weir flow over the roof into the alleyway. The COL applicant determined that the weir would be submerged. However, because the depth of submergence would be small, the COL applicant used a free fall weir discharge equation to estimate a weir flow water depth of 0.15 m (0.5 ft) with a corresponding maximum sheet-flow elevation of 88.54 m (290.5 ft) NAVD88 in this area.

For Area 3, the COL applicant estimated a maximum flow depth of 0.12 m (0.4 ft) that, when added to the site grade outside the CB downstream of the access tunnel resulted in a maximum flood water-surface elevation of 88.36 m (289.9 ft) NAVD88. Similar to the second sheet-flow area analysis, the COL applicant estimated the weir flow water depth of 0.12 m (0.4 ft) with a corresponding maximum sheet-flow elevation of 88.51 m (290.4 ft) NAVD88 in this area.

For Area 4, the COL applicant estimated the weir flow depth passing over the tunnel to be 0.06 m (0.2 ft) with a corresponding maximum sheet-flow elevation of 88.45 m (290.2 ft) NAVD88.

Because of the revisions to the scupper design that would direct flow off building roofs in certain areas, the COL applicant stated that subbasin areas for the HEC-RAS analysis changed. The COL applicant updated the HEC-RAS analysis to reflect these changes. The staff's description in the *Information Submitted by Applicant* section above reflected these changes.

Comparing the safety-related floor and doorway elevations in Area 2 with estimated maximum sheet-flow elevations at the same locations, the COL applicant determined that the elevation of the CB south stairway landing adjacent to the emergency exit door, 88.39 m (290.0 ft) NAVD88, was below the estimated maximum sheet-flow elevation of 88.48 m (290.3 ft) NAVD88.

Therefore, the COL applicant stated that flood protection measures will be provided by installing a curb at the door entrance or by ensuring that the door threshold is above an elevation of 88.48 m (290.3 ft) NAVD88.

Comparing the safety-related floor and doorway elevations in Area 3 with estimated maximum sheet-flow elevations at the same locations, the COL applicant determined that the elevation of the CB north stairway landing adjacent to the emergency exit door, 88.39 m (290.0 ft) NAVD88, was below the estimated maximum sheet-flow elevation of 88.51 m (290.4 ft) NAVD88. Therefore, the COL applicant stated that flood protection measures will be provided by installing a curb at the door entrance or by ensuring that the door threshold is above an elevation of 88.51 m (290.4 ft) NAVD88.

Comparing the safety-related floor and doorway elevations in Area 4 with estimated maximum sheet-flow elevations at the same locations, the COL applicant determined that the elevation of the RB floor adjacent to the equipment access door on the north side of the RB, 88.39 m (290.0 ft) NAVD88, was below the estimated maximum sheet-flow elevation of 88.45 m (290.2 ft) NAVD88. Therefore, the COL applicant stated that flood protection measures will be provided by installing a curb at the door entrance or by ensuring that the door threshold is above an elevation of 88.45 m (290.2 ft) NAVD88.

The COL applicant proposed changes to North Anna 3 COL FSAR Section 2.4.2.3 to describe the effects of sheet flow including a comparison of estimated sheet-flow elevations to floor and door elevations of safety-related SSCs; updates to North Anna 3 COL FSAR Tables 2.4-201 through 2.4-204 to reflect revised subbasin drainage areas, peak discharges, and water-surface elevations; and, updates to North Anna 3 COL FSAR Figures 2.4-201 and 2.4-203 to reflect revised subbasin drainage areas and to show the locations of the access and radwaste tunnels. In addition, the COL applicant proposed revisions to North Anna 3 COL FSAR Section 2.4.10 to describe flood protection measures described above.

The staff reviewed the COL applicant’s response to RAI 02.04.02-15 and determined that the COL applicant’s sheet-flow analysis appropriately followed ANSI/ANS-2.8-1992 Section 11.4 guidance and used current engineering practice methods with conservative assumptions that maximize sheet-flow water-surface elevations adjacent to safety-related SSCs. The COL applicant proposed changes to the North Anna 3 COL FSAR that included a description of the design roof drainage directions, a description of the sheet flow analysis comparisons of safety-related floor and door elevations with maximum sheet-flow elevations, and locations of required flood protection measures. Therefore, the staff determined that the COL applicant’s response was adequate and verified that the appropriate text revisions are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.2-6 from the staff’s advanced SER for North Anna 3 is resolved and closed.

In evaluating the effects of local intense precipitation, the staff relied on the following statements on the part of the COL applicant:

- Locations where supercritical flow regimes are predicted to occur will be provided with linings and hardened surface protection;
- Grading in the vicinity of safety-related SSCs will slope away from the structures to provide sheet flow to drainage ditches;
- No storm drain inlets or depressed areas are located near safety-related buildings;

- During North Anna 3 construction, as-built drawings will be checked against site topography, surface conditions, and channel linings represented in the local intense precipitation flooding HEC-RAS analyses;

- During North Anna 3 construction, drainage facilities will be inspected at least once every two weeks;

- During North Anna 3 operation, the storm water drainage system will be monitored and maintained to ensure consistency with the design conditions represented in the HEC-RAS analyses;

- During North Anna 3 operation, the drainage system will be inspected quarterly for areas with potential for erosion; and

- The scuppers in the parapets of Reactor, Fuel, Control, Turbine, and Service Buildings will be sized to pass the peak discharge from a local intense precipitation and will be designed to prevent clogging.

The Staff’s Independent Review Related to the Previous COLA Reactor Design

Preceding the RAIs discussed above and over the course of the staff’s review, several RAIs were issued by the staff to resolve questions corresponding to earlier versions of the North Anna 3 COL FSAR referencing the APWR design. These earlier versions under the APWR reactor design used a different drainage system design; however, for completeness, these RAIs and their applicability and resolution are discussed below.

In RAI 02.04.02-1 dated August 21, 2008 (ADAMS Accession No. ML082340933), the staff requested additional information from the applicant regarding the local intense precipitation analysis. Specifically in RAI 02.04.02-1, the staff requested that the COL applicant provide the following items:

- Assurance that the “as-built” site topography will match values provided in the HEC-RAS cross sections (locations shown in North Anna 3 COL FSAR Figure 2.4-203) and that this topography will remain static (or is a conservative assumption), considering the length of the North Anna 3 licensing period;

- A description of provisions to prevent placement of obstructions or other channel blockages in key drainage canals throughout the North Anna 3 licensing period and hence, to justify the selected HEC-RAS model parameters (e.g., contraction and expansion coefficients, channel roughness, and channel geometry values); and,

- A description of how runoff from each building and parking lot in North Anna 3 COL FSAR Figure 2.4-201 has been captured in the HEC-RAS model and hence, is correctly represented in the subbasin drainage boundaries in North Anna 3 COL FSAR Figure 2.4-201.

On September 16, 2008, the COL applicant responded to RAI 02.04.02-1 dated September 16, 2008 (ADAMS Accession No. ML082680033). Additionally, North Anna 3 COL FSAR Revision 3, Section 2.4.2 includes statements that address RAI 02.04.02-1.

Specifically concerning RAI 02.04.02-1(a), the applicant stated in North Anna 3 COL FSAR Section 2.4.2 that during construction of North Anna 3, construction and as-built drawings will be checked against site topography, surface type, and channel linings as provided for the local PMP flood analysis including the HEC-RAS modeling analysis.

Specifically concerning RAI 02.04.02-1(b), the applicant stated in North Anna 3 COL FSAR Section 2.4.2 that construction and as-built drawings will be checked against site topography, surface type, and channel linings as provided for the local PMP flood analysis including the HEC-RAS modeling analysis. The applicant also stated in North Anna 3 COL FSAR Section 2.4.2 that during operation of North Anna 3 the drainage system will be monitored so it continues to be consistent with the local PMP flood analysis including the HEC-RAS modeling analysis. Site inspections will be done quarterly to inspect areas with erosion potential.

Specifically concerning RAI 02.04.02-1(c), the applicant provided in North Anna 3 COL FSAR Section 2.4.2 a description of the site grading near the safety-related SSCs and described how ground and roof runoff reaches the drainage system. The applicant provided information on the imperviousness as included in the composite runoff coefficient. The staff addressed its concerns with the local intense precipitation analysis in RAI 02.04.02-10 through 02.04.02-15. As described previously herein, the staff described the resolution of these concerns.

In RAI 02.04.02-2 the staff requested information that was a follow-on to RAI 02.04.02-1 per the following items:

a. This item was a request for revised HEC-RAS model input files;

b. This item was a request that the COL applicant describe in the North Anna 3 COL FSAR a structure in the HEC-RAS model that results in overland flow from the ditch draining into the stormwater management pond;

c. This item requested a map be provided that identifies the locations where supercritical flows and hydraulic jumps are likely to occur in the drainage ditches. Additionally, the question requested the locations where flood events produce velocities higher than the design velocity for the channel bed material. A portion of the item concerned overland flow from the ditch draining into the stormwater management pond. This included the request for a description of how a potential failure of these drainage features could degrade any safety-related SSCs, or structures that satisfy RTNSS criteria; and,

d. This item requested controls and requirements needed to ensure the ditches and outfall canal would remain clear of obstructions, the side-slopes would remain stable, and the site drainage system would function as described in the North Anna 3 COL FSAR Section 2.4.2 for the length of the North Anna 3 licensing period. The item also requested that the COL applicant provide additional detail regarding Administrative Controls or surveillance requirements including the frequencies at which surveys will be conducted.

Specifically concerning RAI 02.04.02-2(a) dated March 06, 2009 (ADAMS Accession No. ML090680312), the applicant provided HEC-RAS files based on the current site storm water management system for the ESBWR reactor design. Therefore, this question item was resolved and closed.

Specifically concerning RAI 02.04.02-2(b), because the storm water management system was modified, the current design and HEC-RAS analysis does not include the referenced structure. Therefore, this question item no longer applied.

Specifically concerning RAI 02.04.02-2(c), because the storm water management system was modified, the current design and HEC-RAS analysis does not include overland flow and the erosion potential that would result from overflows from the ditch draining. Therefore, this portion of the RAI (item c) no longer applied. For the applicable remaining portion of the RAI (item d), the applicant had not provided a map of the potential locations of supercritical velocity and hydraulic jumps for the current storm water management system design. Therefore, in RAI 02.04.02-9, the staff requested that the COL applicant provide a map identifying locations with supercritical velocities and hydraulic jumps. The COL applicant provided a map in the current revision of the North Anna 3 COL FSAR with the locations of supercritical velocities and hydraulic jumps identified from HEC-RAS analyses (Figure 2.4.2-3). Therefore, the staff considered RAI 02.04.02-9, resolved and closed.

Specifically concerning RAI 02.04.02-2(d), the COL applicant committed to implementation of administrative controls and a quarterly monitoring program to inspect locations with erosion potential, as summarized above in this SER section titled “Information Submitted by Applicant.” Additionally, the COL applicant committed to corrective action if erosion were to occur. Therefore, the staff considered RAI 02.04.02-2(d) resolved and closed.

In RAI 02.04.02-3, the staff requested that the COL applicant provide information concerning the hydraulic characteristics created by an access road crossing a ditch with a drop culvert used for floodwater conveyance. This design produced flood elevations capable of affecting the Units 1 and 2 site. This road crossing was not included in the current design for the ESBWR North Anna 3 site. Therefore, RAI 02.04.02-3 no longer applied.

In RAI 02.04.02-4 dated July 28, 2009 (ADAMS Accession No. ML092090567), the staff requested that the COL applicant provide information concerning the construction and maintenance of the storm water drainage system, specifically asking for this information to be added to the North Anna 3 COL FSAR. The requested information included (1) that channels and overbanks be checked prior to use and (2) that channels and overbanks be maintained over the licensing period in the same condition as represented in the updated HEC-RAS model. As summarized above in the SER section titled “Information Submitted by Applicant,” this information has been included in the North Anna 3 COL FSAR. Therefore, the staff considered RAI 02.04.02-4 resolved and closed.

In RAI 02.04.02-5 dated July 28, 2009 (ADAMS Accession No. ML092090567), the staff requested that the COL applicant provide information concerning the construction and maintenance of the storm water drainage system, specifically asking for this information to be added to the North Anna 3 COL FSAR. Noting that the ditch identities below correspond to a previous version of the storm water drainage system, the previously requested information included the following items:

a. All drainage ditches, overflow area and embankments at North Anna 3 will be protected to withstand the predicted flood flow velocities resulting from the local PMP event for the North Anna 3 site;

b. The lining for the south drainage ditch at the location of the hydraulic jump will be designed to withstand the erosive forces generated by the hydraulic jump during the local PMP event;

c. The lining of the north ditch and storm water management basin side slopes in the vicinity of the north ditch will be designed to withstand the erosive forces of the hydraulic jump at the inlet to the storm water management basin; and,

d. The embankment for the outfall channel will be provided with hardened surface protection designed to withstand the erosive forces associated with the supercritical flow and the potential occurrence of a hydraulic jump at the embankment section.

As stated, the current North Anna 3 COL FSAR has different identities for the drainage ditches than was used in this early RAI above. As summarized above in the SER section titled “Information Submitted by Applicant,” this information has been incorporated in the North Anna 3 COL FSAR. Therefore, the staff considered RAI 02.04.02-5 resolved and closed.

In RAI 02.04.02-6 dated July 28, 2009 (ADAMS Accession No. ML092090567), the staff requested that the COL applicant provide information concerning the construction and maintenance of the storm water drainage system, specifically asking for this information to be added to the North Anna 3 COL FSAR. The requested information included surveillance and monitoring requirements, with the frequencies at which the surveys will be conducted. In addition, staff requested that this information not be tied to permits issued by the Commonwealth of Virginia. As summarized above in the staff SER section titled “Information Submitted by Applicant,” this information was included in the North Anna 3 COL FSAR. Additionally, the North Anna 3 COL FSAR does not include text that would tie this information to state issued permits. Therefore, the staff considered RAI 02.04.02-6 resolved and closed.

In RAI 02.04.02-7 dated July 28, 2009 (ADAMS Accession No. ML092090567), the staff requested that the COL applicant provide information concerning the hydraulic characteristics created by an access road crossing a ditch with a drop culvert used for floodwater conveyance. This design produced flood elevations capable of affecting the Units 1 and 2 site. This road crossing was not included in the current design for the ESBWR North Anna 3 site. Therefore, RAI 02.04.02-7 no longer applied.

2.4.2.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.2.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR and staff’s ESP FSER (NUREG-1835). The staff’s review confirmed that the COL applicant has addressed the required information, and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.2 of NUREG–0800, and NRC RGs. The staff’s review concluded that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the COL applicant has adequately addressed NAPS COL Item 2.0-13-A as it relates to floods.

As set forth above, the COL applicant has presented and substantiated information relative to the floods important to the design and siting of this plant. The staff reviewed the available information provided. For the reasons given above, the staff concludes that the identification and consideration of the floods at the site and in the surrounding area are acceptable and meet the requirements of 10 CFR 52.79(a)(31) and 100.20(c), with respect to determining the acceptability of the site for the ESBWR design.

The staff finds that the COL applicant has considered the appropriate site phenomena in establishing the design bases for SSCs important to safety. The staff accepts the methodologies used to determine the locally intense precipitation flood event. Accordingly, the staff concludes that the use of these methodologies results in design bases containing a sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concludes that the identified design bases meet the requirements of 10 CFR 100.20(c) with respect to establishing the design basis for SSCs important to safety.

2.4.3 Probable Maximum Flood on Streams and Rivers

2.4.3.1 Introduction

The PMF on streams and rivers is used to determine the extent of any flood protection required for those safety-related SSCs necessary to ensure the capability to shut down the reactor and maintain it in a safe shutdown condition. The specific areas of review are as follows: (1) design basis for flooding in streams and rivers; (2) design basis for site drainage; (3) consideration of other site-related evaluation criteria; and, (4) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.3.2 Summary of Application

North Anna 3 COL FSAR Section 2.4.3, "Probable Maximum Flood on Streams and Rivers," addresses the need for information on site-specific PMF on streams and rivers.

The COL applicant addressed the ESBWR DCD and ESP information as follows:

COL Item:

- NAPS COL 2.0-14-A — Probable Maximum Flood on Streams and Rivers, COL Applicant to supply site-specific information in accordance with SRP 2.4.3

The COL applicant incorporated by reference ESP SSAR Section 2.4.3 to address ESBWR DCD COL Item 2.0-14-A and provided updated site-specific information to supplement ESP SSAR Sections 2.4.3.

Early Site Permit Variance:

The following variance from the ESP SSAR are discussed in Section 2, "Variances," of Part 7 to the COLA:

- NAPS ESP VAR 2.4-4

As described in Section 2.4.1, the COL applicant stated that, to improve water availability to downstream users during drought conditions, the normal pool elevation of Lake Anna is to be raised 0.08 m (0.25 ft) to 76.01 m (249.39 ft) NAVD88.

- NAPS ESP VAR 2.4-5

The COL applicant supplemented the ESP SSAR Section 2.4.3 with a revised PMF analysis for Lake Anna using the increased normal pool elevation, and also updated the model to use the USACE HEC-HMS code (USACE, 2010b) and USACE guidance on the use of peaked hydrographs to account for a nonlinear response to large storms. The COL applicant stated that the PMF for streams and rivers is at an elevation of 81.25 m (266.56 ft) NAVD88, which is 7.14 m (23.44 ft) below the design plant grade for safety-related components and structures.

2.4.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission's regulations for the PMF on streams and rivers, and the associated acceptance criteria, are contained in Section 2.4.3 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 PMF on streams and rivers presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item NAPS COL 2.0-14-A, and NAPS COL VARs 2.4-4 and 2.4-5), are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d), sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves at the site.

The following related acceptance criteria are summarized from SRP Section 2.4.3:

- Design Bases for Flooding in Streams and Rivers: To meet the requirements of 10 CFR Part 100, estimates of the following characteristics are needed, and should be based on conservative assumptions of hydrometeorologic characteristics in the drainage area: (a) the area of the watershed used to estimate flooding in streams and rivers, (b) the total depth of PMP and the PMP hyetograph, (c) the maximum PMF water surface elevation in streams and rivers with coincident wind-waves, and (d) hydraulic characteristics that describe dynamic effects of PMF on SSC important to safety. If a potential hazard to SSC important to safety exists, the applicant should document and justify the design bases of affected facilities.

- Design Bases for Site Drainage: To meet the requirements of 10 CFR Part 100, estimates of the following characteristics are needed: the runoff from the immediate site area and the drainage from areas adjacent to the site, including the roofs of safety-related structures. Flood response characteristics should be identified to estimate flooding adjacent to and on the plant site. The effects of erosion and sedimentation during the flooding should be identified and their effects on SSC important to safety should be determined. If a potential hazard to SSC important to safety exists, the applicant should document and justify the design bases of affected facilities.

- Consideration of Other Site-Related Evaluation Criteria: To meet the requirements of 10 CFR Part 100 information about the potential effects of site related proximity, seismic, and non-seismic information as they relate to flooding in streams and rivers and local flooding adjacent to and on the plant site is needed.

In addition, the hydrologic characteristics should be consistent with appropriate sections from RGs:

- RG 1.27, describes the applicable UHS capabilities.

- RG 1.29, identifies seismic design bases for SSC important to safety.

- RG 1.59, as supplemented by current best practices provides guidance for developing the hydrometeorological design bases.

- RG 1.102, describes acceptable flood protection to prevent the safety-related facilities from being adversely affected.

2.4.3.4 Technical Evaluation

As documented in Section 2.4.3 of NUREG-1966 and Section 2.4.3 of NUREG-1835, the staff reviewed and approved information related to PMF for the certified ESBWR DCD, Revision 10, and Section 2.4.3 of the North Anna ESP, respectively. The staff reviewed Section 2.4.3 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic. The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Probable Maximum Flood on Streams and Rivers."

The staff's technical review in this section is limited to reviewing the supplemental information pertaining to NAPS COL 2.0-14-A, NAPS ESP VAR 2.4-4, and NAPS ESP VAR 2.4-5 as addressed below.

Information Submitted by COL Applicant:

The current design for the site calls for an increase in the normal pool elevation of Lake Anna by 7.62 cm (3 inches) from 75.94 m (249.14 ft) NAVD88 to 76.01 m (249.39 ft) NAVD88 to increase water availability downstream of Lake Anna during drought conditions when North Anna 3 is operational. With the change in normal pool elevation, the COL applicant updated the PMF analysis, which included an update to the model to use the USACE HEC-HMS code, rather than the HEC-1 code used for the ESP SSAR.

The initial HEC-HMS simulation used the lower normal pool elevation and the same input data used in the ESP SSAR HEC-1 analysis. However, the input parameters for the Coefficient Ratio (CR) and the Recession Ratio (RC) were adjusted so that the HEC-HMS analysis matched the stillwater PMF elevation of 80.23 m (263.21 ft) NAVD88 as developed in the ESP SSAR.

For the North Anna 3 COL FSAR, the COL applicant revised the initial Lake Anna elevation and the stage-discharge relationship to reflect the 0.08 m (0.25 ft) increase in the normal pool elevation. The COL applicant also applied the peaked unit hydrograph. The COL applicant stated that the revised PMF at Lake Anna dam was increased by 0.01 m (0.03 ft) compared to the ESP SSAR PMF elevation. The COL applicant stated that, because the increase in the PMF elevation at the dam was so small, backwater and wind-wave activity effects on the maximum flood elevation were not reanalyzed, but were kept at 1.01 m (3.32 ft) (i.e., 0.03 m [0.09 ft] for wave set-up, 0.92 m [3.03 ft] for wave run-up, and 0.06 m [0.20 ft] for backwater). The COL applicant stated that the PMF elevation for the North Anna 3 site is 81.25 m (266.56 ft) NAVD88 including these associated effects. Additionally, the COL applicant stated that the PMF elevation is 7.14 m (23.44 ft) below the North Anna 3 design plant grade and that all UHS SSCs and the Fire Water Service Complex (FWSC) (which provides makeup water to the UHS from 72 hr. to 7 days post-accident) are above the PMF elevation.

The Staff's Technical Evaluation:

The staff reviewed the North Anna 3 COL FSAR and the COL applicant-provided HEC-HMS files. The staff checked the ESP SSAR and compared the results with the current analysis. The COL applicant updated the method of analysis using HEC-HMS, while the analysis in the ESP SSAR used HEC-1, which was a predecessor to HEC-HMS. The staff finds it acceptable to update the analyses using standard modeling tools, especially because the USACE no long supports HEC-1.

The COL applicant set up a HEC-HMS model to reproduce the maximum water surface as obtained in the ESP SSAR HEC-1 analysis. The COL applicant adjusted two parameters of the HEC-HMS model, the CR used in precipitation loss and the RC. Otherwise, all other inputs were the same as used for the HEC-1 analysis. The COL applicant adjusted the value of CR to match the basin runoff found in the ESP SSAR analysis using HEC-1. The COL applicant computed the value of RC using a conversion formula from the HEC-HMS documentation (USACE, 2010b).

The staff checked the applicant-provided HEC-HMS model run used for conversion from HEC-1 to HEC-RAS and confirmed the stillwater PMF elevation of 80.23 m (263.21 ft) NAVD88 at Lake Anna Dam reported in the North Anna 3 COL FSAR. The staff found the stillwater PMF elevation to be consistent with the value reported in the ESP SSAR. The staff also checked the model run with an initial 7.62 cm (3 in or 0.25 ft) rise of the Lake Anna normal pool elevation and found that the HEC-HMS model produced a stillwater PMF elevation of 80.24 m (263.24 ft) NAVD88 at Lake Anna Dam, the same as reported in North Anna 3 COL FSAR Section 2.4.3.

The COL applicant set the CR and RC parameters to 11.055 and 0.72482, respectively. The staff conducted sensitivity analyses of the adjusted parameters. CR values ranging from 1.0 to 100 produced an elevation change from 80.00 m (262.47 ft) NAVD88 to 80.30 m (263.45 ft) NAVD88. RC values ranging from 0.1 to 1.0 produced an elevation range from 79.92 m (262.19 ft) NAVD88 to 80.24 m (263.27 ft) NAVD88. The staff finds that the model sensitivity to these parameters is at most ±0.15 m (±0.5 ft) which is small in comparison to the 7.14 m (23.44 ft) difference between the PMF elevation and the design plant grade elevation.

The ESP SSAR reports a backwater effect at the North Anna 3 site of 0.06 m (0.2 ft). The ESP SSAR also reports the effect of wind wave activity as 0.03 m (0.09 ft) for wind set-up and 0.92 m (3.03 ft) for wave run-up. Because the increase in the stillwater PMF elevation from the ESP SSAR was only 0.01 m (0.03 ft), the staff finds acceptable for the North Anna 3 COL FSAR the backwater and wind wave effects used in the ESP SSAR. The staff computed a final PMF elevation for the North Anna 3 site of 81.25 m (266.56 ft) NAVD88, which agrees with the PMF elevation reported in the North Anna 3 COL FSAR. Accordingly, the staff accepted NAPS ESP VAR 2.4-4 and NAPS ESP VAR 2.4-5.

2.4.3.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.3.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR and staff's ESP FSER. The staff's review confirmed that the applicant has addressed the relevant information, and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.3 of NUREG–0800, and NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed COL Item NAPS 2.0-14-A as it relates to the PMF on streams and rivers.

As set forth above, the applicant has presented and substantiated information relative to the PMF on streams and rivers important to the design and siting of this plant. The staff reviewed the available information provided. For the reasons given above, the staff concluded that the identification and consideration of the PMF on streams and rivers at the site and in the surrounding area are acceptable and meet the requirements of 10 CFR 52.79 and 10 CFR 100.20(c), with respect to determining the acceptability of the site for the ESBWR design.

The staff finds that the applicant has considered the appropriate site phenomena in establishing the design bases for SSCs important to safety. The staff accepted the methodologies used to determine the PMF on streams and rivers. Accordingly, the staff concluded that the use of these methodologies results in design bases containing a sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concludes that the identified design bases meet the requirements of 10 CFR 100.20(c) with respect to establishing the design basis for SSCs important to safety.

2.4.4 Potential Dam Failures

2.4.4.1 Introduction

The potential dam failures are addressed to ensure that any potential hazard to the safety-related facilities due to the failure of onsite, upstream, and downstream water control structures is considered in the plant design. The specific areas of review are as follows: (1) flood waves resulting from a dam breach or failure, including those due to hydrologic failure as a result of overtopping for any reason, routed to the site and the resulting highest water surface elevation that may result in the flooding of SSCs important to safety; (2) successive failures of several dams in the path to the plant site caused by the failure of an upstream dam due to plausible reasons, such as a PMF, landslide-induced severe flood, earthquakes, or volcanic activity and the effect of the highest water surface elevation at the site under the cascading failure conditions; (3) dynamic effects of dam failure-induced flood waves on SSCs important to safety; (4) failure of a dam downstream of the plant site that may affect the availability of a safety-related water supply to the plant; (5) effects of sediment deposition or erosion during dam failure-induced flood waves that may result in blockage or loss of function of SSCs important to safety; (6) failure of onsite water control or storage structures such as levees, dikes, and any engineered water storage facilities that are located above site grade and may induce flooding at the site; (7) the potential effects of seismic and nonseismic data on the postulated design bases and how they relate to dam failures in the vicinity of the site and the site region; and, (8) any additional information requirements prescribed in the “Contents of Application” sections of the applicable subparts to 10 CFR Part 52.

2.4.4.2 Summary of Application

North Anna 3 COL FSAR Section 2.4.4,”Potential Dam Failures,” addresses the need for site-specific information on potential dam failures. The COL applicant addressed the information as follows:

COL Items:

- NAPS COL 2.0-15-A — Potential Dam Failures, COL Applicant to supply site-specific information in accordance with SRP 2.4.4. COL Applicant to demonstrate that failure of existing and potential upstream or downstream water control structures will not cause flooding to exceed 0.3 m (1 ft) below plant grade.

The COL applicant incorporated by reference ESP SSAR Section 2.4.4 to address ESBWR DCD COL Item 2.0-15-A.

- NAPS ESP COL 2.4-6

- NAPS ESP COL 2.4-7

The COL applicant provided updated site-specific information to supplement ESP SSAR Section 2.4.4 to address ESP COL Action Items 2.4-6 and 2.4-7, indicating that the UHS described in ESBWR DCD Section 9.2.5 addresses NRC’s requirements to provide sufficient emergency cooling capability.

2.4.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission’s regulations for the potential dam failures, and the associated acceptance criteria, are contained in Section 2.4.4 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 description of potential dam failures presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item NAPS COL 2.0-15-A, and NAPS ESP COL Items 2.4-6 and 2.4-7), are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d), sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves at the site.

The related acceptance criteria from SRP Section 2.4.4 are as follows:

- Flood Waves from Severe Breaching of an Upstream Dam: To meet the requirements of 10 CFR Part 100 and 10 CFR 100.23(d), estimates of the following characteristics are needed, and should be based on conservative assumptions of hydrometeorological, geological, and seismic characteristics in the drainage area: (a) modes of assumed dam breaches or failures, (b) consideration of flood control reservoirs at full pool level, and (c) conservatism of coincident flow rates and water surface elevations.

- Domino-Type or Cascading Dam Failures: To meet the requirements of 10 CFR Part 100 and 10 CFR 100.23(d), an appropriate configuration of the cascade of dam failures and its potential to produce the largest flood adjacent to the plant site is needed.

- Dynamic Effects on Structures: To meet the requirements of 10 CFR Part 100, an estimate of dynamic effects of flood waves, such as velocities and momentum fluxes, on SSC important to safety is needed.

- Loss of Water Supply Due to Failure of a Downstream Dam: To meet the requirements of 10 CFR Part 100 and 10 CFR 100.23(d), an assessment regarding loss of safety-related water supply to the plant caused by failure of a downstream dam is needed.

- Effects of Sediment Deposition and Erosion: To meet the requirements of 10 CFR Part 100 and 10 CFR 100.23(d), an assessment is needed regarding loss of functionality of safety-related water supply to the plant caused by blockages due to sediment deposition or erosion during the dam failure-induced flood event.

- Failure of Onsite Water Control or Storage Structures: To meet the requirements of 10 CFR Part 100, an assessment is needed regarding the failure of any onsite water control or storage structures that may cause flooding of SSC important to safety.

- Consideration of Other Site-Related Evaluation Criteria: The potential effects of site-related proximity, seismic, and non-seismic information as they relate to flooding due to upstream dam failures and loss of safety-related water supply due to blockages and failures of downstream dam failures adjacent to and on the plant site and site regions are needed to meet the requirements of 10 CFR Part 100.

In addition, the hydrologic characteristics should be consistent with appropriate sections from: RGs 1.27, 1.29, 1.59, as supplemented by best current practices, and RG 1.102.

2.4.4.4 Technical Evaluation

As documented in Section 2.4.4 of NUREG-1966 and Section 2.4.4 of NUREG-1835, the staff reviewed and approved information related to potential dam failures for the certified ESBWR DCD, Revision 10, and Section 2.4.4 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.4 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Potential Dam Failures."

The elevation of the design plant grade is 88.39 m (290.0 ft) NAVD88, which is 20.86 ft above the maximum flood level at the site resulting from a PMF in Lake Anna's watershed, the simultaneous failure of upstream storage reservoirs, and coincident wave action, as described in the ESP FSER.

The staff's technical review of this application is limited to the supplemental information pertaining to NAPS COL 2.0-15-A and NAPS ESP COL Action items 2.4-6 and 2.4-7, as addressed below.

The staff reviewed the resolution to DCD COL Item 2.0-15-A, related to any potential hazard to the safety-related facilities due to the failure of onsite, upstream, and downstream water control structures. These potential hazards are considered in the plant design included in North Anna 3 COL FSAR Section 2.4.4. The staff finds that the additional information was consistent with the information in the ESP SSAR, which has already been accepted in the ESP FSER.

As described in Section 2.4.1 of this SER, the staff determined that no underground reservoirs are included in the design of the ESBWR UHS and no external source of safety-related makeup water is required for the UHS. Because the predicted flood elevation from dam failure was well below the design plant grade for North Anna 3 and the UHS does not depend on Lake Anna, the staff concludes that dam failure would not affect the North Anna 3 UHS.

2.4.4.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.4.6 Conclusion

The staff reviewed the COLA and checked the referenced ESP SSAR and staff's ESP FSER. The staff's review confirmed that the COL applicant has addressed the relevant information and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.4 of NUREG–0800, and NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed COL Item NAPS 2.0-15-A as it relates to potential dam failure.

As set forth above, the applicant has presented and substantiated information relative to the effects of dam failures important to the design and siting of this plant. The staff reviewed the available information provided. For the reasons given above, the staff concluded that the identification and consideration of the effects of dam failures at the site and in the surrounding area are acceptable and meet the requirements of 10 CFR 52.79, 10 CFR 100.23(d), and 10 CFR 100.20(c).

The staff finds that the applicant has considered the appropriate site phenomena in establishing the design bases for SSCs important to safety. The staff accepted the methodologies used to determine the effects of dam failures reflected in the site characteristics documented in the ESP SER. Accordingly, the staff concludes that the use of these methodologies results in design bases containing a sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concludes that the identified design bases meet the requirements of 10 CFR 100.23(d) and 10 CFR 100.20(c), with respect to establishing the design basis for SSCs important to safety.

2.4.5 Probable Maximum Surge and Seiche Flooding

The probable maximum surge and seiche flooding are addressed to ensure that any potential hazard to the safety-related facilities due to the effects of probable maximum surge and seiche is considered in plant design. The specific areas of review are as follows: (1) probable maximum hurricane (PMH) that causes the probable maximum surge as it approaches the site along a critical path at an optimum rate of movement; (2) probable maximum wind storm (PMWS) from a hypothetical extratropical cyclone or a moving squall line that approaches the site along a critical path at an optimum rate of movement; (3) a seiche near the site, and the potential for seiche wave oscillations at the natural periodicity of a water body that may affect flood water surface elevations near the site or cause a low water surface elevation affecting safety-related water supplies; (4) wind-induced wave run-up under a PMH or PMWS winds; (5) effects of sediment erosion and deposition during a storm surge and seiche-induced waves that may result in blockage or loss of function of SSCs important to safety; (6) the potential effects of seismic and nonseismic information on the postulated design bases and how they relate to a surge and seiche in the vicinity of the site and the site region; and, (7) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

The COL applicant incorporated by reference ESP SSAR Section 2.4.5 to address DCD COL Item 2.0-16-A, related to probable maximum surge and seiche flooding. The staff reviewed the COLA and checked the referenced ESP SSAR and the staff's ESP FSER. The staff confirmed that no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

2.4.6 Probable Maximum Tsunami Hazards

The probable maximum tsunami (PMT) hazards are addressed to ensure that any potential tsunami hazards to the SSCs important to safety are considered in plant design. The specific areas of review are as follows: (1) historical tsunami data, including paleotsunami mappings and interpretations, regional records and eyewitness reports, and more recently available tide gauge and real-time bottom pressure gauge data; (2) PMT that may pose hazards to the site; (3) tsunami wave propagation models and model parameters used to simulate the tsunami wave propagation from the source toward the site; (4) extent and duration of wave run-up during the inundation phase of the PMT event; (5) static and dynamic force metrics including the inundation and drawdown depths, current speed, acceleration, inertial component, and momentum flux that quantify the forces on any safety-related SSCs that may be exposed to the tsunami waves; (6) debris and water-borne projectiles that accompany tsunami currents and may impact safety-related SSCs; (7) effects of sediment erosion and deposition caused by tsunami waves that may result in blockage or loss of function of safety-related SSCs; and, (8) potential effects of seismic and nonseismic information on the postulated design bases and how they relate to tsunami in the vicinity of the site and the site region; (9) any additional information requirements prescribed in the “Contents of Application” sections of the applicable subparts to 10 CFR Part 52.

The COL applicant incorporated by reference ESP SSAR Section 2.4.6 to address DCD COL Item 2.0-17-A related to PMT flooding. The staff reviewed the COLA and checked the referenced ESP SSAR and the staff’s ESP FSER. The staff confirmed that no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

2.4.7 Ice Effects

2.4.7.1 Introduction

The ice effects are addressed to ensure that safety-related facilities and water supply are not affected by ice-induced hazards. The specific areas of review are as follows: (1) regional history and types of historical ice accumulations (i.e., ice jams, wind-driven ice ridges, floes, frazil ice formation, etc.); (2) potential effects of ice-induced, high- or low-flow levels on safety-related facilities and water supplies; (3) potential effects of a surface ice-sheet to reduce the volume of available liquid water in safety-related water reservoirs; (4) potential effects of ice to produce forces on, or cause blockage of, safety-related facilities; (5) potential effects of seismic and nonseismic data on the postulated worst-case icing scenario for the proposed plant site; and, (6) any additional information requirements prescribed in the “Contents of Application” sections of the applicable subparts to 10 CFR Part 52.

2.4.7.2 Summary of Application

The North Anna 3 COL FSAR, Revision 9, Section 2.4.7, “Ice Effects,” addresses site-specific ice effects. The COL applicant addressed the information as follows:

<u>*COL Item:*</u>

- NAPS COL 2.0-18-A — Ice Effects, COL Applicant to supply site-specific information in accordance with SRP 2.4.7

The COL applicant incorporated by reference ESP SSAR Section 2.4.7 to address DCD COL Item 2.0-18-A and provided updated site-specific information to supplement ESP SSAR Section 2.4.7. The COL applicant described the potential for ice formation at the North Anna 3 station water intake building and at the intake trash racks or intake screens. The COL applicant stated that the emergency cooling water for North Anna 3 is provided from the UHS, which is not affected by ice conditions, and that the normal cooling systems for North Anna 3 are not safety-related systems. The COL applicant further clarified that the water intake and associated pumps for North Anna 3 do not perform safety-related functions and that the makeup water supply from the North Anna 3 intake is not safety-related.

2.4.7.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission’s regulations related to ice effects, and the associated acceptance criteria, are contained in Section 2.4.7 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 ice effects presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item 2.0-18-A), are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

The related acceptance criteria from SRP Section 2.4.7 are as follows:

- Historical Ice Accumulation: The application should include a complete history of ice formation at and in the vicinity of the site.

- High and Low Water Levels: The application should include estimates of water levels resulting from potential ice flooding or low flows.

- Ice Sheet Formation: The application should include estimates of the most severe ice sheet formation in water storage reservoirs.

- Ice-induced Forces and Blockages: The application should provide estimates of the most severe ice-induced forces on safety-related SSC.

- Consideration of Other Site-Related Evaluation Criteria: The application should demonstrate that the potential effects of site-related proximity, seismic, and nonseismic information as they relate to worst-case icing scenarios adjacent to and on the plant site and site regions are appropriately take into account.

In addition, the hydrologic characteristics should be consistent with appropriate sections from: RGs 1.27, 1.29, 1.59, as supplemented by best current practices, and RG 1.102.

2.4.7.4 Technical Evaluation

As documented in Section 2.4.7 of NUREG-1966 and Section 2.4.7 of NUREG-1835, the staff reviewed and approved information related to ice effects for the certified ESBWR DCD, Revision 10, and Section 2.4.7 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.7 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Ice Effects."

The staff's technical review of this application is limited to reviewing the supplemental information pertaining to ESBWR DCD COL 2.0-18-A, as addressed below:

The applicant incorporated by reference ESP SSAR Section 2.4.7 to address DCD COL Item 2.0-18-A and provided updated site-specific information to supplement ESP SSAR Section 2.4.7, related to ice effects. As stated in Section 2.4.1 of this SER, the staff confirmed that neither Lake Anna nor the WHTF will be used for safety-related withdrawals, and that the

UHS does not require an external source of safety-related makeup water. Therefore, the staff concludes that no safety-related systems or water supplies are affected by ice.

The staff also reviewed the additional information concerning surface ice and roof loads provided in the North Anna 3 COL FSAR, which states that the snow depths and winter PMP was discussed in North Anna 3 COL FSAR Section 2.3.1.3.4. The staff determined that the additional information was consistent with the information in the ESP SSAR, which has already been accepted in the ESP FSER (NUREG-1835).

2.4.7.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.7.6 Conclusion

The staff reviewed the application and checked the referenced North Anna ESP SSAR and staff's ESP FSER (NUREG-1835). The staff's review confirmed that the applicant has addressed the relevant information and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section.

As set forth above, the applicant has presented and has substantiated information relative to the ice effects important to the design and siting of this plant. The staff reviewed the available information provided. For the reasons given above, the staff concluded that the identification and consideration of the potential for ice flooding, ice blockage of water intakes, ice forces on structures, and the minimum low water levels (from an upstream ice blockage) are acceptable and meet the requirements of 10 CFR 52.79 and 10 CFR 100.20(c), with respect to determining the acceptability of the site for the ESBWR design.

The staff finds that the applicant has considered the appropriate site phenomena for establishing the design basis for SSCs important to safety. The staff accepted the methodologies used to determine the potential for ice formation and blockage reflected in the site characteristics documented in the ESP FSER. Accordingly, the staff concluded that the use of these methodologies results in site characteristics containing a sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concluded that the identified site characteristics meet the requirements of 10 CFR 52.79 and 10 CFR 100.20(c), with respect to establishing the design basis for SSCs important to safety.

2.4.8 Cooling Water Canals and Reservoirs

2.4.8.1 Introduction

The cooling water canals and reservoirs used to transport and impound water supplied to the SSCs important to safety are reviewed to verify their hydraulic design basis. The specific areas of review are as follows: (1) design bases postulated and used by the applicant to protect structures such as riprap, inasmuch as they apply to safety-related water supply; (2) design bases of canals pertaining to capacity, protection against wind waves, erosion, sedimentation, and freeboard and the ability to withstand a PMF (surges, etc.), inasmuch as they apply to a safety-related water supply; (3) design bases of reservoirs pertaining to capacity, PMF design basis, wind wave and run-up protection, discharge facilities (e.g., low-level outlet, spillways, etc.), outlet protection, freeboard, and erosion and sedimentation processes inasmuch as they apply to a safety-related water supply; (4) potential effects of seismic and nonseismic information on the postulated hydraulic design bases of canals and reservoirs for the proposed plant site; and, (5) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.8.2 Summary of Application

North Anna 3 COL FSAR Section 2.4.8, "Cooling Water Canals and Reservoirs," addresses the need for site-specific information on the use of cooling water canals and reservoirs. The COL applicant addressed the information as follows:

<u>*COL Items:*</u>

• NAPS COL 2.0-19-A	Cooling Water Canals and Reservoirs, COL Applicant to supply site-specific information in accordance with SRP 2.4.8

The COL applicant incorporated by reference ESP SSAR Section 2.4.8 to address ESBWR DCD COL Item 2.0-19-A.

- NAPS ESP COL 2.4-8

The COL applicant provided updated site-specific information to supplement ESP SSAR Section 2.4.8 to confirm that the North Anna Reservoir and WHTF, which comprise Lake Anna, are not used for safety-related water withdrawals for North Anna 3. The emergency cooling water for North Anna 3 comes from the UHS, as described in ESBWR DCD Section 9.2.5 and North Anna 3 COL FSAR Section 9.2.5.

2.4.8.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission's regulations related to cooling water canals and reservoirs, and the associated acceptance criteria, are contained in Section 2.4.8 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 cooling water canals and reservoirs presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item 2.0-19-A and NAPS ESP COL Item 2.4-8), are based on meeting the following relevant requirements of 10 CFR Parts 52 and 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d) sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves the site.

The related acceptance criteria from SRP Section 2.4.8 are as follows:

- Hydraulic Design Bases for Protection of Structures: To meet the requirements of 10 CFR Part 100, a complete description of the hydraulic design bases for protection of structures is needed.

- Hydraulic Design Bases of Canals: To meet the requirements of 10 CFR Part 100, a complete description of the hydraulic design bases related to the capacity, protection against wind waves, erosion, sedimentation, and freeboard, and the ability to withstand a PMF, surges, etc., is needed.

- Hydraulic Design Bases of Reservoirs: To meet the requirements of 10 CFR Part 100, a complete description of the design bases of safety-related reservoirs related to their capacity, PMF design basis, wind wave and run-up protection, discharge facilities (e.g., low-level outlet, spillways, etc.), outlet protection, freeboard, and erosion and sedimentation processes is needed.

- Consideration of Other Site-Related Evaluation Criteria: To meet the requirements of 10 CFR Part 100, a complete description of the potential effects of site-related proximity, seismic, and non-seismic information on the postulated design bases of safety-related canals and reservoirs is needed.

In addition, the hydrologic characteristics should be consistent with appropriate sections from RGs 1.27, 1.29, 1.59, as supplemented by best current practices, RG 1.102, and RG 1.125, "Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants."

2.4.8.4 Technical Evaluation

As documented in Section 2.4.8 of NUREG-1966 and Section 2.4.8 of NUREG-1835, the staff reviewed and approved information related to cooling water canals and reservoirs for the certified ESBWR DCD, Revision 10, and Section 2.4.8 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.8 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR that represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Cooling Water Canals and Reservoirs."

The staff's technical review of this application was limited to reviewing the supplemental information pertaining to NAPS COL 2.0-19-A and ESP COL Action Item 2.4-8, as addressed below:

The COL applicant incorporated by reference ESP SSAR Section 2.4.8 to address ESBWR DCD COL Item 2.0-19-A, related to cooling water canals and reservoirs. The staff determined that the additional information is consistent with the information provided in the ESP SSAR, which has already been accepted in the ESP FSER (NUREG-1835).

As described in Section 2.4.1 of this SER, the staff confirmed that the North Anna Reservoir and WHTF are not used for safety-related water withdrawals for North Anna 3.

2.4.8.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.8.6 Conclusion

The staff reviewed the COLA and checked the referenced ESP SSAR and the staff's ESP FSER. The staff's review confirmed that the COL applicant has addressed the required information and no outstanding information remains to be addressed in the COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.8 of NUREG–0800, and NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the COL applicant has adequately addressed COL Item NAPS 2.0-19-A as it relates to cooling water canals and reservoirs.

As set forth above, the COL applicant has presented and substantiated information relative to the design bases of canals and reservoirs important to the design and citing of this plant. The staff has reviewed the available information provided and for the reasons given above, concludes that the identification and consideration of the design bases of canals and reservoirs is acceptable and meets the requirements of 10 CFR 52.79(a)(1)(iii), 10 CFR 100.20(c), and 10 CFR 100.23(d), with respect to determining the acceptability of the site.

2.4.9 Channel Diversions

Plant and essential water supplies used to transport and impound water supplies were evaluated to ensure that they will not be adversely affected by stream or channel diversions. The review includes stream channel diversions away from the site (which may lead to a loss of safety-related water) and stream channel diversions toward the site (which may lead to flooding). In addition, in such an event, the applicant needs to show that alternate water supplies are available to safety-related equipment. The specific areas of review are as follows: (1) historical channel migration phenomena including cutoffs, subsidence, and uplift; (2) regional topographic evidence that suggests a future channel diversion may or may not occur (used in conjunction with evidence of historical diversions); (3) thermal causes of channel diversion, such as ice jams, which may result from downstream ice blockages that may lead to flooding from backwater or upstream ice blockages that can divert the flow of water away from the intake; (4) potential for forces on safety-related facilities or the blockage of water supplies resulting from channel migration-induced flooding (flooding not addressed by hydrometeorological-induced flooding scenarios in other sections); (5) potential of channel diversion from human-induced causes (i.e., land-use changes, diking, channelization, armoring, or failure of structures); (6) alternate water sources and operating procedures; (7) potential effects of seismic and nonseismic information on the postulated worst-case channel diversion scenario for the proposed plant site; and, (8) any additional information requirement prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

The COL applicant incorporated by reference ESP SSAR Section 2.4.9 with no supplement or departure to address DCD COL Item 2.0-20-A, related to channel diversions. The staff reviewed the COLA and checked the referenced ESP SSAR and the staff's ESP FSER. The staff confirmed that no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

2.4.10 Flooding Protection Requirements

2.4.10.1 Introduction

The flooding protection requirements address the locations and elevations of safety-related facilities and those of structures and components required for protection of safety-related facilities. These requirements are then compared with design-basis flood conditions to determine whether flood effects need to be considered in the plant's design or in emergency procedures. The specific areas of review are as follows: (1) safety-related facilities exposed to flooding; (2) type of flood protection (e.g., "hardened facilities," sandbags, flood doors, bulkheads, etc.) provided to the SSCs exposed to floods; (3) emergency procedures needed to implement flood protection activities and warning times available for their implementation reviewed by the organization responsible for reviewing issues related to plant emergency procedures; (4) potential effects of seismic and nonseismic information on the postulated flooding protection for the proposed plant site; and, (5) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.10.2 Summary of Application

The North Anna 3 COL FSAR Section 2.4.10, "Flooding Protection Requirements," address the needs for site-specific information on flooding protection. The COL applicant addressed the information as follows:

COL Items:

- NAPS COL 2.0-21-A — Flooding Protection Requirements, COL Applicant to supply site-specific information in accordance with SRP 2.4.10

The COL applicant incorporated by reference ESP SSAR Section 2.4.10 to address ESBWR DCD COL Item 2.0-21-A and provided updated site-specific information to supplement ESP SSAR Section 2.4.10. The COL applicant described the results of the local PMP drainage analysis presented in North Anna 3 COL FSAR Section 2.4.2.3. The COL applicant stated that the maximum water-surface elevation within drainage ditches in the powerblock area would be 87.90 m (288.4 ft) NAVD88 or 0.49 m (1.6 ft) below the plant grade of 88.39 m (290.0 ft) NAVD88. In response to staff's RAI 02.04.02-15 (ADAMS Accession Nos. ML15022A199 and ML16229A451), the COL applicant stated that an analysis of sheet flow resulting from local intense precipitation between buildings in the powerblock area indicated that water levels would exceed the floor elevations of safety-related SSCs at three entrance locations. To prevent sheet flow from entering the RB and CB, the COL applicant committed to installing curbs at the entrances or to ensure that the door thresholds would be above the maximum sheet-flow elevations. The COL applicant proposed revisions to North Anna 3 COL FSAR Section 2.4.10 to describe flood protection measures. The staff verified that the appropriate text changes are incorporated in the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.10-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

- NAPS ESP COL 2.4-9 Slope Embankment Protection

The COL applicant provided updated site-specific information to supplement ESP SSAR Section 2.4.10 to address ESP COL Action Item 2.4-9. The COL applicant indicated that the North Anna 3 water intake building will be separated from Lake Anna by an elevated berm that will protect it from flood events up to a 100-year flood on the lake. Rip-rap protection of the slope embankment is provided to protect against local erosion near the intake structure. The COL applicant noted that the North Anna 3 water intake is not a safety-related structure.

2.4.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835 the FSER related to the North Anna 3 ESP. In addition, the guidance relevant to the Commission's regulations related to flood protection requirements, and the associated acceptance criteria, are given in Section 2.4.10 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 flooding protection requirements presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item NAPS COL 2.0-21-A and NAPS ESP COL Item 2.4-9), are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d) sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves the site.

The related acceptance criteria from SRP Section 2.4.10 are as follows:

- Safety-related Facilities Exposed to Flooding: To meet the requirements of 10 CFR Part 100, identification of all SSC exposed to flooding is needed.

- Type of Flood Protection: To meet the requirements of 10 CFR Part 100, an evaluation of the applicant's proposed flood protection measures is needed.

- Emergency Procedures: To meet the requirements of 10 CFR Part 100, a listing of proposed emergency procedures is needed.

- Consideration of Other Site-Related Evaluation Criteria: To meet the requirements of 10 CFR Part 100, an assessment regarding the potential effects of site-related proximity, seismic, and non-seismic information on the postulated flooding protection is needed.

In addition, the hydrologic characteristics should be consistent with appropriate sections from: RGs 1.29, 1.59, as supplemented by best current practices, and RG 1.102.

2.4.10.4 Technical Evaluation

As documented in Section 2.4.10 of NUREG-1966 and Section 2.4.10 of NUREG-1835, the staff reviewed and approved information related to flooding protection requirements for the certified ESBWR DCD, Revision 10, and Section 2.4.10 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.10 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic. The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Flooding Protection Requirements."

The elevation of the design plant grade for North Anna 3 is 88.39 m (290.0 ft) NAVD88. This elevation is approximately 6.10 m (20 ft) above the maximum flood level at the site resulting from a PMF in Lake Anna's watershed, the simultaneous failure of upstream storage reservoirs, and coincident wave action (82.30 m [270 ft] NAVD88).

The staff's technical review in this section was limited to the supplemental information pertaining to ESBWR DCD COL Item 2.0-21-A and ESP COL Action Item 2.4-9, and to the flooding protection described in the response to RAI 02.04.02-15, as addressed below.

The staff reviewed the resolution to the ESBWR DCD COL Item 2.0-21-A, related to flooding protection requirements, and the comparison with design-basis flood conditions to determine whether flood effects need to be considered in the plant's design or in emergency procedures included under North Anna 3 COL FSAR Section 2.4.10. As described in Section 2.4.2 of this SER, the COL applicant stated in the response to RAI 02.04.02-15 (ADAMS Accession Nos. ML15022A199 and ML16229A451), that the maximum flood elevation resulting from local intense precipitation exceeds the entrance elevations to some safety-related structures. The COL applicant will take action to provide flood protection measures at the following locations (the floor elevation at all three locations is 88.39 m [290.0 ft] NAVD88):

- CB south stairway emergency exit, maximum water surface elevation of 88.48 m (290.3 ft) NAVD88 (Area 2);

- CB north stairway emergency exit, maximum water surface elevation of 88.51 m (290.4 ft) NAVD88 (Area 3); and

- RB north wall equipment access door, maximum water surface elevation of 88.45 m (290.2 ft) NAVD88 (Area 4).

The COL applicant stated that the flood protection would be provided by installing curbs at the door entrances or by ensuring that door thresholds are above the maximum water surface elevations. The staff reviewed the COL applicant's response to RAI 02.04.02-15 (ADAMS Accession Nos. ML15022A199 and ML16229A451), and concluded that the proposed measures provide the required flood protection. The staff verified that the appropriate text changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.10-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

As described in Section 2.4.1 of this SER, the UHS design for the ESBWR relies on an internal makeup water supply during the initial 7 days following an accident and the makeup water source beyond 7 days is not required to be safety-related. In addition, the staff confirmed that

Lake Anna will not be used for safety-related UHS withdrawals. Accordingly, the staff determined that the intake structure is not a safety-related structure and is not credited for safety-related functions. However, the structure has protection features that the applicant addressed in ESP COL Action Item 2.4-9 as applicable.

2.4.10.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.10.6 Conclusion

The staff reviewed the COLA and checked the referenced North Anna ESP SSAR and staff's ESP FSER. The staff's review confirmed that the COL applicant has addressed the required information and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.10 of NUREG–0800, and NRC RGs. The staff's review concludes that the applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed COL Item NAPS 2.0-21-A as it relates to flooding protection requirements.

As set forth above, the applicant has presented and substantiated information relative to the flood protection measures important to the design and siting of this plant. The staff has reviewed the available information provided and for the reasons given above, concludes that the identification and consideration of the flood protection measures is acceptable and meets the requirements of 10 CFR 52.79(a)(1)(iii), 100.20(c), and 100.23(d), with respect to determining the acceptability of the site.

2.4.11 Low Water Considerations

2.4.11.1 Introduction

The low water considerations address natural events that may reduce or limit the available safety-related cooling water supply. The applicant ensures that an adequate water supply will exist to shut down the plant under conditions requiring safety-related cooling. The specific areas of review are as follows: (1) worst drought considered reasonably possible in the region; (2) effects of low water surface elevations caused by various hydrometeorological events and a potential blockage of intakes by sediment, debris, littoral drift, and ice because they can affect the safety-related water supply; (3) effects on the intake structure and pump design bases in relation to the events described in North Anna 3 COL FSAR Sections 2.4.7, 2.4.8, 2.4.9, and 2.4.11, which consider the range of water supply required by the plant (including minimum operating and shutdown flows during anticipated operational occurrences and emergency conditions) compared with availability (considering the capability of the UHS to provide adequate cooling water under conditions requiring safety-related cooling); (4) use limitations imposed or under discussion by Federal, State, or local agencies authorizing the use of the water; (5) potential effects of seismic and nonseismic information on the postulated worst-case low water scenario for the proposed plant site; and, (6) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.11.2 Summary of Application

The North Anna 3 COL FSAR Section 2.4.11, “Low Water Considerations,” addresses the impacts of low water on site water supply. The COL applicant addressed the information as follows:

<u>COL Items:</u>

- NAPS COL 2.0-22-A — Cooling Water Supply, COL Applicant to supply site-specific information in accordance with SRP 2.4.11.

The COL applicant incorporated by reference ESP SSAR Section 2.4.11 to address DCD COL Item 2.0-22-A.

- NAPS ESP COL 2.4-10

The COL applicant provided updated site-specific information to supplement ESP SSAR Sections 2.4.11.5, “Plant Requirements,” and 2.4.11.6, “Heat Sink Dependability Requirements,” to address ESP COL Action Item 2.4-10.

<u>Early Site Permit Variances:</u>

- NAPS ESP VAR 2.4-4

The COL applicant provided updated site-specific information to supplement ESP SSAR Sections 2.4.11.1, “Low Flow in Streams,” which states that the operating level of Lake Anna will be 76.01 m (249.39 ft) NAVD88 with the addition of Unit 3. In addition, ESP SSAR Section 2.4.11.4, “Future Controls,” provides supplemental information on the water budget and low water levels with the operation of North Anna 3.

2.4.11.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission’s regulations related to low water considerations, and the associated acceptance criteria, are contained in Section 2.4.11 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 low water consideration requirements is presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item NAPS COL 2.0-22-A, NAPS ESP VAR 2.4-4 and NAPS ESP COL Item 2.4-10), are based on meeting the following relevant requirements of 10 CFR Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d) sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves the site.

The related acceptance criteria from SRP Section 2.4.11 are as follows:

- Low Water from Drought: To meet the requirements of 10 CFR Part 100, a complete history of low water conditions at and in the vicinity of the site is needed.

- Low Water from Other Phenomena: To meet the requirements of 10 CFR Part 100, a complete history of low water conditions, caused by phenomena other than a drought, at and in the vicinity of the site is needed.

- Effect of Low Water on Safety-Related Water Supply: To meet the requirements of 10 CFR Part 100, a thorough description of all safety-related water supply requirements and the effects of the most severe low water event reasonably possible at or in the vicinity of the site is needed.

- Water Use Limits: To meet the requirements of 10 CFR Part 100, a thorough description of water use and discharge limitations (both physical and legal), already in effect or under discussion by responsible Federal, regional, State, or local authorities, that may affect water supply at the plant that have been considered and are substantiated by reference to reports of the appropriate agencies is needed.

- Consideration of Other Site-Related Evaluation Criteria: To meet the requirements of 10 CFR Part 100, the applicant should provide an assessment of the potential effects of site-related proximity, seismic, and non-seismic information on the postulated worst-case low-flow scenario for the proposed plant site

2.4.11.4 Technical Evaluation

As documented in Section 2.4.11 of NUREG-1966 and Section 2.4.11 of NUREG-1835, the staff reviewed and approved information related to low water considerations for the certified ESBWR DCD, Revision 10, and Section 2.4.11 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.11 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Low Water Considerations."

The staff's technical review of this application is limited to the supplemental information pertaining to DCD COL 2.0-22-A, NAPS ESP COL Action Item 2.4-10, and NAPS ESP VAR 2.4-4 as addressed below.

<u>*COL Items:*</u>

- NAPS COL 2.0-22-A — Cooling Water Supply, COL Applicant to supply site-specific information in accordance with SRP 2.4.11.

The staff reviewed the resolution to ESBWR DCD COL Item 2.0-22-A, related to low water considerations to ensure that an adequate water supply will exist to shut down the plant under conditions requiring safety-related cooling, included under North Anna 3 COL FSAR Section 2.4.11. The applicant provided supplemental information in North Anna 3 COL FSAR Section 2.4.11.4, in which the water budget for Lake Anna was updated using the ESBWR operational cooling requirements. The staff finds that the additional information is consistent with the information in the ESP SSAR as accepted in the ESP FSER.

- NAPS ESP COL 2.4-10

The COL applicant indicated that the North Anna 3 CWS has two modes of operation: energy conservation (when Lake Anna water level is at or above an elevation of 75.94 m (249.14 ft) NAVD88 at the North Anna Dam), and maximum water conservation (when the water level is below an elevation of 75.94 m (249.14 ft) NAVD88 and is not restored within a reasonable period of time). The COL applicant stated that North Anna 3 will be required to shut down when the Lake Anna water elevation decreases below 73.50 m (241.14 ft) NAVD88. The COL applicant stated that the North Anna 3 UHS does not rely on Lake Anna as a safety-related water source and staff determined that ESP COL Action Item 2.4-10 was addressed by the applicant as required.

Early Site Permit Variances:

- NAPS ESP VAR 2.4-4

As described in Section 2.4.1 of this SER, the staff confirmed that neither Lake Anna nor the WHTF will be used for safety-related withdrawals, and that the UHS does not require an external source of safety-related makeup water. Based on the UHS cooling system design specified in North Anna 3 COL FSAR Section 9.2.5, the staff accepted NAP ESP VAR 2.4-4.

2.4.11.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.11.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR and staff's ESP FSER (NUREG-1835). The staff's review confirmed that the applicant has addressed the required information, and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.11 of NUREG–0800, and NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed COL Item NAPS 2.0-22-A as it relates to low water considerations.

As set forth above, the applicant has presented and substantiated information relative to the low water effects important to the design and siting of this plant. The staff reviewed the available information provided and for the reasons given above, concludes that the identification and consideration of the potential for low water conditions are acceptable and meet the requirements of 10 CFR 52.79(a)(1)(iii), 10 CFR 100.20(c), and 10 CFR 100.23(d), with respect to determining the acceptability of the site.

The staff finds that the applicant has considered the appropriate site phenomena in establishing the design bases for SSCs important to safety. The staff accepted the methodologies used to determine the potential for low water conditions reflected in the site characteristics documented in the ESP FSER. Accordingly, the staff concluded that the use of these methodologies results in design bases containing a sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concluded that the identified design bases meet the requirements of 10 CFR 100.20(c) with respect to establishing the design basis for SSCs important to safety.

2.4.12 Groundwater

2.4.12.1 Introduction

This section describes the hydrogeological characteristics of the site. One of the key objectives of groundwater investigations and monitoring at this site is to evaluate the maximum groundwater-surface elevation at the site, which is used in Section 2.5 of this report to determine the effects of groundwater on the stability of plant foundations and slopes. The evaluation is performed to ensure that the maximum groundwater-surface elevation remains less than the ESBWR DCD site parameter value of 0.61 m (2 ft) below plant grade. Other significant objectives are to examine whether groundwater provides any safety-related water supply, to determine whether dewatering systems are required to maintain groundwater-surface elevations below the required elevation, and to describe subsurface pathways for potential groundwater contaminants.

The specific areas of review are as follows: (1) identification of the aquifers, types of onsite groundwater use, sources of recharge, present withdrawals and known and likely future withdrawals, flow rates, travel time, gradients and other properties that affect the movement of accidental contaminants in groundwater, groundwater-surface elevations beneath the site, seasonal and climatic fluctuations, monitoring and protection requirements, and man-made changes that have the potential to cause long-term changes in local groundwater regime; (2) effects of groundwater-surface elevations and other hydrodynamic effects of groundwater on design bases of plant foundations and those of other SSCs important to safety; (3) reliability of groundwater resources and related systems used to supply safety-related water to the plant; (4) reliability of dewatering systems to maintain groundwater conditions within the plant's design bases; (5) potential effects of seismic and nonseismic information on the postulated worst-case groundwater conditions for the proposed plant site; and, (6) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.12.2 Summary of Application

The North Anna 3 COL FSAR Section 2.4.12, "Groundwater," incorporates by reference ESBWR DCD Tier 2 Chapter 2, "Site Characteristics." This section of the North Anna 3 COL FSAR addresses the groundwater in terms of effects on structures and water supply. All elevations in this SER here and elsewhere are referenced to the NAVD88.

In addition, in North Anna 3 COL FSAR Section 2.4.12, the COL applicant addressed the following COL items:

COL Item:

- COL Item 2.0-12-A — Hydraulic Description Maximum Ground Water Level, per ESBWR DCD Tier 2, Table 2.0-1, 0.61 m (2 ft) below plant grade.

- COL Item 2.0-23-A — Groundwater, COL applicant to supply site-specific information in accordance with SRP 2.4.12.

To address these COL Items, the COL applicant incorporated by reference ESP SSAR Section 2.4.12. The COL applicant provided updated site-specific information to supplement or replace ESP SSAR sections as follows:

- The COL applicant described the local hydrogeology of the site, including the saprolite and bedrock hydrogeologic units, groundwater level measurements, hydraulic gradients, groundwater flow directions, hydraulic conductivity data, porosity data, and groundwater velocity. The COL applicant stated that the saprolite and bedrock are hydrologically connected. The COL applicant estimated a groundwater velocity of 0.11 m/d (0.35 ft/d) and a groundwater travel time to the Lake Anna shoreline of 7.8 yr. from the radwaste building and 6 yr. from the condensate storage tank (CST);

- The COL applicant stated that groundwater from six wells is currently used to supply water for North Anna Units 1 and 2, the North Anna Nuclear Information Center (NANIC), the security training building, and the Meteorology/Environmental Laboratory. The COL applicant provided well capacities and monthly usage data for the wells serving Units 1 and 2, and stated that groundwater will not be used for safety-related purposes for North Anna 3;

- The COL applicant described the groundwater monitoring for the ESP and COL subsurface investigations, and stated that groundwater levels will be monitored monthly during any dewatering activities, quarterly for two years after completion of construction, and semi-annually or annually during operation; and

- The COL applicant described the site characteristics, including the maximum operational groundwater-surface elevation, for groundwater-induced hydrostatic loadings on subsurface portions of safety-related SSCs. The COL applicant developed and applied a groundwater model of the North Anna 3 site and the surrounding area to evaluate post-construction groundwater-surface elevations. The COL applicant stated that the maximum groundwater elevation around seismic Category 1 structures was 86.1 m (282.6 ft), or 2.3 m (7.4 ft) below the North Anna 3 plant grade of 88.39 m (290 ft). The COL applicant stated that, based on the groundwater design bases described in ESBWR DCD Section 3.4 and comparison with the ESBWR DCD site parameter value for maximum groundwater level, a permanent dewatering system is not required.

Early Site Permit Variances

The following variances from the ESP SSAR are discussed in Section 2, “Variances,” of Part 7 to the COLA:

- NAPS ESP VAR 2.0-2 Hydraulic Conductivity

The COL applicant requested VAR 2.0-2 to the ESP SSAR hydraulic conductivity value and used higher maximum and geometric mean values in FSAR Section 2.4.12.1.2.

- NAPS ESP VAR 2.0-3 Hydraulic Gradient

The COL applicant requested VAR 2.0-3 to the ESP SSAR hydraulic gradient value and used a higher value in FSAR Section 2.4.12.1.2.

- NAPS ESP VAR 2.4-1 Void Ratio, Porosity, and Seepage Velocity

The COL applicant requested VAR 2.4-1 to the ESP SSAR values for void ratio, porosity (total and effective), and seepage velocity and estimated lower values for void ratio and porosity, and a higher value for seepage velocity, in FSAR Section 2.4.12.1.2.

- NAPS ESP VAR 2.4-2 NAPS Water Supply Well Information

The COL applicant requested VAR 2.4-2 to use revised information for the water supply well information and provided FSAR Table 2.4-17R to correct certain information in the ESP SSAR Table 2.4-17.

- NAPS ESP VAR 2.4-3 Well Reference Point Elevation

The COL applicant requested VAR 2.4-3 to use revised information for the reference point elevation of observation well WP-3 and provided FSAR Table 2.4-15R to correct groundwater level information for this well originally appearing in ESP SSAR Table 2.4-15.

2.4.12.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835 the FSER related to the North Anna ESP. In addition, the guidance relevant to the Commission's regulations related to ground water considerations, and the associated acceptance criteria, are contained in Section 2.4.12 of NUREG-0800 SRP.

The acceptance criteria for the North Anna 3 ground water consideration requirements presented in the North Anna 3 COL FSAR, beyond that presented in the ESP SSAR (i.e., NAPS COL Item NAPS COL 2.0-12-A, 2.0-23-A, NAPS ESP VAR 2.0-2, 2.0-3, 2.4-1, 2.4-2, and 2.4-3), are based on meeting the following relevant requirements of 10 CFR) Part 52 and 10 CFR Part 100:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d) sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves the site.

The related acceptance criteria from SRP Section 2.4.12 are as follows:

- Local and Regional Groundwater Characteristics and Use: To meet the requirements of 10 CFR 50.55a, “Codes and Standards,” 10 CFR 100.20(c)(3), 10 CFR 100.23(d), and 10 CFR 100.20(c), a complete description of regional and local groundwater aquifers, sources, and sinks, local and regional groundwater use, present and known and likely future withdrawals, regional flow rates, travel time, gradients, and velocities, subsurface properties that affect movement of contaminants in the groundwater, groundwater levels including their seasonal and climatic fluctuations, groundwater monitoring and protection requirements, and any manmade changes with a potential to affect regional groundwater characteristics over a long period of time is needed.

- Effects on Plant Foundations and other Safety-Related SSCs: To meet the requirements of 10 CFR 50.55a, 100.20(c)(3), 100.23(d), and 100.20(c), a complete description of the effects of groundwater levels and other hydrodynamic effects on the design bases of plant foundations and other SSC important to safety is needed.

- Reliability of Groundwater Resources and Systems Used for Safety-Related Purposes: To meet the requirements of 10 CFR 50.55a, 100.20(c)(3), 100.23(d), and 100.20(c), a complete description of all SSC important to safety that depend on groundwater is needed.

- Reliability of Dewatering Systems: To meet the requirements of 10 CFR 50.55a, 100.20(c)(3), 100.23(d), and 100.20(c), a complete description of the site dewatering system, including its reliability to maintain the groundwater conditions within the groundwater design bases of SSC important to safety is needed.

2.4.12.4 Technical Evaluation

As documented in Section 2.4.12 of NUREG-1966 and Section 2.4.12 of NUREG-1835, the staff reviewed and approved information related to groundwater for the certified ESBWR DCD, Revision 10, and Section 2.4.12 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.12 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic.

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to “Groundwater.”

The staff’s technical review of this application was limited to reviewing the supplemental information pertaining to COL Items 2.0-12-A and 2.0-23-A and to variances NAPS ESP VAR 2.0-2, NAPS ESP VAR 2.0-3, NAPS ESP VAR 2.4-1, NAPS ESP VAR 2.4-2, and NAPS ESP VAR 2.4-3 as addressed below.

The staff’s discussion of groundwater characteristics is organized into technical areas as described below. Variances are described where appropriate within these areas.

General Hydrogeological Characteristics of the Site

Information Submitted by COL Applicant:

The COL applicant's description of the regional hydrogeology and groundwater conditions was described in ESP SSAR Section 2.4.12 and is incorporated by reference into the North Anna 3 COL FSAR with no supplements or variances.

The COL applicant's description of the site hydrogeology and groundwater conditions was supplemented based on the results of a North Anna 3 subsurface field investigation conducted from August to November of 2006 and two supplemental investigations conducted from September to October of 2009, as described in North Anna 3 COL FSAR Section 2.5.4.2.3. This investigation included 93 exploratory borings and the installation of seven observation wells.

The North Anna 3 COL FSAR used the same classification of subsurface materials as in the ESP SSAR. The COL applicant classified subsurface materials as crystalline parent bedrock, weathered rock, saprolite of 10 to 50 percent core stone, saprolite of less than 10 percent core stone, residual soil, and fill. The COL applicant stated that the borings described in the ESP SSAR and the North Anna 3 COL FSAR penetrated saprolite with a maximum thickness of 34.7 m (114 ft) and a median thickness of 11.3 m (37 ft). The COL applicant stated that groundwater at the site occurs in the saprolite and in the fractures of the bedrock. Of the seven wells installed as part of the North Anna 3 subsurface field investigation, the COL applicant stated that four were completed in rock and three were completed in soil/weathered rock. The COL applicant stated that the bedrock and saprolite are hydraulically connected, that groundwater heads observed in well pairs completed at different elevations were nearly equal, that the water table at the site reflects the ground surface topography, and that the groundwater flow at the site is toward areas of lower ground surface elevation.

The Staff's Technical Evaluation:

The staff reviewed the supplemental information provided in the North Anna 3 COL FSAR regarding site hydrogeology and groundwater conditions. The staff determined that the methods used were appropriate, and that the supplemental information was consistent with the overall picture of site conditions presented in the ESP SSAR.

The staff evaluated the site groundwater head measurements provided in North Anna 3 COL FSAR Table 2.4-15R and illustrated in North Anna 3 COL FSAR Figure 2.4-205 and North Anna 3 COL FSAR Figures 2.4-207 through 2.4-214. The staff determined that the data obtained in 2006 and 2007 were consistent with earlier measurements. Groundwater flow direction from the North Anna 3 reactor area is generally to the northeast toward Lake Anna. Three of the wells installed as part of the North Anna 3 subsurface field investigation were located adjacent to and deeper than existing wells, providing a total of four well pairs that the staff used to evaluate vertical groundwater head gradients at the site. The staff determined that vertical groundwater head gradients were small and upward for three of the well pairs, but were higher and downward for the well pair located near the North Anna 3 intake (observation wells OW-848 and OW-950). Based on the observed vertical gradients in the well pairs, the staff concluded that the shallow bedrock and saprolite units are hydraulically connected, with vertical gradients between the units generally small, but significant at some locations.

Plant Groundwater Use

Information Submitted by COL Applicant:

The COL applicant stated that any groundwater required will not be used for safety-related functions at North Anna 3 (North Anna 3 COL FSAR Section 2.4.12.1.3, “Plant Groundwater Use”).

The Staff’s Technical Evaluation:

The staff determined that the groundwater supply’s lack of safety function is consistent with the uses stated for groundwater and with provisions for safety-related water supply from other sources, as described in the North Anna 3 COL FSAR.

Hydraulic Conductivity (NAPS ESP VAR 2.0-2)

Information Submitted by COL Applicant:

The COL applicant conducted slug tests in four of the seven wells installed as part of the North Anna 3 subsurface field investigation (three soil/weathered rock wells and one bedrock well) to supplement the existing data used to estimate hydraulic conductivities in the saprolite and the shallow bedrock. The COL applicant conducted packer tests in a borehole adjacent to one of the bedrock wells to estimate the hydraulic conductivity of the shallow bedrock. Using these supplemental data, the COL applicant estimated hydraulic conductivity for the saprolite of 0.076 to 3.017 m/d (0.25 to 9.9 ft/d) with a geometric mean of 0.53 m/d (1.74 ft/d) (as compared to a range of 0.06 to 1.04 m/d and a geometric mean of 0.40 m/d from the ESP SSAR). The COL applicant estimated hydraulic conductivity for the shallow bedrock of 0.152 to 1.920 m/d (0.5 to 6.3 ft/d) with a geometric mean of 0.625 m/d (2.05 ft/d) (compared to a range of 0.61 to 0.91 m/d from the ESP SSAR).

The maximum hydraulic conductivity of 3.0 m/d in North Anna 3 COL FSAR Section 2.4.12.1.2 is higher than the hydraulic conductivity site characteristic in Appendix A of the North Anna ESP. The ESP site characteristic hydraulic conductivity of 1.0 m/d was based on the data obtained during the ESP subsurface field investigation. The additional hydraulic conductivity data obtained during the North Anna 3 field investigation resulted in a higher estimate of the maximum hydraulic conductivity.

In the COL Application Departures Report, the COL applicant identified the hydraulic conductivity variance (NAPS ESP VAR 2.0-2) and requested to use the North Anna 3 COL FSAR value of 3.0 m/d instead of the 1.04 m/d value in the ESP SSAR. The COL applicant provided the following two justifications for the request:

1) The COL applicant used a hydraulic conductivity value of 3.0 m/d in the groundwater transport analysis of North Anna 3 COL FSAR Section 2.4.13 and demonstrated compliance with the requirements of 10 CFR Part 20. The COL applicant stated that the radionuclide concentrations and associated doses calculated in North Anna 3 COL FSAR 2.4.13 are conservative because the hydraulic conductivity 3.0 m/d is the maximum observed at the North Anna 3 site; and

2) The groundwater flow model used in COL FSAR Section 2.4.12 to evaluate the maximum post-construction groundwater-surface elevation incorporated the data from the North Anna 3 subsurface field investigation, and the resulting maximum

groundwater-surface elevation satisfied the ESBWR DCD site characteristic on maximum groundwater level.

The Staff's Technical Evaluation:

The staff reviewed the supplemental slug test and packer test data in North Anna 3 COL FSAR Appendix 2.5.4AA and the resulting saturated hydraulic conductivities in North Anna 3 COL FSAR Table 2.4-16R. The staff determined that the methods used were appropriate and that the estimated conductivities were consistent with the previous estimates in the ESP SSAR. The supplemental data expanded the range of observed saturated hydraulic conductivity for both the saprolite and shallow bedrock, resulting in higher maximum hydraulic conductivity estimates than were provided in the ESP SSAR: 3.0 m/d for the saprolite and 1.9 m/d for the shallow bedrock. Because a saturated hydraulic conductivity value of 3.0 m/d is based on site-specific observations and is conservative, the staff concludes that this value is an appropriate site characteristic and accepts NAPS ESP VAR 2.0-2.

Hydraulic Gradient (NAPS ESP VAR 2.0-3)

Information Submitted by COL Applicant:

The maximum hydraulic gradient of 0.05 provided in FSAR Section 2.4.12.1.2 is higher than the hydraulic gradient site characteristic provided in Appendix A of the North Anna ESP. The ESP hydraulic gradient of 0.03 was based on the groundwater head measurements obtained during the ESP subsurface field investigation. The additional groundwater head measurements obtained during the North Anna 3 field investigation resulted in higher estimates of the maximum groundwater hydraulic gradient.

In the COL Application Departures Report, the COL applicant identified the hydraulic gradient variance (NAPS ESP VAR 2.0-3) and requested to use the North Anna 3 COL FSAR value of 0.05 instead of the value of 0.03 in the ESP SSAR. The COL applicant justified the use of the higher hydraulic gradient by demonstrating compliance with the 10 CFR Part 20, Appendix B, Table 2 concentration limits using the North Anna 3 COL FSAR hydraulic gradient value of 0.05 in the groundwater transport analysis of North Anna 3 COL FSAR Section 2.4.13.

The Staff's Technical Evaluation:

The staff evaluated horizontal groundwater head gradients at the North Anna 3 site using the groundwater head measurements provided in North Anna 3 COL FSAR Table 2.4-15R. The COL applicant used the maximum head at observation well OW-901 and the minimum head at well OW-950 to estimate the horizontal groundwater gradient between the RB and Lake Anna. Based on the observed heads, the staff concluded that although the local gradient at the RB is likely to be higher, 0.05 is a conservative estimate of the average gradient between the RB and Lake Anna. This value is conservative because the actual groundwater flow path would be longer than the straight-line distance between wells OW-901 and OW-950 used to compute the gradient. Because a groundwater hydraulic gradient of 0.05 is based on site-specific observations and is conservative, the staff concluded that this value was an appropriate site characteristic and accepts NAPS ESP VAR 2.0-3.

Void Ratio, Porosity, and Seepage Velocity (NAPS ESP VAR 2.4-1)

Information Submitted by COL Applicant:

The COL applicant used samples from the North Anna 3 field investigation boreholes to supplement the moisture content and specific gravity data used to estimate the void ratio and porosity. Based on laboratory tests of saprolite samples, the COL applicant determined that the median moisture content was 17 percent and the median specific gravity was 2.65. Using these values, the COL applicant estimated a void ratio of 0.45 with a resulting total porosity of 0.31. (The ESP SSAR estimated values of 26 percent for the average moisture content and 2.68 for the specific gravity, resulting in estimates of 0.7 for the void ratio and 0.41 for the porosity.) The COL applicant assumed the effective porosity was 80 percent of the total porosity, or 0.25. (This assumption was also made in determining the ESP SSAR effective porosity of 0.33.)

The COL applicant used the geometric mean saprolite hydraulic conductivity (0.53 m/d), the site characteristic hydraulic gradient of 0.05, and the effective porosity (0.25) to compute a groundwater seepage velocity of 0.11 m/d (0.35 ft/d) (compared to the ESP SSAR groundwater velocity of 0.037 m/d). Based on this velocity and a travel distance of 304.8 m between the radwaste building and Lake Anna, the COL applicant estimated a groundwater travel time of 7.8 yr. (as compared to the travel time of 40 yr. in the ESP SSAR for a distance of 549 m). Using a distance of 234.7 m (770 ft) from CST to Lake Anna, the COL applicant estimated a groundwater travel time of 6 yr.

In the COL Application Departures Report, the COL applicant identified the void ratio, porosity, and seepage velocity variance (NAPS ESP VAR 2.4-1) and requested to use the North Anna 3 COL FSAR values instead of the values in the ESP SSAR. The COL applicant justified the use of the North Anna 3 COL FSAR values by demonstrating compliance with the 10 CFR Part 20, Appendix B, Table 2 concentration limits in the groundwater transport analysis of North Anna 3 COL FSAR Section 2.4.13.

The Staff's Technical Evaluation:

The staff reviewed the data on gravimetric water content described in North Anna 3 COL FSAR Section 2.5.4 and the COL applicant's computation of porosity. While using conservative values (i.e., maximum observed) for the site characteristic hydraulic gradient and saturated hydraulic conductivity, the applicant used an average value for the site characteristic porosity. The staff reviewed the gravimetric water content data in Table 3.1 of North Anna 3 COL FSAR Appendix 2.5.4AA. Using a specific gravity of 2.65 as in North Anna 3 COL FSAR Section 2.4.12, the staff calculated average and minimum porosities for samples with less than 10 percent gravel and for samples with more than 10 percent gravel. Results are in Table 2.4.12-1 (compared to the applicant's total porosity estimate of 0.31, as presented in North Anna 3 COL FSAR Section 2.4.12.1.2). The staff determined that the large number of samples provides confidence in the median porosity value used by the COL applicant, and that the samples with lower average porosity (i.e., those with gravel greater than 10 percent) were few in number, not contiguous, and therefore unlikely to be evidence of a low porosity and high velocity pathway. Therefore the staff concluded that a total porosity estimate of 0.31 is appropriate for the groundwater transport analysis at the North Anna 3 site.

Table 2.4.12-1 Average and minimum porosity for soil samples with percentage of gravel greater than and less than 10 percent

	Gravel < 10%	Gravel > 10%
Number of Samples	102	7
Average Porosity	0.328	0.244
Minimum Porosity	0.129	0.053

The staff reviewed the computation of groundwater velocity using the COL applicant's site characteristic values of hydraulic gradient and effective porosity and the geometric mean saturated hydraulic conductivity for saprolite. The staff confirmed the COL applicant's groundwater velocity of 0.11 m/d provided in North Anna 3 COL FSAR Section 2.4.12.1.2. The staff also computed a more conservative groundwater velocity of 0.6 m/d using the COL applicant's maximum observed hydraulic conductivity (3.0 m/d). The staff determined that the higher groundwater velocity (3.0 m/d) was used by the COL applicant in the groundwater transport analysis of North Anna 3 COL FSAR Section 2.4.13. Although the staff determined that the available data do not provide evidence for a high permeability pathway between either the RW or the CST and Lake Anna, the staff concluded that the COL applicant's use of the maximum observed hydraulic conductivity in the transport analysis provided conservative estimates of accidental release concentrations and doses. Therefore, the staff accepts NAPS ESP VAR 2.4-1.

NAPS Water Supply Well Information (NAPS ESP VAR 2.4-2)

Information Submitted by COL Applicant:

Corrected and supplemental information was provided on the location and pumping rates for existing onsite groundwater supply wells in North Anna 3 COL FSAR Tables 2.4-17R and 2.4-205. The applicant stated that any groundwater used for North Anna 3 will not be safety-related. In the COL Application Departures Report, the applicant identified a variance in the plant water supply well information (NAPS ESP VAR 2.4-2). The variance arose from the use of incorrect information in the ESP SSAR and new information obtained on plant water supply wells. The COL applicant justified the North Anna 3 COL FSAR water supply well information (see North Anna 3 COL FSAR Table 2.4-17R) because it better reflected current plant water supply well conditions, and because it supported the ESP SSAR conclusion that future groundwater withdrawals will likely be from the existing wells or from new wells drilled onsite, and any future additional groundwater use is not expected to impact offsite wells.

The Staff's Technical Evaluation:

The staff reviewed the corrected information provided in the North Anna 3 COL FSAR describing the existing groundwater supply wells and groundwater use and accepted NAPS ESP VAR 2.4-2. The staff also evaluated the potential for a groundwater transport pathway to the well located at the NANIC, which supplies potable water. The staff reviewed the maps of groundwater head and the information provided on the NANIC well construction and operation. The staff determined that the NANIC well is located approximately 0.9 kilometers (0.4 miles) up gradient of the radionuclide source used in the North Anna 3 COL FSAR Section 2.4.13 accidental release analysis, the groundwater head at the NANIC well is approximately 12.2 m (40 ft) higher than at the source location, the NANIC well is finished in bedrock at a depth of 79.2 m (260 ft) (much deeper than the source), and the current groundwater hydraulic heads reflect pumping from the well so future changes in hydraulic gradients are not expected. Therefore, the staff concluded that an accidental release pathway to the NANIC water supply well is implausible.

Well Reference Point Elevation (NAPS ESP VAR 2.4-3)

Information Submitted by COL Applicant:

Supplemental information was provided in the North Anna 3 COL FSAR on the groundwater monitoring programs required during and following plant construction. The COL applicant stated that seven new observation wells were installed during subsurface investigations for North Anna 3, and that these have been monitored in addition to continued monitoring of wells installed previously. The COL applicant stated that some observation wells may need to be closed prior to site earthwork activities and that an evaluation will be conducted to determine whether new wells will be required to provide adequate evaluation of construction impacts on site groundwater levels. Regarding the frequency of monitoring, the COL applicant stated that groundwater levels will be measured monthly during any construction-related dewatering, quarterly for two years following the completion of construction, and semi-annually or annually during plant operations. In the COL Application Departure Report, the applicant identified a variance in the reference point elevation for observation well WP-3 (NAPS ESP VAR 2.4-3). The variance arose from using an un-surveyed vertical coordinate originating from a label attached to the well casing as the basis for the well reference elevation in the ESP SSAR. The COL applicant completed a field survey in 2009 to provide a corrected well reference elevation. The COL applicant justified the North Anna 3 COL FSAR well reference elevation because it was a corrected value and did not materially change the estimates of groundwater flow, post-construction groundwater head, or the analysis of accidental release of liquid effluents to groundwater. The COL applicant provided the corrected well reference elevation and corrected groundwater level measurements in North Anna 3 COL FSAR Table 2.4-15R and updated the groundwater head contour maps in North Anna 3 COL FSAR Figures 2.4-207 to 2.4-214.

The Staff's Technical Evaluation:

The staff reviewed the supplemental information provided in the North Anna 3 COL FSAR regarding groundwater monitoring programs. The staff recognizes that groundwater monitoring would be an ongoing activity, and that existing monitoring wells may need to be abandoned and new wells installed because of changing site access conditions during construction. The staff agrees that further evaluation and the possible installation of new wells will be necessary to assure that groundwater-surface levels will be adequately monitored as site conditions change. The staff determined that the frequency of monitoring proposed by the COL applicant was reasonable for monitoring the effects of construction on, and natural variation of, groundwater-surface levels.

The staff reviewed the groundwater head observations and associated contour maps based on the corrected well reference elevation for observation well WP-3 and verified that the corrected data was used by the COL applicant in the groundwater flow modeling carried out to support the post-construction estimate of maximum groundwater head.

Design Bases for Subsurface Hydrostatic Loading

Information Submitted by COL Applicant:

The design plant grade elevation is specified in the North Anna 3 COL FSAR as 88.39 m (290 ft) NAVD88. The COL applicant stated that construction of North Anna 3 will require cut and fill on the site, which will modify the existing groundwater elevations in the power block area. The ESBWR DCD site parameter for the maximum groundwater level is 0.61 m (2 ft) below plant grade (North Anna 3 COL FSAR Table 2.0-201), which corresponds to a maximum groundwater-surface elevation of 87.78 m (288 ft) NAVD88 at the North Anna 3 site. ESBWR DCD Table 2.0-1 (Note 1) indicates that the maximum groundwater level site parameter applies at seismic Category I, II, and Radwaste Building structures. The COL applicant developed and applied a groundwater flow model of the North Anna 3 site to evaluate post-construction groundwater-surface levels. The COL applicant revised the groundwater flow model in response to RAI 02.04.12-1 dated August 08, 2008 (ADAMS Accession No. ML082210547), and RAI 02.04.12-2 dated March 25, 2009 (ADAMS Accession No. ML090840271). In Enclosure 7 of a letter dated December 18, 2013 (ADAMS Accession No. ML14013A113), the COL applicant provided a response to these RAIs that superseded all prior responses. Enclosure 7 of the COL applicant's letter documented the development and application of a groundwater model of the NAPS site. The COL applicant used results from this model as the basis for the discussion of site characteristics for subsurface hydrostatic loading and dewatering in North Anna 3 COL FSAR, Section 2.4.12.4. The COL applicant provided the groundwater model input and output files in a letter dated August 19, 2014 (ML14238A018).

Based on the results of the groundwater modeling, the COL applicant concluded that the maximum post-construction groundwater-surface elevation in the power block area ranges from 82.30 to 86.56 m (270 to 284 ft) NAVD88 with a maximum of 86.14 m (282.6 ft) NAVD88 at Seismic Category 1 structures. Because the maximum groundwater elevation is less than the DCD site parameter value of 0.61 m (2 ft) below plant grade (87.78 m or 288 ft NAVD88), the COL applicant concluded that a permanent dewatering system is not needed for safe operation of North Anna 3.

The maximum post-construction groundwater elevation provided in North Anna 3 COL FSAR Section 2.4.12.4 is higher than the Maximum Elevation of Groundwater site characteristic provided in Appendix A of the North Anna ESP. In the response to RAI 02.04.12-3 dated October 23, 2012 (ADAMS Accession No. ML12307A196), the COL applicant stated that the ESP site characteristic was relative to the site grade. The ESP maximum groundwater elevation of 82.03 m (269.14 ft) NAVD88 was based on a proposed site grade of 82.34 m (270.14 ft) NAVD88 and a prior estimate of maximum groundwater elevation for the existing units. Because the North Anna 3 COL FSAR design plant grade is higher than the ESP proposed site grade, the North Anna 3 COL FSAR maximum groundwater elevation is also higher than the ESP value, but still less than the ESBWR DCD site parameter for maximum groundwater level.

The Staff's Technical Evaluation:

In RAI 02.04.12-1 the staff requested: (1) a description of the technical basis for the assumptions, parameter values, and boundary conditions used by the COL applicant in the groundwater flow model; (2) a discussion of the discrepancy between the observed and model-simulated groundwater heads at the location of the North Anna 3 RB; and, (3) the technical basis for confidence in model predictions of post-construction groundwater heads. The COL applicant's response to RAI 02.04.12-1 dated December 18, 2013 (ADAMS Accession No. ML14013A113), contained the technical basis for the assumptions, parameter values, and boundary conditions of the groundwater flow model. The COL applicant developed a steady-state, two-layer model, with the upper layer representing the saprolite and the lower layer representing the shallow bedrock. The upper layer reflected the ground-surface topography. The COL applicant based the elevation of the contact between the layers on data from the ESP and COL site investigations geotechnical borings. The COL applicant placed the lower, no-flow boundary at a depth of 38.10 m (125 ft) below the ground surface, reflecting the conceptual model in which the occurrence of water-bearing fractures decreases with depth. The COL applicant placed lateral and internal boundaries to represent the locations of drainages, ponds, and Lake Anna, including the WHTF. The COL applicant treated intermittent streams as drain boundaries and Lake Anna and the WHTF as constant head boundaries. The COL applicant assumed recharge was zero at the location of buildings and paved surfaces, relatively large at the Units 1 and 2 SW reservoir, and uniform over the remainder of the model domain (this latter assumption was tested by the COL applicant via simulation). The COL applicant used two saturated hydraulic conductivity zones defined by differences in the observed values of conductivity from slug tests and by the location of a fault identified in ESP SSAR, Figure 2.5-18. The COL applicant assumed hydraulic conductivities were the same in the two model layers and were isotropic everywhere. These assumptions were tested by the applicant via simulation. The staff reviewed the model assumptions and boundary conditions and concluded that they were appropriate and consistent with the site data and conceptual model presented by the COL applicant.

The COL applicant adjusted the recharge and saturated hydraulic conductivity to fit groundwater heads observed during May 2007. The COL applicant's calibrated recharge values were 28 cm/yr. (11.0 in/yr) over the majority of the domain and 37 cm/yr. (14.5 in/yr) over the SW reservoir. Calibrated hydraulic conductivity values were 0.35 m/d (1.14 ft/d) in the northern zone and 0.13 m/d (0.43 ft/d) in the southern zone. The COL applicant stated that all calibration criteria were met. In RAI 02.04.12-1, the staff noted that the observed head at well OW-901, located at the position of the North Anna 3 RB, was about 4 ft higher than the model simulation. This concerned the staff because of the potential for errors of similar magnitude in the post-construction maximum groundwater head in the reactor area estimated from the model. In response to RAI 02.04.12-1 (ADAMS Accession No. ML14013A113), the COL applicant stated that the model was unable to reproduce the steep gradient in groundwater head observed in the power block area, and that the model calibration therefore underestimated the highest heads and overestimated the lowest heads observed in the power block wells. The COL applicant also completed an alternative calibration in which the general recharge rate was increased to 32.3 cm/yr. (12.7 in/yr) in order to fit the observed head at OW-901. However, the COL applicant stated that the increased recharge resulted in unacceptable errors in the simulated groundwater levels at other wells.

The COL applicant conducted predictive simulations of post-construction groundwater heads using the calibrated model described above. In these simulations, the COL applicant modified the ground surface topography of the model to reflect the final site grading, made model cells inactive where deep building foundations will occur, and increased the constant head boundary conditions for Lake Anna and the WHTF to reflect an 8 cm (3 in) increase in the normal operating lake level. In addition, the COL applicant used a backfill zone with a hydraulic conductivity of 0.86 m/d (2.83 ft/d) in the area around the power block, applied a recharge rate of zero where buildings and paved areas will be located, and included model drain cells to represent the surface drainage ditches planned for controlling surface runoff around the power block and the cooling tower. The COL applicant assumed the May 2007 groundwater observations were close to historic maximum levels and presented data on precipitation and regional water conditions to support this assumption. The COL applicant completed a base case simulation with the model and presented results for this analysis in North Anna 3 COL FSAR Figure 2.4-216. The COL applicant compared the model-simulated heads at a set of 16 points around the power block buildings to the ESBWR DCD maximum groundwater elevation. The maximum groundwater head of 86.53 m (283.9 ft) NAVD88 occurred at the Ancillary Diesel Building and was 1.86 m (6.1 ft) below the design plant grade.

Input files for all the simulations described in the groundwater modeling report were used in the staff's review and confirmatory simulations. The staff concluded that the groundwater model developed by the COL applicant appropriately represented the site characterization data and the conceptual understanding of site groundwater flow. However, the staff was concerned with errors in the model's representation of observed groundwater heads in the power block area and the potential that these errors could be carried through to the model predictions of post-construction groundwater conditions.

The 88.39 m (290 ft) NAVD88 grade for the North Anna 3 power block will be created by excavating the existing soil and rock materials at the site. A significant cut-slope will be created on the southwest and southeast sides of the power block area, as shown on North Anna 3 COL FSAR Figure 2.4-201. As a result of groundwater flow from the upland areas towards the lake, the groundwater heads will be higher than plant grade above the cut-slope. Surface drainage ditches around the power block will be depended upon to also drain groundwater, increasing the groundwater head gradients around the power block and lowering the groundwater heads throughout the power block area. This effect can be seen in the model simulation results of North Anna 3 COL FSAR Figure 2.4-216, where the drainage ditches are shown in yellow.

Based on a set of confirmatory simulations, the staff determined that the groundwater elevations predicted by the COL applicant's groundwater model were strongly dependent on the characteristics of the model drain cells that represent the site surface water drainage system surrounding the power block. For the groundwater model used by the COL applicant, groundwater discharge to a model drain cell is proportional to the conductance parameter, the value of which is unknown, but is related to the effective hydraulic conductivity over the drainage pathway, the geometry of the drain, and the dimensions of the model grid cell. The COL applicant assigned a drain conductance value of 2.32 m^2/day (25 ft^2/day) based on a hydraulic conductivity of 0.35 m/day (1.14 ft/day). The hydraulic conductivity of the model cells within which the drains are located is about one-third of this value along eastern portions of the drainage ditches. Based on this observation, and on geometric considerations, the staff concluded that values of drain conductance less than 2.32 m^2/day (25 ft^2/d) were plausible. The staff requested additional information to resolve this issue in RAI 02.04.12-2.

In response to RAI 02.04.12-2 dated December 18, 2013 (ADAMS Accession No. ML14013A113), the COL applicant provided results of model simulations to evaluate the effect of the drain cell conductance on the groundwater heads in the power block area. In particular, the COL applicant evaluated groundwater heads in the power block area using a smaller drain conductance value of 0.23 m^2/day (2.5 ft^2/d) and reported that this increased the maximum groundwater head to 87.66 m (287.6 ft) NAVD88. Using groundwater model input files provided by the COL applicant, the staff evaluated groundwater heads in the power block area using a drain conductance value of 0.093 m^2/day (1.0 ft^2/d) and found that the simulated maximum groundwater head could exceed 87.78 m (288 ft) at this low conductance value. In RAI 02.04.12-4 dated November 21, 2014 (ADAMS Accession No. ML14325A831), the staff requested documentation in the North Anna 3 COL FSAR of the drainage ditch design, construction methods, and materials, and the function of the drainage ditches in maintaining groundwater levels. In the response to RAI 02.04.12-4 dated January 08, 2015 (ADAMS Accession No. ML15009A237), the COL applicant provided proposed updated North Anna 3 COL FSAR text in the North Anna 3 COL FSAR, Revision 9, and the staff confirmed its inclusion. Based on the description of the ditches provided by the COL applicant the staff determined that drainage ditch materials and construction would not impede the discharge of groundwater into the ditches. Therefore, the staff concluded that drain conductance values of 0.23 m^2/day (2.5 ft^2/d) and lower are unlikely and that a drain conductance value of 2.32 m^2/day (25 ft^2/day) is appropriate and conservative. The staff verified that the appropriate revisions are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.4.12-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

Evaluation of the maximum groundwater elevation using the groundwater model depends on the ability of the model to accurately represent the groundwater system. Examination of the simulation results showed that the model predicted flooding (i.e., steady-state groundwater heads above the surface elevations) at a number of locations across the site, for both the pre-construction and post-construction models. The staff used groundwater head observations to evaluate whether the predicted flooding indicated a model bias.

The COL applicant used groundwater head observations from May 30, 2007 to develop and evaluate the pre-construction groundwater model. The staff plotted these observations as a function of the ground surface elevation at the observation well locations, as shown in Figure 2.4.122-1[3]. As described above, the observations from well pairs at different depths indicated that generally minor vertical gradients exist at the site. The groundwater heads in this shallow unconfined system were therefore interpreted as water table elevations. The staff determined that observed groundwater levels were related to ground surface topography; the envelope of maximum observed groundwater levels was well-represented as a linear function of the ground surface elevation (with a slope of 0.75), as shown in Figure 2.4.12-1. Based on this relationship, maximum observed groundwater levels were close to ground surface at lower elevations (e.g., at the Lake Anna elevation of 76.20 m [250 ft] NAVD88), and progressively deeper as the ground surface elevation increased (e.g., maximum groundwater level was 6.10 m [20 ft] deep at a ground surface elevation of 100.58 m [330 ft] NAVD88).

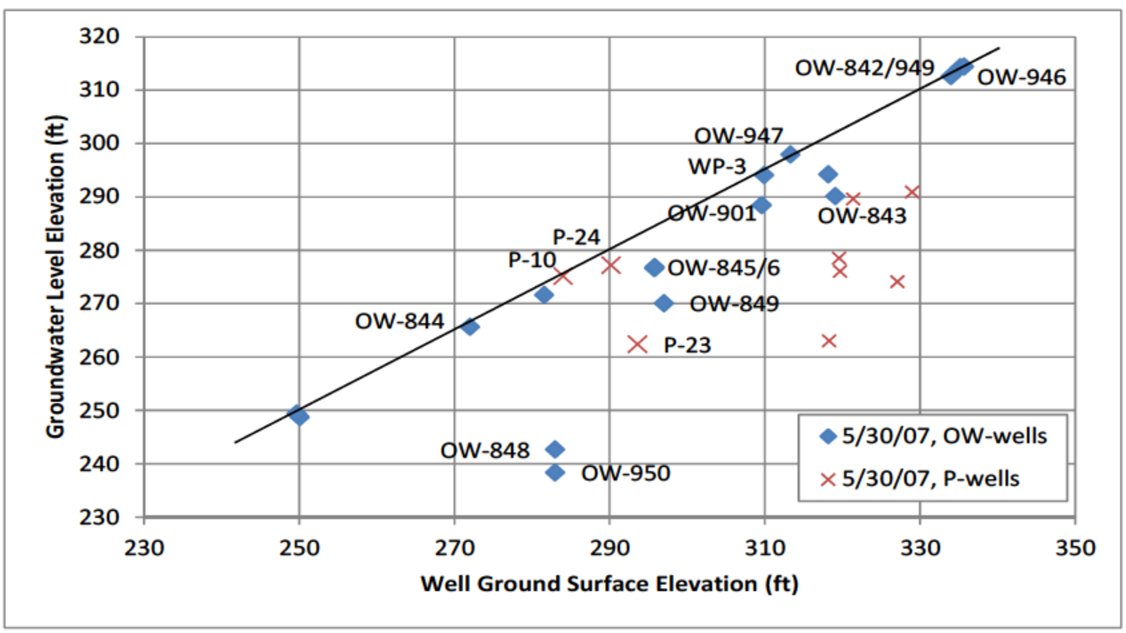

Figure 2.4.122-1. NAPS Unit 3 groundwater head observations on 5/30/2007 as a function of ground surface elevation at the well

[3] For most of the P-series wells surrounding the Units 1 and 2 UHS impoundment, the well stick-up was not specified; these head observations are plotted against the well reference point elevations.

While no observations fall significantly above the envelope line in Figure 2.4.12-1, a number of observations fall significantly below the line. The staff examined the current site topography, as shown on FSAR Figure 2.4-206, and determined that the wells with observations below the line in Figure 2.4.12-1 tended to be located above and near a significant topographic slope. For example, OW-848 and OW-950 are on the bluff above the proposed North Anna 3 intake bay, and OW-849 and OW-843 are above the cut-slope for the switch yard. In contrast, the observations that lie close to the line in Figure 2.4.12-1 tended to be in areas of relatively flat topography, or near the bottom of topographic slopes. For example, OW-844 lies just below the cut-slope down to the Unit 1/2 operations level.

The COL applicant's pre-construction model, calibrated using the May 30, 2007 groundwater observations, resulted in groundwater heads at several observation wells that were above the envelope line shown in Figure 2.4.12-1. The greatest deviations were at wells OW-945, a relatively low-lying area where the model produced flooded conditions, and OW-844, located at the bottom of a cut-slope. The deviation at OW-844 was about 1.22 m (4 ft). Based on the observations shown in Figure 2.4.12-1, the staff concluded that groundwater head measured in a well located at a surface elevation of 88.39 m (290 ft) (the North Anna 3 design plant grade) would be unlikely to exceed 85.34 m (280 ft). The COL applicant's post-construction model predicted heads about 1.22 m (4 ft) greater than this in the power block area: 86.53 m (283.9 ft) at the Ancillary Diesel Building, located near the cut-slope down to the power block. The staff concluded that the COL applicant's groundwater model will tend to over-estimate groundwater heads below a cut-slope such as that planned around the North Anna 3 power block area.

Conclusions about the maximum groundwater heads at the North Anna 3 site that are based on the observed groundwater heads on May 30, 2007, assume that these observations represent maximum historical values. The staff evaluated this assumption by examining the historical record of water level in a USGS well in Louisa County, approximately 11.5 mi from the North Anna 3 site and completed in the fractured rock aquifer[4]. The staff determined that water levels in this USGS well, interpolated to the North Anna 3 observation well sampling dates, were correlated with North Anna 3 well OW-842 observed water levels (correlation coefficient of 0.85). Water levels for the two wells, shown in Figure 2.4.122-2, indicate that the North Anna 3 sampling times may not have coincided with the maximum groundwater levels at the North Anna 3 site. The maximum groundwater level in the USGS well occurred in April 2010. Given the correlation between the water levels in the two wells, the staff determined that the maximum groundwater elevation in well OW-842 may be several feet higher than the elevation observed on May 30, 2007. This implies that the upper end of the envelope line in Figure 2.4.12-1, would increase several feet; the increase at a ground surface elevation of 88.39 m (290 ft) would be less.

Given the staff's independent evaluation of the available data and the staff's confirmatory analysis of the COL applicant's model results, the staff determined that the COL applicant's groundwater model provided conservative estimates of post-construction maximum groundwater elevation in the power block area. Because the model predicted a maximum head in the power block that is well below the DCD requirement, the staff concluded that the applicant's maximum groundwater elevation site characteristic of 86.53 m (283.9 ft) NAVD88 is conservative and acceptable. Accordingly, the staff considers RAI 02.04.12-1 and RAI 02.04.12-2 resolved and closed.

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[4] USGS 380131078001001 46N 1 SOW 056, accessed at http://waterdata.usgs.gov/nwis

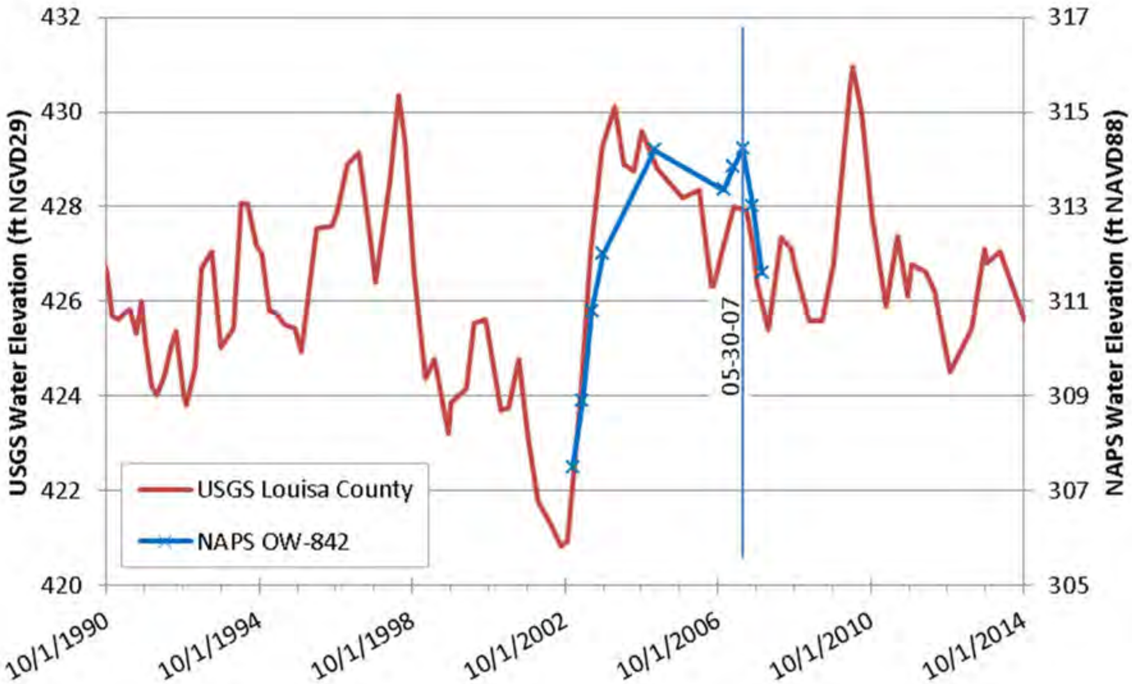


Figure 2.4.122-2. Water levels for the USGS Louisa County well and NAPS Unit 3 well OW-842

Regarding seismic effects, SRP Section 2.4.12 states that seismic criteria should be evaluated to determine whether they should be used in postulating worst-case groundwater effects at a site. In North Anna 3 COL FSAR Section 2.5, the applicant submitted information on seismic risks and the potential effects of earthquakes on structures and foundations. Also in Section 2.5, the applicant discussed groundwater conditions in relation to construction and foundation stability (see Section 2.5.4.6).

While the applicant did not submit specific information on potential effects of seismic events on worst-case groundwater conditions, the staff reviewed available literature on seismic effects on groundwater-surface elevations (e.g., Montgomery and Manga 2003; Wang and Manga 2010; Roeloffs 1996; Bredehoeft 1967) and considered North Anna 3 site-specific conditions. Groundwater in the power block area is unconfined, transmissive depth is from 30 to 100 m (98 to 328 ft) below ground surface, with an estimated effective porosity of 0.25. The staff considered the design earthquakes given in North Anna 3 COL FSAR Table 2.5.2-218, "Mean Magnitude and Distance for LF and HF Response Spectra for Three MAFEs," and used the idealized unconfined aquifer analysis of Bredehoeft (1967) to estimate a maximum increase in groundwater-surface elevation of 0.30 m (1 ft). Given the margin in the maximum groundwater elevation estimated by the COL applicant using the groundwater model discussed above, the staff concluded that no plausible scenarios present conditions in which seismic events could have significant effects on groundwater-surface elevations at this site.

2.4.12.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.12.6 Conclusion

The staff reviewed the application and confirms that the COL applicant addressed the required information as it relates to groundwater, and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.12 of NUREG-0800 SRP, and other NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the COL applicant has adequately addressed COL Items 2.0-12-A and 2.0-23-A as they relate to groundwater.

As set forth above, the applicant presented and substantiated information relative to the groundwater effects important to the design and siting of this plant. The staff has reviewed the available information provided and, for the reasons given above, concludes that the identification and consideration of the potential effects of groundwater in the vicinity of the site are acceptable and meet the requirements of 10 CFR 50.55, "Conditions of construction permits, early site permits, combined licenses, and manufacturing licenses," 10 CFR 50.55a, 10 CFR 100.20(c)(3), 10 CFR 100.23(d), and 10 CFR 100.20(c), with respect to determining the acceptability of the site.

2.4.13 Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters

2.4.13.1 Introduction

This section provides a characterization of the attenuation, retardation, dilution, and concentrating properties governing transport processes in the surface-water and groundwater environment at the site. This section's goal is not to provide an assessment of the impacts of a specific release scenario but to provide a suitable conceptual model of the hydrological environment for other assessments. Since it would be impractical to characterize all the physical and chemical properties (e.g., hydraulic conductivities, porosity, mineralogy, etc.) of a time-varying and heterogeneous environment, this section characterizes the environment in terms of the projected transport of a postulated release of radioactive waste. The accidental release of radioactive liquid effluents in ground and surface waters is evaluated using information on existing uses of groundwater and surface water and the known and likely future uses as the basis for selecting a location to summarize the results of the transport calculation. The source term from a postulated accidental release is reviewed under Section 11.2 of NUREG-0800 following the guidance in Branch Technical Position (BTP) 11-6, "Postulated Radioactive Releases Due to Liquid-Containing Tank Failures" and ISG DC/COL-ISG-013, "Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks for Combined License Applications." The source term is determined from a postulated release from a single tank outside of the containment. The results of a consequence analysis are evaluated against SRP Section 11.2 and BTP 11-6 guidance and the effluent concentration limits (ECLs) of Table 2, Column 2 in 10 CFR Part 20, Appendix B, as SRP acceptance criteria. Under SRP guidance, the ECLs of 10 CFR Part 20, Appendix B are applied as acceptance criteria and are not intended for demonstrating compliance with ECLs.

The following specific areas are reviewed by the staff: (1) alternative conceptual models of the hydrology at the site that reasonably bound hydrogeological conditions at the site inasmuch as these conditions affect the transport of radioactive liquid effluent in the ground and surface water environment; (2) a bounding set of plausible surface and subsurface pathways from potential points of an accidental release to determine the critical pathways that may result in the most severe impact on existing uses and known and likely future uses of ground and surface water resources in the vicinity of the site; (3) the ability of the groundwater and surface water environments to delay, disperse, dilute, or concentrate accidentally released radioactive liquid effluents during transport; and, (4) the assessment of scenarios wherein an accidental release of radioactive effluents is combined with potential effects of seismic and non-seismic events.

2.4.13.2 Summary of Application

North Anna 3 COL FSAR Section 2.4.13, Revision 9, "Accidental Releases of Liquid Effluents to Ground and Surface Waters," incorporates by reference ESP SSAR, Revision 9, Section 2.4.13, "Accidental Releases of Liquid Effluents to Ground and Surface Waters." This section of the North Anna 3 COL FSAR addresses the accidental release of radioactive liquid effluents in ground and surface waters.

In addition, in North Anna 3 COL FSAR Section 2.4.13, the COL applicant addressed COL item 2.0-24-A identified in ESBWR DCD Tier 2, Revision 10, Table 2.0-2 and ESP Permit Condition 3.E(3).

COL Item:

- COL Item 2.0-24-A — COL Applicant to Address SRP 2.4.13

Permit Condition:

- ESP Permit Condition 3.E(3) — Features to Preclude Radioactive Releases into any Potential Liquid Pathway

The COL applicant addressed these issues by including in North Anna 3 COL FSAR, Revision 9 Section 2.4.13 the following information as a supplement to ESP SSAR Section 2.4.13:

The COL applicant described the accident scenario and resulting source term. For the source term, the COL applicant considered tanks that are part of the Liquid Waste Management System (LWMS) and the Condensate Storage and Transfer System (CSTS). The COL applicant described design features of these systems intended to preclude accidental releases into potential liquid pathways, consistent with ESP Permit Condition 3.E (3). The COL applicant nevertheless considered rupture of the CST as the postulated source, because this tank is the largest above-grade tank located outside of containment. The CST is described in ESBWR DCD Section 9.2.6.2. The tank was postulated to instantaneously release 80 percent of its volume to the unconfined aquifer.

The COL applicant determined that a direct surface water pathway would be precluded by design, and identified a groundwater pathway from the CST to the North Anna 3 intake basin. The COL applicant described two conceptual models: a primary conceptual model with North Anna 3 not operating and an alternative conceptual model with North Anna 3 operating. Groundwater travel time was estimated using site data.

The COL applicant described a radionuclide transport analysis, including the calculation of radionuclide concentrations and doses, and comparison with acceptance criteria based on 10 CFR Part 20. The COL applicant's transport analysis was primarily based on a method of characteristics solution to the one-dimensional advection-dispersion equation with first-order decay and linear equilibrium adsorption. The transport analysis was conducted using three stages. The initial stage of the transport analysis considered advection and radioactive decay only. The second stage of the COL applicant's analysis included the effect of advection, radionuclide decay, and adsorption in computing radionuclide concentrations at the groundwater discharge location. The third stage of the COL applicant's analysis included the effect of dilution of groundwater discharged to the North Anna 3 intake basin, and considered the effect of the two conceptual models on dilution.

The COL applicant computed doses to an individual from consumption of water, consumption of fish and invertebrates, and from swimming, boating, and shoreline activities. The COL applicant estimated that the total body dose to a child from all exposure pathways would be 28 mrem.

Early Site Permit Variance:

The following variance from the ESP SSAR is discussed in Section 2, "Variances," of Part 7 to the COLA:

- NAPS ESP VAR 2.0-5 Distribution Coefficients (Kd)

The COL applicant requested VAR 2.0-5 to use the distribution coefficients provided in North Anna 3 COL FSAR Table 2.4-206 rather than the corresponding values in ESP SSAR Tables 1.9-1 and 2.4-20.

2.4.13.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to ESBWR DCD, and in NUREG-1835, the FSER related to the North Anna ESP.

The relevant requirements of NRC regulations for the pathways of liquid effluents in ground and surface waters, and the associated acceptance criteria, are specified in Section 2.4.13 in NUREG-0800 SRP and ISG DC/COL-ISG-014, "Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks in Ground and Surface Waters for Combined License Applications." The applicable regulatory requirements are as follows:

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and time in which the historical data have been accumulated.

- 10 CFR 100.20(c), as it relates to the consideration given to the hydrological characteristics of the site.

- 10 CFR 100.23(d) sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves the site.

The related acceptance criteria from SRP Section 2.4.13 are as follows:

- Alternate Conceptual Models: Alternate conceptual models of hydrology in the vicinity of the site are reviewed.

- Pathways: The bounding set of plausible surface and subsurface pathways from the points of release are reviewed.

- Characteristics that Affect Transport: Radionuclide transport characteristics of the groundwater environment with respect to existing and known and likely future users should be described.

- Consideration of Other Site-Related Evaluation Criteria: The applicant's assessment of the potential effects of site-proximity hazards, seismic, and nonseismic events on the radioactive concentration from the postulated tank failure related to accidental release of radioactive liquid effluents to ground and surface waters for the proposed plant site is needed.

BTP 11-6 provides guidance in assessing a potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

In addition, the hydrologic characteristics should be consistent with appropriate sections from RG 1.113, "Estimating Aquatic Dispersions of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

2.4.13.4 Technical Evaluation

As documented in Section 2.4.13 of NUREG-1966 and Section 2.4.13 of NUREG-1835, the staff reviewed and approved information related to accidental release of radioactive liquid effluent in ground and surface waters for the certified ESBWR DCD, Revision 10, and Section 2.4.13 of the North Anna ESP SSAR, respectively. The staff reviewed Section 2.4.13 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters."

The staff's technical review of this application was limited to the supplemental information pertaining to COL item 2.0-24-A and ESP Permit Condition 3.E(3), as addressed in the following sections. Also discussed within this context are RAIs and variance NAPS ESP VAR 2.0-5.

Radionuclide Transport Analysis

Information Submitted by COL Applicant:

The COL applicant described the accidental radionuclide release source in North Anna 3 COL FSAR Section 2.4.13.1, and stated that tanks from the LWMS and the CSTS were evaluated. The COL applicant described design features of these systems intended to preclude accidental releases into potential liquid pathways, consistent with ESP Permit Condition 3.E(3). The COL applicant nevertheless considered rupture of the CST as the postulated source, because this tank is the largest above-grade tank located outside of containment. In RAI 02.04.13-6 dated January 07, 2015 (ADAMS Accession No. ML14347A004), the staff requested the basis for the source term concentrations provided in North Anna 3 COL FSAR Table 2.4-206. In response to RAI 02.04.13-6 dated January 27, 2015 (ADAMS Accession No. ML15028A392), the COL applicant described the input streams to the CST and referred to the ESBWR DCD tables from which concentrations of these input streams were derived. The COL applicant stated that the North Anna 3 COL FSAR 2.4.13 analysis used a bounding CST concentration for each radionuclide based on the largest of the LWMS and CSTS input streams. Resolution of RAI 02.04.13-6 is discussed in Section 11.2 of this SER.

The COL applicant described the accidental release scenario, rupture of the CST, in North Anna 3 COL FSAR Section 2.4.13.2. The CST selected as the source is located at a grade elevation of 88.24 m (289.5 ft) NAVD88 and has a volume of 4885 m^3 (172,512 ft^3). The COL applicant postulated that the tank instantaneously releases 80 percent of its volume, 3908 m^3 (138,010 ft^3), to the unconfined aquifer, consistent with BTP 11-6.

The COL applicant stated that the basin surrounding the CST precludes an uncontrolled release directly to the ground surface. On this basis, the COL applicant did not consider a surface water pathway.

Based on observed groundwater head contour maps, the COL applicant identified the groundwater transport pathway to be north-northeast toward the cove used for the North Anna 3 intake in Lake Anna. The COL applicant assumed transport would occur along a straight-line path between the CST and the cove, a distance of 234.70 m (770 ft). The COL applicant stated that the existing groundwater supply well in the power block area will be closed before North Anna 3 construction, and as a result, groundwater from the postulated release will discharge to the Lake Anna cove that constitutes the North Anna 3 water supply intake.

The COL applicant described a primary conceptual model in which North Anna 3 is not operating, so that groundwater discharged to Lake Anna would be diluted by water in the North Anna 3 intake cove. For the primary conceptual model, the COL applicant adopted the culverts that connect the intake cove to the main body of Lake Anna as the release point for demonstrating compliance with 10 CFR Part 20, Appendix B, Table 2 radionuclide concentration limits. The COL applicant also described an alternate conceptual model in which North Anna 3 is operating, so that groundwater discharged to Lake Anna would be diluted with lake water before being pumped back into the North Anna 3 facility as makeup water, and ultimately be discharged with cooling tower blowdown to the discharge canal. The COL applicant adopted the end of the discharge canal as the release point for compliance with the 10 CFR Part 20, Appendix B, Table 2 radionuclide concentration limits.

The COL applicant based the groundwater radionuclide transport analysis on a method of characteristics solution to the one-dimensional advection-dispersion equation with first-order decay and linear equilibrium adsorption. The COL applicant neglected dispersion in deriving the analytical solutions for parent and progeny radionuclides. The COL applicant conducted the analysis using three stages of progressive refinement. At the first two stages, the COL applicant considered in the following stage only radionuclides whose concentrations were greater than 1×10^{-6} times the applicable concentration limit. The COL applicant provided calculated concentrations in groundwater in FSAR Table 2.4-206.

The COL applicant’s first stage of analysis considered radioactive decay only, and computed radionuclide concentrations at the groundwater discharge location. The COL applicant computed a groundwater travel time of 1.07 yr. using a hydraulic conductivity of 3.02 m/day

(9.9 ft/day), a hydraulic gradient of 0.05, and an effective porosity of 0.25. The COL applicant included in the next stage of the analysis the 21 radionuclides for which the resulting concentrations were greater than $1x10^{-6}$ times the 10 CFR Part 20, Appendix B, Table 2 values. The second stage of the COL applicant's analysis included the effect of radionuclide decay and adsorption in computing radionuclide concentrations at the groundwater discharge location. The COL applicant stated that chelating agents, which could reduce radionuclide adsorption, are neither required nor planned for use in North Anna 3.

The COL applicant used site-specific distribution coefficient (K_d) values obtained in the laboratory using soil samples from 12 borings and water from the unconfined aquifer, with results listed in North Anna 3 COL FSAR Table 2.4-207. The COL applicant used the minimum observed value in the transport analysis. The COL applicant assumed the distribution coefficient of yttrium isotopes to be that of Sr-90. For those radioactive daughter products without measured values the COL applicant assigned the distribution coefficient values of the parent radionuclides. The COL applicant assumed Te-129m, Zr-95, Nb-95, and H-3 to be unaffected by adsorption. The COL applicant computed retardation factors using an effective porosity of 0.25 and a bulk density of 1.83 g/cm^3 (based on an assumed particle specific gravity of 2.65 g/cm^3 and a total porosity of 0.31). The COL applicant included in the next stage of the analysis the 10 radionuclides for which the resulting concentrations were greater than $1x10^{-6}$ times the 10 CFR Part 20, Appendix B, Table 2 values, these being H-3, Co-60, Ni-63, Sr-90, Y-90, Zr-95, Nb-95, Te-129m, Cs-137, and Pu-239.

The approach to selecting distribution coefficients described above represents a variance from the distribution coefficients as discussed in the ESP SSAR. The COL applicant formally stated this variance in the COL Application Departures Report as NAPS ESP Var 2.0-5. The values reported in ESP SSAR Table 2.4.20 were based on Sheppard and Thibault (1990) and the EPA (1999). The values used in FSAR Table 2.4-207 were based on site-specific measurements. The COL applicant justified the use of the North Anna 3 COL FSAR Table 2.4-206 distribution coefficient values because they were based on site-specific measurements, and compliance with the 10 CFR Part 20, Appendix B, Table 2 concentration limits was demonstrated using the North Anna 3 COL FSAR distribution coefficient values in the North Anna 3 COL FSAR Section 2.4.13 analysis of groundwater release.

The third stage of the COL applicant's analysis included the effect of decay, adsorption, and dilution of groundwater discharged to surface water under two conceptual models. The COL applicant's primary conceptual model assumed North Anna 3 was not operating and diluted the tank release volume in the volume of the Lake Anna cove, using the radionuclide groundwater concentrations from the second stage analysis. The COL applicant calculated a dilution factor of 26 for the primary conceptual model. The COL applicant's alternate conceptual model assumed North Anna 3 was in operation and diluted the groundwater discharge rate to the North Anna 3 intake cove by the total water withdrawal rate from Lake Anna for North Anna 3 operation, with the dilution factor reduced by the cycles of concentration. The COL applicant calculated a dilution factor of 38 for the alternate conceptual model using the maximum cycles of concentration (9). The COL applicant evaluated the "sum of fractions approach" described in 10 CFR Part 20 using the diluted concentrations and found the sum of fractions to be less than 1.0 under both scenarios.

The COL applicant computed doses to an individual from consumption of water, consumption of fish and invertebrates, and from swimming, boating, and shoreline activities using diluted concentrations from the primary conceptual model. The COL applicant estimated that the total body dose to a child from all exposure pathways would be 28 mrem.

The Staff's Technical Evaluation:

In RAI 02.04.13-1 dated August 19, 2008, (ADAMS Accession No. ML082320133), the staff requested information on the presence of chelating agents in the tank used for the source in the accidental release analysis. In North Anna 3 COL FSAR, Revision 9, Section 2.4.13.3.2.2, the COL applicant stated that chelating agents are neither required nor planned to be used. As a result, the staff considers RAI 02.04.13-1 resolved and closed.

The COL applicant assumed that there were no differences in the flow and transport characteristics between the saprolite and the shallow bedrock. The staff determined that this assumption is consistent with the hydrogeological conceptual model in North Anna 3 COL FSAR Section 2.4.12.

The staff verified that the groundwater transport analysis in North Anna 3 COL FSAR Section 2.4.13 used a hydraulic conductivity value that was the maximum observed value (3.02 m/day) from the site slug tests. In RAI 02.04.13-3 dated August 19, 2008 (ADAMS Accession No. ML082320133), the staff requested additional information about the consistency between the MODFLOW model used to model groundwater levels in North Anna 3 COL FSAR Section 2.4.12 and the contaminant transport model. The issue was that these two models used different values of hydraulic conductivity. In response to RAI 02.04.13-3 dated October 02, 2008 (ADAMS Accession No. ML082810405), the COL applicant provided a comparison between the values of hydraulic conductivity used in the two models. The COL applicant also provided a comparison between the groundwater travel times calculated using the different values of hydraulic conductivity. The staff reviewed these calculations and concluded that the COL applicant's contaminant transport model was not consistent with the MODFLOW model because higher, more conservative values of hydraulic conductivity were used in North Anna 3 COL FSAR 2.4.13. The staff concluded that using conservative values in transport modeling was appropriate because it was desirable to calculate groundwater travel times in a conservative manner. The staff also concluded that it was not necessary for the transport model and the MODFLOW groundwater flow model to use the same values of hydraulic conductivity, because the two modeling efforts had different intended objectives.

In RAI 02.04.13-3, the staff requested additional information on alternative groundwater transport pathways considered by the COL applicant. In an October 2, 2008, response to RAI 02.04.13-3 (ADAMS Accession No. ML082810405), the COL applicant identified and considered the following five alternative transport pathways which were designated as follows:

a. Flow north-northeast in the saprolite to the North Anna 3 intake forebay (the selected pathway);

b. Flow northeast in the saprolite to the Units 1 and 2 intake bay;

c. Flow southeast in the saprolite to the discharge canal;

d. Flow north in the saprolite to Lake Anna; and

e. Flow in fractured bedrock to the North Anna 3 intake forebay.

The COL applicant concluded that, compared to the selected pathway, the other saprolite pathways were longer and less plausible when evaluated against the observed groundwater heads and the post-construction MODFLOW model results. The COL applicant stated that the selected pathway was more conservative than the bedrock pathway, because the hydraulic conductivity in the bedrock generally decreased with depth due to a decrease in the number and extent of fractures. The staff noted that effective porosity was also expected to decrease with depth, which would tend to increase groundwater velocity. Based on the slug and pressure test data for the shallow bedrock, the staff determined that the hydraulic conductivity of the shallow bedrock was comparable to that of the saprolite. The staff also determined that there was no site-specific information on which to base an effective porosity estimate for the shallow bedrock. The staff concluded that it was appropriate to base a conservative transport analysis on the site-specific properties of the saprolite. The staff evaluated the alternative transport pathways described by the COL applicant and determined that the selected pathway (pathway a. above) was conservative. This pathway was used by the COL applicant in FSAR Section 2.4.13 and by the staff in its independent confirmatory analysis. The staff finds the discussion of alternative transport pathways acceptable. Accordingly, the staff considers RAI 02.04.13-3 resolved and closed.

The COL applicant made laboratory measurements of adsorption coefficient (K_d) values for the transport analysis on 20 soil and weathered rock samples. The staff reviewed a report documenting the laboratory measurements of K_d for the transport analysis and determined that the K_d values were highly variable with ranges between one and four orders of magnitude for individual radionuclides. Measurements were conducted on the less than 2 millimeter-size fraction of the samples, with the fraction greater than 2 millimeters reported as zero for most of the samples. Given the reported presence of rock fragments in the saprolite and their potential effect on radionuclide adsorption, in RAI 02.04.13-2 the staff requested information on the technical basis for neglecting this effect in a conservative analysis. The staff also noted that a wide range of pH values was measured in the soil samples used in the K_d measurements and that there was an apparent relationship between the measured K_d values and the measured pH values. In RAI 02.04.13-2, the staff also requested information on the technical basis for neglecting this effect in a conservative analysis. In response to both of these issues (ADAMS Accession No. ML082810405), the COL applicant argued that the use of conservative K_d values (the COL applicant used the minimum measured K_d values) implicitly considered the effects of rock fragments and pH, both of which could act to reduce K_d values. Given the wide range of measured K_d values and the lack of a plausible low-pH pathway, the staff concluded that the use of minimum measured K_d values was demonstrably conservative with respect to the effect of the pH on adsorption. Although the staff considers that a pathway containing significant gravel is plausible (e.g., a pathway through Zone IIb/III in North Anna 3 COL FSAR Figure 2.4-217), the staff determined that the impact of gravel on K_d would be small compared to the wide range of K_d values measured by the COL applicant. The staff therefore concludes that a transport analysis using minimum, site-specific measured K_d values is demonstrably conservative, and considers RAI 02.04.13-2 resolved.

The staff reviewed the COL applicant's transport analysis as described in North Anna 3 COL FSAR Section 2.4.13. The staff completed a confirmatory analysis that computed radionuclide concentrations and the limiting value of the radionuclide mixture (as described in 10 CFR Part 20, Appendix B, Table 2, Note 4) without regard to the time of arrival of each radionuclide at the accessible environment, thereby maximizing the value of the sum. For this analysis, the staff computed conservative radionuclide transport times using maximum observed hydraulic conductivity and radionuclide-specific K_d values determined as the smaller value of the minimum measured K_d and the 0.01 quantile[5] estimated from the measured values. Radionuclides without measurements were assigned a K_d value of the 0.1 quantile estimated from the mean and standard deviation from NUREG/CR-6697, Development of Probabilistic RESRAD 6.0 and

[5] Estimated using the method of moments from the measured $\ln(K_d)$ values. The 0.01 quantile is expected to be exceeded by 99% of measured Kd values.

RESRAD-BUILD 3.0 Computer Codes" (ADAMS Accession Number: ML010090284), Attachment C, Table 3.9-1 (Yu et al. 2000). Radionuclide concentrations in groundwater at the discharge location were computed based on these transport times. The staff considered the two surface water dilution scenarios described by the COL applicant in North Anna 3 COL FSAR Section 2.4.13 and concluded that dilution in the volume of the North Anna 3 intake basin cove without North Anna 3 operating (the COL applicant's primary conceptual model) was a bounding approach. The staff verified that the COL applicant's alternative conceptual model (recirculation with North Anna 3 operating, and dilution in the discharge canal) resulted in greater dilution. The staff computed a dilution factor of 0.037 by assuming the entire source release was uniformly mixed with the North Anna 3 intake basin cove. The staff computed the mixture sum by dividing each concentration by its 10 CFR Part 20, Appendix B, Table 2 limit and summing over all radionuclides. This conservative approach resulted in a sum of 0.86, of which 0.35 was due to H-3, 0.04 to Sr-90, and 0.47 to Cs-137. This value was less than the 10 CFR Part 20, Appendix B, Table 2 limit for a radionuclide mixture (1.0).

The transport analysis described above assumed constant K_d values along the transport pathway. The measured K_d values reported by the applicant were obtained on small samples of soil/rock taken from locations across the site. The staff evaluated the degree of conservatism in assuming that the minimum K_d value measured in a small-scale sample represented the average K_d along the transport pathway. This analysis was completed for the Sr-90 and Cs-137 K_d data (the most significant sorbing contributors to the radionuclide mixture sum) using the methods described in NUREG/CR-6565 (Meyer et al. 1997). The results indicated that there is less than a 1 percent chance that the average Sr-90 and Cs-137 K_d values at the site are as low as the minimum measured values.

No accidental releases directly to surface water are described in North Anna 3 COL FSAR Sections 2.4.13 and 11.2.3.2. Surface water releases considered in the North Anna 3 COL FSAR were due to groundwater transport and discharge to surface water features as described above. Based on the COL applicant's description of the design features intended to preclude the release of radioactive liquid effluents, the staff concludes that a direct release to surface water is not plausible.

In RAI 02.04.13-4 dated March 29, 2009 (ADAMS Accession No. ML090840271), the staff requested information demonstrating that the accidental release analysis described in North Anna 3 COL FSAR Section 2.4.13 is bounding. Based on the information provided in North Anna 3 COL FSAR Section 2.4.13, described above, and on the staff's independent confirmatory analyses, the staff concludes that the transport analysis described in North Anna 3 COL FSAR Section 2.4.13 constitutes a bounding analysis. Accordingly, the staff considers RAI 02.04.13-4 resolved and closed.

Section 11.2.4 of this SER provides the staff findings associated with the COL applicant's radiological dose analysis and associated RAIs.

2.4.13.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.13.6 Conclusion

The staff reviewed the COLA and confirmed that the COL applicant addressed the relevant information and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 2.4.13 of NUREG–0800, and NRC RGs. The staff's review concludes that the COL applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the COL applicant has adequately addressed NAPS COL Item 2.0-24-A as it relates to accidental releases of liquid effluents in ground and surface waters. The staff notes that mitigating design features described in the North Anna 3 COL FSAR would further bound groundwater or surface water releases described above.

The review confirms that the COL applicant has satisfactorily addressed the potential for radionuclides to impact receptors under five alternative groundwater transport pathways. The release scenario considered was a worst-case release to groundwater resulting from a catastrophic release of the contents of the CST, the largest above-grade tank located outside containment. Conservative assumptions (i.e., promoting transport and high concentrations) were used in an approach to determine the activity concentrations of radionuclides at locations of groundwater discharge to surface water, relative to the ECLs specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. As described above, the calculated activity concentrations satisfied the ECLs and sum-of-fractions criteria at the groundwater discharge locations using conservative dilution assumptions. The staff concludes that the analysis and its results provide sufficient information to satisfy the requirements of 10 CFR 100.20(c), 10 CFR 100.23(d), and 10 CFR 52.79(a)(1)(iii).

2.4.14 Technical Specification and Emergency Operation Requirements

2.4.14.1 Introduction

The technical specifications (TSs) and emergency operation requirements described here implement protection against floods for safety-related facilities to ensure that an adequate supply of water for shutdown and cool-down purposes is available. The specific areas of review are: (1) controlling hydrological events, as determined in previous hydrology sections of the SAR, to identify bases for emergency actions required during these events; (2) the amount of time available to initiate and complete emergency procedures before the onset of conditions while controlling hydrological events that may prevent such action; (3) reviewing TSs related to all emergency procedures required to ensure adequate plant safety from controlling hydrological events by the organization responsible for the review of issues related to TSs; (4) potential effects of seismic and nonseismic information on the postulated TSs and emergency operations for the proposed plant site; and, (5) any additional information requirements prescribed in the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.4.14.2 Summary of Application

This section of the North Anna 3 COL FSAR addresses TSs and emergency operation requirements. The COL applicant addressed the information as follows:

<u>*COL Items:*</u>

- NAPS COL 2.0-25-A — Technical Specification and Emergency Operation Requirements, COL Applicant to provide site-specific information in accordance with SRP 2.4.14

The COL applicant provided North Anna 3 COL FSAR Section 2.4.14 to address ESBWR DCD COL Item 2.0-25-A and referenced Sections 2.4.2 and 2.4.12 of the North Anna 3 COL FSAR regarding design basis floods and maximum groundwater elevation and their impacts on safety-related SSCs. The COL applicant concluded that the combination of the ESBWR DCD design and the plant grade elevation do not necessitate emergency procedures or TSs to prevent hydrological phenomena from degrading the UHS.

- NAPS ESP COL 2.4-2		Shut Down Water Level

The COL applicant provided site-specific information in North Anna 3 COL FSAR Section 2.4.14 to address ESP COL Action Item 2.4-2. The COL applicant stated that North Anna 3 will be shut down when the water level in Lake Anna drops below the elevation of 73.50 m (241.14 ft) NAVD88. The COL applicant added that this operational restriction is not related to the protection of safety-related SSCs or degradation of the UHS and is therefore not a TS limiting condition for operation (LCO).

2.4.14.3 Regulatory Basis

The relevant requirements of the Commission regulations for the TSs and emergency operation requirements, and the associated acceptance criteria, are in Section 2.4.14 of NUREG–0800. The applicable regulatory requirements are as follows:

- 10 CFR Part 100, as it relates to identifying and evaluating hydrological features of the site. The requirements to consider physical site characteristics in site evaluations are specified in 10 CFR 100.20(c).

- 10 CFR 100.23(d), sets forth the criteria to determine the citing factors for plant design bases with respect to seismically induced floods and water waves at the site.

- 10 CFR 52.79(a)(1)(iii), as it relates to identifying hydrologic site characteristics with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding areas and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

- 10 CFR 50.36, "Technical Specifications," as it relates to identifying limiting conditions on TSs for safe operation of the plant.

The following related acceptance criteria are summarized from SRP Section 2.4.14:

- Bases for Emergency Actions: To meet the requirements of 10 CFR 50.36 and 10 CFR Part 100, an assessment of the hydrological bases for emergency actions is needed.

- Available Response Time: To meet the requirements of 10 CFR 50.36 and 10 CFR Part 100, estimates of available response times to initiate and complete emergency procedures are needed.

- Technical Specifications: To meet the requirements of 10 CFR 50.36 and 10 CFR Part 100, the applicant's proposed TSs related to emergency procedures are reviewed.

- Consideration of Other Site-Related Evaluation Criteria: To meet the requirements of 10 CFR 50.36 and 10 CFR Part 100, the applicant's assessment of the potential effects of site-related proximity, seismic, and non-seismic information on the postulated TSs and emergency operations is needed.

In addition, the hydrologic characteristics should be consistent with appropriate sections from: RGs 1.29, 1.59, and 1.102.

2.4.14.4 Technical Evaluation

As documented in Section 2.4.14 of NUREG-1966, the staff reviewed and approved information related to TSs and emergency operation requirements for the certified ESBWR DCD, Revision 10. The staff reviewed Section 2.4.13 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD and the North Anna ESP SSAR to ensure that the combination of the information in the North Anna 3 COL FSAR and the information in the ESBWR DCD and ESP SSAR that represent the complete scope of information relating to this review topic.

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to "Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters."

In addition the staff reviewed the resolution to ESBWR DCD COL Item 2.0-25-A, related to the TSs and emergency operation requirements that implement protection against floods for safety-related facilities to ensure that an adequate supply of water for shutdown and cool-down purposes is available. Based on the ESBWR DCD design, the COL applicant's selection of design basis plant grade, and the flood protection measures described in Section 2.4.10 of this SER, no emergency procedures or TSs are necessary to prevent hydrological phenomena from degrading the UHS.

Appendix A of the North Anna ESP specifies that the minimum lake water level for operation of North Anna 1, 2, and 3 is elevation 73.50 m (241.14 ft) NAVD88. In North Anna 3 COL FSAR Section 2.4.14 the COL applicant committed to shut down North Anna 3 when the water level in Lake Anna drops below elevation 73.50 m (241.14 ft) NAVD88. Because of the UHS design, this operational restriction is not related to protection of safety-related SSCs or degradation of the UHS.

2.4.14.5 Post Combined License Activities

There are no post COL activities related to this section.

2.4.14.6 Conclusion

The staff reviewed the application and checked the referenced DCD and confirms that the COL applicant has addressed the required information, and no outstanding information remains to be addressed in the North Anna 3 COL FSAR related to this section. The review confirmed that no emergency procedures or TSs are necessary to prevent hydrological phenomena from degrading the UHS.

In addition, the staff compared the additional information in the COL to the relevant NRC regulations, the guidance in Section 2.4.14 of NUREG–0800, and NRC RGs. The staff's review concludes that the applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff has determined that the applicant has adequately addressed NAPS COL Item 2.0-25-A as it relates to TSs and emergency operation requirements.

As set forth above, the applicant has presented and substantiated information relative to the TSs and emergency operations important to the design and siting of this plant. The staff has reviewed the available information provided and for the reasons given above, concludes that the identification and consideration of the TSs and emergency operations is acceptable and meets the requirements of 10 CFR 50.36, 10 CFR 52.79(a)(1)(iii), 10 CFR 100.20(c), and 10 CFR 100.23(d) with respect to determining the acceptability of the site.

2.5 Geology, Seismology, and Geotechnical Engineering

In Section 2.5, "Geology, Seismology, and Geotechnical Engineering," of the North Anna 3 FSAR, the applicant described the geologic, seismic, and geotechnical engineering properties of the North Anna 3 COLA site.

FSAR Section 2.5.1, "Basic Geologic and Seismic Information," presents information on geologic and seismic characteristics of the COL site and region surrounding the site. FSAR Section 2.5.2, "Vibratory Ground Motion," describes the vibratory ground motion assessment for the COL site through a Probabilistic Seismic Hazard Analysis (PSHA) and develops the Safe Shutdown Earthquake (SSE) ground motion. FSAR Section 2.5.3, "Surface Faulting," evaluates the potential for surface tectonic and non-tectonic deformation at the COL site. FSAR Sections 2.5.4, "Stability of Subsurface Materials and Foundations," and 2.5.5, "Stability of Slopes," describe foundation and subsurface material stability at the COL site. FSAR Section 2.5.6, "Embankments and Dams," describes the embankments and dams in the site area.

The FSAR incorporates by reference the information contained in Revision 9 of the ESP SSAR and ESBWR DCD Revision 10; and adds new information to address DCD and ESP COL items, to satisfy ESP permit conditions, and to resolve variances from the ESP. The applicant defined three zones around the site: the region within 320 km (200 miles), a vicinity within 40 km (25 miles), and an area within 8 km (5 miles). The COL site is in the area within 1 km (0.6 mile) of the site location adjacent to North Anna 1 and 2, abandoned foundation mats for Units 3 and 4, and the independent spent fuel storage installation (ISFSI).

The COL FSAR, Section 2.5, provides variances to the ESP SSAR based on new information regarding: (a) the **M**5.8 earthquake that occurred on August 23, 2011, in Mineral, Louisa County, Virginia, and the results of a geological reconnaissance to investigate any surface features associated with the earthquake in the site vicinity; (b) incorporation of the CEUS-SSC model (NUREG-2115); and (c) additional borings to support North Anna 3 ESBWR investigation. The COL FSAR Section 2.5 provides information to satisfy ESP permit conditions (conditions 4, 5, 6, 7); ESP VARs 2.5-2, 2.5-4, 2.5-7; and ESP COL Action 2.5-1. The staff has previously reviewed Section 2.5 of the North Anna 3 ESP SSAR and its findings are documented in NUREG-1835.

The staff reviewed North Anna 3 COL FSAR Section 2.5, interacted with the applicant during public meetings, and issued RAIs to confirm the assertions made by the applicant in the North Anna 3 COL FSAR. In early versions of the North Anna 3 COL FSAR, the applicant used seismic source models developed in 1986 and 1989 by the EPRI, as the starting point for characterizing potential regional seismic sources and resulting vibratory ground motion, and then updated these seismic source models in light of more recent data and evolving knowledge. The applicant later replaced the original EPRI (1989) ground motion models (GMM) with more recent EPRI models (2013), and applied the performance-based approach described in RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," which incorporates PSHA, to develop ground motion response spectra (GMRS) for the site. The applicant subsequently replaced those models with the new seismic source characterization model for the central and eastern United States (CEUS-SSC) published in NUREG-2115, “Central and Eastern United States Seismic Source Characterization for Nuclear Facilities” in response to RAI 02.05.02-4 dated February 13, 2012 (ADAMS Accession No. ML12048A096), which requested the applicant to evaluate the seismic hazard in light of the August 23, 2011, Mineral, Virginia, earthquake.

Further, following the 2011 Fukushima Dai-Ichi nuclear power plant accident in Japan, which occurred as a result of the Great Tohoku earthquake and the subsequent tsunami, the NRC Near-Term Task Force (NTTF) issued a series of recommendations for reevaluating and improving nuclear power plant safety in the U.S. Consequently, on March 12, 2012, the NRC issued an information letter requesting that licensees of all operating nuclear power plants in the U.S. reevaluate the seismic hazard at their respective plants using the most recent data and evaluation methodologies available. That information letter also requested that licensees of operating plants in the CEUS use the seismic source model provided in NUREG-2115 to characterize seismic hazard at their respective plants. Consistent with existing guidance in RG 1.208, pertaining to the need to consider the latest information in the evaluation of seismic hazard, the NRC also requested that all COL and ESP applicants in the CEUS address seismic hazard for their respective proposed plant sites using information in NUREG-2115 and modify the GMRS, if needed. The staff issued this request to North Anna 3 in RAI 01.05-1 dated June 25, 2012 (ADAMS Accession No. ML12214A593).

In a December 18, 2013, response to RAI 01.05-1 (ADAMS Accession No. ML14013A113), the applicant stated that RAI 01.05-1 is no longer applicable to the North Anna 3 site, because it replaced the previous EPRI seismic source models with the CEUS-SSC model presented in NUREG-2115 as the starting point for developing GMRS for the North Anna 3 site in response to RAI 02.05.02-4 dated February 13, 2012 (ADAMS Accession No. ML12048A096).

With this change in the base seismic source model, some of the RAIs the staff previously asked of the applicant became unnecessary, as described in SER Section 2.5.2.4. Therefore, this SER references only the most recent version of the North Anna 3 COL FSAR and the staff’s technical evaluation of that version without discussing the replaced portions of the previous North Anna 3 COL FSAR and some of the staff’s earlier RAIs, which are now unnecessary and closed without specific resolution. The following sections of this report discuss the RAIs that remain applicable to the staff’s review following the change in the base seismic source model, along with the new RAIs related to the most recent version of the North Anna 3 COL FSAR.

2.5 Geology, Seismology, and Geotechnical Engineering

2.5.1 Basic Geologic and Seismic Information

2.5.1.1 Introduction

Section 2.5.1 of this SER provides the basic geologic and seismic information related to the North Anna 3 site. Section 2.5.1.2 of this SER summarizes the relevant geologic and seismic information in FSAR Section 2.5.1 of the North Anna 3 COLA. SER Section 2.5.1.3 summarizes the regulations and guidance used by the applicant to perform the investigation. SER Section 2.5.1.4 reviews the staff’s evaluation of FSAR Section 2.5.1, including any RAIs, open items, and confirmatory analyses performed by the staff. SER Section 2.5.1.5 discusses any post COL activities. Finally, SER Section 2.5.1.6 provides an overall summary of the applicant’s conclusions, as well as the staff’s conclusions; restates any bases covered in the application; and confirms that regulations were met or fulfilled by the applicant.

COL FSAR Section 2.5.1, and by reference the ESP SSAR Section 2.5.1, describes the geologic information that the COL applicant collected during site investigations to address regional and site-specific geologic characteristics derived from previous work and from surface and subsurface investigations. The COL applicant stated it reviewed previous site investigations for North Anna 1 and 2, and abandoned Units 3 and 4 for the geologic properties of the COL site. Additionally, COL FSAR Section 2.5.1, and by reference the ESP SSAR Section 2.5.1, includes newly published information and the recent geologic, seismic, geophysical and geotechnical investigations conducted for North Anna 3. Finally, COL FSAR Section 2.5 includes information on the **M**5.8 earthquake that occurred on August 23, 2011, in Mineral, Louisa County, Virginia, and the results of the geological field reconnaissance program to investigate any surface features associated with the earthquake in the site vicinity.

The COL applicant conducted these investigations to assess geologic and seismic suitability of the site, to determine whether new geologic or seismic data exist that could significantly impact seismic design based on the results of PSHA, and to provide the geologic and seismic data appropriate for plant design.

2.5.1.2 Summary of the Application

Section 2.5.1 of the North Anna 3 COL FSAR, incorporates by reference Section 2.5.1 of the North Anna ESP SSAR, Revision 9. In addition, in FSAR Section 2.5.1, the applicant provided supplemental information to address the geologic and geotechnical data collected as part of the additional North Anna 3 site borings. This information included additional descriptions of the Ta River Metamorphic Suite and the saprolite and artificial material encountered in the site subsurface. The applicant also supplied additional details on the engineering geology of the soil and rock at the site. Finally, the applicant provided information to satisfy permit conditions 5 through 7 from the North Anna ESP.

This COL FSAR section also addresses COL Item 2.0-26-A from Revision 5 to the ESBWR DCD; ESP COL Action Item 2.5-1; and permit conditions identified in the North Anna 3 ESP SER (NUREG-1835) and summarized in Part 3, Section E of the North Anna ESP (ADAMS Accession No. ML073180440).

COL Items, ESP Variances, and ESP Permit Conditions:

- NAPS COL 2.0-26-A

The applicant incorporated by reference Section 2.5.1 of the North Anna 3 ESP SSAR to address NAPS COL 2.0-26-A (ESBWR DCD COL Item 2.0-26-A) which requires that a COL applicant referencing the ESBWR design to provide basic geologic and seismic information for the site in accordance with SRP 2.5.1.

- NAPS ESP VAR 2.0-4

The applicant provided additional information to address ESP COL Action Item 2.5-9, which states that the COL applicant should determine that the average shear wave velocity (V_s) of the material underlying the foundation for the reactor containment equals or exceeds that of the chosen design.

- NAPS ESP COL 2.5-1

The applicant provided additional information to address ESP COL Action Item 2.5-1, which states that the COL applicant should perform additional borings in the subsurface to identify any weathered or fractured rock beneath the new foundations.

- ESP Permit Condition 3.E(4)

The applicant provided additional information to address ESP Permit Condition 3.E(4), which requires the replacement of weathered or fractured rock at the foundation level with lean concrete before initiation of foundation construction.

- ESP Permit Condition 3.E(5)

The applicant provided additional information to address ESP Permit Condition 3.E(5), which prohibits the applicant from using engineered fill with high compressibility and low maximum density, such as saprolite, in the construction of North Anna 3.

- ESP Permit Condition 3.E(6)

The applicant provided additional information to address ESP Permit Condition 3.E(6), which requires the applicant to provide geologic mapping information for future excavations of safety-related structures and to evaluate unforeseen geologic features that are encountered. The applicant should notify the NRC no later than 30 days before any excavations for safety-related structures are open for NRC's examination and evaluation.

Regional Tectonic Setting

COL FSAR Section 2.5.1.1.4 describes the new PSHA based on the CEUS-SSC model described in NUREG-2115. The CEUS-SSC model (NRC, 2012) replaces the previous PSHA based on the Electric Power Research Institute–Seismicity Owners Group (EPRI-SOG) model (EPRI, 1988, 1989) and the Lawrence Livermore National Laboratory model (LLNL, 1993, NUREG/CR-5250, "Seismic hazard characterization of 69 nuclear plant sites east of the Rocky Mountains."). The applicant described the Extended Continental Crust-Atlantic Margin Zone (ECC-AM) as the CEUS-SSC host source for the North Anna 3 site.

Principal Tectonic Structures

COL FSAR Section 2.5.1.1.4.c indicates that the host seismotectonic zone for the site is the ECC AM (Figure 2.5.1-1 of this report) and that this zone includes Mesozoic extensional structures formed during the opening of the Atlantic Ocean. The COL applicant stated that no basin-margin faults have been reactivated during the Quaternary in the site region and that any reactivation of faults bordering or beneath Mesozoic basins is addressed in the CEUS-SSC model. The Stafford fault system, a Tertiary tectonic structure and also located within the ECC-AM, does not reveal any geologic or geomorphic evidence of Quaternary activity based on the COL applicant's field and aerial reconnaissance. The COL applicant indicated that the Stafford fault system is not included as a Quaternary structure in Crone and Wheeler (2000) and thus concluded that it is not a capable tectonic source. In the Quaternary Tectonic Features Section, the COL applicant explained that aftershock data from the August 23, 2011, **M**5.8 Mineral earthquake delineates a previously unmapped geologic structure named the "Quail fault" (Horton et al. 2012, 2014, 2015). The COL applicant concluded that this structure does not fit the criteria for a repeated large magnitude earthquake (RLME) source per NUREG-2115. The FSAR provides information regarding other tectonic features in the site region that have been considered as possibly

Quaternary age such as the paleoliquefaction sites of Obermeier and McNulty, the Everona-Mountain Run Fault Zone, and the East Coast Fault System. None of these tectonic features fit the criteria for a RLME source. Each of these features is considered within the ECC-AM source zone in the CEUS-SSC model.

Seismic Sources Defined by Regional Seismicity

COL FSAR Section 2.5.1.1.4.d describes modifications made to seismic sources defined by regional seismicity based on new data and information in CEUS-SSC model. The Central Virginia Seismic Zone (CVSZ) is located within the ECC-AM seismotectonic source zone of the CEUS-SSC model and includes the August 23, 2011, Mineral, Virginia, earthquake (Figure 2.5.1-1 of this report). The COL applicant stated that the **M**5.8 Mineral earthquake main shock is included in the updated seismicity catalog and indicates reverse motion at a final depth of 6.0 km (4 mi). The COL applicant modeled a possible rupture plane based on aftershock data (Figure 2.5.1-2 of this report). Researchers investigating the epicentral area immediately after the earthquake described several liquefaction features associated with the earthquake.

The COL FSAR also describes the Giles County Seismic Zone located within the Paleozoic extended zone (PEZ) seismotectonic source zone and that the maximum magnitudes (M_{max}) for the Giles County Seismic Zone and Eastern Tennessee Seismic Zone (ETSZ) sources were incorporated into the CEUS-SSC model. The COL applicant used the Charleston and New Madrid Seismic Zones as RLME sources from the CEUS-SSC model to predict seismic hazard at the North Anna 3 site. See specific details regarding the sensitivity analysis of these RLME sources in SER Section 2.5.2.

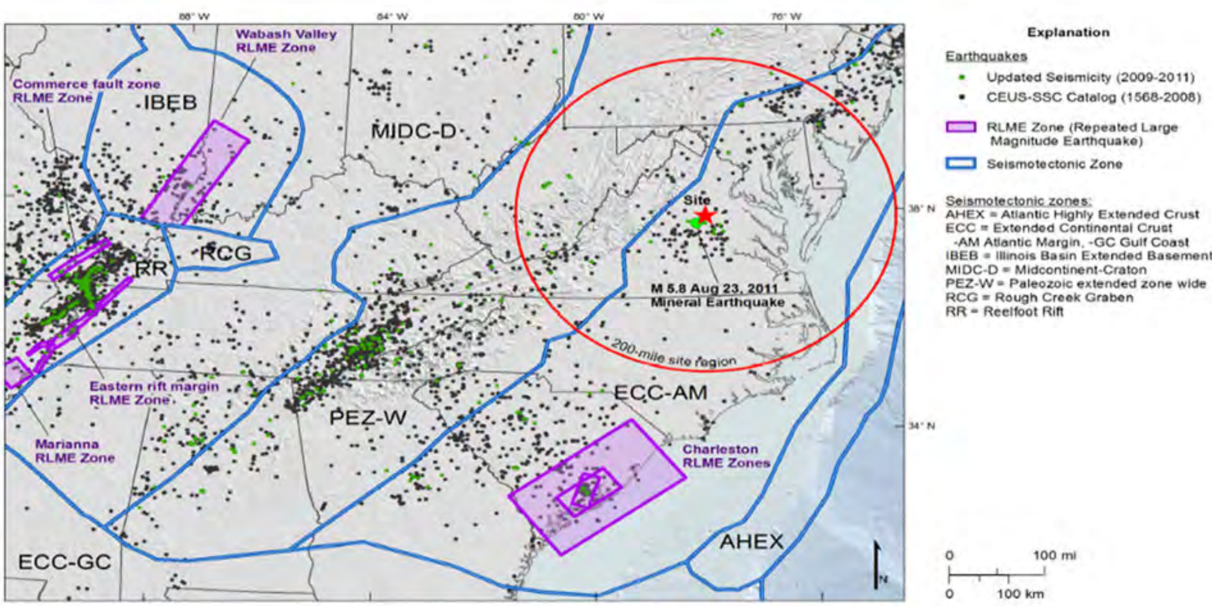


Figure 2.5.1-1. NAPS site region with seismotectonic source zones and the August 2011 Mineral, Virginia, earthquake (from FSAR Figure 2.5.1-202, Rev. 8)

Geologic Bases for Defining Relevant Source Zones

COL FSAR Section 2.5.1.1.6 details the geologic bases for defining relevant source zones. The North Anna 3 site is located within the ECC-AM seismotectonic source zone, a region comprised of rifted and extended continental crust that developed from the Mesozoic rifting that created the Atlantic Ocean and an older basal detachment fault that separates the over-thrusted Appalachian terranes from underlying Precambrian rocks of the North American craton. The COL applicant explained that a global study of earthquakes in stable continental regions (SCRs) (Johnston et al., 1994) and the CEUS-SSC model indicate that Mesozoic and younger extended crust has produced all M ≥ 7 stable craton earthquakes worldwide. The Paleozoic extended crust source zone, located immediately west of the ECC-AM, is comprised of terrane rifted during the Iapetan crustal extension. The COL applicant stated that normal faults formed during the opening of the Iapetus Ocean in this zone created zones of crustal weakness that exhibit a higher rate of seismicity and appear to coincide with the Giles County and the ETSZs.

Information on the August 23, 2011 Mineral, Virginia, Earthquake

The North Anna 3 site is located within the CVSZ, an area of persistent, low-level seismicity in the Piedmont Province and the ECC-AM seismotectonic zone. COL FSAR Section 2.5.1.1.7 describes the seismicity characteristics of the Mineral earthquake and the geologic field reconnaissance completed by the COL applicant to evaluate and document surface deformation from the Mineral earthquake. The COL applicant delineated a zone of possible surface deformation from the Mineral earthquake by fitting a rupture plane to aftershocks relocated by McNamara et al. (2014) and projecting this plane up-dip to the surface (Figure 2.5.1-2 of this report). The rupture plane strikes approximately N30ºE, dipping 45-50º SE with a length of ~6.2 mi (10 km) between the town of Quail, Virginia, and the headwaters of Despar Creek. The COL applicant indicated that the Mineral earthquake was a reverse faulting event that ruptured at a shallow depth (6.0 ± 3.1 km) and the up-dip surface projection of its rupture plane is located within the Chopawamsic Formation (Figure 2.5.1-3) (Burton et al. 2014).

The COL applicant performed a geologic reconnaissance field program (FSAR Section 2.5.1.1.7b) and acquired and processed Light Detection and Ranging (LiDAR) data covering a region encompassing the rupture plane of the Mineral earthquake and the proposed North Anna North Anna 3 site (Figure 2.5.1-4). The COL applicant used LiDAR as a basis for its geomorphic evaluation to document any coseismic surface rupture or other visible deformation at the surface in the Mineral earthquake epicentral region. The LiDAR package included a bare earth Digital Elevation Model (DEM), hillshade, slope and contour maps and orthophotography. The COL FSAR describes the search for evidence of regional fault-related geomorphic features, including geomorphic lineaments caused by active faulting, stream gradient changes or offsets, and contrasting large topographic features. On the ground field reconnaissance by the COL applicant included a search for ground fissures or compressional ground buckling, springs or artesian conditions, changes in vegetation growth, minor fault scarps, fault controlled drainages, and cracked or offset pavement along roads that might indicate surface deformation.

The COL applicant identified strong topographic lineaments in the LiDAR data and suggested that the lineaments reveal contrasts in erosion susceptibility between different geologic units. No liquefaction features were found during the field reconnaissance; however, the COL applicant stated that a few liquefaction features generated by the Mineral earthquake are described by researchers who investigated the epicentral area immediately following the earthquake. The COL applicant concluded that the **M**5.8 earthquake did not produce any discernible rupture or deformation at the ground surface and the Mineral earthquake did not rupture on a previously mapped fault.

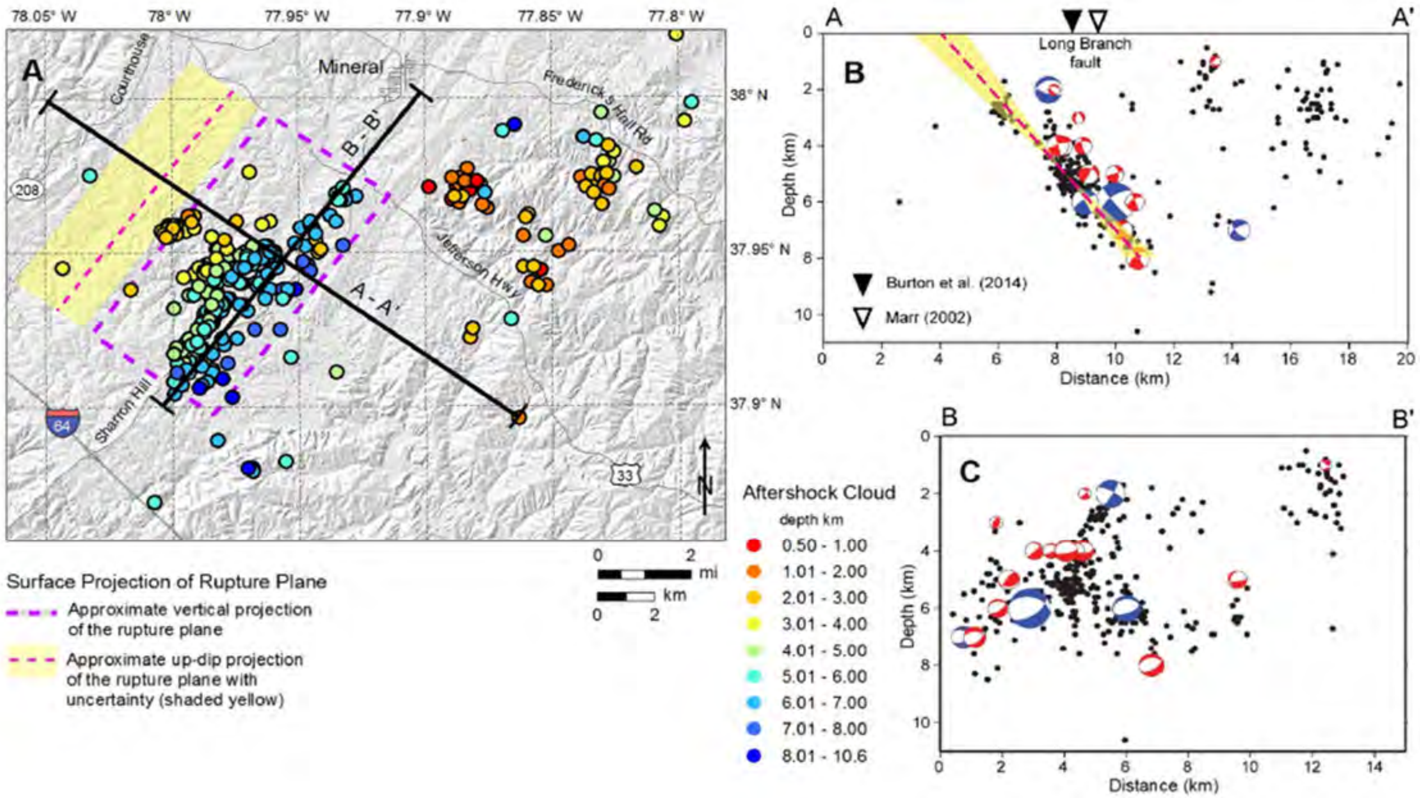


Figure 2.5.1-2. August 2011 Mineral, VA, earthquake aftershocks map and cross-sections illustrating subsurface rupture plane (from McNamara et al. (2014) taken from FSAR Figure 2.5.1-209, Rev. 9

Site Area Stratigraphy

COL FSAR Section 2.5.1.2.3 presents additional information based on supplemental borings collected at the North Anna 3 site in support of the ESBWR DCD, which include 93 borings, 23 cone penetrometer tests (CPTs), along with test pits, borehole geophysical logging, shear wave suspension loggings, and electrical resistivity tests. Details of this subsurface investigation are in FSAR Section 2.5.4 and in appendices 2.5.4 AA, 2.5.4 BB, 2.5.4 CC. The COL applicant briefly described the extent of various zones of fresh to weathered rock, including saprolite, as modified by the supplemental boring program.

The COL FSAR Section 2.5.1.2.3 also adds new information regarding the Ellisville pluton, based on new geologic mapping at the 1:24,000 scale in the northern half of the Ferncliff, Virginia, 7.5 minute quadrangle that suggests that the Ellisville pluton (approximately 440 Ma) cross-cuts and post-dates the Chopawamsic thrust fault (Hughes and Hibbard, 2012).

Site Area Structural Geology

The previous ESP SSAR Section 2.5.1.2.4 lists seven bedrock faults identified within a 5-mile radius of the site: Spotsylvania thrust, Chopawamsic thrust, Long Branch thrust, Sturgeon Creek fault, Unnamed fault (“a”) traversing the North Anna 3 site, Unnamed fault (“b”) separating the Ta River Metamorphic Suite from the Quantico Formation, and Unnamed fault (“c”) separating the

Northeast Creek pluton from the Quantico Formation. In the COL FSAR Section 2.5.1.2.4, the COL applicant stated that none of these faults are capable tectonic sources per RG 1.208.

Site Engineering Geology Evaluation

The COL FSAR Section 2.5.1.2.6 briefly describes the engineering behavior of soil and rock quality designations (RQD) and references details in Appendices 2.5.4 AA, 2.5.4 BB, and 2.5.4 CC. The COL applicant stated that results from the previous geotechnical investigations (ESP SSAR References 7 and 8), and for both the ESP subsurface investigation (ESP SSAR Appendix 2.5.4 B) and the North Anna 3 subsurface investigation (Appendices 2.5.4AA, 2.5.4BB, and 2.5.4CC) indicate that Zone III, III-IV, and IV Rock are suitable bearing surfaces for founding seismic Category I structures and that the density and area extent of jointing and fracturing in these zones is not extensive enough to affect engineering behavior of the rock. The COL applicant also stated that weathered and fractured rock at the foundation level for safety-related features would be excavated and replaced with lean concrete before initiation of foundation construction. In addition, the COL applicant also stated that future excavations for safety-related structures would be geologically mapped in order to detect and evaluate unknown geologic features at the site.

2.5.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the ESBWR DCD and its supplements and in NUREG-1835.

The applicable regulatory requirements for reviewing the applicant's discussion of geologic and seismic information are:

10 CFR 52.79(a)(1)(iii), "Contents of applications; technical information in the final safety analysis report," relates to identifying geologic site characteristics with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity and period of time in which the historical data have been accumulated.

10 CFR Part 100, Section 100.23, "Geologic and seismic siting criteria," provides the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identify geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants.

The related acceptance criteria are summarized from SRP Section 2.5.1:

Regional Geology: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17, 10 CFR 52.79 and 10 CFR 100.23 (c) and guidance in RGs 1.206, 1.208 and 4.7, the description of regional geology is acceptable if a complete and documented discussion is presented for the geologic setting, tectonic framework and conditions caused by human activities, that have the potential to affect the safe siting and design of the plant. This section should contain a review of regional stratigraphy, lithology, structural geology, geologic and tectonic history, tectonic features (with emphasis on the Quaternary period), seismology, geomorphology, paleoseismology, and physiography within the 320 km (200 mi) site region or beyond as necessary to provide a framework within which significance to safety can be evaluated concerning geology, seismology, and conditions caused by human activities. Geologic maps and cross-sections constructed at scales adequate to illustrate relevant regional features should be included in the application.

Site Geology: In meeting requirements of 10 CFR 52.79 and 10 CFR 100.23, and regulatory positions presented in RG 1.208, 1.206, and RG 4.7, the description of site geology is considered acceptable if it contains a description and evaluation of geologic (including tectonic and non-tectonic) features, geotechnical characteristics, seismic conditions, and conditions caused by human activities at appropriate levels of detail within areas defined by circles drawn around the site using radii of 40 km (25 mi) for site vicinity, 8 km (5 mi) for site area, and 1 km (0.6 mi) for site location. In addition, the geologic characteristics should be consistent with appropriate sections from; RG 1.208, and RG 1.206.

2.5.1.4 Technical Evaluation

The applicant incorporated by reference Section 2.5.1 of the ESP SSAR, Revision 9. The staff's technical evaluation of Section 2.5.1 of the ESP SSAR is documented in NUREG-1835.

The staff reviewed Section 2.5.1 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD, Revision 10 and the North Anna 3 ESP SSAR, to ensure that the combination of the DCD, the North Anna 3 ESP SSAR and the COLA represents the complete scope of information related to this review topic.[1]

The staff's review confirms that the information in the COL FSAR and incorporated by reference addresses the required information for geologic characterization information.

The staff's technical evaluation of COL FSAR Section 2.5.1 is limited to reviewing (1) the resolution of DCD COL Item 2.0-26-A and ESP Action 2.5-1; (2) adherence to Permit Condition Section(E)(6); (3) resolution of ESP VAR 2.0-4 and; (4) applicant's responses to RAIs, as addressed below.

COL Items, ESP Variances, and ESP Permit Conditions:

- NAPS COL 2.0-26-A

In accordance with DCD COL Item 2.0-26-A, the applicant provided additional information on the site stratigraphy, engineering geology evaluation, and groundwater conditions as determined from additional subsurface investigations conducted at the North Anna 3 site. This new information presented by the applicant supplements the information in the ESP SSAR and includes additional information and data obtained through the COL site investigations. The staff concludes that the applicant has included sufficient information from subsurface investigations to supplement ESP SSAR Section 2.5.1 and to resolve DCD COL Item 2.0-26-A.

- NAPS ESP COL 2.5-1

ESP COL Action Item 2.5-1 requires the applicant referencing the North Anna 3 ESP to provide additional boring data to identify any weathered or fractured rock that may be beneath the new foundations. In FSAR Section 2.5.1.2.3, the applicant stated that the borings completed for North Anna 3, the logs of which are included in Appendix 2.5.4AA of the FSAR, encountered weathered rock from the elevation of 62.7 to 86.8 m (206 to 285 ft) and again from 56.9 to 89.0 m (187 to 292 ft) and from 53.0 to 84.7 m (174 to 278 ft). The elevations corresponded too moderately to highly weathered Zone III rock, slightly too moderately weathered Zone II-IV rock, and slightly weathered to fresh Zone IV rock, respectively. Because the applicant identified the subsurface elevation where weathered rock occurs beneath the foundations, the staff concludes this information is sufficient to satisfy the requirements of ESP Action Item 2.5-1. Therefore, the staff considers ESP COL Action Item 2.5-1 to be resolved.

- ESP Permit Conditions 3.E(4) through 3.E(6)

Three permit conditions were identified in the ESP SER and summarized in Section E to Part 3 of the ESP. Permit Condition 3.E(4) requires the replacement of weathered and fractured rock at the foundation level with lean concrete before the initiation of foundation construction. The applicant stated in FSAR Section 2.5.1.2.6 that weathered or fractured rock encountered at the site will be excavated and replaced with lean concrete. The staff concluded that this planned action, in addition to the excavation plans summarized in SER Section 2.5.4.2.10, is acceptable and meets the criteria in Permit Condition 3.E(4).

Permit Condition 3.E(5) prohibits the applicant from using engineered fill with high compressibility and low maximum density, such as saprolite, in the construction of North Anna 3. FSAR Section 2.5.1.2.3 states that “engineered fill such as saprolite, will not be used as engineered fill to support or backfill seismic Category I or II structures.” The staff reviewed additional excavation and backfill plans in FSAR Section 2.5.4 and determined that the plans do not include the use of high compressibility and low maximum density materials such as engineered fill to support any seismic Category I or II structures.

Permit Condition 3(E)(6) requires the applicant to provide geologic mapping information for future excavations of safety-related structures and to evaluate any unforeseen geologic features that are encountered. The applicant is also required to notify the NRC no later than 30 days before any such excavation is open for NRC examination and evaluation. An applicant for a construction permit (CP) or COL referencing this ESP shall perform geologic mapping of any excavation for a safety-related structure, evaluate any unforeseen geologic features that are encountered, and notify the NRC no later than 30 days before any such excavation is open for NRC examination and evaluation. This permit condition has been carried forward as a license condition for future excavations of safety-related structures (Section 2.5.1.4, this report).

The North Anna 3 COL FSAR Section 2.5.1, “Basic Geologic and Seismic Information,” incorporates by reference the North Anna 3 SSAR Section 2.5.1. The staff reviewed the COL FSAR variance to the ESP SSAR (North Anna 3 ESP VAR 2.0-4) for the North Anna 3 FSAR Section 2.5.1 and submitted several RAIs. The staff's evaluation of this variance to the ESP SSAR in COL FSAR Section 2.5.1 and of the COL applicant's responses to staff RAIs is presented below.

Basic Geologic and Seismic Information

The COL FSAR Section 2.5.1, and by reference the ESP SSAR Section 2.5.1, includes newly published information and the recent geologic, seismic, geophysical, and geotechnical investigations conducted for North Anna 3. This includes information on the **M**5.8 earthquake that occurred on August 23, 2011, in Mineral, Louisa County, Virginia, and the results of the geological field reconnaissance program (FSAR Section 2.5.1.1.7b) to investigate any surface features associated with the earthquake in the site vicinity. In COL FSAR Section 2.5.1, Basic Geologic and Seismic Information, the COL applicant stated that they contacted the USGS, State geological survey organizations, and universities and identified relevant unpublished geologic literature, studies, and projects. Since a large part of this new information on the effects of the Mineral earthquake is not yet in peer reviewed publications, staff asked the applicant in RAI 02.05.01-1 dated April 22, 2014 (ADAMS Accession No. ML14112A156), to provide further details regarding research by others and to explain how they have considered the findings and interpretations of others in their characterization of the CVSZ and the effects of the Mineral earthquake.

In a May 21, 2014 response to RAI 02.05.01-1 (ADAMS Accession No. ML14143A239), the COL applicant provided a list of persons contacted within various organizations and a summary of the topics that were discussed. The COL applicant attended professional conferences, visited USGS and the Virginia Department of Mines, Minerals and Energy (DMME) offices and talked with geoscientists who were actively collecting and analyzing data from the Mineral earthquake including assessment of aftershock data, LiDAR analyses, geologic mapping and trenching, and investigation of liquefaction sites. This information guided the COL applicant in its own geologic reconnaissance of the epicentral area. The COL applicant used aftershock data analysis by M. Chapman of Virginia Tech to direct the field team to areas where surface effects from the Mineral earthquake would most likely have occurred. LiDAR data covering the epicentral area was subsequently obtained from interstate 64 to the northeast shore of Lake Anna. The COL applicant reviewed and compared various mapping products from USGS, DMME and NC State University researchers, included information from the ESP application and incorporated the information into the Geologic Reconnaissance Report. Key elements of the Geologic Reconnaissance Report are included in the revised FSAR Section 2.5.1 because of FSAR revisions made by the COL applicant in various RAI responses (RAI 02.05.01-4, 5, 02.05.01-8). The COL applicant provided a summary of the geologic reconnaissance program in FSAR Section 2.5.1.1.7b and c.

The staff reviewed the COL applicant's RAI response and also talked with geoscientists presenting recent research on the effects of the Mineral earthquake at the GSA southeastern section meeting in Blacksburg, VA, March 2014. In addition, staff audited the COL applicant's Geologic Reconnaissance Report in Frederick, MD on March 11, 2014. The staff's audit summary is available in ADAMS Accession No. ML14203A211. The Geologic Reconnaissance Report includes a compilation and evaluation of published information, communications with other researchers, and a geomorphic evaluation of LiDAR data acquired by Dominion for this project related to the potential for surface deformation in the site vicinity for North Anna Power Station North Anna 3. Based on the RAI response, staff's own contact with active investigators and staff's audit of the COL applicant's Geologic Reconnaissance Report, staff acknowledges that the COL applicant reached out to known active investigators to capture the breadth of scientific understanding currently available for the geologic effects of the Mineral earthquake. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-1 resolved and closed.

Regional Tectonic Setting

In FSAR Section 2.5.1.1.4, Regional Tectonic Setting, the COL applicant describes the orientation of tectonic stress in the site region. The staff notes that Mazzotti and Townend (2010) determined that the principle horizontal stress direction in the CVSZ is essentially east to west, rotated 48 degrees clockwise from the regional northeast to southwest stress direction. In RAI 02.05.01-2 dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to provide a discussion regarding the current local stress field within CVSZ and the focal mechanisms of the Mineral earthquake and aftershocks and the impact on suitably or susceptibly oriented faults in the area.

In a May 21, 2014, response to RAI 02.05.01-2 (ADAMS Accession No. ML14143A239), the COL applicant stated that the recently revised world stress map indicates an overall NE-SW maximum horizontal compressive stress orientation throughout the eastern and central US (Hurd and Zoback, 2012). This was based on borehole breakout tests and hydrofracturing, and to a lesser extent on earthquake focal mechanisms. The COL applicant stated that for the CVSZ specifically, Mazzotti and Townend (2010) based their findings on 13 earthquake focal mechanisms. Hurd and Zoback (2012) also report an E-W direction to stress for the CVSZ. The COL applicant concluded that this is strong corroborating evidence that the E-W stress field is real and deviates from the regional NE-SW stress direction. The E-W stress field is more consistent with the Mineral earthquake data than the regional NE-SW stress field. For the focal mechanisms of the Mineral earthquake, the COL applicant cited McNamara et al. (2014) who found that locations and focal mechanisms from the Mineral earthquake and aftershocks indicate a rupture plane striking approximately N36 degrees E, dipping 49 degrees ESE, with a reverse slip focal mechanism. The COL applicant stated that other NE to SW oriented structures, aligned with the regional tectonic fabric, are thus favorably oriented for reactivation within the local stress field.

The staff considered the RAI responses and reviewed the findings of Mazzotti and Townend (2010) and Hurd and Zoback (2012). The staff agrees with the COL applicant's conclusions in that the local stress field is consistent with the character of the Mineral earthquake and that other NE-SW striking structures are favorably oriented for reactivation in this area. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-2 resolved and closed. The COL applicant provided a proposed COL revision to include portions of the RAI response in a future revision of the North Anna 3 FSAR. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.01 from the staff's advanced SER for North Anna 3 is resolved and closed.

Central Virginia Seismic Zone

The COL applicant stated in the section on the CVSZ, that researchers who investigated the epicentral area immediately following the 2011 Mineral earthquake describe several liquefaction features generated by the earthquake. In RAI 02.05.01-3 dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to provide additional details regarding these recent features as well as the paleoliquefaction features documented by Obermeier and McNulty (1998), all within 30 miles of North Anna 3. The staff asked the COL applicant to discuss the possible impact to the SSC of the eastern part of the CVSZ in light of new age determinations on the paleoliquefaction sites.

In a June 23, 2014, response to RAI 02.05.01-3 (ADAMS Accession No. ML14177A441), the COL applicant explained that immediately following the August 23, 2011, Mineral earthquake, an Earthquake Engineering Research Institute (EERI) Geotechnical Extreme Events Reconnaissance (GEER) team of engineers and geologists initiated a regional ground reconnaissance program and identified two sites along the South Anna River where liquefaction occurred (EERI 2011) (Yancey-3 & BOR-2 sites). The COL applicant plotted the locations on high-resolution topographic hill shade maps derived from LiDAR data to show the local geomorphic context for these sites. Both these sites are within the 25-mile radius of North Anna 3.

The Yancey-3 site is located within the incised South Anna river channel near the intersection of Yanceyville and Vigor Roads and the South Anna River. These sand boils are small and the ejected material is described as well-graded sand with silt and gravel (Green et al., 2014). The Bor-2 site is about 3 km northwest of the Yancey-3 site, in a tributary channel of the South Anna River. Material ejected is described as silt. The EERI team reported that even though the sand boils resulted from liquefaction, the material properties, stratigraphy and liquefaction source zone were less than ideal. The COL applicant stated that given the magnitude and period of the Mineral earthquake, widespread liquefaction would not be expected.

The applicant also provided information about 3 paleoliquefaction sites that lie just beyond the site vicinity (Obermeier and McNulty, 1998) and a new figure (FSAR Figure 2.5.1-225) showing the locations of both the paleoliquefaction and the Mineral earthquake liquefaction sites relative to North Anna 3. The paleoliquefaction sites that are located on the James, Rivanna, and South Anna Rivers reveal a few small clastic dikes in riverbank deposits. Radiocarbon dates for the James River site indicate an age of a few hundred years. The other sites might be early to late Holocene age based on the severe weathering of the clastic dikes. Recent radiocarbon and Optically Stimulated Luminescence dates suggest ages between 2,000 to 900 years before present (Harrison et al., 2014). These dates were presented in conference and the specific context of the samples could not be evaluated with respect to previous dates. The COL applicant concluded that both the paleoliquefaction and the recent liquefaction sites are consistent with a local moderate-magnitude earthquake, similar to the 2011 Mineral earthquake.

The staff considered the information and maps provided in the RAI response and notes that the Mineral earthquake would not likely cause widespread, numerous liquefaction features based on the size of the earthquake and the lack of ideal liquefaction conditions in the region. The staff also reviewed the information in the Obermeier and McNulty (1998) publication. The staff agrees with the COL applicant’s conclusion that the paleoliquefaction features likely reflect moderate-size earthquakes, possibly similar to the Mineral earthquake. The staff notes that the North Anna 3 and the CVSZ are located in the ECC-AM host zone of the CEUS-SSC model that includes a large Mmax distribution for the zone and recurrence parameters derived from the historical seismicity. The staff thus concludes that the CEUS-SSC adequately captures the current understanding of the CVSZ. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-3 resolved and closed. The COL applicant provided a proposed COL revision to include portions of the RAI response in a future revision of the North Anna 3 FSAR. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore Confirmatory Item 2.5-02 from the staff’s advanced SER for North Anna 3 is resolved and closed.

Mineral Virginia Earthquake

In COL FSAR Section 2.5.1.1.7, the staff reviewed new information regarding the 2011 Mineral Virginia Earthquake. The COL applicant stated that up-dip surface projections of aftershock data (now called Quail fault) served as a guide for geologic field reconnaissance to determine the possibility of surface deformation caused by the Mineral 2011 earthquake (Figure 2.5.1-2). In RAI 02.05.01-4a dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to comment on the uncertainty of the surface projection of the geophysical data and discuss other clusters of aftershocks located to the northeast of the main cluster that might align with other structures. The staff also asked the COL applicant regarding other possible expressions of surface deformation, such as deformation expressed as an uplifted area in the hanging wall of the Quail fault.

In a June 10, 2014, response to RAI 02.05.01-4a (ADAMS Accession No. ML14162A436), the COL applicant stated that the field program focused on evidence for surface deformation in the epicentral area and the possible surface rupture zone. The surface rupture trace is one possible zone and was used as guide for field and remote sensing investigation. The COL applicant used information from McNamara et al. (2014) that provides a catalog of 365 aftershocks. The map of aftershock data reveal three discrete clusters of concentrated seismicity surrounded by a broader region of diffuse seismicity. The largest cluster contains the main shock. The staff notes that many investigators evaluated these data and proposed best-fit planes, which are intended to represent the location and geometry of the Mineral earthquake source. Horton et al. (2012, 2015) name the large cluster with the main shock, the Quail fault. The COL applicant focused their field program in the area where this fault projects to the surface as well as in the epicentral area (Figure 2.5.1-4). The Quail fault rupture plane is approximately 10 km long, 6 km wide, strikes N30E, and dips SE 45-55 degrees at depths from 8 to 2 km.

The COL applicant stated that the other subsidiary clusters lie east of the main cluster, typically contain aftershocks with local magnitudes of 2.6 or less, and are located at shallow depths less than 4 km. No studies available at this time have defined rupture planes or characterized potential sources from these subsidiary clusters. Also, McNamara et al. (2014) describe only one focal mechanism for aftershocks outside the main cluster, and its orientation is significantly different than those of the main cluster. The COL applicant stated that these subsidiary clusters of aftershocks do not appear to be structurally linked with the main aftershock plane and likely represent minor triggered slip on multiple, minor shears of limited extent in a zone of otherwise highly deformed bedrock. The COL applicant provided an enhanced map and cross section of the McNamara et al. (2014) aftershock data with labels to indicate the location of known surface faults, focal plane mechanisms, and the projection of the rupture plane to the surface with uncertainty zones (Figure 2.5.1-2).

Based on the staff's examination of aftershock locations and in consideration of modeled best fit planes (Horton et al., 2015), the staff concludes that surface deformation associated with the Mineral earthquake would most likely be found in the surface projection zone defined by the main aftershock cluster, and within the boundaries of the COL applicant's field reconnaissance program. The staff also agrees with the COL applicant that fitting a plane to subsidiary aftershock clusters is inappropriate due to the diffuse distribution of hypocenters and the lack of focal mechanisms to constrain rupture orientation. The staff examined the waypoint stations and the extent of the stream profile evaluation and considered the analysis of aftershock data reported in McNamara et al. (2014). The staff determined that the scope of the field program covered the fault zone surface projection as well as the hanging wall area located above the epicentral area and concluded that this was the appropriate focus given the published aftershock data. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-4a resolved and closed. The COL applicant provided a proposed COL revision to include portions of the RAI response in a future revision of the North Anna 3. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-03 from the staff's advanced SER for North Anna 3 is resolved and closed.

Chopawamsic Fault

The COL applicant concluded, in COL FSAR Section 2.5.1.1.7, that the Chopawamsic fault is the nearest mapped structural surface to the projected surface expression of Quail fault on which a fault could be located and is a possible candidate for the causative fault for the Mineral earthquake. The staff notes that there are issues and recent changes to the mapped traces of faults in this area including the Chopawamsic fault. In RAI 02.05.01-4b dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to provide more details regarding the location of the Chopawamsic fault.

In response to RAI 02.05.01-4b dated June 10, 2014 (ADAMS Accession No. ML14162A436), the COL applicant provided a revised history of mapping in the area and focused on the most recent mapping of Hughes and Hibbard, 2012 and (Burton et al. 2014) that place the Chopawamsic fault further northwest of previous interpretations. The staff notes that the

Chopawamsic fault, therefore, is most likely structurally below the aftershock cluster and the rupture plane of the Mineral earthquake and is not a source candidate for that earthquake.

Based on analysis of LiDAR based slope and relief maps, the COL applicant describes a NW facing and a SE facing pair of topographic scarps bounding the neck region of the Ellisville pluton, where granodiorite is in contact with the Chopawamsic Formation. (Burton et al. 2014) interpret both these contacts to be faulted and named the fault along the NW facing scarp the Harris Creek fault. The COL applicant suggests that the topographic scarps are likely an expression of erosion susceptibility differences between the granodiorite and the Chopawamsic Formation (metavolcanic, felsic to mafic compositions) rather than a tectonic expression. The applicant, using geologic and LiDAR derived elevation maps, points out that where the lithologic units divert from the trace of the fault, the scarp follows the lithologic contacts rather than the fault.

The staff notes that the NW facing topographic scarp is more or less coincident with the newly identified Harris Creek and Roundabout Farm faults and the surface projection of the Mineral earthquake rupture plane. The staff also note that the maps and figures (RAI 2.05.01-4b response, Figures 5A, 5B, and 6) provided for explaining the erosion susceptibility differences did not clearly support the observations stated in the text and that other interpretations were possible. Therefore, in a supplemental RAI 02.05.01-8 dated August 1, 2014 (ADAMS Accession No. ML14283A557), the staff asked the COL applicant to provide clarification and further justification that this is not a neotectonic signature in the landscape.

In a September 30, 2014, response to RAI 02.05.01-8a (ADAMS Accession No. ML14274A303), the COL applicant stated that the Harris Creek fault is largely coincident with the northwest-facing topographic scarp along approximately 10 km of the fault's mapped extent. The COL applicant provided several new figures (RAI response 02.05.01-8a, Figure 1B, 2A, 2B, 3A, and 3B) that illustrate the expression and extent of the topographic scarp and the geologic traces of the Harris Creek fault and Roundabout Farm faults. The staff observes, in the new figures, that the Harris Creek fault places Ellisville pluton granodiorite alongside Chopawamsic Formation for most of its extent and that the Harris Creek fault extends beyond or bifurcates from the topographic scarp to the SW and to the NE along the fault trace. There is a notable difference in erosion resistance between the granodiorite and the Chopawamsic formation lithology. The neck region of the Ellisville pluton is highly foliated (Burton et al., 2012) and susceptible to weathering and erosion whereas the Chopawamsic Formation, which includes mylonite, metafelsite, quartzite and schist, is more resistant to erosion. The Chopawamsic quartzite and schist (Ocqs map unit, Figure 2.5.1-3) is a relatively resistant unit within the Chopawamsic Formation and forms a series of linear ridges and topographic in the epicentral area. The COL applicant pointed out that the lineament, as characterized over most of its length, does not extend beyond Beaver Creek. The alignments of short, discontinuous and subtle landforms (i.e., ridges, spurs, small drainages) northeast of Beaver Creek do not match the continuity and prominence of the topographic scarp to the SW and are not coincident with the mapped trace of the Harris Creek fault. The staff notes that this difference is illustrated in RAI 02.05.01-8 dated August 1, 2014 (ADAMS accession No. ML14283A557), Figures 3A and 3B.

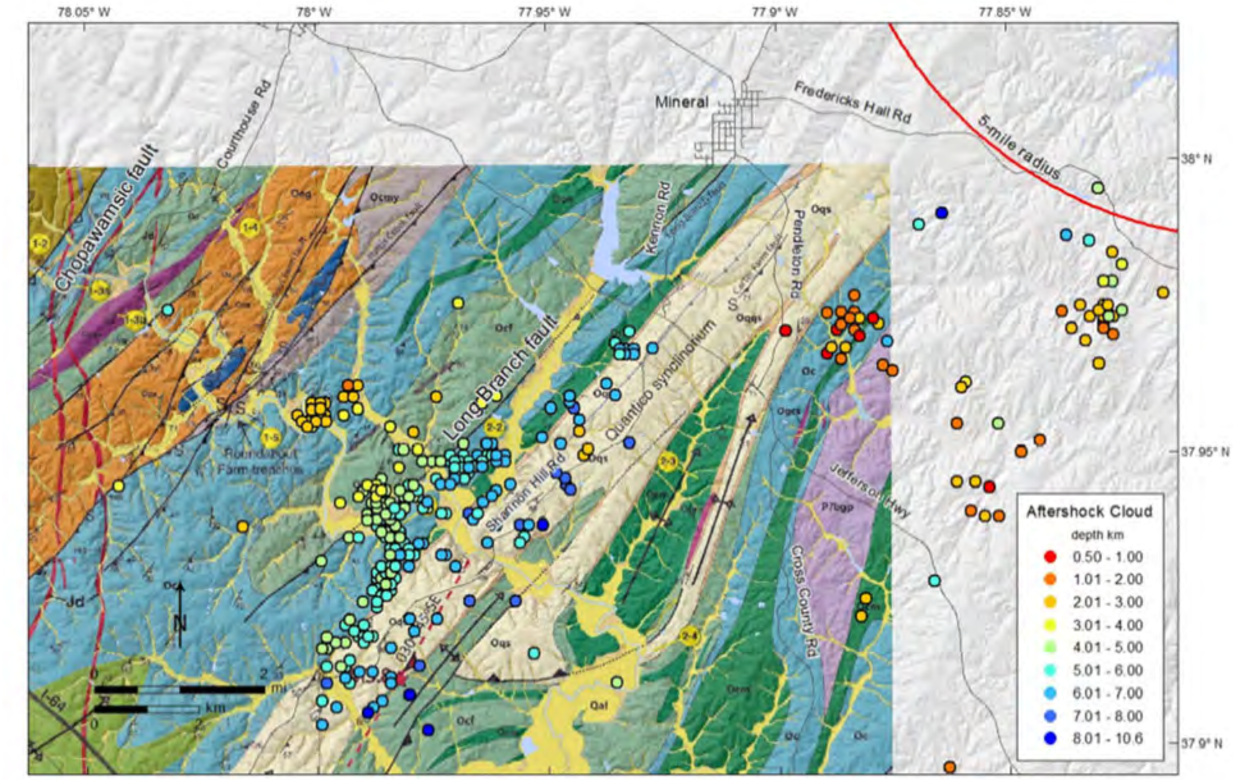


Figure 2.5.1-3. Recent geologic map (Burton et al. [2014]) and aftershocks (McNamara et al. 2014) in the 2011 Mineral, VA, earthquake epicentral area within 25 miles of the NAPS site (from FSAR Figure 2.5.1-210C, Rev. 9)

In supplemental RAI 02.05.01-8 dated August 1, 2014 (ADAMS Accession No. ML14283A557), the staff also asked the COL applicant for additional information regarding the tectonic significance high relief values concentrated in the up-dip projection of the Quail fault and the epicentral area in general as illustrated in Figure 6 of previous response to RAI 02.05.01-4, Part B.

In response, the COL applicant provided new map figures to provide a basis for their analysis regarding surface deformation related to the Mineral earthquake. Figure 2.5.1-5 shows a newly derived relief map using a linear color ramp to symbolize the local relief value across the epicentral area and to the NE, closer to North Anna 3. The staff notes that, in the area around the Ellisville pluton neck, high to low relief boundaries closely correspond to geologic map unit contacts. This supports the COL applicant's suggestion that the steep relief gradients are related to lithologic difference between map units rather than subtle tectonic uplift related to shallow earthquakes. The Chopawamsic Formation, to the NW and SE of the Ellisville pluton neck, is more erosion resistant than the Ellisville and, therefore, supports higher elevation and higher relief zones. In addition, staff notes, that the South Anna river system crosses the same geologic contacts by the Elllisville neck and the Mineral earthquake epicentral area. The river is a significant erosional agent in the area and lowers elevations in its basin but also contributes to the development of high local relief within its basin (Compare Figures 2.5.1-5 and 2.5.1-6). The staff also notes that high relief values diminish to the NE, near the basin divide between the South Anna and the North Anna river systems. The most continuous areas of low relief can be found along prominent drainage divides and areas of higher elevation, which represent areas farthest removed from the increased erosion rates associated with trunk streams. The staff agrees with the COL applicant that the landscape revealed in the new relief and elevation maps supports the interpretation that erosion rates increase toward the trunk of major drainages, and this enhances differential erosion rates associated with variable lithology. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-8a resolved and closed.

The COL applicant stated that the FSAR would be updated to reflect aspects of this response. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-04 from the staff's advanced SER for North Anna 3 is resolved and closed.

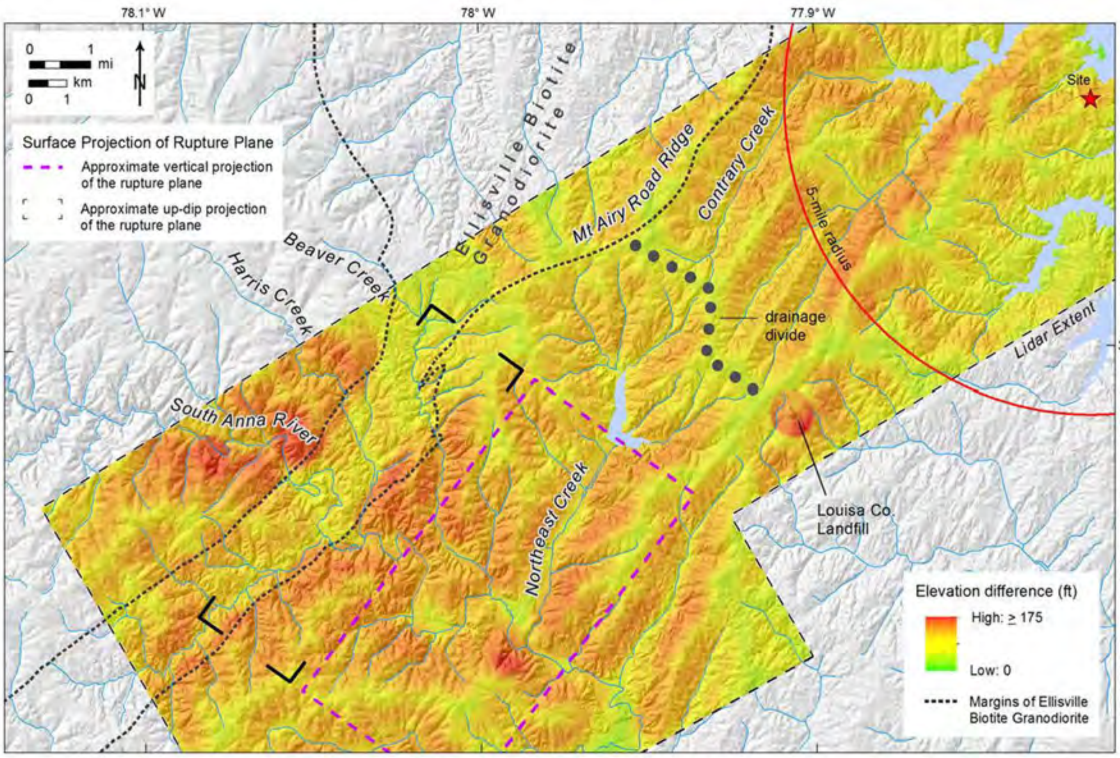


Figure 2.5.1-5. LiDAR-Derived Relief Map of the 2011 Mineral, VA, Earthquake Vicinity (from FSAR Figure 2.5.1-212A, Rev 9). Relief is represented as elevation difference within 0.5 km. The margin of Ellisville Biotite Granodiorite based on Burton et al. (2014) and Dicken et al. (2005)

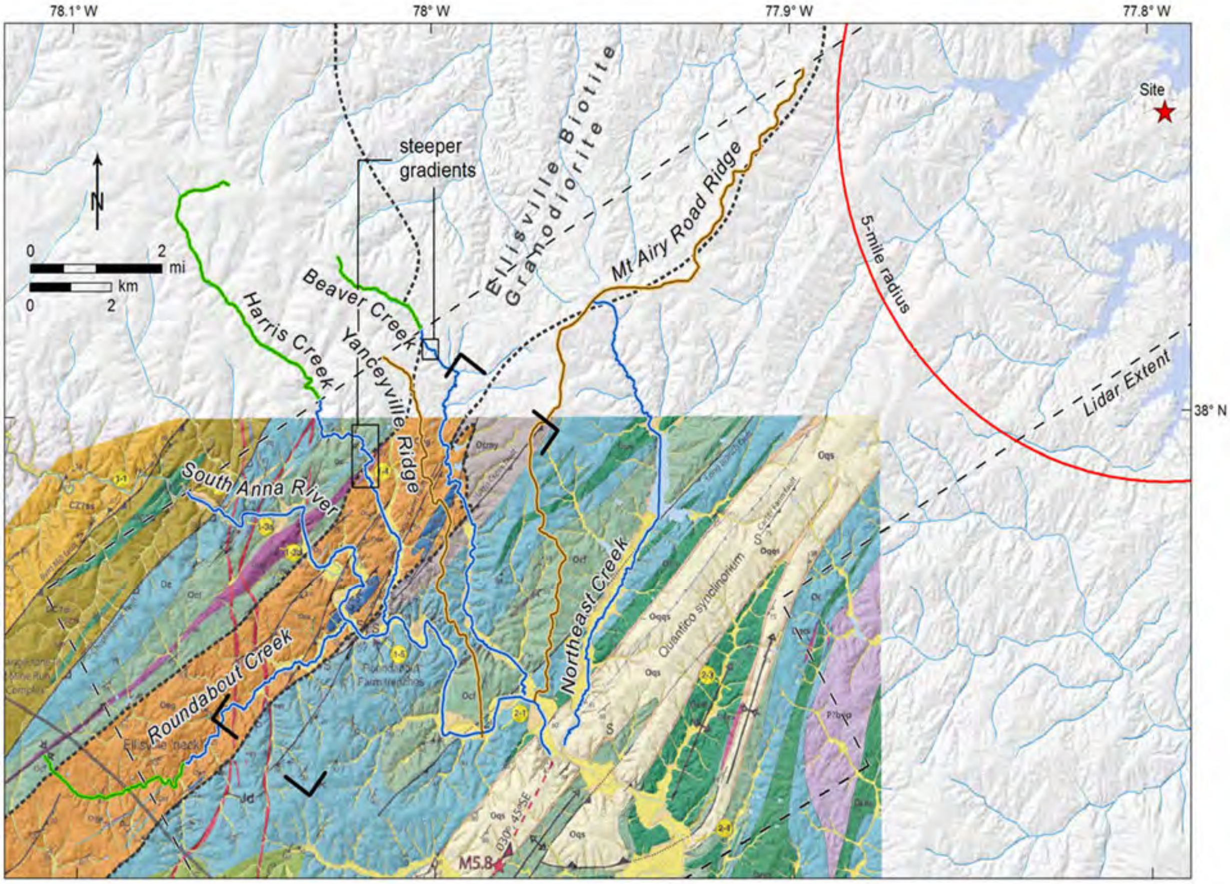


Figure 2.5.1-6. Stream and Ridge Topographic Profiles from FSAR Figure 2.5.1-216, Rev 9.0. The four brackets denote the approximate up-dip projection of the aftershock plane (Quail fault). Blue and green lines indicate locations of stream profiles from LiDAR and NED data, respectively. Brown lines indicate locations of profiles on ridgeline topographic profile

Long Branch Fault

The COL applicant stated that the Long Branch fault (LBF) as currently mapped is too far to the east of the surface projection of the Mineral earthquake rupture plane and thus dismiss it from consideration as an active structure in the Mineral earthquake. The staff notes that there are issues and recent changes to the mapped trace of the LBF. At least two groups of geoscientists have suggested the LBF might be an active structure in the Mineral EQ: Hughes and Hibbard (2012), and Harrison et al. (2011). In RAI 02.05.01-4c dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to discuss the relevance of the suggestions of other geologists regarding the SW extension of the LBF and the potential of LBF in conjunction with the geophysical data from the Mineral earthquake to have been active during this earthquake.

In a June 10, 2014, response to RAI 02.05.01-4c (ADAMS Accession No. ML14162A436), the COL applicant reviewed the geologic mapping of (Burton et al. 2014); Hughes and Hibbard (2012); Dicken et al. (2005); and Marr (2002). The LBF is not consistently located between these publications. However, the most recent mapping (Burton et al. 2014), mapped at 1:24,000, indicates the LBF strikes N35E, and is assumed to be dipping to the 40 to 50 degrees SE, congruent with foliation in the Chopawamsic Formation subunits. The COL applicant indicated that regardless of the specific interpretation for the location of LBF, all interpretations place the fault above deep aftershocks; therefore, the fault is structurally higher than the rupture plane of the Mineral earthquake and is not likely an active structure in the Mineral earthquake. The COL applicant added that there is no alignment of aftershock data in the main or subsidiary clusters that align with previously identified faults ‘a’ and ‘b’ in the North Anna 3 site area.

The COL applicant also stated that, based on the new mapping, the Chopawamsic fault is about 5 km northwest of the projected rupture plane (refer to previous RAI 02.05.01-4b) and the LBF is about 5 km southeast of it, placing the rupture plane of the Mineral earthquake in between these two faults in the subsurface. The COL applicant also pointed out that prior to the recent detailed geologic mapping (Burton et al., 2014), there were no faults previously mapped in the up dip projection of the Mineral earthquake rupture plane.

The COL applicant reviewed the LiDAR data and found a variety of topographic lineaments collinear with the southern extension of the LBF, consistent with the Burton et al. (2014) geologic map. However, the COL applicant interpreted this topographic expression to be bedrock structure exerting strong control on landscape morphology rather than geologically recent faulting.

The staff considered the COL applicant’s response and independently reviewed the geologic mapping of the LBF included in publications (Burton et al., 2014; Hughes and Hibbard, 2012; Dicken et al., 2005; and Marr, 2002) and concluded that, regardless of the particular investigator’s interpretation of the location of the LBF, the fault in all cases directly overlies deep aftershocks and must be structurally higher than the rupture plane of the Mineral earthquake. Therefore the fault is unlikely to be the seismic source of the Mineral earthquake. The staff notes that the earlier mapping efforts were completed at scales of 1:100,000. The most recent mapping completed by (Burton et al. 2014), was done at a 1:24,000 scale, which provides more detail or more resolution than the others and might be the most accurate geologic map of this structure to date. The staff concludes that current data indicate the LBF is not structurally involved with the Mineral earthquake rupture. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-4c resolved and closed. The COL applicant stated that a COL revision, that will include portions of this RAI response, will be included as part of the response to RAI 02.05.01-5 in a future revision of the North Anna 3 FSAR. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-05 from the staff’s advanced SER for North Anna 3 is resolved and closed.

Geologic Reconnaissance Program

FSAR Section 2.5.1.1.7(b), Geologic Reconnaissance, provides information regarding the field reconnaissance program completed to evaluate potential surface deformation associated with the Mineral earthquake. The FSAR placed a special focus on the up dip projection of the Quail fault, evaluation of geomorphic features in the epicentral landscape, and a field map with routes and waypoints (Figure 2.5.1-4). The details of the field reconnaissance are reported in the Geologic Reconnaissance Report that staff audited on March 11, 2014. The summary of the staff’s audit can be reviewed in (ADAMS Accession No. ML14203A211). The COL applicant provided a summary of the geologic reconnaissance program in FSAR Section 2.5.1.1.7b and c. The report addressed the question of whether the August 23, 2011, Mineral earthquake did or did not cause surface faulting or surface deformation. The report detailed geologic field reconnaissance and geomorphic analyses performed using high-resolution LiDAR elevation data in the region of the August 2011 **M**5.8 Mineral, Virginia, earthquake’s epicentral region specifically acquired by Dominion for this field program. The report also included a compilation and evaluation of published information, communications with other researchers, all related to the potential for surface deformation in the site vicinity for North Anna Power Station North Anna 3. The staff issued an RAI relevant to the information found in this report. Thus in RAI 02.05.01-5 dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to provide additional details about the data analysis and the field program including:

a) At each waypoint, what was examined and what is its significance.

b) Provide a high resolution LiDAR map (scale ~1:10,000) for areas immediately west of North Anna 3 where fault ‘a’ might be located, such as waypoint sites 23, 24, and 25.

c) Discuss longitudinal stream profile analysis completed in the epicentral area. Discuss any anomalies revealed by this analysis that could indicate subtle tectonic deformation in the hanging wall of the Quail fault, such as gradient changes, offset stream terraces, elevated topography.

d) Explain how you evaluated the Quaternary geology of the epicentral area and the distribution, correlation and elevation of river terraces on the South Anna River. Discuss any indication of subtle surface uplift in river terraces on the hanging wall of Quail fault that might indicate prolonged or repeated surface deformation.

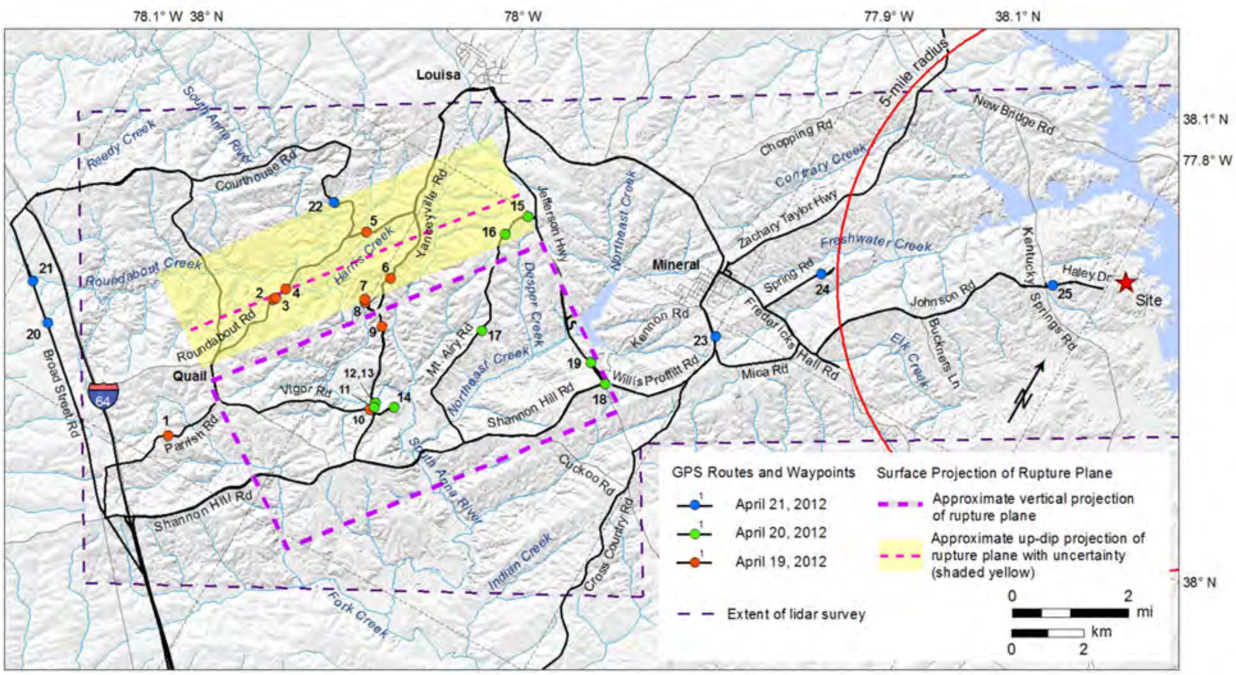


Figure 2.5.1-4. NAPS Geologic Field Reconnaissance after the 2011 Mineral, VA, earthquake showing traverse routes, waypoints and the LiDAR survey boundary (from FSAR Figure 2.5.1-204, Rev. 9)

In a June 10, 2014, response to RAI 02.05.01-5a and b (ADAMS Accession No. ML14177A441), the COL applicant provided a table with details for the significance of each waypoint visited during the field reconnaissance program. Observations at some of the waypoints confirm structural, geomorphic features or relationships previously published by others or observed by Dominion. The staff notes in particular that Waypoint 25, located just outside the plant boundary, is along the extended strike of fault ‘a’, as mapped by Mixon et al. (2000). The waypoint is located on a flat, broad ridge crest, with a deeply weathered soil profile. This ridge crest is likely one of the more stable landforms in this area and useful to evaluate potential deformation or activity on fault ‘a’. The COL applicant provided several detailed LiDAR-based elevation panels of the waypoints they examined to evaluate the possible extent of fault ‘a’. The staff notes that there are no anomalous features revealed in the detailed LiDAR-based elevation panels to indicated surface faulting or deformation. The COL applicant pointed out that the lack of expression of fault ‘a’ in this area support previous studies that determined fault ‘a’ to be pre-Quaternary.

During the May 8, 2014, site audit, as summarized in (ADAMS Accession No. ML14203A179), the staff visited several waypoint stations to fully understand how the LiDAR and field reconnaissance were used to verify geologic features, map contacts and geomorphic landforms. The staff talked with geologists David Fenster (Bechtel, Dominion contractor) and Scott Lindvall (LCI, Bechtel contractor) regarding the extent of fault ‘a’ across Lake Anna to the northeast and further to the southwest with respect to the locations of the 1970’s Dames and Moore exploratory trenches 1 through 3. The staff toured the site vicinity to examine the geomorphic landforms and geologic characteristics of the site vicinity especially with respect to possible surface deformation related to neotectonism in the site vicinity. The staff examined upland surfaces near the possible extension of fault ‘a’, at waypoint 25, and observed no evidence of anomalous deformation. The staff visited exposures of crystalline rock near the Chopawamsic fault and the Ellisville pluton neck and noted the foliation in the granodiorite. The staff also visited the possible exposure of the southeastward extension of the LBF and the location of the small, limited liquefaction related to the Mineral Virginia earthquake. The staff was able to verify the significance of the waypoint stations that the COL applicant examined within their field reconnaissance program after the Mineral earthquake. The staff also determined that the scope of the field reconnaissance was focused in the area where we would expect to see possible effects of the Mineral earthquake on the landscape.

In a June 23, 2014, response to RAI 02.05.01-5c and d (ADAMS Accession No. ML14177A441), the COL applicant provided a figure to indicate the five stream profiles derived from LiDAR data and discussed the analysis of longitudinal stream profiles in the epicentral area to determine if subtle anomalies in the profiles indicate possible surface deformation from the Mineral earthquake (Figure 2.5.1-7). Most profiles were vertically exaggerated 25 times. The analysis revealed several subtle anomalies such as gradient changes and knick points that could be related to many geologic conditions or processes but none that could unequivocally be attributed to tectonic deformation in the hanging wall of the Quail fault. The staff examined the stream profiles and agrees that the profiles show well-graded streams and that anomalies are observable only at great vertical exaggeration. The COL applicant concluded that there is no consistent relationship of anomalies in streams crossing the up-dip projection of the Mineral earthquake rupture plane. However, the COL applicant stated that there is a consistent relationship between lithology changes and stream profile anomalies.

In describing the South Anna River, the COL applicant suggested that, in addition to lithology changes along the stream profile, large increases in drainage area at the confluence of Roundabout, Harris, and Beaver Creeks likely drive a noticeable gradient change along that stretch of river. A dramatic increase in drainage area impacting a river implies an increase in stream power, which governs the ability of the river to incise its channel and modify the gradient. However, staff notes that it is not possible to verify that statement based on the figures provided. Therefore, in supplement RAI 02.05.01-8c dated August 1, 2014 (ADAMS Accession

No. ML14283A557), the staff asked the COL applicant for further clarification on the analysis of stream profiles and changes in stream power along the course of South Anna River.

In a September 30, 2014, response to RAI 02.05.01-8c (ADAMS Accession No. ML14274A303), the COL applicant stated that a subtle gradient change lies near a 20 percent increase in drainage area due to confluences of Roundabout and Harris Creeks, and upstream of a 17 percent increase in drainage area due to confluences of Beaver and Northeast Creeks and provided a new figure for the South Anna River profile with drainage area increases (RAI 02.05.01-8 Figure 11). The staff notes that Dominion considered and performed additional assessments on some profiles, such as stream gradient (SL) index (Hack, 1957), slope versus distance, and drainage basin versus distance (for South Anna River only) but these methods did not provide useful results for evaluating the subtle anomalies due in part to the extremely low gradient of the streams and the high-frequency (HF) data noise (Figure 2.5.1-8).

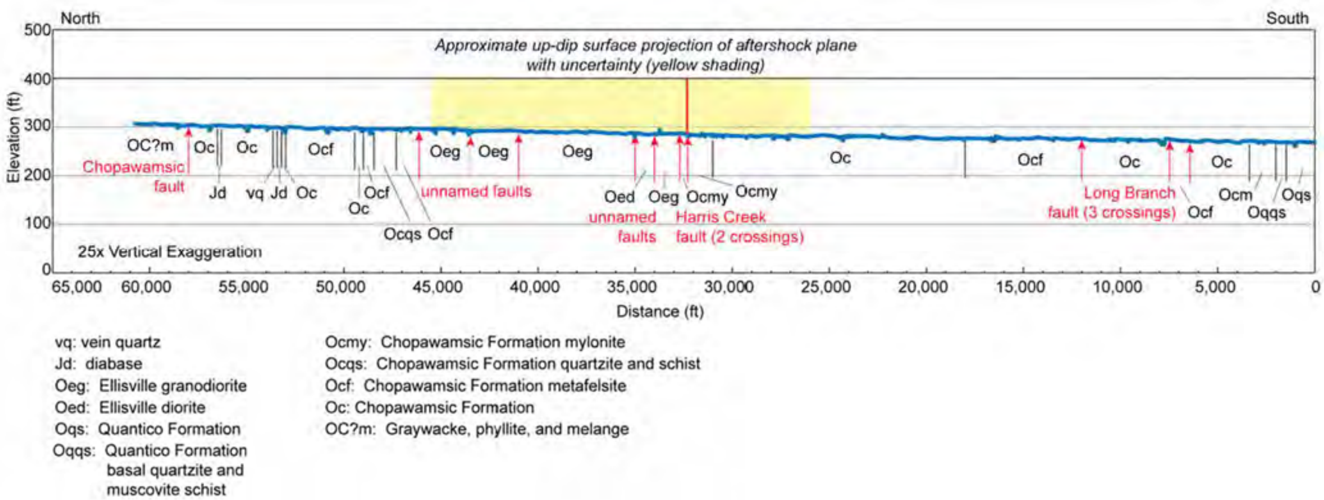
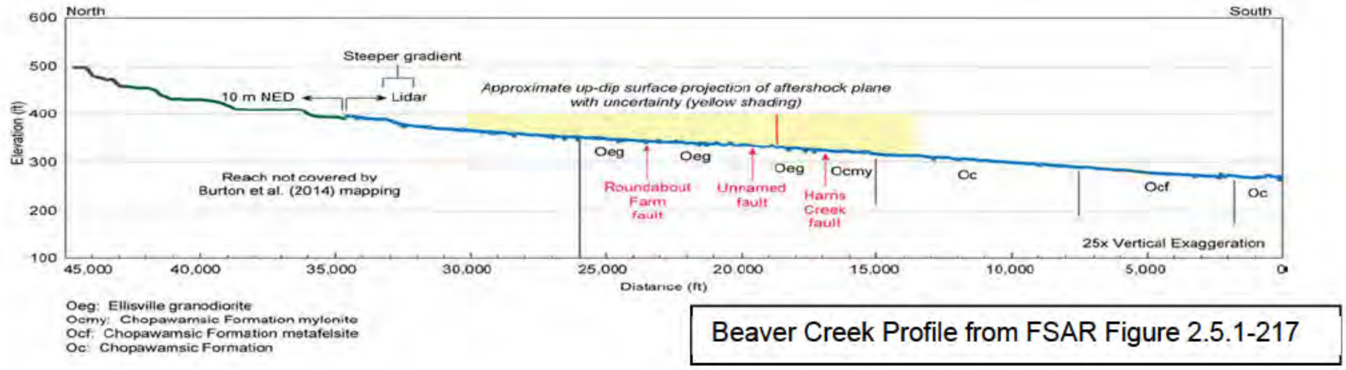


Figure 2.5.1-7. South Anna River Profile Showing Geology of Burton et al. (2014) from FSAR Figure 2.5.1-223, Rev. 9



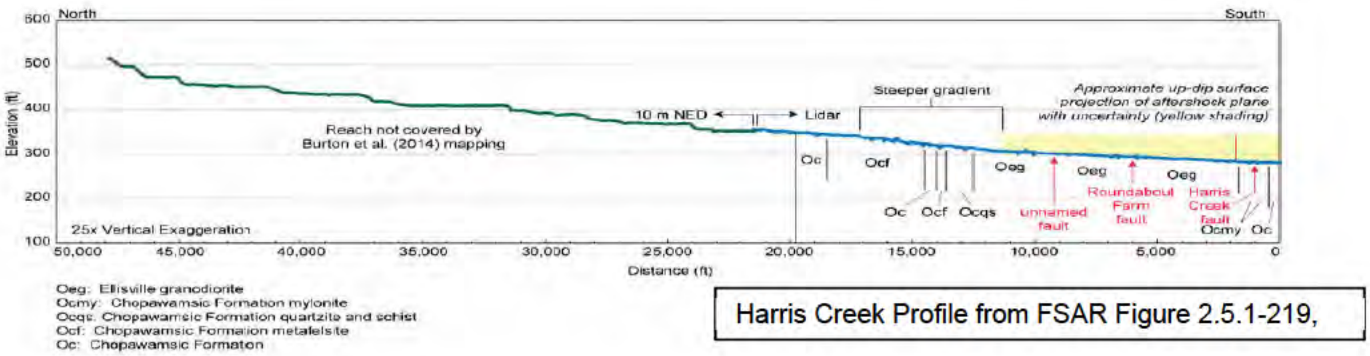


Figure 2.5.1-8. Stream Profiles with Geology of Burton et al. (2014) from FSAR Figure 2.5.1-217 and -219, Rev. 9

The stream profile analysis also reveals a series of possible river terraces along South Anna River. The river terraces were identified in the LiDAR data products but were not evaluated in the field program. The COL applicant stated many geologic conditions and processes could be in operation to drive river incision and the development and preservation of terrace surfaces such as: climate change, stream capture, changes in sediment influx, eustatic sea level change, and tectonic activity. The LiDAR data reveal several possible terrace surfaces along the South Anna River, and the COL applicant plotted representative elevation points along the South Anna River profile. The COL applicant stated that they have not correlated terrace sets along the profile. The staff notes that terraces are more abundant downstream of the surface projection of the Mineral earthquake rupture plane, at greater heights above the channel than in the upstream reach and also along the low-gradient reach of the river. This is the same reach of river where there is a sharp increase in stream drainage area. The COL applicant stated that an increase in drainage area increases the river's capacity to incise its channel and to keep pace with the impacts imposed by any of the geologic conditions or processes previously mentioned. Therefore, staff concludes that a greater number of terraces, at greater height above the channel on the low gradient reach of the South Anna River, is expected and does not uniquely indicate tectonic activity.

The staff noted that the geologic map used (assemblage of earlier geologic mapping) for the stream profile analysis is not the same as the more recent geologic map (Burton et al., 2014), used to respond to RAI 02.05.01-4 and features previously discussed such as the Harris Creek and Chopawamsic faults, lithologic contacts, and the topographic scarps are not the same or are not indicated on maps or on the various stream profiles provided in addressing RAI 2.5.1-5c.

Therefore in supplemental RAI 02.05.01-8b dated August 1, 2014 (ADAMS Accession No. ML14283A557), the staff asked the COL applicant to provide clarification and coordination between the discussions for topographic scarps and geologic faults in RAI 2.5.1- 5c with the analysis of stream profiles in RAI 2.5.1-4b.

In a September 30, 2014, response to RAI 02.05.01-8b (ADAMS Accession No. ML14274A303), the applicant stated that the profiles show that streams crossing the epicentral area are all very well graded (smoothly descending curve) and that the profiles do not show significant anomalies associated with the up-dip projection of the Mineral earthquake rupture plane or any of the faults mapped by (Burton et al. 2014), including the Harris Creek fault. The COL applicant provided new figures of these profiles on a geologic base map from (Burton et al. 2014). The staff notes that there are two slight anomalously steep gradients in the stream profiles of Harris and Beaver Creeks. The steep gradients do not correlate with the up-dip projection of the rupture plane, the Harris Creek fault, Roundabout Farm fault, or other faults. They are located on or near the Chopawamsic Formation contact with the Ellisville granodiorite, suggesting a lithologic correlation. The COL applicant stated that the steepened southeast facing gradient is likely not tectonic, because it is inconsistent with deformation produced by a southeast-dipping reverse fault, such as the Mineral earthquake rupture. The staff notes that the higher gradient reach of Harris Creek crosses five lithologic units in close succession, including Chopawamsic metafelsite (Ocf); Chopawamsic Formation undifferentiated (Oc), Chopawamsic metafelsite (Ocf), Chopawamsic quartzite and schist (Ocqs), and Ellisville granodiorite (Oeg) (FSAR Figure 2.5.1-219). The Chopawamsic quartzite and schist represents a relatively resistant unit that forms a series of linear ridges and topographic highs in the area so this characteristic could cause stream gradient anomalies. Based on the new figures and explanation provided by the COL applicant, staff's concerns are addressed. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-8b resolved and closed.

The COL applicant stated that the FSAR will be updated to focus on the two most prominent gradient changes in the profiles, eliminate some of the description of the very subtle features in the profiles that may be beyond the threshold of detection, and to include updated figures showing (1) relief and elevation from the LiDAR and (2) profiles annotated with the Burton et al. (2014) geology. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-06 from the staff's advanced SER for North Anna 3 is resolved and closed.

Conclusions on Possible Surface Deformation Associated with the Mineral, Virginia Earthquake

Based on the forgoing discussions, the staff concludes that the topographic expression of a portion of the Harris Creek fault and the pattern of local relief in the area is best explained by differential erosion of contrasting lithologies and higher rates of erosion near the South Anna River, rather than neotectonic surface deformation. The staff also concludes that the updated stream profiles with the more recent geologic mapping of Burton et al. (2014) clarifies that only two of the observed river anomalies on Harris and Beaver Creeks are significant, and they are located on or along the major lithologic contact between the Chopawamsic Formation and the Ellisville granodiorite. Some of the potential stream anomalies originally identified are very subtle features and do not represent significant perturbations in the profiles and may in fact be artifacts from the LiDAR generated stream profiles.

Based on the COL applicant's field program in addition to fieldwork reported by USGS and other academic research teams that staff independently reviewed, the staff finds that there is no observable surface deformation associated with the **M**5.8 Mineral earthquake. Thus it is unlikely that any previous repeated events of a Mineral type earthquake in this area would be recorded in the landscape. Finally, staff concludes that larger magnitude events would likely be necessary to produce surface rupture or topographic expression in this landscape.

Site Area Stratigraphy

FSAR Section 2.5.1.2.3, Site Area Stratigraphy, the applicant described borings from the supplemental subsurface investigation described in greater detail in Section 2.5.4.3. In RAI 02.05.01-6 dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the applicant to provide further explanations of site area stratigraphy and subsurface conditions.

In RAI 02.05.01-6a dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant if the severely weathered and jointed intervals in Zone III-IV and Zone IV rock, described in site area borings, indicate the presence of a geologic structure or shear zone. In a June 23, 2014, response to RAI 02.05.01-6a (ADAMS Accession No. ML14177A441), the COL applicant stated that even though these weathered and jointed intervals are found in several borings, no systemic distribution of the zones between borings could be determined; therefore, the zone cannot be mapped. The true orientation of the zones, based on dip of foliation, could not be determined because the core was not oriented. The COL applicant pointed out that several intervals are encountered in each borehole, and the severe weathering was typically found in mafic intervals and the closely spaced, tight joints were found in the felsic, biotite quartz gneiss. Because there was not a systematic distribution of these zones between bore holes and within elevation intervals, the COL applicant concluded there was no indication for a single geologic structure.

The staff reviewed the COL applicant’s response to RAI 02.05.01-6a and also examined core at the North Anna 3 during a site audit conducted May 8, 2014, as documented in ADAMS Accession No. ML14203A179. The staff directly examined portions of several borings (W-1, -2, -3, -4, -5, -6, -7; M-1, M-27, B-905, B-920) to observe the severely weathered and jointed intervals within more competent Zone III-IV and Zone IV crystalline rock, as reported in the FSAR. The staff notes the essentially random distribution of these zones within each core and between cores. In addition, during the field trip portion of the audit, staff visited outcrops of the same rock formation and noted the same pattern of well-weathered intervals of mafic rock within fresher felsic gneiss. The staff agrees with the COL applicant’s position that there is little reason to conclude that this represents a single, mapable geologic structure. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-6a resolved and closed.

In RAI 02.05.01-6b dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant if the micro-shear zone identified in boring W-1, within Zone III-IV rock, is structurally associated with the severely weathered and jointed zone, or if this micro shear is structurally related to fault ‘a’, a previously identified fault and shear zone discovered during construction of Units 1 and 2 (fault ‘a’ observed in excavations for Units 1 and 2 and abandoned Units 3 and 4). In a June 23, 2014, response to RAI 02.05.01-6b (ADAMS Accession No. ML14177A441), the COL applicant replied that it does not think that the micro-shear zone is structurally associated with the severely weathered and jointed intervals discussed above based on the following reasons. The shear zone is found at elevation 210 ft in boring W-1 and at elevation 185.5 ft in boring W-5. In both borings, the shear zone is characterized by rock fragments, an indication of brittle deformation, mixed with yellow-brown clay and chlorite. The COL applicant stated that the material in the zone is characteristic of fault gouge. The COL applicant stated that the micro-shear zone in W-1 and W-5 is not associated with fault ‘a’ Dames and Moore (1973) trenched fault ‘a’ and determined the fault ‘a’ dipped 45 to 50 degrees NW.

Borings W-1 and W-5, located NW of fault ‘a’ would intersect fault ‘a’ at elevations much lower than where the micro-shear zone is located. The COL applicant looked for the micro-shear zone in adjacent borings and found no indication of this feature.
During the May 2014 site audit, as summarized in ADAMS Accession No. ML14203A179, the staff examined the micro-shear zone in W-1 and W-5 to understand the character and extent of the feature with respect to what was described in the FSAR. In the borings, the micro shear is a relatively thin layer. Furthermore, the micro-shear zone is not exposed at the surface in rock exposures in the site vicinity. The staff reviewed several Dames and Moore reports from the 1970’s regarding fault ‘a’ in addition to the findings in the ESP SER regarding fault ‘a’ (NUREG-1835). The micro-shear has similar features to fault ‘a’ but at a much less significant scale. Because the micro-shear zone in W-1 and W-5 is located NW of fault ‘a’ and likely also dips NW, it is structurally higher than fault ‘a’. The staff notes that significant structures such as fault ‘a’ typically have a zone of deformation and deformation fabric is not necessarily limited to a single fault plane so the micro-shear zone could be associated with fault ‘a’. Regardless of a structural association or not, the deformation associated with fault ‘a’ was determined to be geologically old, greater than 1 million years old. The staff considers the micro-shear zone in W-1 and W-5 likely to be the same age as fault ‘a’ and not a potential future surface deformation hazard to the site. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-6b resolved and closed.

The staff reviewed the previous ESP SER and the investigations completed by Dames and Moore in the early 1970’s and notes that North Anna 3 abandoned Units 3 and 4 excavations revealed fault 'a' and that this fault traces across the ESP parameter envelope. In RAI 02.05.01-6 d dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to describe what evaluation it completed to determine the potential for future surface deformation on fault ‘a’ in light of the Mineral earthquake and possible structural links to the Mineral earthquake epicentral area.

In a June 23, 2014, response to RAI 02.05.01-6d (ADAMS Accession No. ML14177A441), the COL applicant stated that Dames and Moore (1973) concluded that fault ‘a’ was pre-Quaternary and not a capable tectonic structure. The COL applicant provided a new figure on a LiDAR hillshade base with key North Anna 3 borings and the trace of fault ‘a’ as mapped by the Dames and Moore and as mapped by Mixon et al. (2000). Mixon et al. (2000) does not place fault ‘a’ at the same location as Dames and Moore. However, Dames and Moore explored the extent and character of fault ‘a’ in 3 onsite trenches so staff considers the Dames and Moore fault trace more accurate. The COL applicant stated that after the Mineral earthquake it initiated a geologic reconnaissance field program and acquired the high-resolution topographic LiDAR data. The purpose was to look for evidence of surface deformation from the Mineral earthquake. The COL applicant found no evidence for surface deformation along the extension of fault ‘a’ beyond the site boundaries, along Mixon et al.’s (2000) interpretation of the fault or the projection of the Dames and Moore’s mapped extent.

On March 11, 2014, the staff reviewed information supplied by the COL applicant in a reading room at the Bechtel Park Campus in Frederick, MD as summarized in (ADAMS Accession No. ML14203A211). The staff examined the LiDAR data and the geologic field reconnaissance Waypoints 23, 24, and 25 to specifically consider if LiDAR data revealed the presence of surface deformation along fault ‘a’. The staff also considered the COL applicant’s descriptions of Waypoints 23, 24, and 25 (previous RAI 02.05.01-5). The staff concludes that there is no obvious deformation revealed in the high-resolution LiDAR base maps. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-6d resolved and closed.

The COL applicant provided a proposed COL revision to include portions of the RAI response in a future revision of the North Anna 3 FSAR. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-07 from the staff's advanced SER for North Anna 3 is resolved and closed.

In FSAR Section 2.5.1.2.4, Site Area Structural Geology, the COL applicant concluded that none of the faults in the site area are considered capable tectonic sources, as defined in RG 1.208, Appendix A. The staff notes that the capable tectonic source definition in RG 1.208 is not the sole criteria for staff's safety finding for the site area (SRP 2.5.1.2) and for surface deformation (SRP 2.5.3). As discussed in RG 1.208, a PSHA characterizes seismic potential through consideration of the historic and geologic record from the Quaternary Period. In addition, 10 CFR 100.23(d)(2) specifically requires the potential for surface tectonic and non-tectonic deformation to be determined. Therefore, in RAI 02.05.01-7 dated April 22, 2014 (ADAMS Accession No. ML14112A156), the staff asked the COL applicant to describe the analysis that it completed to determine the potential for future surface deformation, tectonic and non-tectonic, at the site and to state whether these findings have an impact on the PSHA for North Anna 3.

In response to RAI 02.05.01-7, dated June 23, 2014 (ADAMS Accession No. ML14177A441), the COL applicant described its analysis to determine the potential for future surface deformation at the site by referencing previous regional geologic studies and its own previous work for Units 1 and 2; referencing current regional geologic mapping studies and its own recent geologic reconnaissance program and concluded that the potential for tectonic deformation at the site is negligible based on the results these investigations:

Since original site studies in the early 1970's, no new information has been reported to substantiate the existence of a Quaternary fault near the site.
The 2011 Mineral earthquake prompted new research on the part of government and academic institutions that included detailed geologic mapping at scales more detailed than previous mapping projects.

Dominion initiated its own investigation to determine impacts of the Mineral earthquake with acquisition of high resolution topographic data (LiDAR) and subsequent geomorphic desk-top analysis in addition to a field reconnaissance study in the epicentral area of the Mineral earthquake.

The COL applicant acknowledges that the Mineral earthquake occurred on a previously unmapped subsurface fault zone within the site vicinity and provides details in FSAR Section 2.5.2.2 regarding why this fault is not an RLME seismic source and how this earthquake is incorporated into the updated PSHA.

With respect to potential for non-tectonic surface deformation, the COL applicant discussed:

- The negligible impact of Quaternary glaciation;
- The lack of carbonate or evaporite rock in the metamorphic and igneous geology in the site vicinity;
- The lack of growth faulting in this area's geologic setting;
- The lack of Quaternary age volcanic centers within 200 mile radius of site;

- No oil or gas resources are expected to be found in the site area; and
- No mining of commercial value.

The COL applicant stated that an additional FSAR subsection would be added to FSAR Section 2.5.3 to describe the analysis completed to determine the potential for future tectonic and non-tectonic surface deformation at the site.

In consideration of the COL applicant’s response to RAI 02.05.01-7, the staff independently reviewed several documents from previous North Anna 3 investigations completed in the early 1970’s for the licensing of Units 1 and 2 (Virginia Electric and Power Company (VEPCO),1974 and 1973) and the material provided by the COL applicant in the ESP SSAR. These studies provide one basis for the applicant’s analysis for future surface deformation potential. Geologic faulting discovered at the site during excavation of Units 1 through 4 was determined to be geologically old and unlikely to cause a future surface deformation problem for the site. The details of those studies are found in the ESP SSAR and the numerous Dames and Moore reports and letters to the NRC from the 1970’s. The staff has also independently considered the findings in the current literature regarding the local impact of the Mineral earthquake and the possible impact on future surface deformation potential for the North Anna 3 site including but not limited to: Burton et al., 2014; Green et al. (2012); Harrison et al. (2014); Horton et al. (2012); Hughes and Hibbard, 2012; and Spears and Gilmer (2012). To date there has been no surface rupture related to the Mineral earthquake reported in publications or in conference presentations. The staff reviewed the COL applicant’s geologic reconnaissance report in an audit in March 2014 as summarized in (ADAMS Accession No. ML14203A211), and considered the scope of that investigation with respect to how the COL applicant would determine the potential for tectonic deformation at the site. The staff concludes that the COL applicant executed what would be a typical geomorphic study designed to investigate questions of neotectonism in the landscape. The evaluation of longitudinal stream profiles, examination of geologic maps relative to high resolution topographic data (LiDAR), and field traverses to check the position of lithologic contacts and fault locations are part of such a typical investigative program.

The staff considered the COL applicant’s analysis for non-tectonic surface deformation in conjunction with the regional and local geology of Appalachian Piedmont geology, where North Anna 3 is located. The staff find that non-tectonic hazards such as subsurface dissolution leading to surface collapse and volcanic hazard are not present and do not contribute to the future surface deformation hazard. The staff agrees with the COL applicant’s response that oil and gas reserves are not likely in this geologic environment and therefore would not cause a man-made surface deformation hazard.

Based on the foregoing considerations for tectonic, non-tectonic and man-made surface deformation, the staff agrees with the COL applicant’s findings that the potential for tectonic and non-tectonic deformation at the site is negligible. Accordingly, and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-7 resolved and closed. The COL applicant provided a proposed COL revision to include portions of the RAI response in a future revision of the North Anna 3 FSAR. The staff finds the proposed COL FSAR changes acceptable and verified that the appropriate changes are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5-08 from the staff’s advanced SER for North Anna 3 is resolved and closed.

2.5.1.5 Post Combined License Activities

The staff identified the following licensing condition as the responsibility of the COL licensee. This License Condition relates to geologic mapping of both tectonic and non-tectonic surface deformation features at the site. This geologic license condition replaces ESP Permit Condition 3(E)(6).

> **License Condition 2.5.1-1.** The licensee shall (1) perform detailed geologic mapping of future excavations for North Anna 3 nuclear island structures; (2) examine and evaluate geologic features discovered in excavations for safety-related structures; and (3) notify the Director of the Office of New Reactors, or the Director's designee, once excavations for North Anna 3 safety-related structures are open for examination by staff.

2.5.1.6 Conclusion

The staff reviewed the COL FSAR, Revision 8, and considered the referenced ESP SSAR, Revision 9. The staff also considered the ESP FSER (NUREG-1835) in the review of the COL FSAR. The staff's review confirms that the applicant has addressed the relevant information to support 10 CFR 100.23 and 10 CFR 52.79 and there is no outstanding information to be addressed in the COL FSAR related to Section 2.5.1. The staff concludes that the information pertaining to North Anna 3 COL FSAR Section 2.5.1 is within the scope of the ESP and adequately incorporates by reference Section 2.5.1 of the North Anna ESP SSAR and is thus acceptable. In addition, the staff compared the additional COL information in the application to the relevant NRC regulations and acceptance criteria defined in NUREG-0800 and concludes that the applicant is in compliance with the relevant requirements of 10 CFR Parts 52 and 100. The staff also concludes that COL Action Item 2.0-26-A has been adequately addressed by the applicant and can be considered closed. The staff further concludes that the criteria in Permit Conditions 3.E(4) through (6) of the ESP have been met and that VAR 2.0-4 is acceptable.

On the basis of the foregoing, the staff concludes that the applicant has provided a thorough and accurate characterization of the geologic and seismic characteristics of the site as required by 10 CFR 52.17(a)(1)(vi), 10 CFR 100.23(c), and 10 CFR 100.23(d). Therefore, the staff concludes that the site is suitable with respect to the geologic and seismic siting criteria for new nuclear power plants.

2.5.2 Vibratory Ground Motion

2.5.2.1 Introduction

Section 2.5.2 of this SER provides information on the vibratory ground motion at the North Anna 3 site. Section 2.5.2.2 of this SER provides a summary of relevant geologic and seismic information in FSAR Section 2.5.2 of the North Anna 3 COLA. SER Section 2.5.2.3 summarizes the regulations and guidance used by the applicant to perform the investigation. SER Section 2.5.2.4 reviews the staff's evaluation of FSAR Section 2.5.2, including any RAIs, open items, and confirmatory analyses performed by the staff. SER Section 2.5.2.5 discusses post COL activities. Finally, SER Section 2.5.2.6 provides an overall summary of the applicant's conclusions, as well as the staff's conclusions, restates any base covered in the application, and confirms that regulations have been met or fulfilled by the applicant.

North Anna 3 COL FSAR Section 2.5.2 presents the applicant's evaluation of the vibratory ground motion that relates to the North Anna 3 site. The vibratory ground motion is evaluated based on seismological, geological, geophysical, and geotechnical investigations carried out to determine the site-specific ground motion response spectrum (GMRS), which must meet the regulations for the SSE provided in 10 CFR 100.23. The GMRS is defined as the free-field horizontal and vertical response spectra at the plant site. The development of the GMRS is based on a detailed evaluation of earthquake potential, taking into account the regional and local geology, Quaternary tectonics, seismicity, and site-specific geotechnical engineering characteristics of the site subsurface material. The specific investigations necessary to determine the GMRS include the seismicity of the site region and the correlation of earthquake activity with seismic sources. Seismic sources are identified and characterized, including the rates of occurrence of earthquakes associated with each seismic source. Seismic sources that have any part within 320 km (200 miles) of the site must be identified. More distant sources that have a potential for earthquakes large enough to affect the site must also be identified. Seismic sources can be capable tectonic sources or seismogenic sources. The review covers the following specific areas: (1) seismicity, (2) geologic and tectonic characteristics of the site and region, (3) correlation of earthquake activity with seismic sources, (4) PSHA and controlling earthquakes, (5) seismic wave transmission characteristics of the site, (6) site-specific GMRS, and (7) any additional information requirements prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

2.5.2.2 Summary of Application

Section 2.5.2 of the North Anna 3 COL FSAR, incorporates by reference Section 2.5.2 of the North Anna 3 ESP SSAR, Revision 9. In addition, in FSAR Section 2.5.2, the applicant provided supplemental information on additional subsurface details discovered during the COL site investigations.

This COL FSAR section also addresses COL Item 2.0-27-A from Revision 10 of the ESBWR DCD as follows:

<u>*COL Items:*</u>

- NAPS COL 2.0-27-A

NAPS COL 2.0-27-A addresses the information provided in accordance with SRP Section 2.5.2 and requires confirmatory information to ensure that the RB and FB, CB, and FWSC foundation input response spectra (FIRS) are enveloped by the ESBWR certified seismic design response spectra (CSDRS) referenced at the foundation level. In FSAR Section 2.5.2, the applicant provided site-specific information in accordance with SRP Section 2.5.2 to address COL Item North Anna 3 COL 2.0-27-A, and to resolve item 2.5-3, which addresses the provision for performing site-specific evaluations if the site-specific GMRS at foundation level exceeds the ESBWR DCD design response spectra referenced at the foundation level.

- NAPS ESP VAR 2.0-4

In response to the August 23, 2011, **M**5.8 earthquake that occurred in the town of Mineral, Virginia, of Louisa County, the applicant updated its selection of seismic source model. In NAPS ESP VAR 2.0-4, the applicant selected the new SSC model for CEUS published in NUREG-2115, hereafter referred to as the CEUS-SSC model, for conducting its PSHA, rather than the EPRI-SOG model (EPRI, 1986) used in developing the site ground motion for the ESP. In addition, the applicant requested that the North Anna 3 horizontal and vertical GMRS be defined at Elevation 68.3 m (224 ft) which corresponds to the deepest excavation at the site and lies on competent material rather than Elevation 76.2 m (250 ft). The applicant developed the

GMRS using the performance-based approach recommended in RG 1.208. The applicant then updated its selection of GMM from the EPRI (2004, 2006) model to the most recent EPRI (2013) model. Based on the evaluation, the applicant presented the following details related to the vibratory ground motion information for the North Anna 3 site.

Seismicity

FSAR Section 2.5.2.1 states that the applicant used the most recent earthquake catalog published as part of the CEUS-SSC model in its seismic hazard assessment at the North Anna 3 site. The CEUS-SSC earthquake catalog covers earthquakes in the CEUS region from 1568 through 2008. The applicant stated that the CEUS-SSC catalog is the starting point for developing an updated earthquake catalog for the North Anna 3 site. The applicant developed the updated catalog for the entire region covered by the CEUS-SSC for the period from January 1, 2009, through mid-December 2011. This period includes the August 23, 2011, Mineral, Virginia, earthquake, hereafter referred to as the Mineral earthquake, which occurred within the North Anna 3 site vicinity. The applicant followed the process used in the CEUS-SSC for developing an earthquake catalog. Consistent with the CEUS-SSC catalog, E[**M**] is the expected value of the true moment magnitude (**M**) and was calculated for all post-CEUS-SSC catalog earthquakes in the updated catalog.

The applicant reported 141 additional mainshock earthquakes with **M** greater than or equal to 2.9 in the 320 km (200 mi) site region and that the 2011 **M**5.8 Mineral earthquake was the most significant earthquake identified in the 2009 to 2011 earthquake catalog update. SER Figure 2.5.2-1 shows the seismicity of the North Anna 3 site region within the surrounding CEUS. The applicant also noted that a few moment magnitude values in the CEUS-SSC report were incorrect due to a period of manual processing of earthquake data at Saint Louis University and reported that in general these differences were small and had a negligible impact on any analysis performed in the CEUS-SSC report.

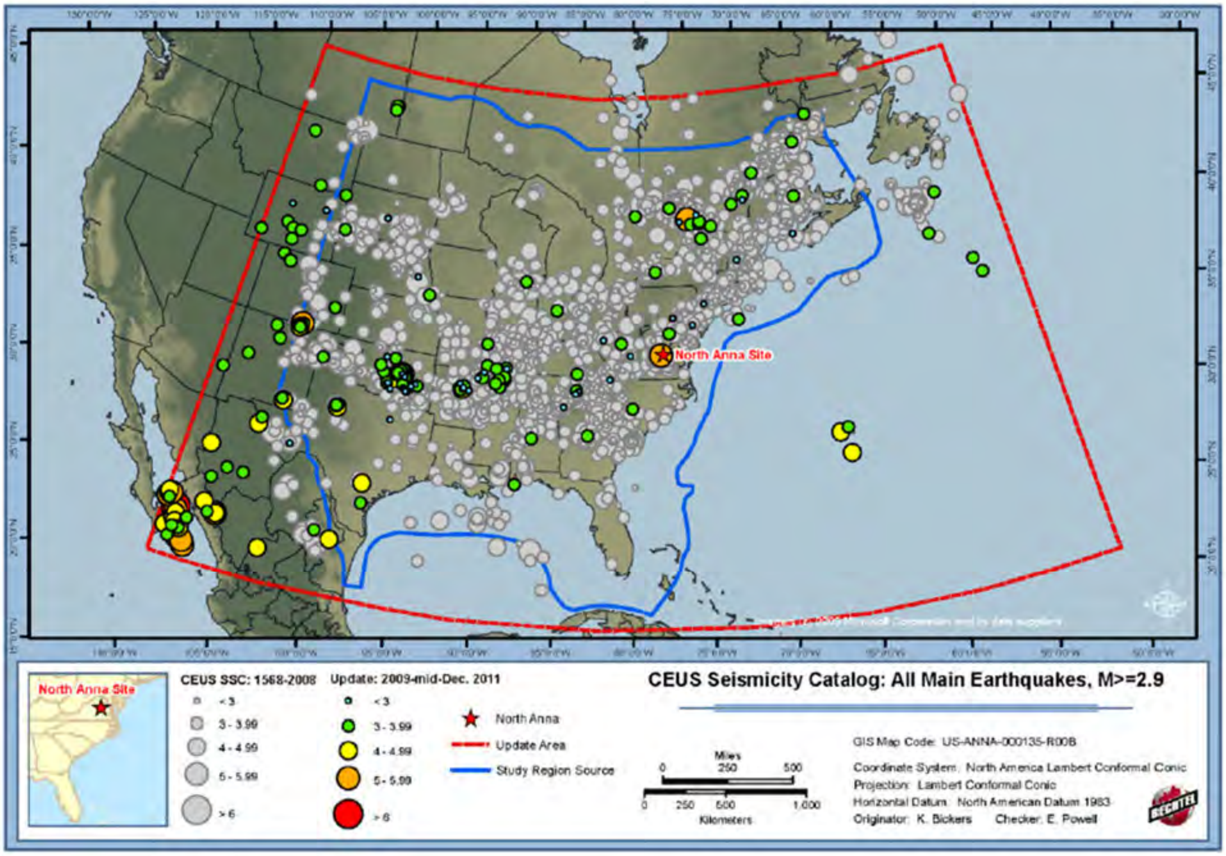


Figure 2.5.2-1. **Map Showing the COL Applicant's Updated Seismicity Catalog for the CEUS-SSC Region (FSAR Figure 2.5.2-202, Rev. 8)**

Seismic Information Related to the Mineral Earthquake

The applicant stated that the August 23, 2011, Mineral earthquake had a hypocenter located at latitude 37.936°N, longitude 77.933°W, and depth 6 km (3.7 mi), or approximately 18 km (10.8 mi) southwest of the North Anna 3 site. The applicant described the earthquake as occurring on a reverse fault within the CVSZ, a previously recognized zone of moderate seismicity. FSAR Section 2.5.2.1.3 states that the Mineral earthquake is the largest instrumentally recorded earthquake in eastern North America since the 1988 M5.9 Saguenay, Canada earthquake and that shaking was felt across a large area of the eastern U.S. including Washington, D.C., Philadelphia, PA, and portions of New York.

FSAR Section 2.5.2.1.3 states that there are different estimates of moment magnitude for the Mineral earthquake, ranging from M5.65 to **M**5.8. Following procedures outlined in the CEUS-SSC, the applicant determined that the best estimate (BE) uniform magnitude for the event was E[M]5.71.

The applicant stated that prior to the Mineral earthquake the largest earthquakes to occur in the CVSZ were an 1875 M4.8 and a 2003 M4.5 event that occurred in Goochland County, Virginia, south of the Mineral earthquake's epicenter.

The applicant stated that aftershocks of the Mineral earthquake ranged in depth from 1 to 7.5 km (0.6 to 4.5 mi), with magnitudes up to M3.9. Additionally, the applicant stated that global and USGS moment tensor solutions and the location of aftershocks for the Mineral earthquake defined a rupture plane 10 km (6.2 mi) in length striking approximately N26º – 30ºE and dipping 37º – 55ºSE (FSAR Table 2.5.2-204). The applicant used the up-dip projection of the rupture plane defined by aftershocks to highlight a zone on the surface that may have been susceptible to ground deformation from the mainshock. As discussed in SER Section 2.5.1.1.3, the applicant stated that field reconnaissance in the epicentral region of the Mineral earthquake revealed no discernable surface rupture or ground deformation.

The applicant discussed the two sets of three-component strong ground motion accelerograms of the **M**5.8 Mineral earthquake recorded at the North Anna 1 structure. One recording was located at the containment mat foundation approximately 16 m (54 ft) below plant grade and the second recording was at the containment operating deck approximately 6 m (20 ft) above plant grade. The applicant stated that the largest acceleration recorded at the foundation was 0.26 g, and the largest horizontal acceleration recorded at the operating deck level was 0.4 g. The applicant reported that these records are the closest available strong motion recordings of the Mineral earthquake. Based on the analysis of strong-motion recordings collected by the Center for Engineering Strong-Motion Data obtained at different distances from the Mineral earthquake, the applicant concluded that recorded ground motions correlated well with ground motion prediction equations for the CEUS at high frequencies (peak ground acceleration (PGA), 5 Hz but were lower than predicted at low frequency (1 Hz).

Geologic and Tectonic Characteristics of the Site and Region

FSAR Section 2.5.2.2 describes the seismic sources and seismic model parameters that the applicant used to calculate the seismic ground motion hazard at the North Anna 3 site. The applicant used the CEUS-SSC as a starting point for its hazard calculations rather than the EPRI-SOG model used in the ESP SSAR. Published in January 2012, the CEUS-SSC was developed following the Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 procedures as outlined in NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts." It is a regional seismic source model to be used as a starting model in seismic hazard calculations for nuclear facilities in the CEUS region. The applicant stated that it conducted a review of the CEUS-SSC model to identify whether there was a need to update any of the seismic sources.

Summary of the Central and Eastern United States – Seismic Source Characterization Model

The applicant stated that the CEUS-SSC model contains two types of seismic sources: distributed seismicity sources and RLME sources. While the distributed seismicity sources were developed based on available earthquake locations and regional geologic and tectonic characterizations, the RLME sources were based on paleo- and historic earthquake records. The RLME sources represent the zones of repeated (two or more) RMLEs (M>6.5) in the CEUS region.

The CEUS-SSC model categorizes the distributed seismicity sources into two subgroups: maximum magnitude (M_{max}) zones and seismotectonic zones. These subgroups represent uncertainties in source characterizations and differences of opinions in seismic source identification in the region. In hazard estimates, the M_{max} and seismotectonic sources are weighted by 40 percent and 60 percent, respectively, to determine their contributions to the total seismic hazard at the site. The M_{max} zones are broad seismic sources identified based on limited tectonic information and represent potential seismic sources of future earthquakes. The seismotectonic sources are those developed by extensive analyses of regional geology and geophysics, tectonics, and seismicity in the CEUS region. Both the M_{max} and the seismotectonic zones also include alternative source geometries, accommodating inherent uncertainty in SSC. RLME sources are superimposed on the distributed seismicity sources when calculating total site hazard.

In FSAR Sections 2.5.2.2.2 and 2.5.2.2.3, the applicant stated that the PSHA conducted for the North Anna 3 site includes the contributions from all or parts of each distributed seismicity model (i.e. M_{max} and seismotectonic source zones) that lie within 1,000 km (620 mi) of the site. As a result, the applicant used the following alternative seismic source configurations for the M_{max} zones where Mesozoic-aged tectonic extension occurred (MESE) and did not occur (NMESE): MESE-N, MESE-W, NMESE-N, NMESE-W, and the Study Region. The Study Region is the largest seismic source in the CEUS-SSC model, and it represents the entire area of the CEUS region with no division between MESE and NMESE. The applicant considered narrow (N) and wide (W) extensions to represent varying alternative geometries of the MESE and NMESE sources resulting in four alternative configurations of the two overall classifications: MESE-N, MESE-W, NMESE-N, and NMESE-W. The applicant noted that the North Anna 3 site is located in the MESE M_{max} source zone in both interpretations. The applicant included the following seismotectonic source zones in the seismic hazard model for the North Anna 3 site: Atlantic Highly Extended (AHEX) Crust; Extended Continental Crust-Atlantic Margin (ECC-AM), PEZ including PEZ-N and PEZ-W; Midcontinent-Craton (MidC) including MidC-A, MidC-B, MidC-C, and MidC-D; St. Lawrence Rift (SLR); and Illinois Basin Extended Basement (IBEB) (SER Figure 2.5.2-2).

The applicant indicated that AHEX, ECC-AM, PEZ, and MIDC seismic sources were located within 320 km (200 mi) of the North Anna 3 site, and the North Anna 3 site itself is located within the ECC-AM seismic source. The applicant described the ECC-AM seismic source as a zone that encompasses portions of the Piedmont, Coastal Plain, and Continental Shelf physiographic provinces that experienced Mesozoic and younger extension. The applicant noted that the ECC-AM seismic zone is defined by the observation that earthquakes greater than M7 in SCRs occur within crust extended during the Mesozoic and younger period. Magnetic and gravity anomalies define the boundaries of the ECC-AM seismic zone near the North Anna 3 site.

The applicant stated that the AHEX seismic source lies offshore along the continental shelf at the eastern edge of the 320 km (200 mi) site radius. The applicant characterized the AHEX seismic source as a zone of thinned mafic oceanic crust extended during the Mesozoic. The third seismotectonic zone used, PEZ, represents the seismic zone in the western part of the North Anna 3 site region. Because the western boundary of this zone is not well constrained, the CEUS-SSC model has two alternative source geometries for this source representing a wide (W) or narrow (N) geometry: PEZ-W and PEZ-N. The applicant stated that the last seismotectonic zone, MidC, is a large areal zone encompassing the continental interior where very little or no significant tectonic deformation took place in the past several hundred million years. Since the MidC zone boundaries are also uncertain, this zone is defined by four alternatives: MidC-A; MidC-B; MidC-C; and MidC-D. The applicant stated that, although only MidC-A and MidC-B configurations are within the 320 km (200 mi) site radius, all four model alternatives were included in the baseline hazard calculation.

In FSAR Sections 2.5.2.2.4, the applicant summarized the RLME sources used in the North Anna 3 seismic hazard calculations. The CEUS-SSC model requires contributions from the RLME sources to be added to the seismic hazard estimates obtained from the distributed seismicity models. Figure 2.5.2-3 in this SER shows the locations of the RLME sources characterized in the CEUS-SSC model. The applicant stated that the RLME sources that contribute significantly to seismic hazard at the North Anna 3 site are Charleston, New Madrid Fault System, and the Wabash Valley sources.

Figure 2.5.2-2. **Map Showing the CEUS-SSC Seismotectonic Zones for One of the Four Alternative Models for the MidC Seismotectonic Zone (FSAR Figure 2.5.2-215, Rev. 8)**

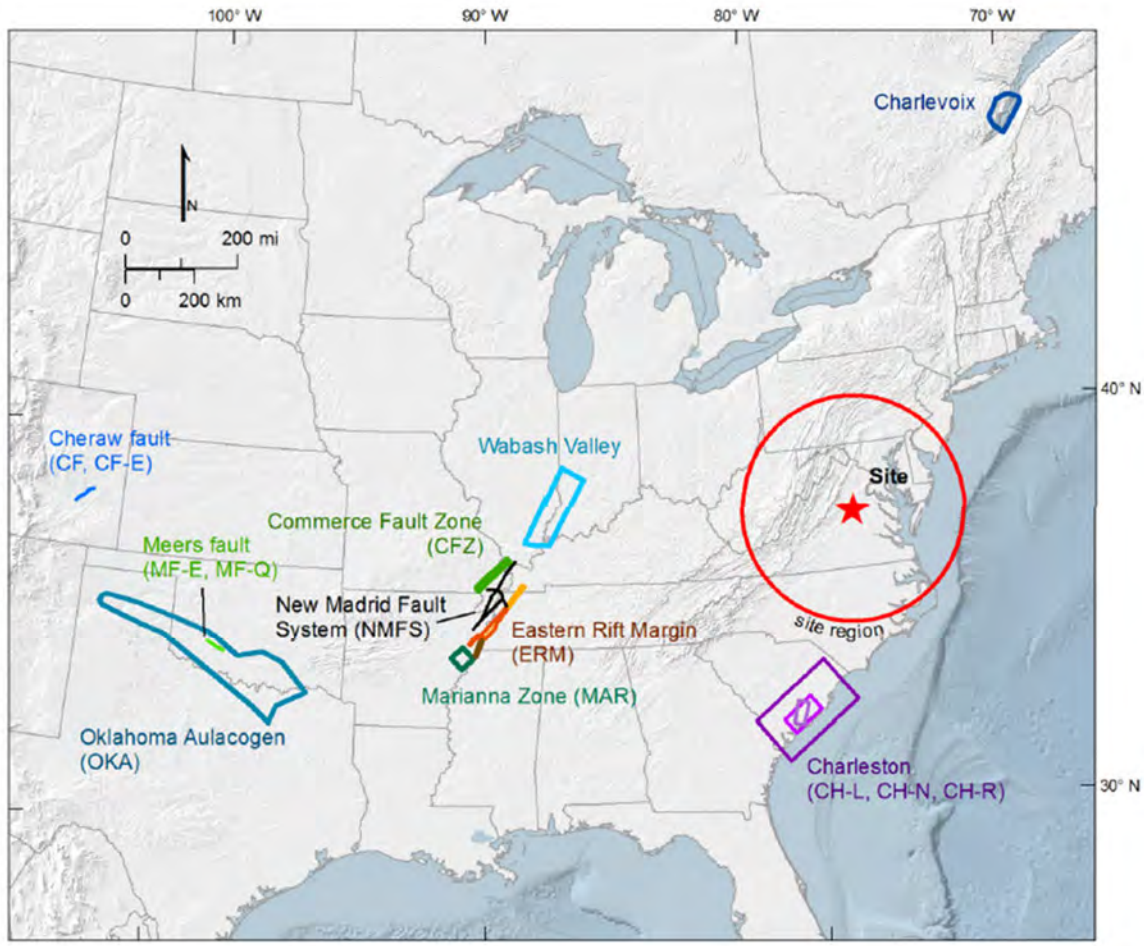


Figure 2.5.2-3. Map Showing the Repeated Large Magnitude Earthquake (RLME) Sources in the CEUS-SSC Model (FSAR Figure 2.5.2-218, Rev. 8)

Post-Central and Eastern United States – Seismic Source Characterization Studies

In FSAR Section 2.5.2.2.5, the applicant described geologic and seismic investigations of the North Anna 3 site region used to evaluate and potentially update the CEUS-SSC model. The applicant performed sensitivity studies to determine the impact of the Mineral earthquake on the M_{max} and earthquake recurrence distributions for the ECC-AM, MESE-N, MESE-W, and Study Region seismic sources. The applicant stated that because earthquakes in background zones are modeled as finite ruptures on randomly oriented faults, a future earthquake similar to the Mineral earthquake is included within the updated CEUS-SSC model.

In FSAR Section 2.5.2.2.3.1, the applicant noted that the E[M]5.71 Mineral earthquake, which occurred after the development of the CEUS-SSC earthquake catalog, is now the second largest earthquake not associated with an RLME in the ECC-AM. Based on sensitivity studies, the applicant increased the minimum M_{max} in the ECC-AM region from 6.0 to 6.1 (FSAR Table 2.5.2-211). The applicant performed a SSHAC Level 2 assessment to determine if incorporating the rupture plane of the Mineral earthquake as a new fault source was appropriate (FSAR Section 2.5.2.4). The applicant stated that although a potentially causative structure for the Mineral earthquake is defined, there are no constraints on slip rate, recurrence, and M_{max}. Therefore, the applicant incorporated the Mineral earthquake in the PSHA for the North Anna 3 site by increasing the M_{max} distribution for the ECC-AM zone. The applicant also indicated that it did not include the rupture plane of the Mineral earthquake as an RLME source since RLME sources are defined as locations of repeated large-magnitude (M≥6.5) earthquakes.

The applicant also discussed the impact of recent paleoseismic studies in the ETSZ. The applicant did not represent the ETSZ as an RLME since these studies did not provide information on earthquake recurrence interval or magnitude parameters for the ETSZ.

Correlation of Earthquake Activity with Seismic Sources

FSAR Section 2.5.2.3 describes the correlation of updated seismicity with the CEUS-SSC seismotectonic zones and RLME sources significant to the site (SER Section 2.5.2.2.2). The applicant discussed correlations of seismicity in the updated catalog with the Charleston, New Madrid Fault System, and Wabash Valley RLME sources (FSAR Figures 2.5.2-223 and 2.5.2-226), but identified no significant deviations from zones or faults defined within these sources. The applicant concluded that seismicity in the updated catalog was consistent with the patterns of seismicity for the PEZ, AHEX, SLR, and IBEB seismotectonic zones defined in the CEUS-SSC model.

Within the ECC-AM seismotectonic zone, the applicant identified elevated rates of seismicity in the CVSZ and the New York-Philadelphia region. The applicant noted that these zones are not RLMEs as there is no evidence for repeated, large-magnitude earthquakes or discrete faults associated with seismicity. The applicant indicated that while the 2011 Mineral earthquake and its aftershocks defined a northeast-striking and southeast-dipping rupture plane, there is not sufficient information to designate the rupture plane of the Mineral earthquake as an RLME. The magnitude of the Mineral earthquake, E[M]5.71, is less than the maximum magnitude for the ECC-AM (M_{max} = 6.5), its host seismotectonic zone. The applicant suggested that the largest earthquake possibly recorded in the ECC-AM is the 1755 Cape Ann, Massachusetts E[M]6.10 earthquake. However, the uncertainty in the location of the Cape Ann earthquake could place its epicenter in the Northern Appalachian (NAP) seismotectonic zone instead of the ECC-AM. Therefore, the applicant stated that if the Cape Ann earthquake occurred in the NAP, the largest event in the ECC-AM would then be the 2011 Mineral E[M]5.71 earthquake. The applicant noted that including the Mineral earthquake and other post-2008 seismicity in the updated CEUS-SSC catalog caused minor increases in seismicity rates (*a*-values) in the ECC-AM.

Probabilistic Seismic Hazard Analysis and Controlling Earthquake

FSAR Section 2.5.2.4 describes the applicant's PSHA calculations for the North Anna 3 site. The hazard curves generated by the applicant's PSHA represent the hazard calculated for generic hard rock conditions characterized by a shear wave (S-wave) velocity of 2.8 km/s (9,200 fps). In accordance with RG 1.208, FSAR Section 2.5.2.4 also describes the earthquake potential for the North Anna 3 site in terms of the most likely earthquake magnitudes and source-to-site distances, which are referred to as 'controlling earthquakes' at low-frequency (LF) (1 and 2.5 Hz) and HF (5 and 10 Hz) at the 10^{-4} and 10^{-5} mean annual frequencies of exceedance levels.

Probabilistic Seismic Hazard Analysis Inputs

The applicant's PSHA calculations used the CEUS-SSC model updated to include seismicity through December 2011 and the GMM described in EPRI Technical Report 3002000717,"Ground-Motion Model (GMM) Review Project, (EPRI, 2013)."

Seismic Source Model

The applicant stated that the PSHA inputs for the North Anna 3 site consist of the distributed seismicity sources (M_{max} and seismotectonic zones) or portions of these zones that are within 1,000 km (620 mi) of the North Anna 3 site. The applicant conducted PSHA sensitivity calculations to aid in the selection of an appropriate set of RLME sources to include in the PSHA from the CEUS-SSC model. Based on these results, the applicant included the Charleston, New Madrid Fault System, and Wabash Valley RLME sources because they contribute close to or greater than 1 percent to the total mean hazard at the North Anna 3 site. The seismic sources used in the PSHA calculations are summarized earlier in SER Section 2.5.2.2.2.

Ground Motion Models

The applicant used the EPRI (2013) GMM to calculate seismic hazard. The GMM developed by EPRI characterize the range of expected ground motions from a seismic source at seven oscillator frequencies; 0.5, 1, 2.5, 5, 10, 25, and 100 Hz. The applicant applied two different sets of GMMs depending on the seismic source under consideration: the 9 general, non-rift EPRI (2013) GMM relationships for the Midcontinent region were applied to all background seismic sources, and the 12 non-general, rift EPRI (2013) GMM relationships for the Midcontinent region were applied to all RLME sources.

Probabilistic Seismic Hazard Analysis Methodology and Calculation

Using the modified CEUS-SSC, with modified M_{max}, recurrence, and rate distributions described in FSAR Section 2.5.2.4.3 and summarized in this SER, and EPRI GMM (2013), the applicant performed the PSHA calculations using a fixed lower bound magnitude of M5.0 and modeled earthquakes occurring in the CEUS-SSC-distributed seismicity sources as point sources. The applicant applied the EPRI (2013) models for distance adjustment and additional aleatory variability resulting from the use of point sources (epicenter to model earthquakes) for distributed seismicity. The models assumed a random rupture location with respect to the epicenter. The applicant modeled earthquakes occurring in the RLME sources as extended ruptures and did not apply the distance adjustment and additional aleatory variability models to these sources.

The applicant performed the above PSHA calculations for ground motion frequencies of 0.5, 1, 2.5, 5, 10, 25 Hz, and PGA as described in RG 1.208. FSAR Figures 2.5.2-230 through 2.5.2-236 show the mean and fractile hazard curves for the seven oscillator frequencies.

Probabilistic Seismic Hazard Analysis Results

In order to determine which earthquakes are most significant to hazard at the North Anna 3 site, the applicant performed deaggregation for LF and HF ground motions. These earthquakes, termed controlling earthquakes, were determined by averaging the deaggregated impact of distance and magnitude on hazard at 1 and 2.5 Hz for LF and 5 and 10 Hz for HF following procedures outlined in RG 1.208, Appendix D. The applicant deaggregated the PSHA results at target mean annual frequencies of exceedance levels to determine the controlling earthquakes in terms of magnitude and site-to-source distance. SER Figure 2.5.2-4 shows the deaggregation plots for HF and LF 10^{-4} mean annual frequencies of exceedance hazard results. Following RG 1.208, the applicant selected the controlling earthquake for LF ground motions from the distance calculation of greater than 100 km (62 mi).

The applicant followed Approach 2A described in NUREG/CR-6728, “Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines.” As part of Approach 2A, the applicant determined the site response analysis input ground motion by calculating spectral shapes based on NUREG/CR-6728 for HF and LF ground motions at 10^{-4}, 10^{-5}, and 10^{-6} mean annual frequencies of exceedance. The applicant anchored HF input ground motions at the PSHA values for frequencies of 2.5 Hz and higher and the LF input ground motions at the PSHA values for frequencies of 2.5 Hz and lower. FSAR Figure 2.5.2-257 shows the Uniform Hazard Response Spectrum (UHRS) that the applicant determined by enveloping the LF and HF input motions.

Table 2.5.2-1 Mean Magnitude and Distance for LF and HF Response Spectra for Three MAFEs (Table 2.5.2-218, Rev 9)

MAFE	**10^{-4}**	**10^{-5}**	**10^{-6}**
Low Frequency M	7.1	6.4	6.7
Low Frequency R (km)	340	21	16
High Frequency M	5.9	6.1	6.4
High Frequency R (km)	22	15	13

LF: low frequency, 1 to 2.5 Hz
HF: high frequency, 5 to 10 Hz
MAFE: mean annual frequency of exceedance

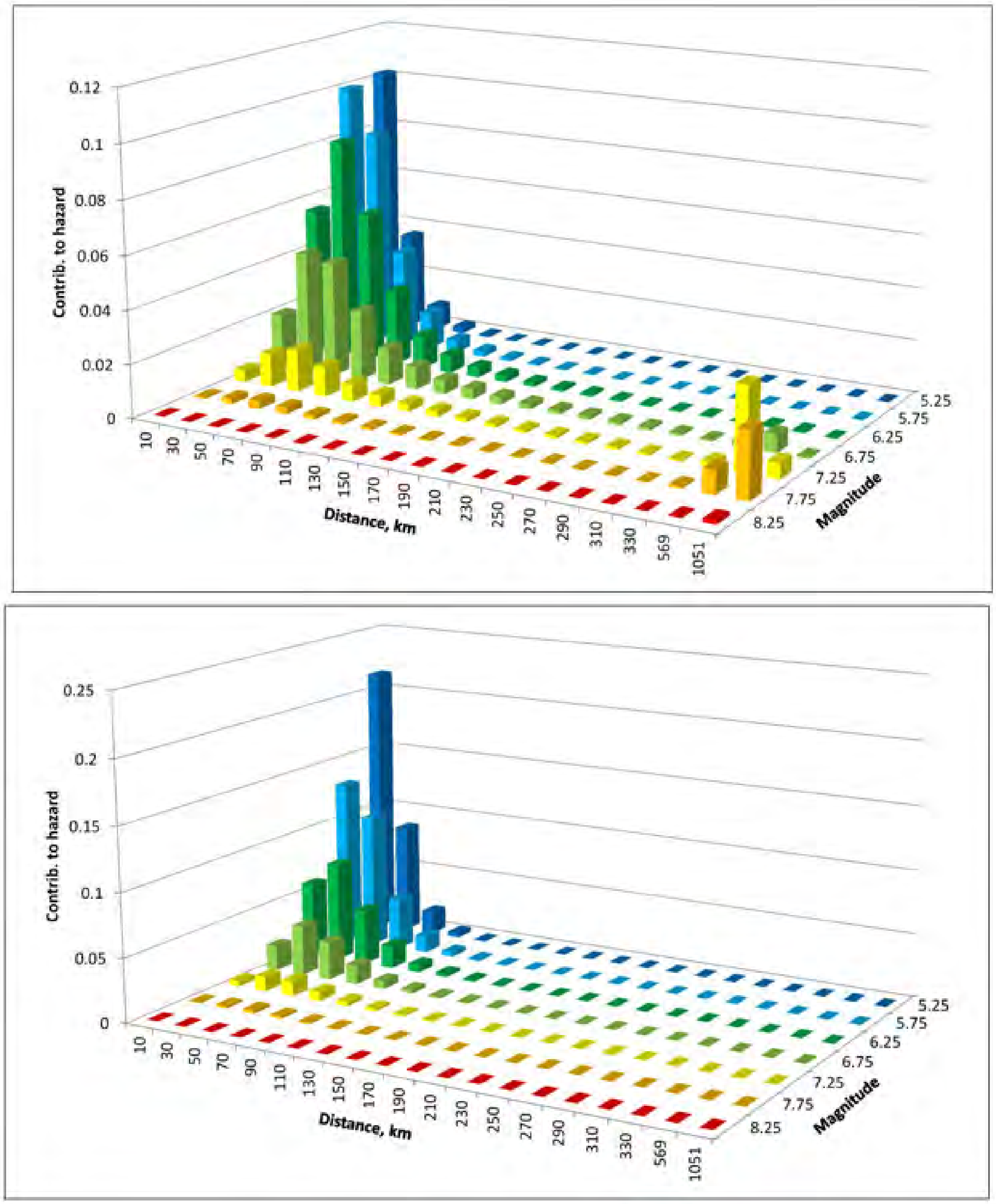


Figure 2.5.2-4. Deaggregation Results for LF (Upper) and HF (Lower) at the 10-4 Mean Annual Frequency of Exceedance Level (Figure 2.5.2-250 and Figure 2.5.2-251, Rev. 9)

Seismic Wave Transmission Characteristics of the Site

FSAR Section 2.5.2.5 describes the procedure the applicant used to assess the effects of soils on seismic wave transmission beneath the North Anna 3 site. The PSHA calculates hazard curves for generic hard rock conditions, characterized by S-wave velocity of 2.8 km/s (9,200 fps). For the North Anna 3 site, these hard rock conditions exist at depths ranging from 47.3 to 50.3 m (155 to 165 ft) below surface elevation 88.4 m (290 ft) NAVD88. To determine the near-surface soil UHRS, the applicant first developed soil/rock profile models for the North Anna 3 site; selected representative hard rock ground motions based on a hard rock seismic hazard calculations; and performed site response analysis to obtain the free-field soil UHRS at the elevation of the competent layer beneath the North Anna 3 site.

In FSAR Section 2.5.2.5, the applicant described two sets of site response analyses. The applicant used one analysis to develop the site-specific GMRS and the second analysis to perform the soil structure interaction (SSI) analyses. For the SSI analyses inputs, the applicant developed the performance-based surface response spectra (PBSRS) and FIRS. While the applicant described development of PBSRS and FIRS in FSAR Section 2.5.2.5, the summary and evaluation of the PBSRS, FIRS, and SSI analysis are discussed in SER Section 3.7.1.

The applicant stated that the geology of the site is complex, consisting of undulating layers of saprolite and rock of varying degrees of weathering. In order to account for the uncertainty in the material properties of the rock at the GMRS elevation across the footprint of the plant, the applicant developed BE velocity profiles for the GMRS elevation based on borings (B-901, B-907, and B-909) within the footprint of the RB/FB and the CB. The applicant developed separate models for the two buildings at the GMRS Elevation 68.3 m (224 ft) NAVD88 and enveloped the resulting response spectra to determine the site GMRS.

Site Response Model

According to the applicant, the geology at the North Anna 3 site consists of layers of saprolite overlying rocks of the Ta River Metamorphic suite that have varying degrees of weathering and fracturing. The applicant subdivided the saprolite and weathered rock layers into zones termed Zone I-IV based on physical characteristics. The applicant proposed to locate the GMRS at Elevation 68.3 m (224 ft) NAVD88 in the rock layer termed Zone IV, a layer of competent rock material. The applicant encountered CEUS generic hard rock conditions (i.e., an S-wave velocity of about 2.8 km/s [9,200 fps]) at a depth of approximately 47.2 m (155 ft) (Elevation 41.2 m [135 ft]).

In addition to the S-wave velocity profile, the applicant noted that the other material parameters used as inputs to the site response analysis include material unit weight, shear modulus, and damping. The applicant obtained soil and rock unit weights for the site response profile from laboratory test results and site characterization analysis. The applicant stated that unit weights for the rock units beneath the site range from 2,000 to 2,600 kg/m^3 (125 to 164 pounds per cubic foot).

The applicant determined that for saprolite and Zone III rock, strain dependent damping and shear modulus reduction curves were appropriate. For Zone III-IV and Zone IV rock, the applicant stated that the materials were expected to behave linearly, so no shear modulus reduction curve was required and a constant damping value was used.
The applicant modeled the variability in the site data by randomizing the S-wave velocity profile, the layer thickness, and the shear modulus reduction and damping relationships for the soil. In order to consider the appropriate level of variability in calculating soil profiles, the applicant

considered measurements beneath both the RB/FB and the CB when determining the standard deviation used in randomizing the soil profile. The applicant generated randomized profiles using the S-wave velocity correlation model developed by Silva et al. (1996). The applicant also randomized the shear modulus reduction and damping in the saprolite and Zone III rock. These artificial profiles represent the soil column from the top of the bedrock (rock with an S-wave velocity equal to that of reference rock [2.8 km/s (9,200 fps)]) to Elevation 68.3 m (224 ft) for calculating the GMRS. The applicant used these randomized profiles as input to the site response calculations, which are summarized below.

The applicant separately developed soil profiles for the RB/FB and the CB based on closest downhole measurements. The applicant randomized each of these profiles and calculated the expected site response at the GMRS elevation. In order to account for observed variability in physical characteristics across the site, the applicant enveloped the site response curves for RB/FB and CB profiles when calculating the GMRS. SER Figure 2.5.2-5 shows the input S-wave velocity profiles for the RB/FB and the CB.

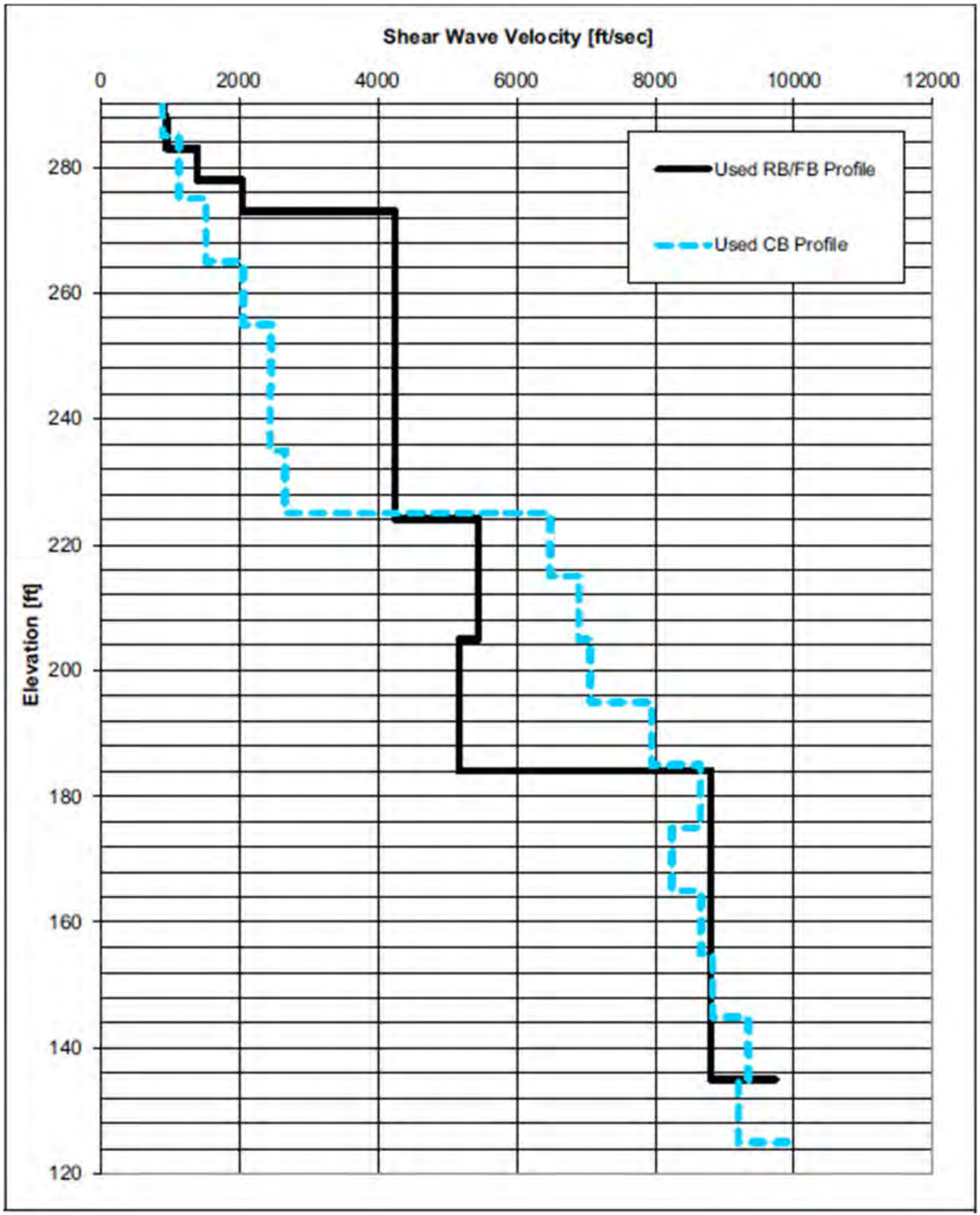


Figure 2.5.2-5. **Input Shear-wave Velocity Profiles for the RB/FB and CB Buildings Used for Site Response Calculations (FSAR Figure 2.5.2-259, Rev. 8)**

Site Response Methodology and Results

In FSAR Section 2.5.2.5.3, the applicant described its approach to developing site response analysis input and methodology. The applicant used the computer program P-SHAKE to calculate site response at the North Anna 3 site. The P-SHAKE program uses equivalent-linear site-response formulations in combination with Random Vibration Theory (RVT) to produce site response input at the reference rock/soil boundary that is propagated through the soil profile. The program takes input response spectra calculated using equations in NUREG/CR-6728 scaled to the hard rock UHRS and converts them to an acceleration power spectral density (PSD). The program calculates a transfer function for shear strain in each soil layer and convolves this with the PSD to calculate an effective strain that is used as input in the next iteration. The program iterates until convergence when the amplitude response spectrum (ARS) at each layer interface can be calculated from the PSD of the solution using the RVT approach.

The RVT method requires additional inputs, particularly strong-motion duration and effective strain ratio. The applicant used NUREG/CR-6728 to calculate strong-motion duration based on the HF and LF controlling earthquakes at the 10^{-4} and 10^{-5} annual frequencies of exceedance. The applicant determined the effective strain ratio using equation 2.5.2.5-1 in the FSAR.

To calculate the final site amplification effects of the soil, the applicant divided the response spectrum for the computed surface motion by the corresponding response spectrum for the hard rock input motion. The applicant calculated the ARS for each of the 60 site profiles and took the arithmetic mean to define the amplification function. The applicant performed the analysis for the HF and LF spectra at the 10^{-4} and 10^{-5} exceedance frequencies and enveloped the resulting ARS to determine the UHRS at the GMRS elevation. FSAR Figures 2.5.2-286 and 2.5.2-287 show the amplification functions determined by the applicant for the 10^{-4} and 10^{-5} exceedance frequencies respectively.

Ground Motion Response Spectra

FSAR Section 2.5.2.6 describes the method the applicant used to develop the horizontal and vertical site-specific GMRS. To obtain the horizontal GMRS, the applicant used the performance-based approach described in RG 1.208 and in ASCE/SEI Standard 43-05, "Seismic Design Criteria for Structures, System, and Components in Nuclear Facilities" (ASCE/SEI, 2005). The applicant developed the vertical GMRS using site-specific vertical to horizontal (V/H) response spectral ratios developed using guidance provided in NUREG/CR-6728 for CEUS sites.

Horizontal Ground Motion Response Spectra

The applicant calculated a horizontal, site-specific, performance-based GMRS using the method described in RG 1.208. The performance based method achieves the annual target performance goal (P_F) of 10^{-5} per year for the frequency of onset of significant inelastic deformation. This damage state (i.e., deformation) represents a minimum structural damage state – or essentially elastic behavior – and falls well short of the damage state that would interfere with functionality. The GMRS was calculated using the following relationship:

$$GMRS = DF * UHRS(10^{-4})$$

Where:

$$DF = max\{1.0, 0.6 * (A_R)^{0.8}\}$$
$$A_R = UHRS(10^{-5})/UHRS(10^{-4})$$

The applicant noted that when the value of A_R exceeds 4.2, RG 1.208 specifies that it is appropriate to use a GMRS value equal to 45 percent of the mean 10^{-5} UHRS. The applicant calculated a GMRS using the above approach for both the RB/FB and the CB at Elevation 68.3 m (224 ft) NAVD88 and enveloped them to determine the site-specific performance-based GMRS. SER Figure 2.5.2-6 shows the resulting horizontal GMRS.

Vertical Ground Motion Response Spectra

The applicant obtained the vertical GMRS by calculating site-specific V/H ratios and applying them to the horizontal GMRS. The applicant used information provided in NUREG/CR-6728 and velocities at the GMRS elevation to calculate a site-specific V/H ratio. SER Figure 2.5.2-6 shows the vertical GMRS for the North Anna 3 site using the V/H ratio shown in FSAR Figure 2.5.2-320.

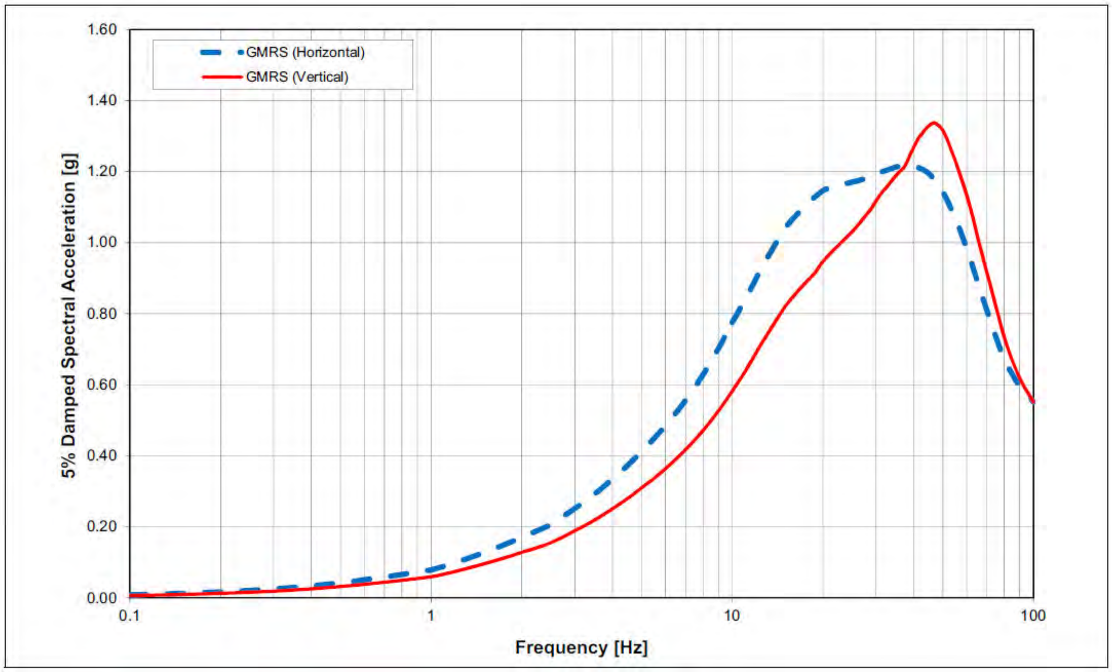


Figure 2.5.2-6. Horizontal and Vertical GMRS for the North Anna 3 Site at Elevation 68.28 m (224 ft) (FSAR Figure 2.5.2-313, Rev. 9)

2.5.2.3 Regulatory Basis

The regulatory basis for incorporating information by reference to the ESP SSAR is 10 CFR 52.79(b), which states (in part) that if a COLA references an ESP, then the FSAR need not contain information or analyses submitted to the Commission in connection with the ESP provided that the FSAR must either include or incorporate by reference the ESP SSAR and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP. Full descriptions of the applicable regulatory and acceptance criteria, and related NRC guidance, are provided in SRP Section 2.5.2 (NUREG-0800).

The regulatory basis for the information incorporated by reference is addressed in the SER related to the North Anna 3 ESP (NUREG-1835).

The applicable regulatory requirements for reviewing the applicant's discussion of vibratory ground motion are:

- 10 CFR 100.23, with respect to obtaining geologic and seismic information necessary to determine site suitability and ascertain that any new information derived from site-specific investigations does not impact the GMRS derived by a PSHA. The site-specific GMRS satisfies the requirements of 10 CFR 100.23 with respect to development of the SSE. In complying with this regulation, the applicant also meets guidance in RG 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Revision 2; and RG 1.208.

- 10 CFR 52.79(a)(1)(iii), as it relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity and period of time in which the historical data have been accumulated.

The related acceptance criteria summarized from NUREG-0800 Section 2.5.2 are as follows:

- **Seismicity**: To meet the requirements in 10 CFR 100.23, this section is accepted when the complete historical record of earthquakes in the region is listed and when all available parameters are given for each earthquake in the historical record.

- **Geologic and Tectonic Characteristics of Site and Region:** Seismic sources identified and characterized by the LLNL and the EPRI were used for studies in the CEUS in the past.

- **Correlation of Earthquake Activity with Seismic Sources:** To meet the requirements in 10 CFR 100.23, acceptance of this section is based on the development of the relationship between the history of earthquake activity and seismic sources of a region.

- **Probabilistic Seismic Hazard Analysis and Controlling Earthquakes:** For CEUS sites relying on LLNL or EPRI methods and databases, the staff will review the applicant's PSHA, including the underlying assumptions and how the results of the site investigations are used to update the existing sources in the PSHA, how they are used to develop additional sources, or how they are used to develop a new database.

- **Seismic Wave Transmission Characteristics of the Site:** In the PSHA procedure described in RG 1.208, the controlling earthquakes are determined for generic rock conditions.

- **Ground Motion Response Spectra:** In this section, the staff reviews the applicant's procedure to determine the GMRS.

In addition, the geologic characteristics should be consistent with appropriate sections from: RG 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants"; RG 1.132, RG 1.206; and RG 1.208.

2.5.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 2.5.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 2.5.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESP SSAR and the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 COL FSAR, the ESP SSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.

The applicant incorporated by reference Section 2.5.2 of the ESP SSAR, Revision 9. The staff's technical evaluation of Section 2.5.2 of the ESP SSAR is in NUREG-1835 and its supplement.

The staff reviewed Section 2.5.2 of the North Anna 3 COL FSAR and checked the referenced ESP SSAR. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to this section.

During the course of staff's review of the application, the applicant changed its selection of reactor technology. Previously in RAI 2.5.2-1 dated December 21, 2010 (ADAMS Accession No. ML110270358), the staff had a concern about the elevation of the GMRS. In the response to RAI 2.5.2-1 dated March 22, 2011 (ADAMS Accession No. ML110880254), the applicant states this question is no longer applicable because of the FSAR revisions following the selection of a new reactor design. Therefore, RAI 2.5.2-1 is resolved and closed.

The staff's technical evaluation of this application is limited to the resolution of DCD COL Item 2.0-27-A, discussion of ESP VAR 2.0-4, and new and significant information regarding the August 23, 2011, Mineral earthquake, additional subsurface investigations, and the availability of the CEUS-SSC, as addressed below:

COL Items:

- NAPS COL 2.0-27-A

In accordance with COL Action Item 2.0-27-A, and to resolve COL item 2.5-3, the applicant updated the site subsurface material properties with results from COL field investigations. The applicant performed several additional borings to sample the subsurface and did additional field geophysical measurements. The staff reviewed the new information and found it important for the site response analysis. The staff used this information to perform updated confirmatory site response analysis described in Section 2.5.2.4.2 of this SER.

ESP Variance:

- NAPS ESP VAR 2.0.4

The applicant requested VAR 2.0-4 in order to use the spectral acceleration values at elevation 68.3 m (224 ft), rather than the ESP GMRS elevation of 76.2 m (250 ft). The applicant also updated its PSHA to incorporate the recent CEUS-SSC. The staff considered this variance request and determined that because the GMRS elevation was redefined based on the applicant's COL subsurface investigations, the use of the base of the RB/FB foundation for GMRS elevation in place of that determined as part of the ESP is acceptable. The staff also finds use of the CEUS-SSC acceptable as it represents the most up to date model of seismic sources in the Central and Eastern U.S.

Probabilistic Seismic Hazard Analysis Updates

On August 23, 2011, the **M**5.8 Mineral earthquake occurred approximately 23 km (14 mi) from the North Anna 3 site. The occurrence of a moderate magnitude earthquake within the site vicinity indicates that a previously unrecognized seismic source may exist that poses a hazard at the plant. This new and significant information led the staff to reopen the PSHA previously evaluated as part of the ESP. In RAI 2.5.2-4, dated November 1, 2011 (ADAMS Accession No. ML11305A261), the staff asked the applicant to assess the adequacy of the EPRI SOG (EPRI, 1986, 1989) seismic source model in light of the Mineral, Virginia earthquake. In RAI 2.5.2-8 dated July 8, 2015 (ADAMS Accession No. ML15233A433), the staff also asked the applicant to address any exceedances of the postulated GMRS by observed ground motions at the existing North Anna 1 in terms of the adequacy of the seismic design parameters in FSAR Section 3.7.1 to account for the recordings. The RAI also asked the applicant to specify the operability criteria for the as-found conditions of safety-related SSCs, until the SSC is restored to meet the original design basis and design criteria, to ensure that such demonstrations would consider the Mineral, Virginia earthquake recordings. In the response to RAI 2.5.2-4 dated February 13, 2012 (ADAMS Accession No. ML12048A096), the applicant responded that the record of the **M**5.8 Mineral earthquake is considered in development of the North Anna 3 SSE by including a comparison with the CSDRS. The applicant demonstrated that the Unit 1 containment mat earthquake recorded motion in all three directions are enveloped by the North Anna 3 CSDRS at all frequencies. Further, the applicant clarified the FSAR description of the seismic design parameters in FSAR Section 3.7.1 by noting that these site-specific recorded motions for North Anna are enveloped by the CSDRS, which is the licensing basis for all Category I structures. Regarding operability, the applicant included a criteria in Section 3.7.1 of the FSAR that the SSE design ground motion will be used in operability assessments to demonstrate plant safety for the as-found conditions of safety-related SSCs. Since the SSE design ground motion includes both the CSDRS and the site-specific FIRS, and the CSDRS envelopes these recordings and is the licensing basis for all Category I structures and would be used in determining operability or other demonstrations of plant safety, the staff considers RAI 2.5.2-8 resolved and closed**.** The staff verified that the appropriate change is incorporated in the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.2.01 from the staff’s advanced SER for North Anna 3 is resolved and closed.

Following the Fukushima accident in Japan in March 2011, and subsequent NRC NTTF recommendations, on March 12, 2012, the NRC issued a letter, “Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident” (ADAMS Accession No. ML12053A340), requesting the operating nuclear power plants to re-assess seismic hazards at their sites using the most recent seismic source models. Consistent with existing guidance in RG 1.208, pertaining to the need to consider the latest information in the evaluation of seismic hazard, the staff issued an RAI to all COL and ESP applicants. In RAI 1.5-1 dated June 25, 2012 (ADAMS Accession No. ML12177A435), issued to North Anna 3 to reassess the seismic hazard at their sites using the new seismic source models. In the response to RAI 1.5-1 dated July 30, 2012 (ADAMS Accession No. ML12214A593), the applicant stated that based on FSAR changes made in responding to RAI 2.5.2-4, RAI 1.5-1 no longer applied at the North Anna 3 site.

The staff reviewed the applicant’s response to RAI 1.5-1, and agrees that the applicant’s response to RAI 2.5.2-4, in which the applicant stated that CEUS-SSC model would be used for PSHA, adequately addressed issues in RAI 1.5-1. Therefore, the staff considers RAI 1.5-1 resolved and closed.

In the February 13, 2012, response, the applicant also stated that it would update its COLA to use the CEUS-SSC to perform a new hard rock PSHA and develop a new site-specific GMRS for the North Anna 3 site. The applicant stated that this new PSHA would incorporate earthquake data from January 2009 through December 2011, which is subsequent to the period covered by the CEUS-SSC earthquake catalog. The applicant then updated its selection of GMM from the EPRI (2004, 2006) model to the most recent EPRI (2013) model and presented the results in the updated version of the North Anna 3 COL FSAR. The staff verified that the appropriate updates are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.2.02 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff reviewed the applicant's response and associated FSAR updates. The CEUS-SSC, as published in NUREG-2115, is a seismic source model that represents the state of the practice concerning the conduct of PSHA in CEUS. Additionally, the applicant followed applicable guidance in updating the seismicity catalog, selecting seismic sources, and determining controlling earthquakes. Therefore, based on the updated PSHA source model, the updated site response analysis, and the staff's confirmatory analysis, discussed below, the staff considers RAI 2.5.2-4 resolved and closed.

In the response to RAI 2.5.2-4 dated February 13, 2012 (ADAMS Accession No. ML12048A096), the applicant stated that it would update the CEUS-SSC to account for seismicity occurring after the period covered by the CEUS-SSC. In its response to RAI 2.5.2-4, the applicant updated the CEUS-SSC to account for seismicity occurring after the period covered by the CEUS-SSC catalog. The applicant updated seismicity maps and evaluated the impact of updated seismicity on seismicity rates and b-values in the CEUS-SSC. The applicant did not provide detailed maps of where seismicity rates changed due to the catalog updates. In RAI 2.5.2-7 dated April 8, 2014 (ADAMS Accession No. ML14098A297), the staff asked the applicant to demonstrate quantitatively how the applicant updated the CEUS-SSC to incorporate recent seismicity. Specifically, the staff asked the applicant to demonstrate the updated recurrence rates, b-values, and comparisons of the hazard using the CEUS-SSC catalog, as published, and the updated catalog.

In the response to RAI 2.5.2-7 dated May 9, 2014 (ADAMS Accession No. ML14140A087), and supplemented on May 29, 2014 (ADAMS Accession No. ML14150A439), the applicant provided detailed information about how the updated seismicity catalog influenced rates and b-values in the CEUS-SSC and provided the requested comparison of hazard. The applicant provided plots (example shown on Figure 2.5.2-7 of this SER) of updated rates and b-values for the four distributed seismicity zones that the North Anna 3 site lays within (ECC-AM, MESE-N, MESE-W, and STUDY-R). Further In its response to RAI 2.5.2-7, the applicant provided a Table-1 and a Figure-13, comparing the updated and the baseline seismic hazard at a variety of input spectral acceleration levels. The applicant demonstrated that the updated seismic catalog increases hazard at the North Anna 3 site up to 9 percent for annual frequencies of exceedance lower then 10^{-4}.

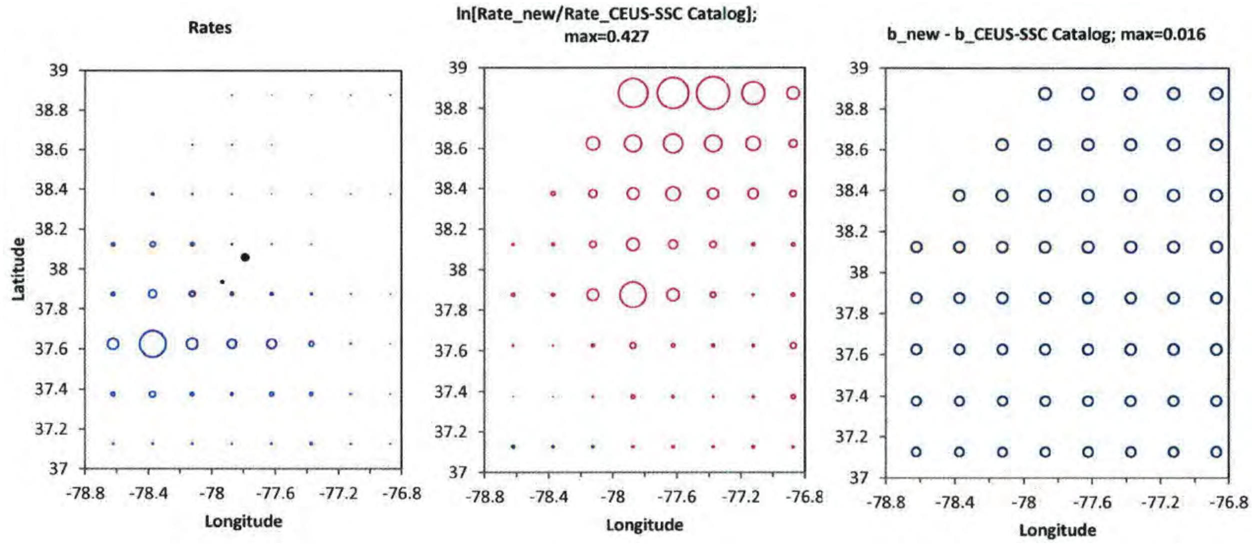


Figure 2.5.2-7. **Map** ***of Changes in Seismicity Rates and B-Values for*** **CEUS-SSC** ***Source Zone*** **ECC-AM, Case A** ***(*****Figure** ***from Applicant Response to*** **RAI** ***2.5.2-7.)***

The staff reviewed information provided by the applicant in response to RAIs about the CEUS-SSC catalog updates and the Mineral earthquake. The staff conducted a site audit on May 8, 2014, as documented in ADAMS Accession No. ML14203A179, during which the staff and the applicant discussed the details of their approach to the catalog updates and site response.

The staff also conducted an independent confirmatory analysis of the PSHA. The staff calculated the hazard at the North Anna 3 site using the published CEUS-SSC for distances up to 500 km (310 mi) for distributed seismicity sources and 1,000 km (620 mi) for RLME sources. In its confirmatory analysis, staff used the EPRI (2013) GMM. Figure 2.5.2-8 of this SER compares the PSHA results from the staff's independent confirmatory analysis with those of the applicant for PGA and frequencies of 25, 10, 2.5, and 1 Hz. The staff's and the applicant's calculations are in acceptable agreement. The staff used its independent PSHA results to develop site specific UHRS at the 10^{-4} and 10^{-5} exceedance frequencies. SER Figure 2.5.2-9 compares 10^{-4} and 10^{-5} UHRS developed by the staff with those developed by the applicant. Because the UHRS results developed by the staff are in acceptable agreement with those developed by the applicant and the applicant has incorporated seismicity after the publication of the CEUS-SSC, including the Mineral earthquake, the staff finds the applicant's PSHA acceptable.

Based on the applicant's response, the results of staff's site audit and its independent confirmatory analysis, staff considers RAI 2.5.2-7 resolved and closed.

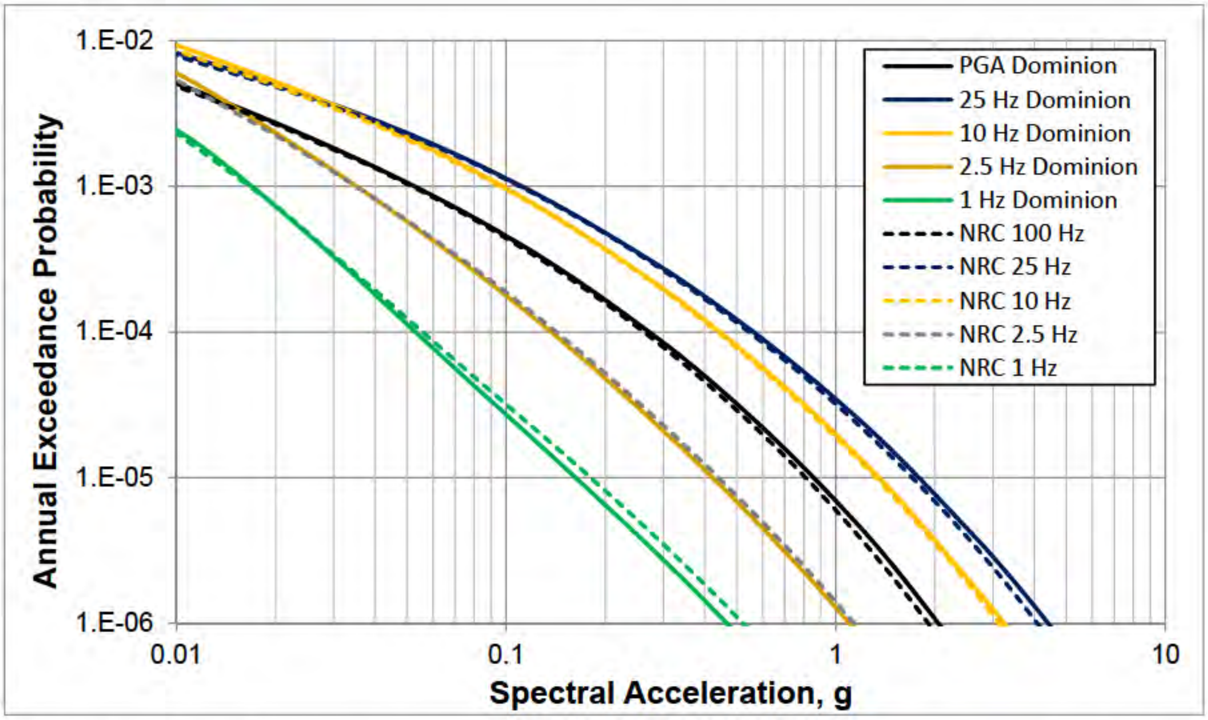


Figure 2.5.2-8. Comparison of the Applicant's Base Rock Hazard Curves with the Results of the Staff's Confirmatory Analysis

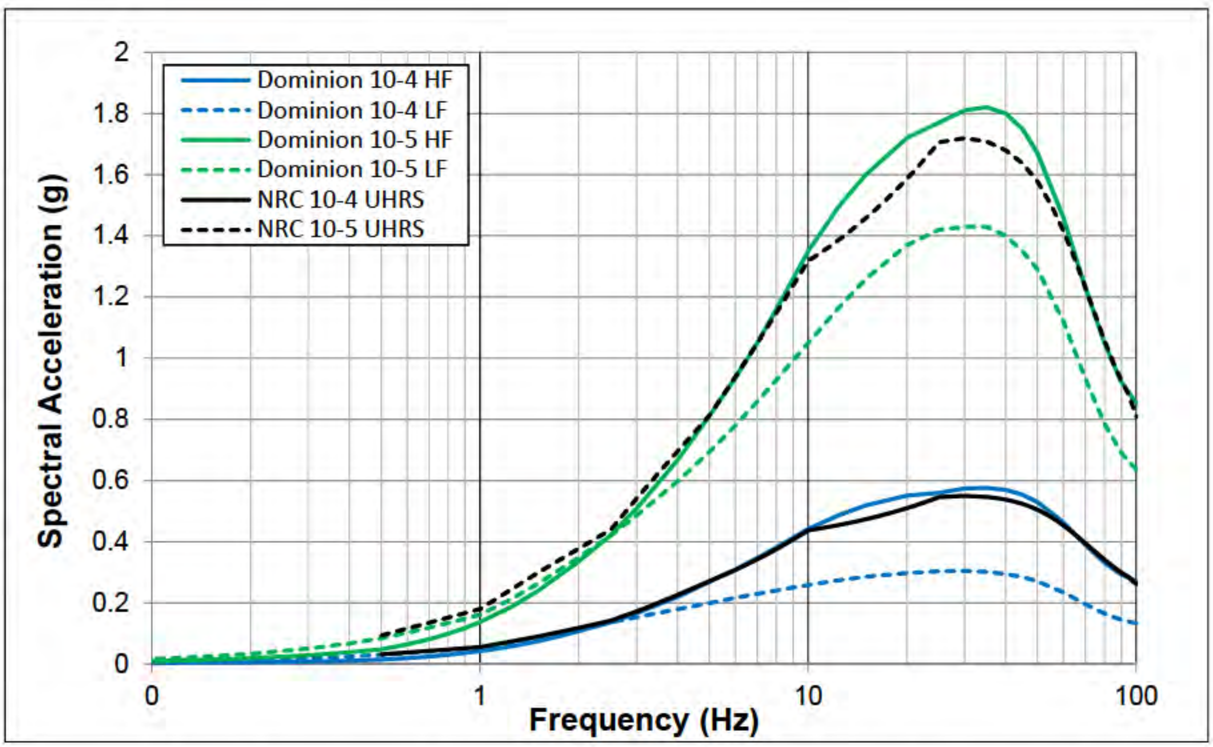


Figure 2.5.2-9. Comparison of the Applicant's UHRS at the 10-4 and 10-5 Annual Frequencies of Exceedance with the Results of Staff's Confirmatory Analysis

Ground Motion Response Spectra Updates

The applicant conducted additional site investigations subsequent to the issuance of the ESP. These investigations included additional geologic borings and subsurface geophysical measurements. As a result, the applicant developed new shear wave velocities for each of the rock units at the site. In addition, these additional borings revealed a more complex subsurface structure than was presented in the ESP SSAR. Therefore, in RAI 2.5.2-2a, dated December 21, 2010 (ADAMS Accession No. ML110340012), the staff asked the applicant to justify the use of one-dimensional site response methodology when significant topographic relief characterizes the subsurface layer interfaces. In RAI 2.5.2-2b, dated December 21, 2010 (ADAMS Accession No. ML110340012) the staff also asked, how the applicant ensured that the site response analysis captured this variability.

In the response to RAI 2.5.2-2a dated December 18, 2013 (ADAMS Accession No. ML14013A113), the applicant's response was revised. In the response to RAI 2.5.2-2b dated December 18, 2013 (ADAMS Accession No. ML14013A113), the applicant stated that even though there appears to be significant subsurface variability across the site and within the footprint of the plant, the distinction between different layers are, in fact, based on incremental differences in weathering. Because the criteria used to define the different layers within the rock are somewhat arbitrary, the layers are a result of the natural variability in the level of weathering across the site. The applicant stated that the vertical extent of this variability is small relative to the footprint of the plant, and concluded that a one-dimensional site response was appropriate. The applicant further stated that because this variability is the result of defining layers, not an actual stratification of the geology, that randomization of layer thicknesses, shear-wave velocity, and damping and shear modulus degradation curves accounts for this variability in site response. To further account for subsurface variability across the site, the applicant used data from three boreholes located within the footprint of the plant to generate shear-wave velocity profiles, and enveloped design response spectra from the RB/FB soil column and the CB soil column to determine the GMRS.

The staff reviewed the information provided by the applicant in response to RAI 2.5.2-2, and found that while the definition of different rock types (e.g., Zone III vs. Zone IV) was somewhat arbitrary, seismic shear-wave velocities varied greatly throughout the vertical soil profile of the site. As these shear-wave velocities correlate with different zones, the complex topography of the weathering profile across the site indicates that one-dimensional site response analysis may not be appropriate. In RAI 2.5.2-3a dated August 25, 2011 (ADAMS Accession No. ML11241A058), the staff asked the applicant to justify the one-dimensional site response analysis using only vertically propagating shear waves given the complex topography of the subsurface layers. In RAI 2.5.2-3b dated August 25, 2011 (ADAMS Accession No. ML11241A058), the staff requested that the applicant provide detailed site response input parameters. In RAI 2.5.2-3c dated August 25, 2011 (ADAMS Accession No. ML11241A058), the staff requested that the applicant explain how the shear-wave velocity profiles used in site response analysis were developed.

In the response to RAI 2.5.2-3a dated August 25, 2011 (ADAMS Accession No. ML11241A058), the applicant's response, supplemented on December 18, 2013 and February 23, 2015, stated that the use of one-dimensional site response analysis is appropriate because the soil and rocks at the site are all derived from the same parent rock. The applicant stated that the boundaries between rock types are gradational and so do not represent lateral impedance boundaries that may result in refraction, reflection, or trapping of shear waves traveling in horizontal directions. The applicant also stated that the uncertainties used in performing the site response such as varying the layer thicknesses, velocities, and shear modulus degradation and damping curves accounts for the variability in layer thickness across the site.

In order to ensure that appropriate uncertainties are included in their site response analysis, the applicant stated that they used geophysical data from three boreholes in their site response analysis. Data from boreholes B-901, B-907, and B-909 were used to develop a BE, log-mean, velocity profile for the RB/FB, and composite profiles, Profiles 1 and 2, were combined with the BE profile to develop the standard deviation profile for the RB/FB. The CB profile was developed using information from the closest borehole B-909. The applicant performed an independent site response analysis for each profile and enveloped the resulting response spectra to determine the GMRS for the site.

In addition, the applicant performed a sensitivity study in which the applicant calculated site response for all three boreholes individually. The applicant weighted these individual response spectra according to the borehole's proximity to the RB/FB centerline and enveloped. The applicant stated that the approach taken above to determine the GMRS is conservative relative to the results of the sensitivity study at all frequencies except for a small number of frequencies around 60 Hz.

The staff reviewed information provided by the applicant in response to RAI 2.5.2-3, but it was unclear to staff why the envelope of two site response calculations was used rather than the envelope of the three site response calculations undertaken by the applicant as part of its FIRS analysis. Therefore, in RAI 2.5.2-6 dated April 8, 2014 (ADAMS Accession No. ML14098A297), the staff requested that the applicant clarify why the GMRS was calculated as the envelope of the RB/FB and CB spectra and not the envelope of the profiles used for FIRS.

In a May 9, 2014 response (ADAMS Accession No. ML14140A087), the applicant clarified that information from all three boreholes (B-901, B-907, and B-909) was used to develop the soil profile for the RB/FB, and information from B-909 was used to develop the soil profile for the CB. The applicant stated that it used the envelope of the response spectra to represent the GMRS at the site because the envelope appropriately considered the uncertainties across the footprint of the site.

In the response to RAI 2.5.2-6 dated February 27, 2015 (ADAMS Accession No. ML15124A005), the applicant determined that the information provided sufficiently characterizes the subsurface geologic structure. The randomization procedures undertaken by the applicant appropriately account for the variability in layer thickness. Additionally, because the site materials are all derived from the same parent material, the use of multiple profiles ensures that horizontal variability in subsurface structure is accounted for.

The staff performed a confirmatory analysis of site response using values reported by the applicant for geophysical parameters. The staff independently developed BE velocity profiles, randomized the velocity profile and shear modulus degradation and damping curves and calculated site-specific amplification functions at the GMRS elevation. Figure 2.5.2-10 shows a comparison of amplification functions developed by the staff with those developed by the applicant. The differences in site amplification functions calculated by the staff and the applicant are not significant considering that staff used Approach 3 and the applicant used Approach 2, as described in NUREG/CR-6728, for the site response calculations. The staff subsequently combined its PSHA results at the 10^{-4} and 10^{-5} exceedance frequencies with its amplification functions and calculated a site-specific GMRS. Figure 2.5.2-11 shows a comparison of the site-specific GMRS developed by the staff with that developed by the applicant. The applicant's calculations are similar to that of the staff up to the frequency of about 25 Hz, and envelope staff's calculations at higher frequencies.

Based on the applicant's response to RAIs related to the site response calculations and staff's independent confirmatory analysis that is consistent with the applicant's results, the staff considers RAI 2.5.2-2, RAI 2.5.2-3, and RAI 2.5.2-6 resolved and closed.

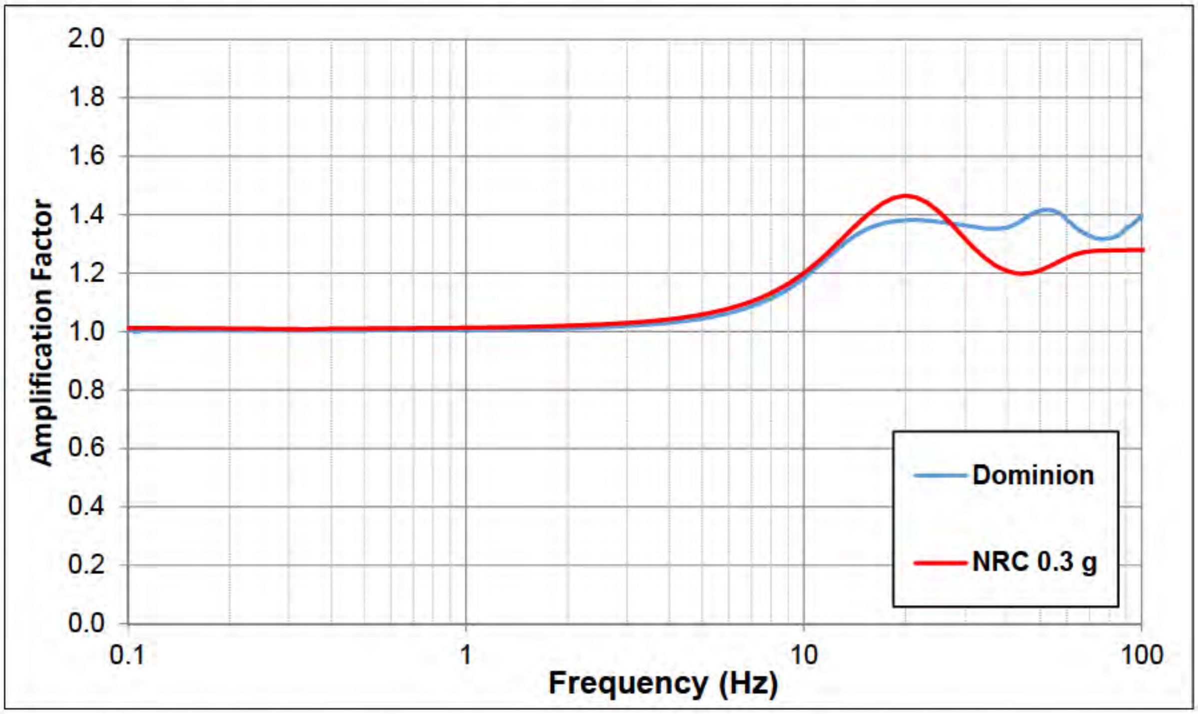


Figure 2.5.2-10. Comparison of the Applicant's Site Amplification Function with the Results of Staff's Confirmatory Analysis

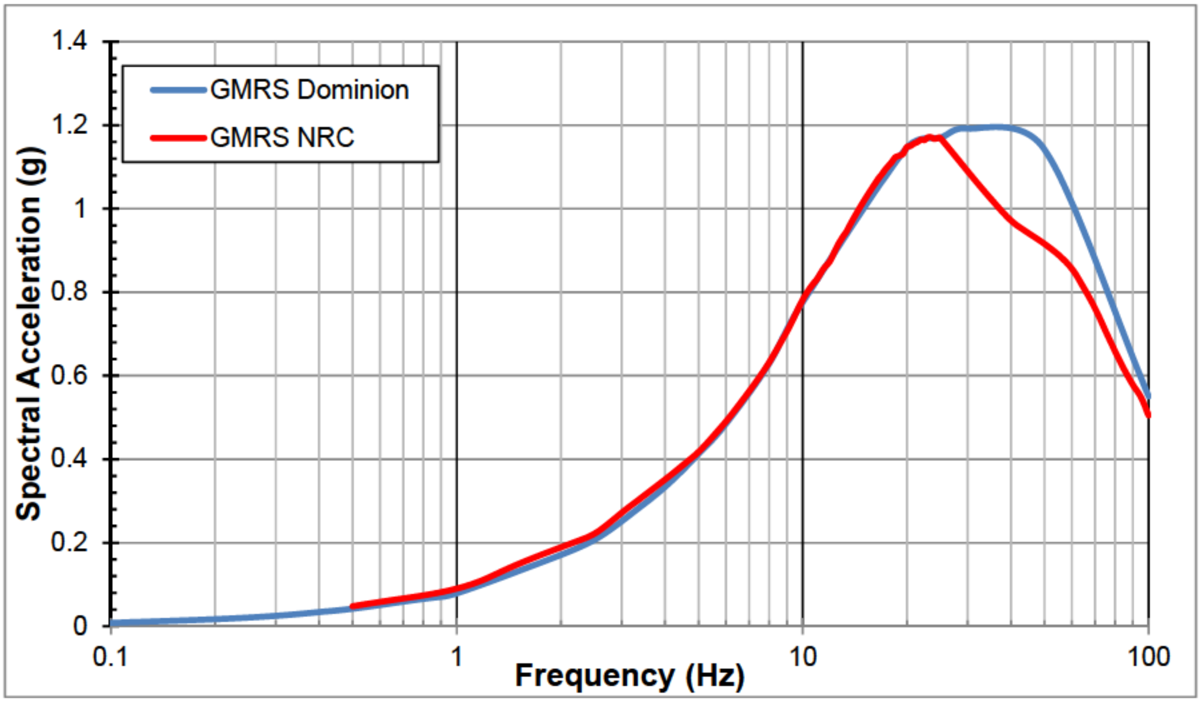


Figure 2.5.2-11. Comparison of the Applicant's GMRS with the Results of Staff's Confirmatory Analysis at Elevation 68.3 m (224 ft).

2.5.2.5 Post COL Activities

There are no post COL activities associated with this section.

2.5.2.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff's review confirmed that the applicant has addressed the relevant information and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

The staff concludes that the information pertaining to North Anna 3 COL FSAR Section 2.5.2 is within the scope of the ESP and adequately incorporates by reference Section 2.5.2 of the ESP SSAR and is thus acceptable. Additionally, the staff concludes that the applicant has adequately addressed new and significant information pertaining to the Mineral, Virginia earthquake, the CEUS-SSC model, and additional subsurface geologic information from the COL subsurface investigations. Finally, the staff compared the additional COL information in the application to the relevant NRC regulations and acceptance criteria defined in NUREG-0800. The staff concluded that the applicant is in compliance with the relevant requirements of 10 CFR Parts 52 and 100. COL Action Item 2.0-27-A has been adequately addressed by the applicant and can be considered resolved. Therefore, the staff concluded that the site is suitable with respect to the vibratory ground motion criteria for new nuclear power plants.

2.5.3 Surface Faulting

2.5.3.1 Introduction

Section 2.5.3 of this SER provides information on surface faulting related to the North Anna site. Section 2.5.3.2 of this SER provides a summary of relevant geologic and seismic information contained in FSAR Section 2.5.3 of the North Anna COLA. SER Section 2.5.3.3 provides a summary of the regulations and guidance used by the applicant to perform the investigation. SER Section 2.5.3.4 reviews the staff's evaluation of FSAR Section 2.5.3, including any RAIs, open items, and confirmatory analyses performed by the staff. SER Section 2.5.3.5 discusses post COL activities. Finally, SER Section 2.5.3.6 provides an overall summary of the applicant's conclusions, as well as the staff's conclusions, restates any bases covered in the application and confirms that regulations were met or fulfilled by the applicant.

2.5.3.2 Summary of Application

Section 2.5.3 of the North Anna 3 COL FSAR, incorporates by reference Section 2.5.3 of the North Anna ESP SSAR, Revision 9. In addition, in FSAR Section 2.5.3, the applicant provided supplemental information on additional borehole data from North Anna 3 borings. The applicant stated that information contained in COL FSAR Section 2.5.3 is consistent with RG 1.208 and is intended to satisfy 10 CFR 100.23.

COL Item:

- NAPS COL 2.0-28-A

This COL FSAR section also addresses DCD COL Item 2.0-28-A of Revision 5 to the ESBWR DCD. NAPS COL 2.0-28-A addresses the permanent ground deformation from tectonic or nontectonic faulting. The ESBWR design requires the applicant to demonstrate that there is no potential for permanent ground deformation at the site area.

Early Site Permit Variance:

- NAPS ESP VAR 2.0.4

The staff's review of the ESP VAR 2.0-4 associated with North Anna 3 COL FSAR Section 2.5.3 is addressed below in the Technical Evaluation.

Geological Evidence, or Absence of Evidence, for Surface Deformation

The COL FSAR Section 2.5.3.2.1 described recent geologic mapping at the 1:24,000 scale by Hughes and Hibbard (2014) in the Ferncliff, VA 7.5' quadrangle (southwest of North Anna site) that shows the Chopawamsic fault as un-folded, in contrast to previous mapping, and the Ellisville pluton (440 Ma) intruding and cross-cutting the Chopawamsic fault. The Ellisville pluton thus postdates the Chopawamsic fault. This mapping simplifies the geometry of the Chopawamsic fault and moves the surface trace of the fault further northwest than mapped previously.

The COL FSAR Section 2.5.3.2.2 describes the main shock and deep aftershock epicenters of the Mineral earthquake as located near the LBF. The COL applicant pointed out that the Mineral earthquake aftershock-delineated rupture plane projects to the surface several miles west of the LBF.

Ages of Most Recent Deformations

The COL FSAR Section 2.5.3.4 states that the subsurface structure defined by aftershocks of the Mineral earthquake is located outside the 5-mi (8 km) radius site area. The COL applicant concluded based on its field reconnaissance in the epicentral region on April 19 to 21, 2012, that there is no evidence of surface rupture, surface fault features, or geomorphic expression of surface rupture or co-seismic surface tectonic deformation from the Mineral earthquake. The COL applicant further concluded that the rupture plane of the Mineral earthquake does not appear to coincide with a previously mapped fault.

2.5.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed within the FSER related to the ESBWR DCD and its supplements and in ESP FSER (NUREG-1835).

The applicable regulatory requirements for reviewing the applicant's discussion of surface tectonic and non-tectonic deformation are:

- 10 CFR 52.79(a)(1)(iii), relates to identifying geologic site characteristics with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity and period of time in which the historical data have been accumulated.

- 10 CFR 100.23, provides the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identify geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants.

The related acceptance criteria are summarized from SRP Section 2.5.3:

- **Geologic, Seismic, and Geophysical Investigations**: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi),or 10 CFR 52.79(a)(1)(iii), and 10 CFR 100.23(c) and 10 CFR 100.23(d)(2), and guidance in RGs 1.208, and 4.7, this area of review is considered acceptable if discussions of Quaternary tectonics, structural geology, stratigraphy, geochronologic methods used for age dating, paleoseismology, and geologic history of the site vicinity, site area, and site location are complete, compare reasonably with studies conducted by others in the same area, and are supported by detailed investigations performed by the applicant.

- **Geologic Evidence for Surface Deformation**: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi) or 10 CFR 52.79(a)(1)(iii), and 10 CFR 100.23(c) and 10 CFR 100.23(d)(2), and guidance in RGs 1.208, and 4.7, this area of review is considered acceptable if the applicant provides sufficient surface and subsurface information for the site vicinity, area, and location to confirm and characterize presence or absence of surface deformation (e.g., faulting, growth faulting, subsidence or collapse related to dissolution of limestone, salt or gypsum deposits, or salt diapirism and paleoliquefaction) features. The applicant should also take into account the potential for blind faults.

- **Timing of Deformation**: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi) or 10 CFR 52.79(a)(1)(iii), 10 CFR 100.23(c), and 10 CFR 100.23(d)(2), this area of review is considered acceptable if recognized surface deformation features (e.g., tectonic faults and non-tectonic features including growth faults) and features associated with a blind fault, are investigated in sufficient detail to constrain the age of the most recent surface deformation event, and, if applicable, the ages of preceding deformation events.

- **Correlation of Earthquakes with Tectonic Features**: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi or 10 CFR 52.79(a)(1)(iii)), and 10 CFR 100.23(c), and 10 CFR 100.23(d)(2), this area of review is considered acceptable if the applicant evaluates all reported historical earthquakes within the site vicinity with respect to accuracy of hypocenter location and source of origin, and with respect to correlation to tectonic features.

- **Relationship of Geologic Features in the Site Vicinity to Regional Geologic Features**: In meeting the requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi) or 10 CFR 52.79(a)(1)(iii), and 10 CFR 100.23(c) and 10 CFR 100.23(d)(2), this area of review is considered acceptable if the applicant evaluates the relationships between faults or other deformation features in the site vicinity and the regional framework. The application should provide an acceptable evaluation of the relationships between the regional (tectonic and non-tectonic) framework and deformation features in the site vicinity, including growths faults and growth fault systems. The applicant should show how this information is used in the evaluation of potential for future surface deformation at the site.

- **Potential for Surface Deformation at the Site:** To meet requirements of GDC 2 in Appendix A of 10 CFR Part 50, 10 CFR 52.17(a)(1)(vi) or 10 CFR 52.79(a)(1)(iii), and 10 CFR 100.23(c) and 10 CFR 100.23(d)(2), this area of review is considered acceptable if the applicant assessed the potential future tectonic and nontectonic surface deformation at the site. The applicant should provide sufficient geological, seismological, and geophysical information to clearly establish whether there is a potential for future surface deformation at the site. If the potential for future surface deformation exists at the site, the application must provide information that demonstrates the potential effects of surface deformation are within the design basis of the proposed facility. NRC regulations do not restrict building in an area with surface faulting potential, but if that potential exists, the regulations require that surface deformation must be taken into account in the design and operation of the proposed nuclear power plant. It is questionable whether it might be feasible to design for surface deformation with any degree of confidence that safety-related SSCs would maintain their safety functions if surface displacements occur in the future. Consequently, it is NRC policy (e.g., RG 1.208) to recommend that any site located on a surface or near-surface feature with a potential for future displacement be re-located to an alternate site.

Geologic characteristics should also be consistent with the related guidance from appropriate sections of RG 1.132, Revision 2, RG 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites,” RG 1.206, and 1.208.

2.5.3.4 Technical Evaluation

The staff reviewed Section 2.5.3 of the North Anna 3 COL FSAR and checked the referenced DCD, Revision 10 and the North Anna 3 ESP SSAR, Revision 9, to ensure that the combination of the DCD, the North Anna 3 ESP SSAR and the COLA represents the complete scope of information related to this review topic. The staff's review confirms that the information in the COL FSAR and North Anna 3 ESP SSAR addresses the required information for determining the potential for tectonic and non-tectonic surface deformation. The results of the staff's evaluation of the North Anna 3 ESP SSAR are documented in NUREG-1835.

The staff's technical evaluation of COL FSAR Section 2.5.3 is limited to reviewing (1) the resolution of DCD COL Item 2.0-26-A, and DCD COL Item 2.0-28-A, and ESP Action 2.5-1; (2) adherence to Permit Condition Section 3(E)(6); (3) resolution of ESP Variance 2.0-4 and; (4) applicant's responses to RAIs as addressed below.

The staff reviewed the information in the COL FSAR for conformance with DCD COL Item 2.0-26-A. Additional information on the site geologic characteristics is derived from additional subsurface investigations completed for the proposed North Anna 3 site. The staff concludes that the applicant included sufficient information from subsurface investigations to supplement SSAR Section 2.5.3 and to resolve DCD COL Item 2.0-26-A.

The staff reviewed COL Action Items in the North Anna 3 ESP. ESP Action Item 2.5-1 pertains to SER Section 2.5.1: A COL or CP applicant should perform additional borings to identify any weathered or fractured rock beneath the new foundations. Exact unit locations are not known at the ESP stage. The applicant made 93 borings for COL that were used to determine the geology characteristics and geotechnical properties of the subsurface material at the North Anna 3 site to resolve ESP Action Item 2.5-1. SER 2.5.4 provides staff's detailed evaluation of the additional borings. The staff concludes that the applicant included sufficient information from the additional boring program to support the COL and to resolve ESP Action Item 2.5-1.

The staff reviewed the North Anna 3 ESP Permit Conditions. Permit Condition, Section 3(E)(6) pertains to SER Section 2.5.1: If the ESP holder performs an excavation for a safety-related structure, the ESP holder shall perform geologic mapping of such excavation, evaluate any unforeseen geologic features that are encountered, and notify the NRC no later than 30 days before any such excavation is open for NRC examination and evaluation. An applicant for a CP or COL referencing this ESP shall perform geologic mapping of any excavation for a safety-related structure, evaluate any unforeseen geologic features that are encountered, and notify the NRC no later than 30 days before any such excavation is open for NRC examination and evaluation. The staff proposes that this permit condition be updated to a license condition for future excavations of safety-related structures. Section 2.5.1.4 of this report addresses this license condition.

The staff reviewed the COL FSAR variances to the ESP SSAR (NAPS ESP VAR 2.0-4) for Section 2.5.3 and DCD COL Item 2.0-28-A, and submitted an RAI. The staff's evaluation of information presented by the COL applicant in COL FSAR Section 2.5.3 and of the COL applicant's responses to the RAIs are presented below.

The COL FSAR Section 2.5.3 includes new geophysical and geotechnical information from the North Anna 3 site supplemental subsurface investigation. FSAR Section 2.5.3.2.5 states that borehole data, from the supplemental subsurface investigation described in Section 2.5.4.3, were reviewed for evidence of Quaternary fault movement and no such evidence was exhibited by the borehole data. The staff asked the COL applicant in RAI 02.05.01-6c dated April 22, 2014 (ADAMS Accession No. ML14112A156), to explain how evidence or lack of evidence for Quaternary faulting was determined in borehole data targeted for geotechnical information.

In a response to RAI 02.05.01-6c dated June 23, 2014 (ADAMS Accession No. ML14177A441), the COL applicant stated that it reviewed the borehole logs for evidence of highly weathered/sheared zones that contained fault gouge, which may have represented a major shear zone or an indication of Quaternary faulting. The applicant stated that wording in FSAR Section 2.5.3.2.5 will be revised in a future revision of the COLA to more clearly indicate that there is no evidence of major shear zones in the borehole data. The COL applicant maintains that a shear zone in W-1 is entirely within felsic gneiss and does not juxtapose different lithologic units across a fault contact. The implication being that a large amount of displacement has not occurred and the feature cannot be a major shear zone. The staff examined W-1 and W-5 at the May 8, 2014, site audit, the summary of which is available in the staff audit report (ADAMS Accession No. ML14203A179), and observed that in both borings there is a shear zone characterized by rock fragments, indication of brittle deformation, mixed with yellow-brown clay and chlorite. However, staff observed that the shear zone is confined to a single, relatively thin layer within each core. The COL applicant stated that the shear zone in W-1 and W-5 is not associated with fault 'a'. In work completed for North Anna site, Dames and Moore (1973) trenched fault 'a' and determined the fault dipped 45 to 50 degrees NW. Borings W-1 and W-5, located NW of fault 'a' would intersect fault 'a' at elevations much lower than where the micro shear-zone is located. The COL applicant looked for the micro-shear zone in adjacent borings and found no indication of this feature.

The staff reviewed several Dames and Moore reports from the 1970's regarding fault 'a' (VEPCO, 1974; 1973) in addition to the findings in the ESP SER regarding fault 'a' (NUREG-1835). The shear zone observed in W-1 and W-5 has similar features to fault 'a' but at a much less significant scale. Because the micro-shear zone in W-1 and W-5 is located northwest of fault 'a' and likely also dips northwest, it is structurally higher than fault 'a' (Figure 2.5.3-1 of this report). The staff notes that significant tectonic structures such as fault 'a' typically have a zone of deformation and deformation fabric is not necessarily limited to a single fault plane so the micro-shear zone could be associated with fault 'a'. Regardless of a structural association or not, the deformation associated with fault 'a' was determined to be geologically old, greater than 1 million years old. The staff considers the shear zone in W-1 and W-5 likely to be the same age as fault 'a' and not a potential future surface deformation hazard to the site.

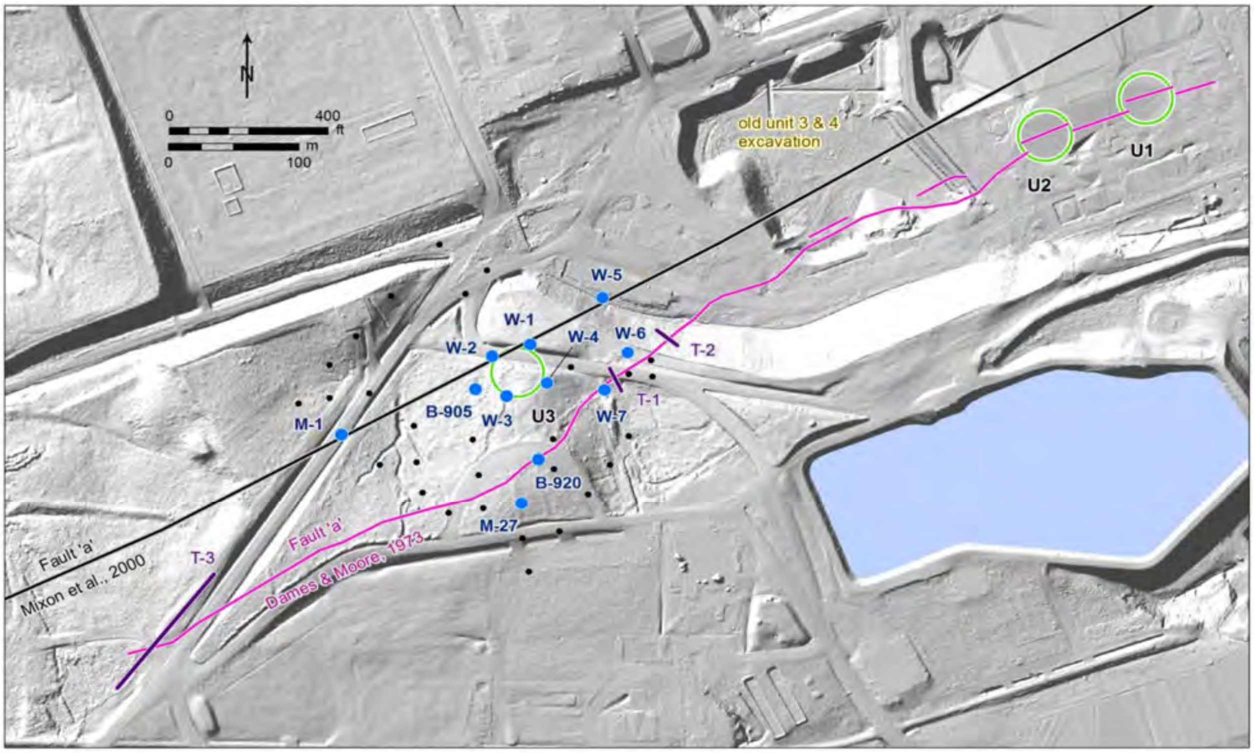


Figure 2.5.3-1. LiDAR-derived hillshade map showing locations of key North Anna 3 borings and surface mapped (Mixon et al, 2,000) and trench mapped (Dames and Moore, 1973) representations of fault 'a' (from Response to RAI 2.5.1-6d, Figure 1)

The staff reviewed DCD COL Item 2.0-28-A, which states the ESBWR design requires the applicant to demonstrate that there is no potential for permanent ground deformation at the site area. The staff concludes that the additional information from additional borings in the site area in conjunction with response to RAI 02.05.01-6c, that provides clarification regarding the possibility of finding major shear zones in the borings as opposed to determining specifically Quaternary fault movement, that there is sufficient subsurface information to resolve DCD COL Item 2.0-28-A. Accordingly and in compliance with 10 CFR 100.23 and 10 CFR 52.79, the staff considers RAI 02.05.01-6c resolved and closed.

The COL applicant proposed a future COL revision for FSAR Section 2.5.3.2.5 to more clearly indicate that there is no evidence of major shear zones in the borehole data and to remove the statement about evidence of Quaternary fault movement in borehole data. The applicant also proposed further revisions in FSAR Section 2.5.3.8 to supplement conclusions regarding tectonic and non-tectonic deformation at the site. The staff considers this to be acceptable and verified that the appropriate revisions are incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.3-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

2.5.3.5 Post Combined License Activities

There are no post COL activities related to COL FSAR Section 2.5.3. However, in Section 2.5.1.4 the staff identified a geologic mapping License Condition related to COL FSAR Section 2.5.1.2 as the responsibility of the COL licensee. Section 2.5.1.4 of this report addresses this license condition.

2.5.3.6 Conclusion

The staff reviewed the application and checked the referenced ESP SSAR. The staff's review confirmed that the applicant has addressed the relevant information and there is no outstanding information expected to be addressed in the COL FSAR related to this subsection.

The staff concludes that the information pertaining to North Anna 3 COL FSAR Section 2.5.3 is within the scope of the ESP and adequately incorporates by reference Section 2.5.3 of the ESP SSAR and investigated the potential for surface deformation in the site area. For the new information provided in COL FSAR Section 2.5.3, the staff concludes that the applicant adequately followed RGs 1.208, 1.206 and 4.7 and performed appropriate field and aerial reconnaissance of the site vicinity and conducted appropriate subsurface investigations at the site, as set forth above. In addition, the staff compared the additional COL information in the application to the relevant NRC regulations and acceptance criteria defined in NUREG-0800, and concludes that the material provided by the COL applicant meets the requirements of 10 CFR 100.23 and 10 CFR 52.79 (a)(iii). COL Action Item 2.0-28-A has been adequately addressed by the applicant and can be considered closed. Therefore, the staff concluded that the North Anna 3 site is suitable with respect to the tectonic and non-tectonic surface deformation criteria for new nuclear power plants.

2.5.4 Stability of Subsurface Materials and Foundations

This section of the SER addresses the North Anna 3 COL FSAR, Revision 8, site-specific information on the stability of subsurface materials and foundations for the North Anna 3 site identified in the ESBWR DCD, Revision 10.

Section 2.5.4.2 of this SER provides a summary of relevant geologic and seismic information in FSAR Section 2.5.4 of the North Anna 3 COLA. SER Section 2.5.4.3 provides a summary of the regulations and guidance used by the applicant to perform the investigation. SER Section 2.5.4.4 provides a review of the staff's evaluation of FSAR Section 2.5.4, including any RAIs, open items, and confirmatory analyses performed by the staff. SER Section 2.5.4.5 discusses post COL activities. Finally, SER Section 2.5.4.6 provides an overall summary of the applicant's conclusions, as well as the staff's conclusions, restates any bases covered in the application and confirms that regulations are met or fulfilled by the applicant.

2.5.4.1 Introduction

Section 2.5.4 of this FSAR discusses the stability of subsurface materials and foundations that relate to the North Anna 3 site. The properties and stability of the soil and rock underlying the site are important to the safe design and siting of the plant. The information in Section 2.5.4 of this FSAR addresses (1) geologic features in the site vicinity; (2) static and dynamic engineering properties of soil and rock strata underlying the site; (3) the relationship of the foundations for safety-related facilities and the engineering properties of underlying materials; (4) results of geophysical surveys, including in-hole and down-hole explorations; (5) safety-related excavation and backfill plans and engineered earthwork analyses and criteria; (6) groundwater conditions and piezometric pressure in all critical strata as they affect the loading and stability of foundation materials; (7) responses of site soils or rocks to dynamic loading; (8) liquefaction potential and consequences of liquefaction of all subsurface soils, including the settlement of foundations; (9) earthquake design bases; (10) results of investigations and analyses conducted to determine foundation material stability, deformation, and settlement under static conditions; (11) criteria, references, and design methods used in static and seismic analyses of foundation materials; (12) techniques and specifications to improve subsurface conditions, which are to be used at the site to provide suitable foundation conditions, and any additional information deemed necessary in accordance with 10 CFR Part 52.

Based on the information collected during ESP and COL site investigations, the applicant evaluated the stability of the site subsurface materials and foundations as well as the stability of slopes at the proposed North Anna 3 site.

2.5.4.2 Summary of Application

Section 2.5.4 of the North Anna 3 COL FSAR, incorporates by reference Section 2.5.4 of the ESP SSAR, Revision 9. In addition, in FSAR Section 2.5.4, the applicant provided the following supplements, including additional borehole data from North Anna 3 borings.

COL Items:

- NAPS COL 2.0-29-A

NAPS COL 2.0-29-A provides supplemental information and additional borehole data from the North Anna 3 borings to address the provisions listed in ESBWR DCD Table 2.0-1, regarding stability of subsurface materials and foundation requirements. The applicant provided additional information to address NAPS COL 2.0-29-A (ESBWR DCD COL Item 2.0-29-A), which requires that a COL applicant referencing the ESBWR design to provide site-specific information in accordance with SRP 2.5.4 and address: (1) localized liquefaction potential under other than seismic Category I structures, and (2) settlement and differential settlements.

- NAPS ESP COL 2.5-2

The applicant provided additional information to address ESP COL Action Item 2.5-2, which states that plot plans and profiles of all seismic Category I facilities need to be submitted for comparison with the subsurface profile and material properties.

- NAPS ESP COL 2.5-3

The applicant provided additional information to address ESP COL Action Item 2.5-3, which states that detailed excavation and backfill plans will be provided as part of the COLA.

- NAPS ESP COL 2.5-4

The applicant provided additional information to address ESP COL Action Item 2.5-4, which states that the COLA will include an evaluation of groundwater conditions as they affect foundation stability and/or detailed dewatering plans.

- NAPS ESP COL 2.5-5

The applicant provided additional information to address ESP COL Action Item 2.5-5, which states that additional site response analyses should be included at the COL stage once specific locations are selected for the nuclear power plant structures.

- NAPS ESP COL 2.5-6

The applicant provided additional information to address ESP COL Action Item 2.5-6, which states that an analysis of the stability of all planned safety-related facilities, including bearing capacity, rebound, settlement, and differential settlements under deadloads of fills and plant facilities, as well as lateral loading, will be addressed in the COLA.

- NAPS ESP COL 2.5-7

The applicant provided additional information to address ESP COL Action Item 2.5-7, which states that design-related criteria that pertain to structural design, such as wall rotation, sliding, and overturning will be addressed in the COLA.

- NAPS ESP COL 2.5-8

The applicant provided additional information to address ESP COL Action Item 2.5-8, which states that the COL applicant will provide specific plans for each proposed ground improvement technique the applicant plans to use so that the staff will be able to determine whether the chosen technique will ensure that Zone II saprolitic soils will be able to support safety-related foundations.

- NAPS ESP COL 2.5-9

The applicant provided additional information to address ESP COL Action Item 2.5-9, which states that the COL applicant is responsible for ensuring that the average shear wave velocity of the material underlying the foundation for the reactor containment equals or exceeds that of the chosen design.

- ESP Permit Condition 3.E(5)

The applicant provided additional information to address ESP Permit Condition 3.E(5), which states that the COL applicant should replace weathered or fractured rock at the foundation level with lean concrete before initiation of foundation construction.

- ESP Permit Conditions 3.E(6)

The applicant provided additional information to address ESP Permit Condition 3.E(6), which states that the COL applicant should include information on geologic mapping of future excavations for safety-related structures and should evaluate any unforeseen geologic features encountered at the site area. This permit condition has been carried forward as a license condition for future excavations of safety-related structures (Section 2.5.1.4).

- ESP Permit Condition 3.E(7)

The applicant provided additional information to address ESP Permit Condition 3.E(7), which states that the COL applicant should improve Zone II saprolitic soils to reduce any liquefaction potential if safety-related structures are to be founded on them. This permit condition is addressed in FSAR Section 2.5.4.8.

Overall Summary:

The applicant conducted additional field and laboratory tests to determine the static and dynamic properties of subsurface materials and confirmed that the associated parameters meet the design requirements defined in the ESBWR DCD, such as the minimum shear wave velocity and angle of internal friction of soil. The applicant also performed a site subsurface material liquefaction potential analysis; a static and dynamic bearing capacity analysis; and a settlement analysis to demonstrate that the subsurface materials meet the minimum static and dynamic bearing capacity, no liquefaction, and maximum total and differential settlement requirements. In the analyses, the applicant assumed properties of backfill material based on design. The liquefaction potential analysis results indicated that there might be localized liquefaction at certain depths at the site, but those potential liquefiable zones were too small and limited to have any impact on the safety of structures.

The applicant performed additional site investigations to further constrain the properties of the subsurface materials, which included redefining the elevation range at which the rock units were encountered at the site during the COL investigations. These investigations were generally of smaller ranges than those determined in the ESP investigations. The applicant also provided contour maps of the subsurface rock units as a supplement to the subsurface profiles presented as part of the ESP. The COL field investigations, a supplement to the ESP investigations, included additional exploratory borings, observation wells, CPTs, packer tests, geophysical loggings, and electrical resistivity tests. The applicant also completed additional laboratory testing, such as chemical and resonant column torsional shear (RCTS) tests, which further constrained the material properties that were determined from similar tests completed as part of the ESP. The applicant then used the results of the field investigations and the laboratory testing to further constrain the engineering properties of the subsurface materials, as determined during the ESP investigation.

The applicant also used the selected reactor design to better describe the foundation interfaces and developed more detailed subsurface profiles.

The applicant provided more detailed description of an excavation and backfill program compared to what was provided as part of the ESP. The applicant included the excavation plans and total depths to which excavation and backfilling would be required for the ESBWR design proposed for the North Anna 3 site. The applicant also included additional information regarding the groundwater conditions at the site, supplementing the earlier ESP information with design and site-specific interactions between the foundations and the groundwater level, such as construction dewatering plans and the effects of groundwater on foundation stability.

The applicant reassessed the response of soil and rock to dynamic loading at the site presented in the ESP as part of the COLA, with the consideration of the placement of concrete basemat on the native rock or backfill as part of its development of the shear wave velocity profile for the site, and the variation of shear modulus and damping with cyclic shear strain.

Regarding liquefaction potential, the applicant concluded in the ESP that the Zone IIA saprolitic soils were prone to liquefaction and would therefore be replaced with structural backfill. In the COLA, the applicant determined that the factor of safety (FS) against liquefaction of 1.1, which was determined during the ESP application, is still applicable.

The applicant revised the static stability evaluation for the site to incorporate the design-specific dimensions of structures in the COLA, as opposed to the assumed values used in the ESP application. The applicant also included the bearing capacity, settlement, and earth pressures in the structural fill or other load-bearing layers in the COLA, whereas the ESP had assumed that North Anna 3 would be constructed on Zone IIA saprolitic soils. Due to the change in load-bearing materials and the selection of a reactor design, the applicant reassessed the settlement, bearing capacity, and earth pressures to ensure that they were within the design parameters stated in the ESBWR DCD.

The applicant also restated the design criteria, including factors of safety against liquefaction and slope stability failure, as specified in the ESP, and provided additional factors of safety-related to bearing capacity and lateral earth pressure. Finally, the applicant revised the description of techniques to be used to improve subsurface material conditions, which in the ESP involved the use of vibro-stone columns to reinforce the Zone IIA saprolitic soils, while in the COL the applicant committed to removing the potentially liquefiable Zone IIA saprolitic soils and replacing the excavated material with structural backfills, both concrete and granular material fills.

2.5.4.2.1 Description of Site Geologic Features

FSAR Section 2.5.4.1 refers the description of regional and site geologic features to FSAR Sections 2.5.1.1 and 2.5.1.2. Since additional North Anna 3 borings were conducted, the applicant described the integrated site geologic features in the aforementioned sections based on information from the ESP and COL site investigation data. Section 2.5.1.4 of this SER contains the technical evaluation of this information.

2.5.4.2.2 Properties of Subsurface Materials

FSAR Section 2.5.4.2 describes the material and engineering properties of the COL site subsurface materials. This section gives an overview of the subsurface profile materials, field investigation results, and the results of laboratory tests on the subsurface samples from the North Anna 3 site investigations.

Description of Subsurface Materials

The applicant divided the subsurface materials into four zones, consistent with the site investigation findings of the ESP. FSAR Section 2.5.4.2.2 describes each zone as summarized below. The applicant also developed profiles to illustrate the subsurface across the North Anna 3 power block area. Figure 2.5.4-1 of this SER illustrated one subsurface profile, the line A-A in FSAR Figure 2.5.4-207, crossing the power block area of the North Anna 3 site. The applicant stated that the design grade elevation for North Anna 3 is at an Elevation of 88.3 m (290 ft).

Zone IV Bedrock. The applicant described the bedrock underlying the power block area as gneiss. The applicant identified the top of Zone IV rock as ranging in elevation from of 52.1 m (171 ft) to 84.7 m (278 ft), while the Zone III-IV transitional rock ranged in elevation from 56.9 m (187 ft) to 89.0 m (292 ft).

Zone III Weathered Rock. Above Zone IV, the applicant identified Zone III as weathered rock. The top of Zone III ranged in elevation from about 62.7 m (206 ft) to 85.8 m (292 ft).

Zone IIA and Zone IIB Saprolites. The applicant identified the weathered rock lying above the Zone III rock as saprolite, a highly weathered rock, divided into two zones - Zones IIA and IIB. The applicant further identified the Zone IIA saprolite as the upper layer, composed of 80 percent coarse, silty sands and 20 percent finer grained, clayey sands and silts. In contrast, the applicant described the Zone IIB saprolite as dense, silty sands with 10 to 50 percent core stone. The elevation at the top of Zone IIA ranged from 70.7 m (232 ft) to 102.1 m (335 ft) and IIB ranged from 65.5 m (215 ft) to 92.0 m (302 ft).

Zone I and Fill. The applicant stated that it will excavate all Zone I soils and existing fills, and will therefore not further consider these materials for the North Anna 3 site.

Subsurface Profiles

SER Figure 2.5.4-1 (FSAR Figure 2.5.4-207) illustrates the typical subsurface profile across the North Anna 3 power block area. The applicant also illustrated the excavation in the cross section figures to show the foundations of plant structures.

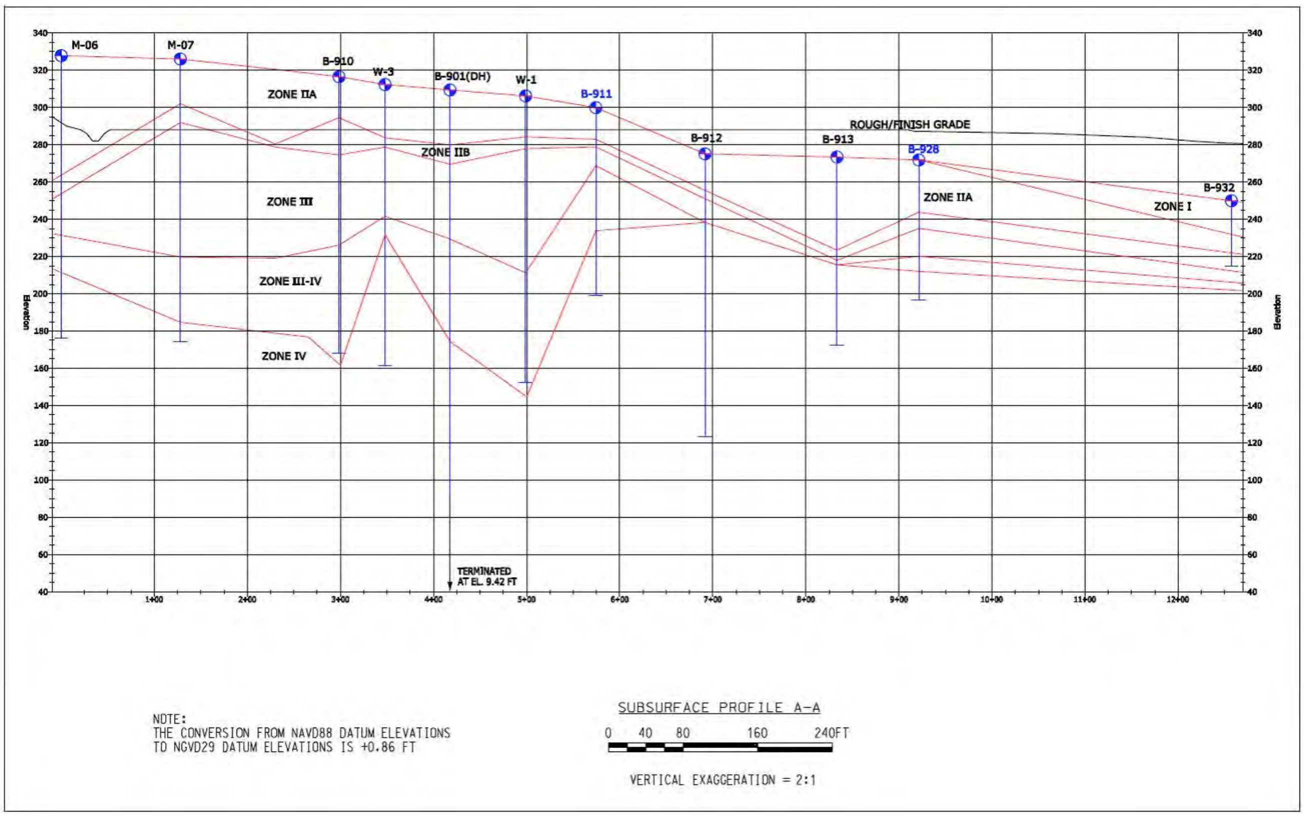


Figure 2.5.4-1. Typical Subsurface Profile across Unit 3 Power Block Area (FSAR Figure 2.5.4-207)

Field Investigations

As previously stated, the applicant performed a number of additional borings and tests in support of the COLA. The applicant stated that these investigations conformed to the guidance in

RG 1.132, and Subpart 2.20 of American Society of Mechanical Engineers (ASME) NQA-1 (ASME, 2012). FSAR Section 2.5.4.2.3 describes the additional work completed to characterize the geological, seismological, and geotechnical engineering properties of the North Anna 3 site, which included 93 borings, seven observation wells, four packer tests, 23 CPTs (including four down-hole seismic cone tests), six test pits, five sets of borehole geophysical logging, five sets of shear wave suspension logging, two sets of electrical resistivity tests, and a survey of the exploration points for all the investigations as part of the subsurface investigation program. The following paragraphs summarize the tests performed.

Borings and Samples/Cores. The applicant drilled 93 borings for the COL site investigation to depths between 6.7 to 91.4 m (22 to 300 ft) around the power block area. The applicant collected soil and rock samples in accordance with relevant American Society of Testing and Materials (ASTM) International standards, including, but not limited to, ASTM D 1586 (ASTM, 2011), D 1587 (ASTM, 2012), and D 2113 (ASTM, 2014). The applicant collected the soil samples using the standard penetration test (SPT) sampler at 0.76 m (2.5 ft) intervals to about 4.6 m (15 ft) in depth and at 1.5 m (5 ft) intervals below 4.6 m (15 ft). The applicant made nine sets of energy measurements on the automatic SPT hammers used by the drill rigs. The applicant obtained undisturbed samples by removing disturbed portions at both ends of the sample tube and trimming the ends square. The applicant also performed pocket penetrometer tests on the trimmed lower end of the samples. The applicant recovered rock core samples by first removing the cores from the split inner barrel before describing the core in detail and recording the information, such as joints and fractures, on the boring log. The applicant also computed the percentage of recovery and the RQD. Finally, the applicant labeled and transported all samples to the sample storage area.

Observation Wells. The applicant installed seven observation wells adjacent to sample borings, three in the soil/weathered rock zone and four in rock. The applicant developed each well by pumping until the pH and conductivity stabilized and the pumped water was reasonably free of suspended sediment. Using the slug test method, the applicant performed permeability tests in each of the three wells screened in soil/weathered rock and in one of the wells screened in rock. The applicant also used the packer method to conduct permeability tests in the borings adjacent to the four wells screened in rock.

Cone Penetrometer Tests. The applicant conducted 23 CPTs measuring tip resistance, sleeve friction, and porewater pressure. The applicant also performed down hole seismic and pore pressure dissipation tests in four CPTs.

Test Pits. The applicant excavated six test pits with depths ranging from 0.6 to 1.3 m (2 to 4.5 ft) at the North Anna 3 site to collect soil samples for laboratory tests. It used the test results to determine the soil properties and backfill suitability.

Laboratory Testing

FSAR Section 2.5.4.2.4 describes the results of numerous laboratory tests of soil and rock samples that the applicant performed for the North Anna 3 site investigation. The applicant performed the laboratory tests to verify the large number of test results from previous investigations, including tests performed for existing units and ESP site investigations. The applicant focused on three areas when conducting the tests and followed the guidance of RG 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants." The applicant verified that the properties of the soil and rock beneath the North Anna 3 power block area are similar to those beneath Units 1 and 2. The applicant performed chemical tests on the Zone IIA saprolites to determine corrosiveness toward buried steel and aggressiveness toward buried concrete. Finally, the applicant conducted RCTS tests on selected saprolite samples to determine the properties of shear modulus and damping ratio variation with cyclic strain. FSAR Table 2.5.4-205 summarizes the type and number of tests, and FSAR Appendix 2.5.4AA includes details and results of the laboratory tests with Appendix 2.5.4AAS1 presenting the RCTS test results.

Engineering Properties

FSAR Section 2.5.4.2.5 describes the engineering properties of selected materials in subsurface Zones IIA, IIB, Ill, III-IV, and IV based on the outcomes of the North Anna 3 field exploration and laboratory testing programs. Table 2.5.4-1 of this SER summarizes the main engineering properties of the site soil and rock layers based on FSAR Table 2.5.4-208 and related descriptions. The following sections describe the various test programs or field observations employed to derive the material properties.

Rock and Concrete Properties.

The applicant determined that the rock strength and stiffness values from the field and laboratory testing of the North Anna 3 rock are generally higher than the values obtained during the ESP site investigation. This finding suggested to the applicant that less fractured or weathered rock may underlie the North Anna 3 site, or better rock coring equipment and techniques produced better quality cores. The RQD values based on the results for each core in the boring logs are summarized in SER Table 2.5.4-1.

The applicant determined rock unconfined compressive strengths, unit weights, and elastic modulus values based on the rock strength test results. The applicant derived the shear modulus values using the elastic modulus and Poisson's ratio values. The applicant also determined that the high and low strain shear modulus values are essentially the same for high strength rock (Zones IV and III-IV). Finally, the applicant determined the shear and compression wave velocities profiles based on suspension P-S (compression and shear wave) velocity logging and CPT down-hole seismic tests performed during the COL site investigation program.

The applicant described the concrete fill that will replace Zone II soils and Zone III weathered rock beneath the RB/FB, CB, and FWSC seismic Category I structures. The applicant stated that the concrete fill would have a minimum strength of 17.2 MPa (2,500 psi), a unit weight of 232 kg/m^3 (145 pcf), and a Poisson's ratio of 0.15. Finally, because the V_s of the in-situ rock is about 1,524 m/s (5,000 fps), the applicant concluded that the concrete fill should have a V_s equal or greater to that of the in-situ rock. The applicant noted that concrete with the given strength of 17.2 MPa (2,500 psi) will have a BE V_s of 2,134 m/s (7,000 fps).

Soil Properties.

The applicant presented the engineering properties of North Anna 3 site soils in FSAR Table 2.5.4-208 (SER Table 2.5.4-1) and described the methods used to determine the properties in FSAR Section 2.5.4.2.5.b. The applicant combined laboratory test and field test (SPT and CPT) to determine the undrained shear strength of soil. The V_s values were determined based on down hole seismic tests and suspension P-S velocity measurements. The applicant calculated the low strain, defined as a strain level of 10^{-4} percent, and the shear modulus of the soil using the relationship between V_s and soil density. The applicant derived the low-strain elastic modulus using the relationship between the elastic modulus, shear modulus, and Poisson's ratio. The applicant determined the high-strain, defined as the strain level in the range of 0.25 to 0.5 percent, elastic modulus values by applying the relationship with the SPT N-value in Davie and

Lewis (1988). The applicant plans to use crushed rock as structural fill that will conform to the gradation of Size No. 21A in the Virginia Department of Transportation (VDOT) Road and Bridge Specifications (VDOT, 2002).

RCTS Testing.

The applicant performed three RCTS tests, two on Zone IIA saprolite and one on Zone IIB saprolite, to determine soil degradation properties under seismic loading conditions. The applicant then used the test results to generate curves of normalized shear modulus (G/G_{max}) and material damping ratio (D) versus shear strain. The applicant compared these results with generic curves in FSAR Section 2.5.4.7, which is summarized in Section 2.5.4.2.7 of this SER.

Table 2.5.4-1 Properties of NAPS 3 Site Subsurface Materials (FSAR Table 2.5.4-208)

STRATUM	Structural Fill	Concrete Fill	ZONE IIA	ZONE IIB	ZONE III	ZONE III-IV	ZONE IV
General description	Gravelly materials	-	Saprolite (< 10 percent core stone)	Saprolite (10 – 50 percent of core stone)	Weathered rock (> 50 percent core stone)	Moderately to slightly weathered rock	Parent rock – slightly weathered to fresh rock
Unified Soil Classification System symbol	GW	-	SM, SC	SM	-	-	-
Top of layer elevation	76.2-102.1 m (250-335 ft)		70.7-102.1 m (232-335 ft)	65.5-92.0 m (215-302 ft)	62.8-89.0 m (206-292 ft)	57.0-89.0 m (187-292 ft)	52.1-84.7m (171-278 ft)
Percent fines (%)	6-12	-	25	20	-	-	-
Moisture content (%)	-	-	19	15	-	-	-
Total unit weight (kg/m^3 (pcf))	2,082 (130)	2,322 (145)	2,002 (125)	2,082 (130)	2,403 (150)	2,611 (163)	2,627 (164)
Measured SPT N-value (blows/ft)	-	-	15	75	Ref	-	
Adjusted SPT N60-value (blows/ft)	50	-	20	100	Ref	-	-
Unconfined compressive strength, q_u, MPa (ksi)	-	17.2 (2.5)	-	-	6.8 (1.0)	62.0 (9.0)	117 (17.0)
Effective cohesion, c', kPa (ksf)	0	-	6.0 (0.125)	0	-	-	-
Effective friction angle, ' (degrees)	40	-	33	40	-	-	-
Shear wave velocity, V_s, m/s (fps)	335 (1,100)	2,134 (7,000)	259 (850)	488 (1,600)	914 (3,000)	1,829 (6,000)	2,743 (9,000)
Compression wave velocity, V_p, m/s (fps)	732 (2,100)	3,322 (10,900)	549 (1,800)	1,067 (3,500)	2,225 (7,300)	3,658 (12,000)	4,877 (16,000)
Poisson's ratio, *u* (high strain)	0.3	0.15	0.35	0.3	0.4	0.33	0.27
Poisson's ratio, *u* (low strain)	0.3	0.15	0.35	0.37	0.4	0.33	0.27
Elastic modulus (high strain), E_h	86.2 MPa (1,800 ksf)	19,650 MPa (2,850 ksi)	34.5 MPa (720 ksf)	172.4 MPa (3,600 ksf)	2,757 MPa (400 ksi)	13,100 MPa (1,900 ksi)	49,987 MPa (7,250 ksi)
Elastic modulus (low strain), E_l	622 MPa (13,000 ksf)	19,650 MPa (2,850 ksi)	359 MPa (7,500 ksf)	1,340 MPa (28,000 ksf)	5,515 MPa (800 ksi)	13,100 MPa (1,900 ksi)	49,987 MPa (7,250 ksi)
Shear modulus (high strain), G_h	33.5 MPa 700 ksf	8,549 MPa (1,240 ksi)	12.9 MPa (270 ksf)	67.0 MPa (1,400 ksf)	1,034 MPa (150 ksi)	4,826 MPa (700 ksi)	19,994 MPa (2,900 ksi)
Shear modulus (low strain), G_l	239 MPa (5,000 ksf)	8,549 MPa (1,240 ksi)	134 MPa (2,800 ksf)	478 MPa (10,000 ksf)	2,068 MPa (300 ksi)	4,826 MPa (700 ksi)	19,994 MPa (2,900 ksi)
Coefficient of subgrade reaction, k_1, kg/m^3 (kcf)	32.03 (2,000)	-	4.16 (260)	32.03 (2,000)	-	-	-
Coefficient of sliding	0.55	0.7	0.35	0.45	0.6	0.65	0.7
Static earth pressure coefficients							
Active, K_a	0.22	-	0.30	0.22	-	-	-
Passive, K_p	4.60	-	3.40	4.60	-	-	-
At-rest, K_0	0.36	0	0.50	0.36	-	-	-
Optimum Moisture Content, W_{opt} (%)	-	-	14	-	-	-	-
Maximum Dry Unit Weight, g_{max} kg/m^3 (pcf)	-	-	1,858 (116)	-	-	-	-
Rock Quality Designation, RQD (%)	-	-	-	-	20	65	95

Electrical Resistivity and Chemical Properties.

The applicant assessed corrosion potential by using field electrical resistivity and laboratory chemical tests on the Zone IIA and IIB saprolites. The test results indicated a low corrosion potential. Therefore, the applicant concluded that special sulfate resisting cement would not be necessary.

2.5.4.2.3 Foundation Interfaces

FSAR Section 2.5.4.3 describes the locations of site exploration points for the North Anna 3 subsurface investigation, including borings, observation wells, CPTs, electrical resistivity tests, and test pits made in the power block area. While FSAR Figure 2.5.4-217 illustrates these locations, FSAR Figure 2.5.4-206 shows the excavation plan for the safety-related structures and other major facilities. The applicant included the outline of these structures, plant dimensions, and the subsurface material contours under the plant structures on 10 subsurface profiles (see FSAR Figures 2.5.4-207 through 2.5.4-216). Finally, the applicant presented cross sections of the structure foundations with the proposed excavation and backfilling limits superimposed (see FSAR Figures 2.5.4-225 through 2.5.4-234).

2.5.4.2.4 Geophysical Surveys

FSAR Section 2.5.4.4 describes the geophysical testing conducted for North Anna 3, including field electrical resistivity testing, geophysical down hole testing, and seismic CPTs. The following subsections summarize these survey programs and investigations.

Field Electrical Resistivity Testing

FSAR Section 2.5.4.4.1 describes the field electrical resistivity tests performed along two crossing lines in the North Anna 3 site area. The applicant used four electrodes equidistant from a central point and inserted approximately 0.3 m (1 ft) into the ground to measure the voltage recorded at two inner electrodes after sending a current through two outer electrodes. The applicant used these results, included in FSAR Appendix 2.5.4AA, to evaluate corrosion potential in FSAR Section 2.5.4.2.5.

Geophysical Down-Hole Testing

For the North Anna 3 site geophysical investigation, the applicant performed geophysical down-hole tests in three borings (B-901, B-907 and B-909) within the footprint of Seismic Category 1 structures with depths of 91.4 m (300.0 ft), 61.1 m (200.5 ft), and 61.5 m (201.9 ft). FSAR Section 2.5.4.4.2 describes these tests, which included natural gamma, 3-arm caliper, resistivity, spontaneous potential, borehole acoustic televiewer, boring deviation, and suspension P-S velocity logging.

Natural Gamma and 3-Arm Caliper.

The applicant used a Model 3ACS 3-leg caliper probe to continuously measure natural gamma emissions from the borehole wall at 0.015 m (0.05 ft) intervals. The applicant described this probe as capable of measuring boring diameter and volume; locating hard and soft formations; identifying fissures; caving, pinching and casing damage; identifying bed boundaries; correlating strata between borings; and providing natural gamma measurements. The applicant conducted these tests by dropping the probe to the bottom of the borehole and collecting data during the return to the surface at a rate of 3.0 m (10 ft) per minute.

Resistivity, Spontaneous Potential, and Natural Gamma.

The applicant used a Model ELXG electric log probe to measure single point resistance, short and long normal resistivity, spontaneous potential and natural gamma at 0.015 m (0.05 ft) intervals. The applicant used the data to identify bed boundaries, correlate strata between borings, identify strata geometry (shale indication), and provide natural gamma measurements. Similar to the 3-arm caliper test, the applicant started this test at the bottom of the borehole and collected data while surfacing at a rate of 3.0 m (10 ft) per minute.

Acoustic Televiewer and Borehole Deviation Measurement.

The applicant used a High Resolution Acoustic Televiewer probe to measure boring inclination and deviation based on acoustic images and boring deviation data collected at 0.24 cm (0.096 in.) intervals. The images generated by processing acoustic pulses reflection data transmitted by an ultrasonic beam sensor to the borehole wall show the borehole wall at different depths. The applicant used this data to determine the need to correct soil and geophysical log depths to true vertical depths; provide acoustic imaging of the borehole to identify fractures, dikes, and weathered zones; and determine the dip and azimuth of these features. Again, the applicant conducted the survey by first dropping the instruments to the bottom of the borehole and then resurfacing at a rate of 0.91 m (3 ft) per minute.

Suspension P-S Velocity Logging.

The applicant also performed suspension P-S velocity logging tests to directly determine the average in-situ horizontal V_s and V_p of a 1.0 m high (3.3 ft) segment of the soil and rock column surrounding the borehole. This method involves dropping a source and two receivers to a specific depth in the borehole where the source creates a pressure wave and the receivers record the resulting seismic waves from the borehole wall.

Seismic Tests with Cone Penetrometer

FSAR Section 2.5.4.4.3 describes the CPTs conducted by the applicant for North Anna 3 site investigation. The applicant performed seismic CPTs to measure shear wave velocity at 1.5 m (5 ft) intervals in four CPTs and provided test results in Appendix 2.5.4AA.

Results of Shear and Compression Wave Velocity Tests

FSAR Section 2.5.4.4.4 presents the results of V_s and V_p tests for soil and rock at the North Anna 3 site. For soil, the applicant determined the V_s from suspension P-S velocity logging and seismic CPTs in saprolite. The applicant concluded that for Zone IIA saprolite, the average V_s increases with depth from 152.4 to 365.7 m/s (500 to 1,200 fps) with a median value of 259 m/s (850 fps), comparable to the median value of 289 m/s (950 fps) in the ESP SSAR. The low strain Poisson's ratio for Zone IIA saprolite is 0.35. For Zone IIB saprolite, the applicant noted that the average V_s ranges from 365.7 to 762 m/s (1,200 to 2,500 fps) with a median value of 487 m/s (1,600 fps), the same as the ESP SSAR, and with a low strain Poisson's ratio of 0.37.

For rock, the applicant illustrated the V_s measurements from suspension P-S velocity logging. The applicant noted that the V_s determined at the North Anna 3 site as part of the COL investigations are slightly higher than those determined in the ESP SSAR. The BE V_s was 914 m/s (3,000 fps) for Zone III weathered rock, 1,829 m/s (6,000 fps) for Zone III-IV partially weathered rock, and 2,743 m/s (9,000 fps) for Zone IV fresh rock.

2.5.4.2.5 Excavation and Backfill

FSAR Section 2.5.4.5, “Excavation and Backfill,” describes the extent of seismic Category I structure related excavations, fills and slopes; methods to be used for excavation and stability control; and sources of backfill including quantities, compaction specifications, and quality control.

Extent of Excavations, Fills, and Slopes

FSAR Section 2.5.4.5.1 describes the extent of excavations, fills, and slopes at the North Anna 3 site. In this section, the applicant included numerous figures to illustrate this information, including FSAR Figure 2.5.4-206 showing the extent of excavations, fills, and slopes for North Anna 3 and FSAR Figures 2.5.4-225 through 2.5.4-234 showing cross sections of the excavations. The applicant indicated that it will excavate up to 12.2 m (40 ft) to reach the design plant grade of elevation 88.2 m (290 ft), but some lower areas may need to be backfilled. The applicant estimated the total cut at about 478,140 cubic meters (625,380 cubic yards), while the amount of backfilling with compacted structural fill about 184,830 cubic meters (241,750 cubic yards) and concrete fill about 83,810 cubic meters (109,620 cubic yards). The applicant described the excavation plan as having 3-horizontal to 1-vertical (3H:1V) slopes extending up from the plant grade around the southern and eastern perimeters of the area. To the northeast of the TB, going towards the existing Units 1 and 2, ground surface elevation reduces at an approximately 5 percent slope down to elevation 85.3 m (280 ft) at the SW Building. As existing grade falls off from the power block area northeast towards Units 1 and 2, the applicant stated that it may need an additional 9.14 m (30 ft) of backfill to bring the ground level currently at elevation 76.2 m (250 ft) in the area of the originally planned Units 3 and 4 to achieve the designed finish grade.

Excavation Methods and Stability

FSAR Section 2.5.4.5.2 describes the methods of excavation and plans to maintain stability along the excavation surfaces. The applicant included plans for the excavation of both soil and rock zones at the North Anna 3 site. The following subsections summarize these excavation methods.

<u>Excavation in Soil</u>.

The applicant stated that it will use conventional equipment for excavation in soil Zones IIA and IIB and in any existing fills. For excavation of less than 6.1 m (20 ft) in height, the applicant stated that it will follow U.S. Office of Safety and Health Administration (OSHA) regulations. The applicant further described plans to use a temporary vertical wall system to stabilize the power block excavation, and the slopes around the perimeter of the power block area will be no steeper than 3H:1V, with a bench at approximately 7.5 m (25 ft) height. Due to the erosive potential of the saprolitic soils, the applicant concluded that it will need to seal and protect even temporary slopes cut into the saprolite.

<u>Excavation in Rock</u>.

Based on lessons learned from the construction of Units 1 and 2, the applicant stated that it will use techniques to reduce vibrations during rock excavation, including a temporary vertical wall system to support the excavation where necessary during North Anna 3 excavation. Because North Anna 3 is about 457.2 m (1,500 ft) from the center of the Unit 2 containment building, not

91.44 m (300 ft) as originally planned, the applicant concluded that the initially planned excavation methods would be effective for the new North Anna 3. These methods include controlled blasting techniques, preservation of the rock integrity outside of the excavations, and reinforcing the rock to ensure adequate support and safety. The applicant also stated that it would geologically map the excavations for safety-related structures and notify the NRC no later than 30 days before any safety-related excavations are open to allow for staff examination or evaluation. Finally, the applicant stated that it will not monitor the excavation in rock because there is no measurable rebound or heave of the sound rock subgrade.

Structural Fill Sources, Compaction and Quality Control

FSAR Section 2.5.4.5.3 describes the sources of backfill, compaction requirements, and quality controls for the North Anna 3 site. The applicant illustrated the anticipated extent of structural fills on the foundation cross-section plots (see FSAR Figures 2.5.4-225 through 2.5.4-234). The applicant described plans to replace moderately to severely weathered Zone III rock exposed at the bottom of the excavations for the seismic Category I RB/FB, CB, and FWSC foundation mats with concrete fill. The FSAR states that saprolitic soil material found onsite will not be used as structural fill to support or backfill seismic Category I and II structures. Because backfill material is not naturally available at the site, the applicant described plans to set up a crushing and blending plant onsite to produce crushed aggregate to the required specifications for use as structural fill. The applicant described the fill as well-graded, angular or sub-angular sand and gravel-sized particles conforming to the gradation of Size No. 21A in the “Virginia Department of Transportation Road and Bridge Specifications (VDOT, 2002)”, and it will confirm the soundness through sulfate soundness and Los Angeles abrasion tests. The applicant stated that it plans to place the structural fill in lifts of no more than 30.48 cm (12 in.) loose thickness and compacted to at least 95 percent of the maximum dry density from the modified Proctor Test (ASTM D1557) and within 3 percent of its optimum moisture content. The applicant assumed that a N_{60} value of 50 blows per foot and an internal friction angle of 40 degrees were reasonable and conservative. The applicant stated that it plans to perform confirmatory gradation tests, modified Proctor compaction tests, and CU triaxial compression tests to ensure that the structural fill meets the selected criteria.

The applicant also referred to TSs that addresses fill placement and compaction control procedures. The applicant stated that it plans to perform at least one field density test per lift of fill and at least one test for every 191 cubic meters (250 cubic yards) of fill placed. Finally, the planned test fill program will determine the optimum size roller, number of passes, lift thickness, and other data to achieve the specified compaction.

Control of Groundwater during Excavation

Although FSAR Section 2.5.4.5.4 briefly describes the applicant’s plans for controlling groundwater during the excavations, FSAR Section 2.5.4.6.2 provides more details. The applicant described plans to slope back the tops of excavations to prevent runoff down the excavated slopes during heavy rainfall and to construct lined dewatering sumps and ditches due to the erosive nature of the saprolitic soil.

2.5.4.2.6 Groundwater Conditions

In FSAR Section 2.5.4.6, the applicant briefly described the groundwater conditions at the North Anna 3 site. This section includes groundwater measurements and elevations, construction dewatering and seepage, and the effect of groundwater conditions on foundation stability. FSAR Section 2.4.12 describes the groundwater conditions at the North Anna 3 site in greater detail.

Groundwater Measurements and Elevations

FSAR Section 2.5.4.6.1 describes the groundwater measurements and elevations at the North Anna 3 site. The applicant stated that groundwater is present in unconfined conditions in both the surficial sediments and underlying bedrock. In addition to the nine wells installed as part of the ESP subsurface investigation, the applicant installed seven observation wells during the COL site investigation. The applicant stated that the groundwater level in the observation wells ranged from an elevation of 72.5 m (238 ft) to an elevation 95.7 m (314 ft) between December 2002 and August 2007. The applicant concluded that the depth of surface ground water in the North Anna 3 power block area ranges from about 5.5 m (18 ft) to 7.6 m (25 ft) below the present surface.

The applicant performed slug tests and obtained hydraulic conductivity values for saprolite and bedrock in the range of 0.076 m (0.25 ft) to 3.02 m (9.9 ft) per day with a geometric mean value of 0.53 m (1.74 ft) per day. For rock, the values ranged from 0.15 m (0.5 ft) to 1.92 m (6.3 ft) per day with a geometric mean value of 0.62 m (2.05 ft) per day. The applicant also stated that ground water movement at the site is generally to the north and east, towards Lake Anna.

The applicant stated that the maximum allowable groundwater level for operation of the power block area of North Anna 3 is at an elevation of 87.8 m (288 ft), or 0.6 m (2 ft) below the design plant grade at an elevation of 88.4 m (290 ft). The groundwater level in the power block area of North Anna 3 is presented in FSAR Section 2.4.12.4 and ranges from about an elevation of 82.6 m (271 ft) at the north end of the TB to about an elevation of 86.1 m (282.5 ft) at the south end of the RB/FB.

Construction Dewatering and Seepage

FSAR Section 2.5.4.6.2 describes dewatering plans during construction and the method used to reduce seepage in both the soil and rock zones at the site. The applicant stated that the relatively low permeability of the saprolite and underlying rock allows the use of gravity-type systems to accomplish the necessary dewatering for all major excavations. Specifically, the applicant concluded that sump-pumping ditches will be adequate to dewater the soil. For rock, the applicant stated that it plans to use sump-pumping to collect water from relief drains installed in the major rock excavation walls to prevent the buildup of hydrostatic pressure. Although the applicant noted a head of approximately 12.2 m (40 ft) between the excavation grade and Lake Anna during the final excavation stages for abandoned Units 3 and 4, the applicant did not encounter any dewatering difficulties. The applicant attributed this to the tight nature of the joints in the rock below an elevation of about 73.2 m (240 ft). The applicant anticipated negligible seepage effects from the lake since the excavation for North Anna 3 is at least 305 m (1,000 ft) from Lake Anna.

Effects of Groundwater Conditions on Foundation Stability

FSAR Section 2.5.4.6.3 refers to FSAR Section 2.5.4.10 for a description of the maximum groundwater level below plant grade. The applicant concluded that there are no buoyancy issues at the North Anna 3 site; therefore a permanent dewatering system is not necessary.

2.5.4.2.7 Response of Soil and Rock to Dynamic Loading

In FSAR Section 2.5.4.7, the applicant described the seismic ground motion amplification/attenuation estimated from the V_s profiles of the subsurface materials, the variation of shear modulus and damping with strain, and the site-specific acceleration-time histories. The applicant stated that it will found the seismic Category I structures on Zone III-IV rock, Zone IV rock, or on concrete placed on the bedrock.

Shear Wave Velocity Profile

FSAR Section 2.5.4.7.1 describes the development of the V_s profiles for the soil and bedrock at the North Anna 3 site. To develop the profiles, the applicant compiled various measurements to determine the V_s in the soil and rock at the North Anna 3 site, as described in FSAR Section 2.5.4.4. The applicant developed the BE V_s profiles beneath the seismic Category I RB/FB, CB, and Firewater Service Complex (FWSC) based on shear wave velocity data collected from borings B-901, B-907, and B-909. The bottom of foundation elevation for these structures is Elevation 68.3 m (224 ft), Elevation 73.5 m (241 ft) and Elevation 86.0 m (282 ft), respectively. SER Figure 2.5.4-2 shows the BE V_s profiles for the RB/FB and CB, and SER Figure 2.5.4-3 presents the BE V_s profiles for the FWSC.

In addition to the V_s profiles considered for the seismic Category I structures, the applicant also developed a V_s profile beyond the excavation for the power block. The applicant developed this profile based on the V_s measured in C-916, the N-values measured in B-947, the average V_s values derived from site-wide V_s measurements in saprolite, and data collected from borings B-901, B-907 and B-909. SER Figure 2.5.4-4 shows the V_s profile which the applicant used to determine the PGAs in the free-field for use in liquefaction potential and slope stability analyses.

For the structural fill to be used as backfill around the seismic Category I structures, the applicant developed a V_s profile based on the relationships between the N-value (adjusted for overburden pressure) and V_s developed by Seed, et al. (1983) and Imai and Tonoucchi (1982). The applicant averaged this profile in 1.5 m (5 ft) intervals vertically to produce the average V_s profile shown in SER Figure 2.5.4-5. The upper and lower bound values shown in this figure are 1.414 and 0.707 times the mean value of shear wave velocity, respectively. The applicant used this profile as input in the seismic response analyses.

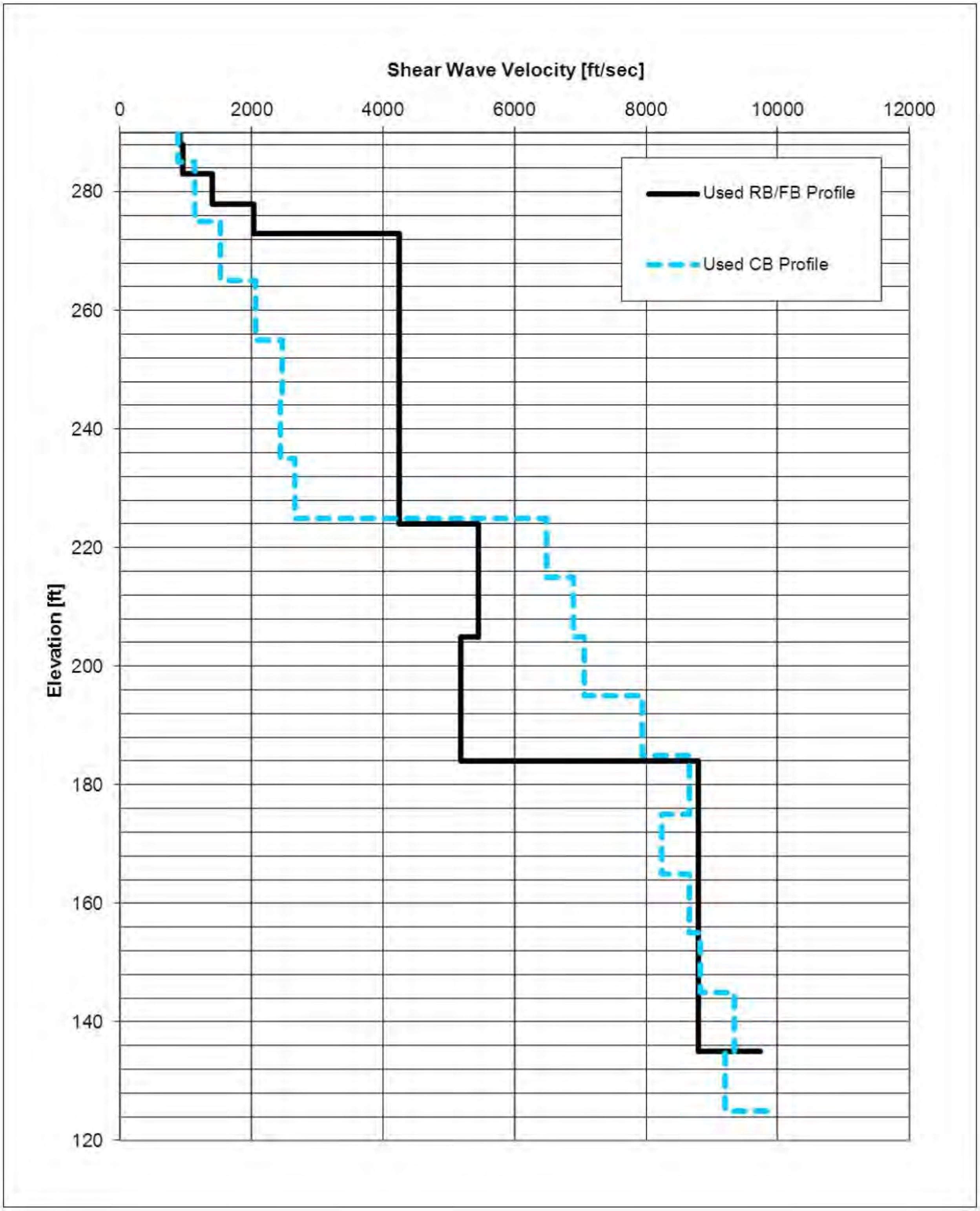


Figure 2.5.4-2. Best Estimate Shear Wave Velocity Profiles for RB/FB and CB (FSAR Figure 2.5.4-242)

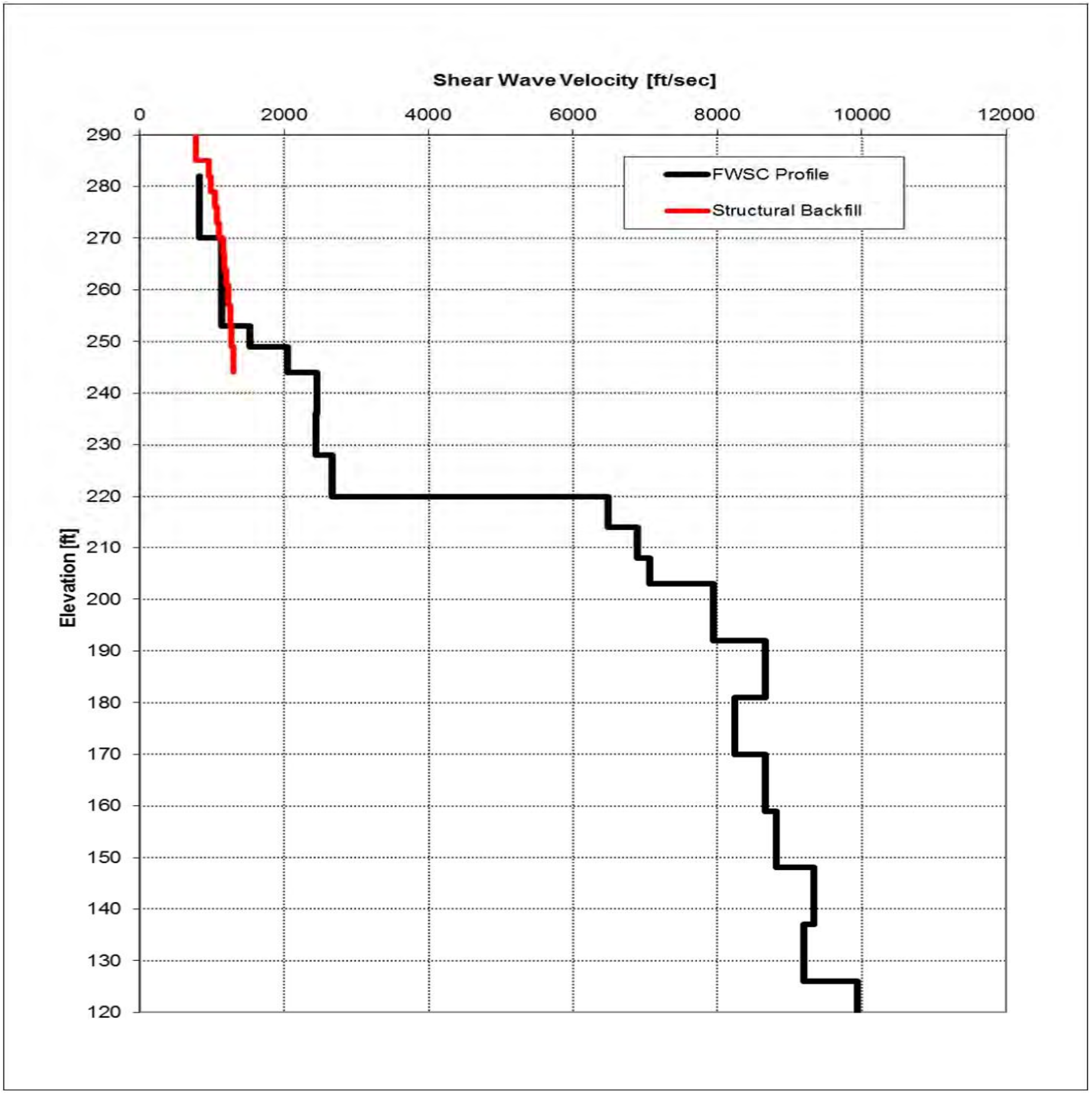


Figure 2.5.4-3. Best Estimate Shear Wave Velocity Profiles for FWSC (FSAR Figure 2.5.4-243)

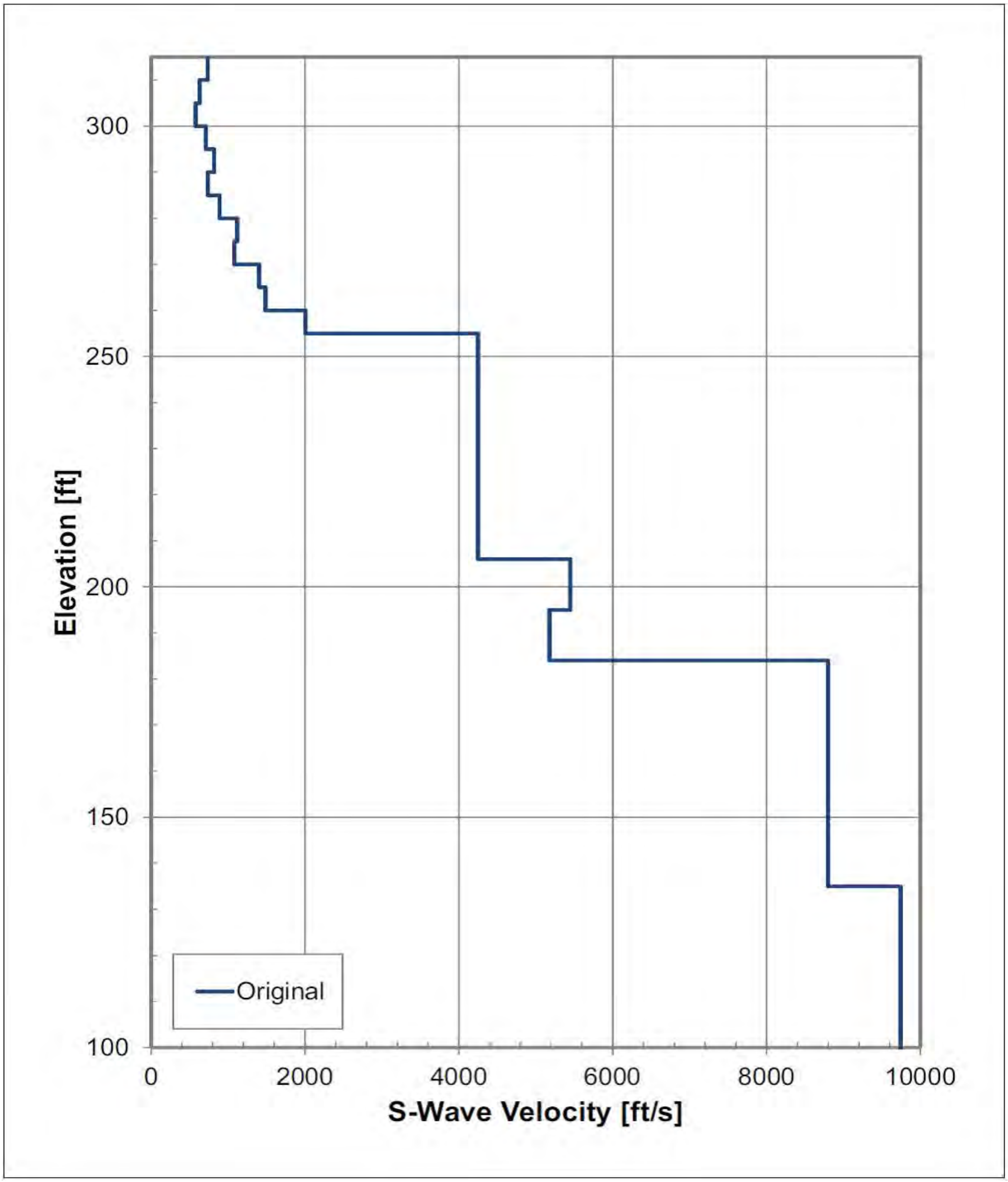


Figure 2.5.4-4. Best Estimate Shear Wave Velocity Profiles for Free-Field Slope (FSAR Figure 2.5.4-244)

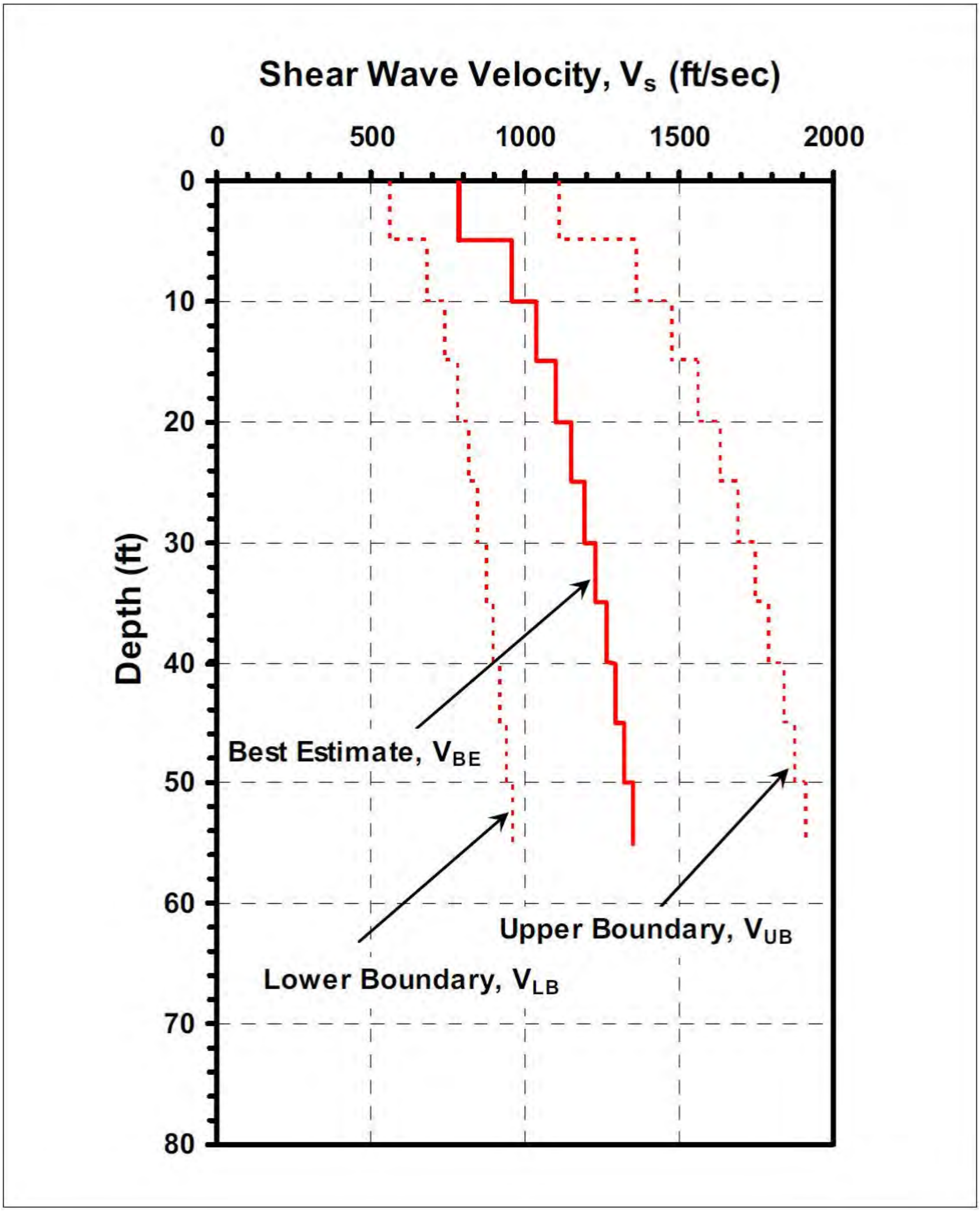


Figure 2.5.4-5. Best Estimate Shear Wave Velocity Profile for Structural Fill in 5-Foot Intervals (FSAR Figure 2.5.4-246)

Variation of Shear Modulus and Damping with Strain

FSAR Section 2.5.4.7.2 describes the effect of varying shear strain on both the shear modulus and damping. The soil degradation properties, specifically the variations of soil shear modulus and damping ratio with shear strain levels, are important inputs in site seismic response analysis. The applicant divided the section into two subsections to discuss the variations specific to the shear modulus and damping ratio.

Shear Modulus.

The applicant used the same shear modulus reduction curve as in the ESP SSAR for the Zone IIA saprolite, which was the mean of a 1970 Seed and Idriss (1970) average curve for sand and two curves from a 1993 EPRI report.

In combining these studies, the applicant took into account of several factors, including reference strain and effective vertical stress. Unlike the ESP site investigations in which the Zone IIB contained more gravel than Zone IIA, the applicant found no appreciable gravel in either Zone IIA or IIB during the COL investigations. Therefore, the applicant applied the same shear modulus reduction curve to both Zone IIA and IIB soils as shown on SER Figure 2.5.4-6.

The applicant compared the RCTS test results with a shear modulus reduction curve that represents the Zone IIA and IIB soils and it showed that the test data points are very close to that curve, which confirmed that the recommended shear modulus curve can reasonably represent the soil condition in the field. The applicant selected Curve 2 and Curve 3 from ESP SSAR Figure 2.5-63 as the shear modulus reduction curve for the structural backfill, and for the Zone III weathered rock, respectively. Finally, the applicant stated that the shear modulus of the Zone IV and Zone III-IV weathered rock was non-strain dependent.

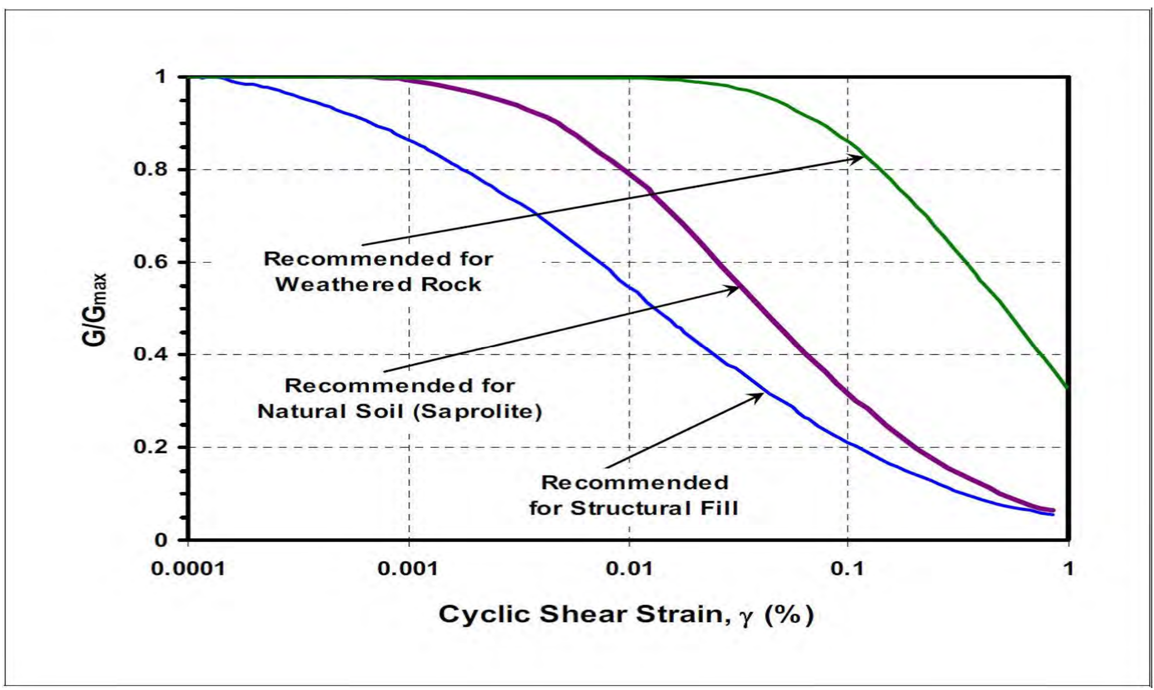


Figure 2.5.4-6. Shear Modulus Reduction Design Curves (FSAR Figure 2.5.4-247)

Damping Ratio.

SER Figure 2.5.4-7 illustrates the EPRI curves for depths of 0 to 6.09 m (0 to 20 ft) and 6.09 to 15.24 m (20 to 50 ft) selected for Zone IIA and IIB saprolite and structural backfill, and Curve 3 from ESP SSAR Figure 2.5-64 used for Zone III weathered rock. The applicant compared the results of the RCTS tests with the curve selected for granular soils and concluded that the results show reasonable agreement. The applicant also concluded that the damping ratio of the Zone III-IV and Zone IV rock does not vary with cyclic shear strain; however, the applicant selected a damping ratio of 1 percent with a ±0.5 percent variation.

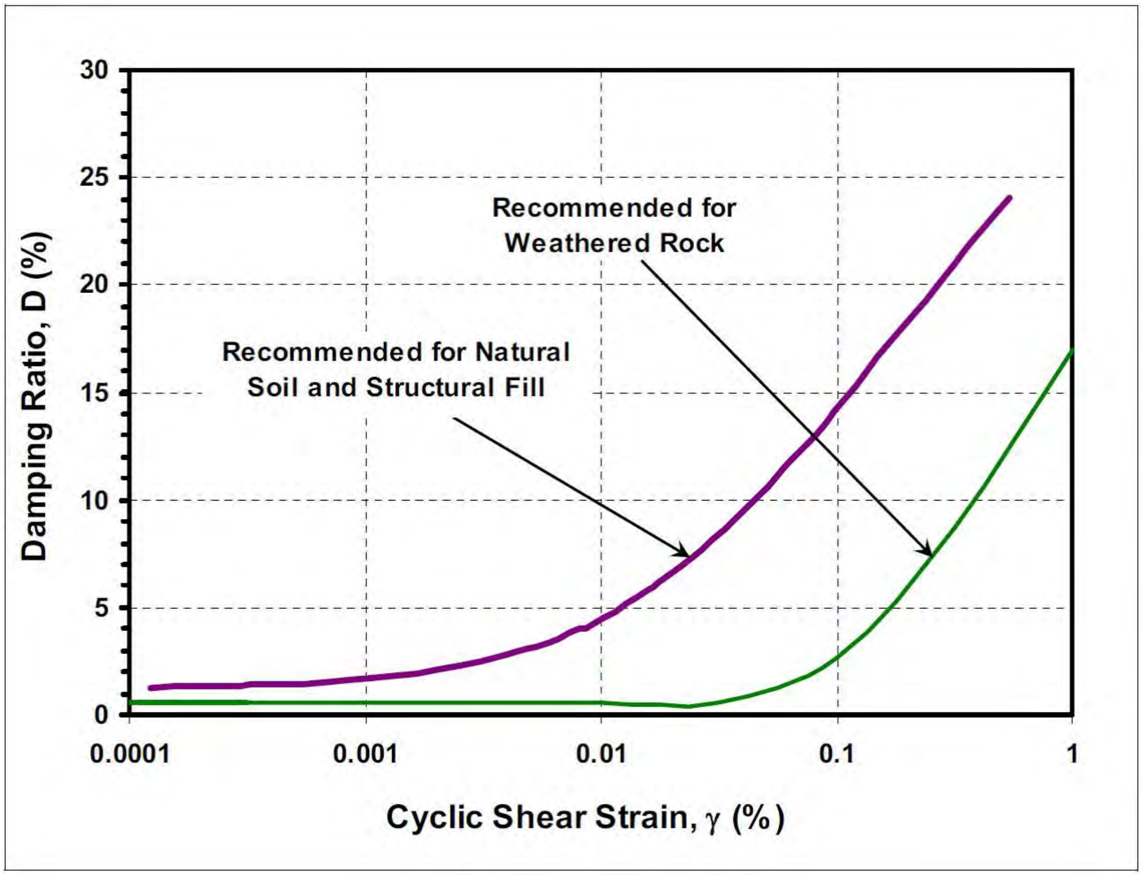


Figure 2.5.4-7. Damping Ratio versus Cyclic Shear Strain (FSAR Figure 2.5.4-249)

Site-Specific Acceleration-Time Histories

FSAR Section 2.5.4.7.3 states that the P-SHAKE program does not need acceleration-time histories as an input.

Rock and Soil Column Amplification/Attenuation Analysis

FSAR Section 2.5.4.7.4 describes the soil and rock amplification/attenuation analyses performed for the North Anna 3 site. The applicant referred to FSAR Section 3.7.1 for the acceleration response spectra as derived from the P-SHAKE analyses for seismic Category I structures. The applicant used the P-SHAKE program to obtain PGAs in the free-field for use in slope stability and liquefaction analysis with the V_s profile described in FSAR Section 2.5.4.7.1.d. The results show that the PGA occurs at about 12.8 m (42 ft) depth and the values of the PGA are about 0.56g for the HF earthquake and about 0.31g for the LF earthquake.

2.5.4.2.8 Liquefaction Potential

FSAR Section 2.5.4.8 describes the liquefaction potential evaluation of the soil at the North Anna 3 site, including the analyses performed and the conclusions reached. The applicant concluded that due to the density and high percentage of core stone in Zone III weathered rock, it is not prone to liquefaction. The applicant further concluded that the structural fill was not liquefiable because of its angularity and degree of compaction under the given seismic loading condition. The applicant identified slopes whose failure due to liquefaction could impact adjacent safety-related structures, and performed the liquefaction potential analysis for those slopes.

Liquefaction Analyses Performed for North Anna 3

FSAR Section 2.5.4.8.2 describes the liquefaction analyses performed for North Anna 3 site. The applicant first determined the magnitude and acceleration values for North Anna 3 liquefaction analyses, then performed seismic margin assessments, and analyzed samples and CPT results to estimate the liquefaction potential. The applicant followed the guidelines in RG 1.198, regarding the acceptable FS against liquefaction.

Based on rock and soil column analyses described in the previous section, the applicant obtained the peak accelerations at the natural ground surface of 0.31g and 0.56g for the LF (M= 7.4) and HF (M = 6.0) earthquake, respectively. The applicant used these values as the PGAs for the liquefaction analyses.

Because Zone IIA saprolitic soil in the power block area where the seismic Category I structures are located will be excavated, there is no need to analyze the liquefaction potential of these soils prior to excavation. Therefore, the applicant performed liquefaction analysis focused on slopes whose failure could impact safety-related structures.

The applicant used six SPT borings, two CPT borings and two V_s measurements taken from two borings to assess the liquefaction potential of the slope soils. The analysis followed the method proposed by Youd, et al. (2001) based on the evolution of the Seed and Idriss “Simplified Procedure” (1983). The analysis of the SPT results gave FS values against liquefaction greater than 1.1 for the approximately 80 Zone IIA saprolite samples, except for eight samples. The liquefaction analysis using CPT data yielded FS against liquefaction greater than 1.1 for all data points. For analysis using V_s measurements, only eight data points gave FS of less than 1.1 against liquefaction.

The applicant used the method outlined in Tokimatsu and Seed (1997) to estimate dynamic settlement of the Zone IIA saprolite due to earthquake shaking obtaining less than 12.7 cm (5 in) of the maximum dynamic settlement.

Applicant's Conclusions about Liquefaction

The applicant stated that the aforementioned liquefaction analyses showed that a very small percentage of the Zone IIA saprolitic soils have a potential for liquefaction based on the LF and HF North Anna 3 site seismic characteristics. The liquefaction analysis did not consider the beneficial effects of age, structure, fabric, and mineralogy; the applicant therefore concluded that the probability of any liquefaction occurring in the North Anna 3 site area is very low. Furthermore, the applicant concluded that any liquefaction of the Zone IIA saprolite will not impact the stability of any North Anna 3 seismic Category I structures because the safety-related structures will not be founded on Zone IIA material, which will be removed entirely during excavation at the site.

2.5.4.2.9 Earthquake Site Characteristics

FSAR Section 2.5.4.9 refers to FSAR Sections 2.5.2 and 3.7.1 for a discussion of the GMRS and FIRS for the North Anna 3 site, respectively.

2.5.4.2.10 Static Stability

FSAR Section 2.5.4.10 states that the applicant will found the North Anna 3 RB/FB structures on Zone III-IV or Zone IV bedrock. The applicant will remove and replace Zone III weathered rock or fractured rock encountered at the foundation subgrade level with concrete fill for all seismic Category I structures. For seismic Category II structures, depending on the elevation and location, there can be more than one material beneath the foundation of larger structures because of variable stratigraphy. FSAR Table 2.5.4-209 summarizes the dimensions, foundation elevation, embedment depth and design static and dynamic loads of structures including seismic Category I and II structures and the RW.

Bearing Capacity

FSAR Section 2.5.4.10.1 describes the estimation of allowable static and dynamic bearing capacity values for bedrock and soil.

<u>Allowable Bearing Capacity of Rock and Concrete Fill</u>.

FSAR Table 2.5.4-210 gives the allowable static bearing capacity values for each bedrock zone. The applicant determined the dynamic allowable bearing capacity as 957 kPa (20 ksf), that is less than 20 percent of the ultimate rock crushing strength of 6,896 kPa (144 ksf), using various building codes for moderately weathered to freshly foliated rock (D'Appolonia et al., 1975). Because the RB/FB will not be directly founded on Zone III weathered rock, the applicant stated that if excavation during construction for this foundation reveals any weathered or fractured zones at foundation level, it will be over-excavated and replaced with concrete fill. The applicant stated that the Zone III-IV and Zone IV bedrock have a design unconfined compressive strength of 62 MPa (1,296 ksf) and 117 MPa (2,448 ksf) with allowable static values of the bearing capacity of 3,830 kPa (80 ksf) and 7,660 kPa (160 ksf), respectively. The applicant selected 20 percent of the ultimate crushing strength, 12,400 kPa (259 ksf) for Zone III-IV and 23,460 kPa (490 ksf) for Zone IV, as dynamic bearing capacity. Finally, the applicant determined that the allowable bearing capacity for 17.2 MPa (2,500 psi) concrete fill is 9,528 kPa (199 ksf) for both static and dynamic loading.

Allowable Bearing Capacity for Structures.

FSAR Table 2.5.4-211 provides the estimated and selected allowable static and dynamic bearing capacity values for the seismic Category I and II structures at the North Anna 3 site. The applicant noted that there is concrete fill beneath each structure underlain by Zone III-IV bedrock. For the static case, the applicant noted that the bearing capacity of the Zone III-IV bedrock is less than that of concrete, but for the dynamic case, the bearing capacity of the concrete is less than half of that of the Zone III-IV materials. The applicant assumed the lesser bearing capacity in each case, selecting the bearing capacity of the Zone III weathered rock for both the static and dynamic cases. The applicant also limited the allowable bearing capacity to 191 kPa (4 ksf) for the Zone IIA saprolite due to settlement considerations, but noted that the actual allowable bearing capacity may be less, especially based on settlement considerations for larger foundations.

Buoyancy Effects.

The applicant predicted that the maximum groundwater level in the power block area of North Anna 3 would increase from about elevation 82.6 m (271 ft) at the north end of the TB to about elevation 86.1 m (282.5 ft) at the south end of the RB/FB and concluded that it is possible for a hydrostatic uplift force to act on the structures founded below grade. However, the applicant also concluded that the below-ground structures have sufficient applied foundation loads such that there are no net uplift forces at the maximum ground water level. The applicant indicated that uplift forces can be significant in the design of buried piping, particularly empty pipes. The applicant used a FS of 3 in its analysis of the weight and strength of the backfill above the pipe to ensure satisfactory resistance to uplift forces.

Settlement Analysis

FSAR Section 2.5.4.10.2 describes the pseudo-elastic method of analysis used for settlement estimates, an approach suitable for both granular soils and bedrock. The applicant calculated the settlement of discrete layers using a stress-strain model of analysis that determined settlement to a depth where the increase in vertical stress due to the applied load was equal to or less than 10 percent of the applied foundation pressure. SER Table 2.5.4-2 summarizes the estimated settlements for major structures. Based on the analysis, the applicant expected that the estimated average settlement for seismic Category I structures is about 2.54 mm (0.1 in) or less.

Table 2.5.4-2 Estimated Settlements Structures (FSAR Table 2.5.4-212)

STRUCTURE	APPLIED LOAD kPa (ksf)	CALCULATED SETTLEMENT Mm (in.)			
		CENTER	EDGE	AVERAGE[1]	CORNER
Reactor/Fuel Building	669 (14.6)	3.0 (0.12)	1.9 (0.075)	2.5 (0.10)	1.3 (0.05)
Control Building	292 (6.1)	0.6 (0.022)	0.4 (0.014)	0.5 (0.02)	0.3 (0.010)
Fire Water Service Complex	165 (3.45)	0.3 (0.011)	0.2 (0.008)	0.3 (0.010)	0.13 (0.005)
Turbine Building	287 (6)	56.6 (2.23)	29.0 (1.14)	42.9 (1.69)	14.7 (0.58)
Radwaste Building	287 (6)	19 (0.75)	10 (0.38)	14.5 (0.57)	6.9 (0.27)
Service Building	192 (4)	17.3 (0.68)	8.9 (0.35)	13.2 (0.52)	6.9 (0.27)
Ancillary Diesel Building	192 (4)	3.3 (0.13)	1.7 (0.065)	(0.10)	0.9 (0.034)

Notes: (1) Average is average of center and edge settlements.

Earth Pressures

FSAR Section 2.5.4.10.3 describes the estimates made for static and seismic lateral earth pressures for plant below-ground walls. The applicant considered both active and at-rest cases in the calculations. As part of the earth pressure calculations, the applicant used Rankine values as earth pressure coefficients. The applicant assumed that backfill was level with a friction angle between the soil and the wall of zero, hydrostatic pressures were 0.6 m (2 ft) below grade, and the surcharge pressure was 23.9 kPa (500 psf).

The applicant used Mononobe-Okabe method (Mononobe, 1929 and Okabe, 1926) to estimate the active lateral earth pressure. The applicant used peak LF acceleration of 0.31g as the seismic force that develops seismic active earth pressure, because it considered that using the peak HF acceleration was overly conservative given the low magnitude (energy) of this earthquake. The applicant used the method described in ASCE 4-98, "Seismic Analysis of Safety-Related Nuclear Structures," Section 3.5.3.2 (ASCE, 1998) to estimate the dynamic component of seismic at-rest lateral earth pressure for the below-grade walls of the power block structures and provided an elastic solution demonstrated in a nomograph. The applicant developed the nomograph for a dimensionless normalized in-situ lateral stress at 1.0g horizontal earthquake acceleration for a normalized depth at a given Poisson's ratio. The applicant calculated the site-specific at-rest pressure from the nomograph at various depth intervals using the site-specific acceleration and Poisson's ratio.

The applicant illustrated lateral earth pressure diagrams for the active and at-rest cases in FSAR Figures 2.5.4-253 and 2.5.4-254, respectively, and indicated that the lateral pressures in the figures are BEs with an FS of 1. The applicant concluded that the FS against a gravity wall or structure foundation sliding, as well as for a wall overturning, is normally 1.1 when seismic pressures are included.

2.5.4.2.11 Design Criteria

FSAR Section 2.5.4.11 summarizes the geotechnical design criteria discussed in other sections of the FSAR. FSAR Section 2.5.4.8 specifies that the acceptable FS against liquefaction of site soils should be equal or greater than 1.1. FSAR Section 2.5.4.10 presents bearing capacity and settlement criteria. For static bearing capacity and to prevent the failure of a buried pipe due to uplift forces, the applicant indicated that a minimum FS of 3 is required. For soils, the applicant reduced this FS to 2.25 under dynamic or transient loading conditions. FSAR Section 2.5.4.10 also provides lateral earth pressure values versus depth with FS=1.0 and notes that FS=1.1 is normally used for sliding and overturning due to these lateral loads when the seismic component is included. FSAR Section 2.5.5.2 concludes that the minimum acceptable long-term static FS against slope stability failure is 1.5. Finally, FSAR Section 2.5.5.3 indicates that 1.1 is the minimum acceptable long-term seismic FS against slope stability failure.

2.5.4.2.12 Techniques to Improve Subsurface Conditions

FSAR Section 2.5.4.12 describes plans to remove Zone IIA and IIB saprolite beneath or within the zone of influence of seismic Category I or II structures and replace the saprolite with structural fill. Furthermore, the applicant described plans to remove zones of weathered or fractured rock immediately beneath the RB/FB, CB, and FWSC foundations and replace the rock with concrete fill. Finally, for non-seismic Category I and II structures, the applicant indicated that improvement of the Zone IIA saprolite will follow the methods described in ESP SSAR Section 2.5.4.12.

2.5.4.3 Regulatory Basis

The applicable regulatory requirements for reviewing the applicant's discussion of stability of subsurface materials and foundations are:

- 10 CFR 50.55a, requires that SSCs be designed, fabricated, erected, constructed, tested, and inspected in accordance with the requirements of applicable codes and standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records," requires that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. It also requires that appropriate records of the design, fabrication, erection, and testing of SSCs important to safety be maintained by or under the control of the nuclear power unit licensee throughout the life of the unit.

- 10 CFR Part 50, Appendix A, GDC 2, relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

- 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plants," establishes quality assurance requirements for the design, construction, and operation of those SSCs of nuclear power plants that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public.

- 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," applies to the design of nuclear power plant SSCs important to safety to withstand the effects of earthquakes.

- 10 CFR 100.23, provides the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identify geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants.

The related acceptance criteria are summarized from SRP Section 2.5.4:

- **Geologic Features**: In meeting the requirements of 10 CFR Parts 50 and 100, the section defining geologic features is acceptable if the discussions, maps, and profiles of the site stratigraphy, lithology, structural geology, geologic history, and engineering geology are complete and are supported by site investigations that are sufficiently detailed to obtain an unambiguous representation of the geology.

- **Properties of Subsurface Materials**: In meeting the requirements of 10 CFR Parts 50 and 100, the description of properties of underlying materials is considered acceptable if state-of-the-art methods are used to determine the static and dynamic engineering properties of all foundation soils and rocks in the site area to sufficient depth that impact behavior during construction and over the life of the facility, including during postulated seismic events.

- **Foundation Interfaces**: In meeting the requirements of 10 CFR Parts 50 and 100, the discussion of the relationship of foundations and underlying materials is acceptable if it includes: (1) a plot plan or plans showing the locations of all site explorations, such as borings, trenches, seismic lines, piezometers, geologic profiles, and excavations with the locations of the safety-related facilities superimposed thereon; (2) profiles illustrating the detailed relationship of the foundations of all seismic Category I and other safety-related facilities to the subsurface materials; (3) logs of core borings and test pits; and (4) logs and maps of exploratory trenches in the application for a COL.

- **Geophysical Surveys**: In meeting the requirements of 10 CFR 100.23, the presentation of the dynamic characteristics of soil or rock is acceptable if geophysical investigations have been performed at the site and the results obtained therefrom are presented in detail.

- **Excavation and Backfill**: In meeting the requirements of 10 CFR Part 50, the presentation of the data concerning excavation, backfill, and earthwork analyses is acceptable if: (1) the sources and quantities of backfill and borrow are identified and are shown to have been adequately investigated by borings, pits, and laboratory property and strength testing (dynamic and static); long-term solubility properties and dissolution behavior during the life of the facility have been determined; and this data is included, interpreted, and summarized; (2) the extent (horizontally and vertically) of all seismic Category I excavations, fills, and slopes are clearly shown on plot plans and profiles; (3) compaction specifications and embankment and foundation designs are justified by field and laboratory tests and analyses to ensure stability and reliable performance over the life of the plant; (4) the impact of compaction methods are incorporated into the structural design of the plant facilities; (5) quality control methods are discussed and the quality assurance program described and referenced; (6) control of groundwater during excavation to preclude degradation of foundation materials and properties is described and referenced. If backfill is to be placed under safety-related structures, proper ITAAC should be specified in the applicant's technical submittal to ensure that the static and dynamic properties of in-place backfill material will be the same as, or better than the design parameters. In case cementitious construction material is to be placed under safety -related structures, proper ITAAC should be specified in the applicant technical submittal to ensure that the cementitious backfill placed underneath any seismic Category I structures to a thickness greater than 5 ft, meets the design, construction and testing of applicable American Concrete Institute (ACI) standards. In addition, the long-term behavior of the backfill subjected to any aggressive groundwater characteristics is evaluated; (7) For sites where deeply embedded structures are involved, deep excavation techniques will likely utilize wall retaining systems rather than a sloped excavation of the soil. Also, a description of the planned excavation technique(s) and design of the wall retention system with sufficient details is provided and it should be able to demonstrate that the excavation technique used will not significantly affect the surrounding soil properties that are relied upon in the analysis and design of the foundation and plant structures.

- **Groundwater Conditions**: In meeting the requirements of 10 CFR Parts 50 and 100, the analysis of groundwater conditions is acceptable if the following are included in this subsection or cross-referenced to the appropriate subsections in SRP Section 2.4 of the applicant's technical submittal: (1) discussion of critical cases of groundwater conditions relative to the foundation settlement and stability of the safety-related facilities of the nuclear power plant; (2) plans for dewatering during construction and the impact of the dewatering on temporary and permanent structures. This includes consideration of the potential for substantial head and volume of water due to the deep excavation for the plant structures; (3) analysis and interpretation of seepage and potential piping conditions during construction; (4) records of field and laboratory permeability tests as well as dewatering-induced settlements; (5) history of groundwater fluctuations as determined by periodic monitoring of an adequate number of local wells and piezometers. Flood conditions should also be considered; (6) Evaluation of chemical properties of the groundwater that may impact long-term behavior of the rock/soil/fill materials as well as structural elements (concrete and steel materials).

- **Response of Soil and Rock to Dynamic Loading**: In meeting the requirements of 10 CFR Parts 50 and 100, descriptions of the response of soil and rock to dynamic loading are acceptable if: (1) an investigation has been conducted and discussed to determine the effects of prior earthquakes on the soils and rocks in the vicinity of the site. Evidence of liquefaction and sand cone formation should be included; (2) field seismic surveys (surface refraction and reflection and in-hole and cross-hole seismic explorations) have been accomplished and the data presented and interpreted to develop bounding P and S wave velocity profiles; (3) dynamic tests have been performed in the laboratory on undisturbed samples of the foundation soil and rock sufficient to develop strain-dependent modulus-reduction and hysteretic damping properties of the soils and the results included. If generic soil degradation properties are used in the related preliminary analyses (e.g., site seismic response and SSI analyses), then reconciliation of the generic properties and laboratory testing results should be performed. The section should be cross-referenced with Section 2.5.2.5.

- **Liquefaction Potential**: In meeting the requirements of 10 CFR Parts 50 and 100, if the foundation materials at the site adjacent to and under seismic Category I structures and facilities are saturated soils and the water table is above bedrock, then an analysis of the liquefaction potential at the site is required.

- **Static and Dynamic Stability**: In meeting the requirements of 10 CFR Parts 50 and 100, the discussions of static and dynamic analyses are acceptable if the stability of all safety-related facilities has been analyzed from a static and dynamic stability standpoint including bearing capacity, rebound, settlement, and differential settlements under deadloads of fills and plant facilities, dynamic loads including “live” and seismic loads with consideration of loading sequences and combinations, and lateral loading conditions.

- **Design Criteria**: In meeting the requirements of 10 CFR Part 50, the discussion of criteria and design methods is acceptable if the criteria used for the design, the design methods employed, and the factors of safety obtained in the design analyses are described and a list of references presented.

- **Techniques to Improve Subsurface Conditions**: In meeting the requirements of 10 CFR Part 50, the discussion of techniques to improve subsurface conditions is acceptable if plans, summaries of specifications, and methods of quality control are described for all techniques to be used to improve foundation conditions (such as grouting, vibroflotation, bridging mats, dental work, rock bolting, or anchors).

In addition, the geotechnical engineering characteristics should be consistent with appropriate sections from: RG 1.27, RG 1.28, “Quality Assurance Program Requirements (Design and Construction)”; RG 1.132, RG 1.138, RG 1.198, and RG 1.206.

2.5.4.4 Technical Evaluation

This section provides the staff’s evaluation of the geophysical and geotechnical investigations including field and laboratory tests carried out by the applicant to determine the static and dynamic engineering properties of the materials that underlie the North Anna 3 site. The staff reviewed the resolution to the COL specific items related to the properties and stability of the soil and rock underlying the site that could affect the safe design and siting of the plant, specifically the Permit Conditions identified in NUREG-1835. In addition, the staff observed some of the applicant’s onsite borings and field explorations to determine whether the applicant had followed the guidance in RG 1.132.

The staff evaluated the information provided to resolve DCD COL Item 2.0-29-A and ESP Permit Conditions 3.E(4) to 3.E(7). DCD COL Item 2.0-29-A requires the COL applicant to complete additional borings at the COL site to address the provisions listed in ESBWR DCD, Table 2.0-1 regarding stability of subsurface material and foundation requirements, which is resolved in Section 2.5.4.4.3 of this SER. Permit Condition 3.E(4) requires that an applicant for a CP or COL referencing this ESP shall excavate weathered or fractured rock at the foundation level and replace it with lean concrete before the commencement of foundation construction for safety-related structures. This was addressed in North Anna 3 FSAR Section 2.5.1 and evaluated in Section 2.5.1.4 of this SER. More detailed discussion regarding the resolution of this permit condition was presented in Sections 2.5.4.5.2 and 2.5.4.5.3 of the North Anna 3 FSAR, and additional staff evaluation was presented in Section 2.5.4.4.5 of this SER. Permit Condition 3.E(5) requires the applicant not to use an engineered fill with high compressibility and low maximum density, such as saprolite, this is resolved in Section 2.5.4.4.5 of this SER. Permit Condition 3.E(6) requires the applicant to include information on geologic mapping of future excavations for safety-related structures and to evaluate any unforeseen geologic features encountered at the site area, which is resolved in Section 2.5.4.4.5, in conjunction with Sections 2.5.1 and 2.5.3 of this SER. Permit Condition 3.E(7) requires the applicant to improve Zone II saprolitic soils to reduce any liquefaction potential if safety-related structures are to be founded on them, which is resolved in Section 2.5.4.4.8 of this SER.

2.5.4.4.1 Description of Site Geologic Features

FSAR Section 2.5.4.1 references FSAR Sections 2.5.1.1 and 2.5.1.2. The staff's evaluations of, and conclusions for these sections are presented in Section 2.5.1.4 of this SER.

2.5.4.4.2 Properties of Subsurface Materials

FSAR Section 2.5.4.2 describes the subsurface materials and the field investigations and laboratory tests used to determine the static and dynamic engineering properties of these materials at the North Anna 3 site. The staff reviewed the applicant's description of the four zones of subsurface materials and the methods used to determine the engineering properties of those materials and to develop the subsurface profile as shown on SER Figure 2.5.4-1. The staff also reviewed the applicant's use of the latest field and laboratory methods, including boring sample analysis, observation wells, SPT, P-S suspension logger, and CPTs, to determine the properties of the subsurface materials.

To clarify how the properties of Zone IIA soil were determined, the staff issued RAI 02.05.04-1 (ADAMS Accession Number No. ML081690661) dated June 17, 2008, requesting that the applicant justify the use of an effective cohesion value (c') of 6.0 kPa (125 psf) for Zone IIA soil, given that the SPT and C-U test results imply very little effective cohesion (interpreted as c' = 0). In the applicant's response to RAI 02.05.04.-1 (ADAMS Accession No. ML082050558) dated July 14, 2008, the applicant stated that it derived the effective cohesion value from various data sources. The applicant assumed some effective cohesion due to the mineralogy, texture, and fabric of the Zone IIA saprolite. To determine the effective cohesion value, the applicant performed consolidated-undrained triaxial tests on samples of the Zone IIA saprolite and used the results—combined with the mineralogy, texture, and fabric observations—to select the effective cohesion value of 6.0 kPa (125 psf) for the Zone IIA saprolite.

The staff reviewed the applicant's response, and concluded that although it is not a conservative approach to use a small effective cohesion value, it was reasonable as detailed below. Based on the results of the staff's independent confirmatory analysis, the staff noted that the small effective cohesion value does not produce notable changes in foundation stability analyses with relatively large internal friction angles of soil. The results of the staff's confirmatory analyses also noted that with a decrease of c' value from 6.4 to 5.5 kPa (135 to 115 psf), the FS for slope stability only decreases from 1.29 to 1.26. Section 2.5.5.4.2 of this SER provides additional information regarding the staff's confirmatory analysis. Based on the results of the confirmatory analysis, which suggest that the applicant's approach of determining the effective cohesion value is reasonable, the staff concludes that the applicant provided adequate information to resolve RAI 02.05.04-1.

During the review of FSAR Section 2.5.4.2.5, the staff noted that the applicant stated that it will place concrete fill with an average thickness of 3.0 m (10 ft) and a maximum thickness of 15.2 m (50 ft) below the base of the RB/FB, CB and FWSC foundations. Because thermal cracking can be an issue for a large concrete mass, the staff issued RAI 02.05.04-22 dated February 09, 2011 (ADAMS Accession No. ML110400770). The staff asked the applicant to describe how it will place the concrete fill in the field to reduce thermal cracking distress and how it will ensure the long-term strength and stability of the concrete fill.

In the applicant's response to RAI 02.05.04-22 dated April 04, 2011 (ADAMS Accession No. ML110950474), the applicant stated that in order to minimize thermal cracking distress for large concrete masses, the general objective is to limit volume changes and the temperature differential across the concrete as much as practical by properly controlling and/or limiting the heat generated by hydration of the mass of concrete. The applicant committed to follow ACI 349, Code Requirements for Nuclear Safety-Related Structures, which provides provisions and guidelines regarding concrete material properties, quality, mixing and placing requirements, durability requirements to ensure long-term strength and stability of the concrete, and requirement to reduce thermal cracking distress. The applicant also stated that it will follow additional standards referenced in ACI 349, such as ASTM standards and publications of ACI Committees 201 and 207, in the detailed concrete fill design. The applicant also committed to revise FSAR Section 2.5.4.2.5 to include a statement referencing ACI 349 with regard to concrete fill durability, design, construction, and quality assurance.

The staff reviewed this RAI response and relevant chapters of ACI 349 and ACI 207, and finds that the applicant identified appropriate industrial standards that it will follow to address the thermal cracking distress issue in mass concrete fill. The staff noted that the applicant committed to develop construction specifications in accordance with the applicable standards to provide controls on the construction process, including placement techniques, material properties (including mix design and concrete properties during placement such as slump, air content, and mix temperature), and proposed a revision to FSAR Section 2.5.4.2.5 to reflect those focus areas of staff concern. The staff later confirmed that the latest version of the FSAR incorporated the proposed changes. Accordingly, the staff concludes that the applicant adequately addressed the long-term strength and stability of the concrete fill and provided necessary specification in its application. Therefore, the staff considers RAI 02.05.04-22 resolved and closed.

Based on the acceptable determination of the subsurface properties and the resolution of related RAIs, the staff concludes that the field investigations and laboratory testing performed by the applicant to determine the subsurface material properties were performed in accordance with RGs 1.132 and 1.138 and are sufficient to meet the relevant criteria of 10 CFR Parts 50 and 100.

2.5.4.4.3 Foundation Interfaces

FSAR Section 2.5.4.3 describes and illustrates the location of site exploration points for the North Anna 3 subsurface investigation including borings, observation wells, CPTs, electrical resistivity tests, and test pits made in the power block area; the excavation plan for the safety-related and other major facilities including the plan outline of these structures, plan dimensions, and the bottom of foundation elevations for the major structures; the location of ten subsurface profiles; and cross sections of the structure foundations and the proposed excavation and backfilling limits.

The staff reviewed the additional borings performed by the applicant to confirm engineering properties and the stability of soil and rock underlying future plant SSCs. As part of this review, the staff also examined the site exploration points for the North Anna 3 subsurface investigations, including SER Figure 2.5.4-8 (FSAR Figure 2.5.4-217), which shows the locations of additional boreholes, observation wells, CPTs, electrical resistivity tests, and test pits. The staff considered this information along with the exploration points outside of the power block area and concluded that the additional boreholes are sufficient to resolve DCD COL Item 2.0-29-A, which requires the COL applicant to complete additional borings at the COL site to address the provisions listed in ESBWR DCD Table 2.0-1, regarding stability of subsurface material and foundation requirements.

In addition, the staff reviewed the boring logs submitted in Appendix 2.5.4AA for completeness, in accordance with 10 CFR Parts 50 and 100. These regulations also require the applicant to submit plot plans and profiles of all seismic Category I facilities for comparison with the subsurface profiles and material properties at the North Anna 3 site. The staff reviewed the subsurface profiles and cross sections and plot plans and concludes that the relevant information provided by the applicant is acceptable and satisfies the previously mentioned requirements.

Finally, the staff reviewed the future excavation and backfill plans for the North Anna 3 site as illustrated in SER Figure 2.5.4-9 (FSAR Figure 2.5.4-225). The staff concludes that the information presented in these figures, together with the description in FSAR Section 2.5.4.3, meets the minimum acceptability requirements of 10 CFR Parts 50 and 100.

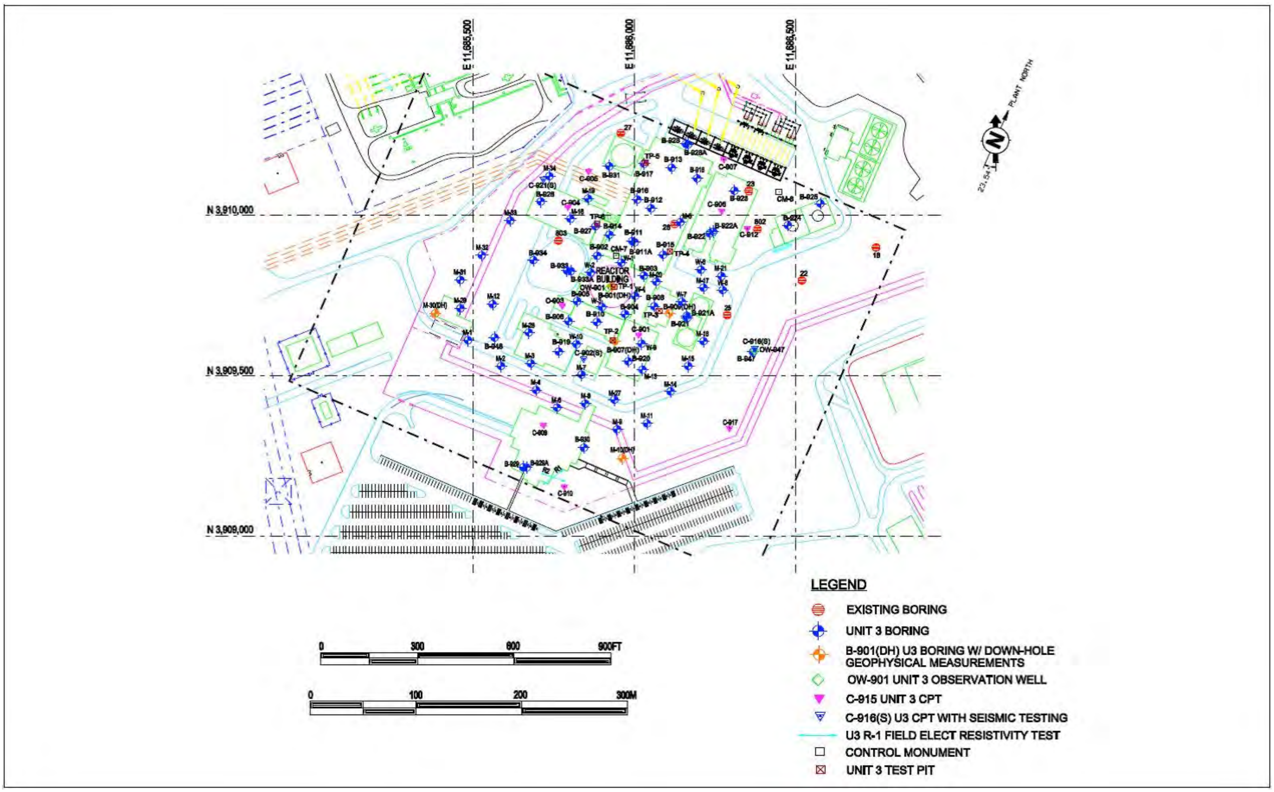


Figure 2.5.4-8. Unit 3 Boring Locations (FSAR Figure 2.5.4-217)

Resolution of ESP COL Action Items 2.5-1 to 2.5-3

ESP COL Action Item 2.5-1 was resolved in Section 2.5.1.4 of this SER. ESP COL Action Item 2.5-2 requires the applicant referencing the North Anna ESP to submit plot plans and profiles for all seismic Category I structures for comparison with the subsurface profile and material properties. FSAR Section 2.5.4.3 describes the locations of site exploration borings and provides the excavation plan for the seismic Category I structures, plan dimensions, and bottom of foundation elevations for those structures.

The applicant included several figures that show the subsurface profiles with the cross sections of foundation structures superimposed for comparison. SER Figure 2.5.4-8 shows the locations of the exploration points at the North Anna 3 site. Because the applicant included the plot plans and profiles that compare the foundations of seismic Category I structures to the subsurface profiles at the North Anna 3 site, the staff concludes that the applicant provided sufficient information to satisfy the requirements of ESP COL Action Item 2.5-2. Accordingly, the staff considers ESP COL Action Item 2.5-2 resolved.

ESP COL Action Item 2.5-3 requires the applicant referencing the North Anna ESP to provide detailed excavation and backfill plans for the North Anna 3 site. In FSAR Section 2.5.4.3, the applicant provided the plot plans and comparison figures of the excavation, subsurface profiles, and seismic Category I foundations. SER Figure 2.5.4-9 presents a representative plot plan and excavation and backfill plan. In FSAR Section 2.5.4.5.3, the applicant described details such as the source, type and material properties of backfill, the extent of excavations, and the compaction specifications that the backfill will be designed to meet. The applicant also described the quality control measures that it will employ to ensure that the backfill meets the design values. The staff concludes that the applicant provided adequate information to describe the excavation and backfill plans for the North Anna 3 site as required by ESP COL Action Item 2.5-3. Accordingly, the staff considers ESP COL Action Item 2.5-3 resolved.

Based on the information and findings above, the staff concludes that the discussion of the foundation interfaces, including the subsurface investigations at the North Anna 3 site, is acceptable and meets the relevant requirements of 10 CFR Parts 50 and 100.

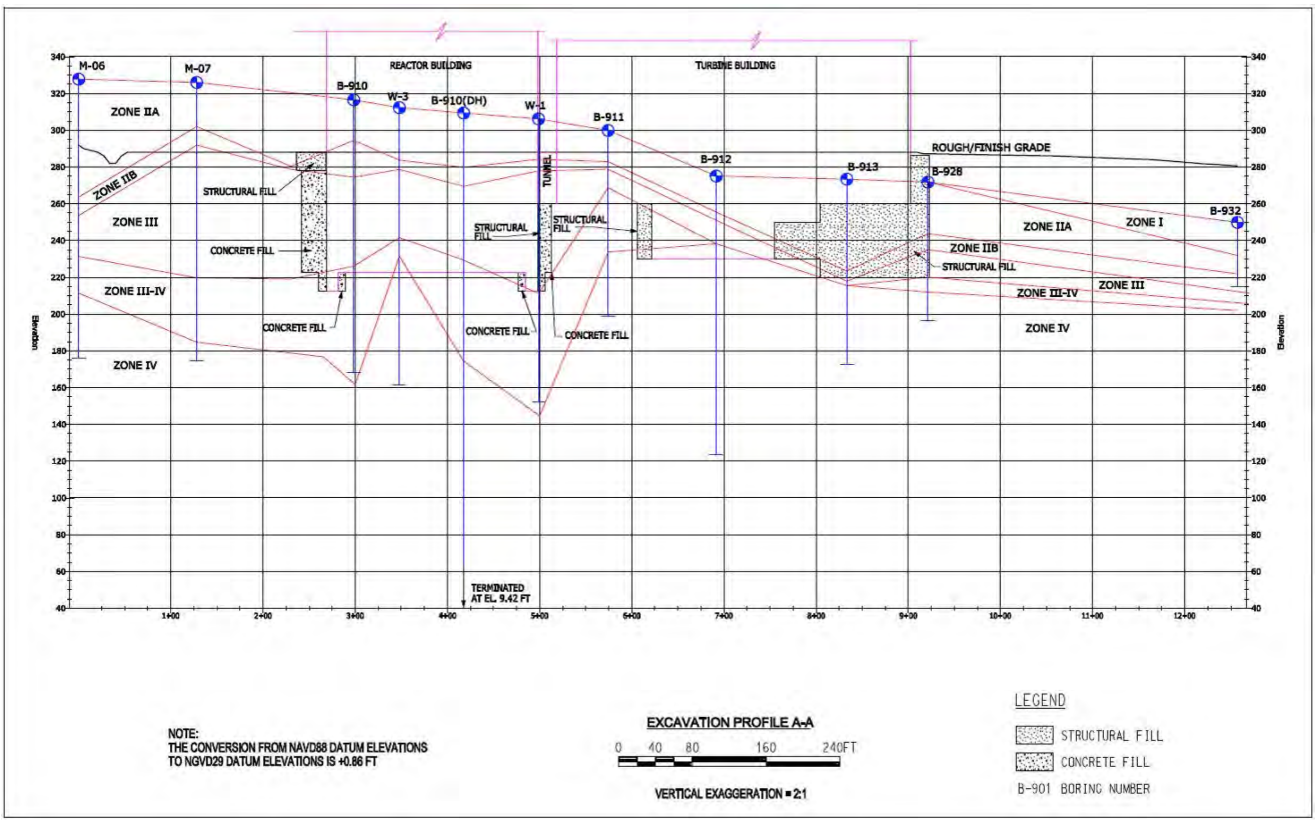


Figure 2.5.4-9. Excavation and Backfill Plan for Cross Section A-A'
(FSAR Figure 2.5.4-225)

2.5.4.4.4 Geophysical Surveys

FSAR Section 2.5.4.4 describes the geophysical investigations undertaken by the applicant to determine soil and rock dynamic properties. The applicant used field electrical resistivity testing, geophysical downhole testing, and seismic CPTs during both ESP and COL site investigations, as well as laboratory measurements of soil and rock properties to determine the shear wave velocities.

The staff reviewed the applicant's use of the latest geophysical and geotechnical testing methods and equipment in accordance with RGs 1.132 and 1.138, as well as the results that detail the dynamic properties of the soil and rock underlying the site, in accordance with 10 CFR 100.23. The staff concludes that the applicant used acceptable methods commonly used in current engineering practices to determine shear wave velocity for each of the soil and rock zones at the North Anna 3 site. The staff further concludes that the applicant adequately described the results of laboratory analyses to confirm the validity of the dynamic properties obtained from field explorations and tests.

The staff concludes that the results of the geophysical surveys completed as part of the COLA and presented in the FSAR are in accordance with 10 CFR 100.23, and therefore are acceptable. However, the staff noted a discrepancy between the previous ESP site investigations and those completed in support of the COLA. The staff issued RAI 02.05.04-2 dated June 17, 2008 (ADAMS Accession No. ML081690661), requesting the applicant explain the difference in the North Anna 3 site median V_s values presented in the ESP SSAR versus the 36 to 50 percent higher median V_s in the COL FSAR.

The applicant's response to RAI 02.05.04.-2 dated July 14, 2008 (ADAMS Accession No. ML082050558), stated that the reasons for the difference in median V_s values between the ESP SSAR and COL FSAR are two-fold. First, the applicant stated that it took the V_s values in the ESP SSAR across a widely spaced area that does not reflect the conditions of the North Anna 3 specific location. Also, the applicant pointed out that it took the V_s measurements in rock presented in the COL FSAR from closely spaced boreholes at the specific location of North Anna 3 seismic Category I structures. Second, the applicant stated that there was a difference in the equipment used to measure the V_s values during ESP and COL site investigations. The applicant used suspension P-S velocity logging equipment to measure and determine the median V_s during the COL site investigation, which is a more sophisticated and advanced method than the crosshole and downhole testing methods used during the ESP site investigations and reported in the ESP SSAR.

The staff reviewed the RAI response and agrees that the P-S suspension logging equipment will yield a better constrained measurement of median V_s. The staff also considered the refined locations of boreholes used to measure V_s values and agrees that a broader distribution of boreholes, coupled with a less sophisticated testing method, would explain the variance in median V_s values between the ESP SSAR and COL FSAR. Accordingly, the staff considers RAI 02.05.04-2 resolved and closed.

Based on the review of FSAR Section 2.5.4.4, the acceptability of the results of geophysical surveys performed in support of the COLA and the applicant's response to RAI 02.05.04-2, the staff concludes that the applicant adequately determined the dynamic properties of soil and rock through the geophysical surveys of the North Anna 3 site to satisfy the relevant requirements of 10 CFR 100.23.

2.5.4.4.5 Excavation and Backfill

FSAR Section 2.5.4.5 describes the extent of seismic Category I structure foundation excavations, fills, and slopes, the excavation methods and stability, and the backfill sources including quantity, compaction, and quality control. The applicant also addressed Permit Condition 3.E(6), as identified in the North Anna ESP. This permit condition requires the applicant to include information on geologic mapping of future excavations for safety-related structures and to evaluate any unforeseen geologic features encountered at the site area.

The staff reviewed the extent of seismic Category I structure foundation excavations, fills, and slopes, as illustrated in FSAR Figure 2.5.4-206, which shows the planned excavations relative to power block foundations. The staff compared the excavation plans with the requirements of 10 CFR 100.23 and concludes that the description of the extent of the excavations, fills, and slopes is acceptable. The staff also concludes that this information, with additional information provided in FSAR Sections 2.5.1 and 2.5.3, satisfies Permit Condition 3.E(6). The staff then reviewed the excavation methods and stability for the North Anna 3 site, which included a review of the soil excavation methods as well as the blasting techniques to be used for rock excavations, against the requirements of 10 CFR 100.23 and guidance contained in RG 1.132. The staff concludes that the methods of excavation and stability are acceptable because the applicant described plans to follow OSHA regulations when excavating into soil and will use conventional and widely accepted industry equipment to accomplish the excavation. Furthermore, the staff concludes that the applicant's plans to monitor blasting, including the use of controlled blasting techniques as part of the excavation into rock, are acceptable as it will reduce vibrations and ensure the integrity of the rock mass at the site during the excavation.

The staff also reviewed the descriptions of backfill the applicant proposed to be used in place of the removed weathered rock at the site. The staff determined that the applicant did not provide adequate information regarding the concrete fill under the seismic Category I foundation building mats. The staff issued RAI 02.05.04-3 dated June 17, 2008 (ADAMS Accession No. ML081690661), requesting the applicant to provide additional material and engineering properties of the concrete fill that will replace weathered rock exposed at the bottom of the excavation for seismic Category I building foundation mats. The applicant's initial response to RAI 02.05.04.-3 dated July 14, 2008 (ADAMS Accession No. ML082050558), stated that the properties of the concrete fill were yet to be determined. However, the applicant stated that it will design the concrete mix to have a V_s within the same range as the Zone III-IV rock at the North Anna 3 site. The applicant revised the FSAR to include a statement that the V_s of the concrete fill will be within the range of Zone III-IV rock.

In order for the staff to fully evaluate and determine the acceptability of the engineering properties of the concrete fill, the staff issued RAI 02.05.04-12 dated March 26, 2009 (ADAMS Accession No. ML090840271), and RAI 02.05.04-19 dated March 26, 2009 (ADAMS Accession No. ML090840271), in which the staff asked the applicant to provide the engineering properties of concrete fill, and, if the properties are assumed, to clarify how to ensure that the in-place concrete fill will have the same engineering properties as that used in stability analyses. The staff issued RAI 02.05.04-13 dated March 26, 2009 (ADAMS Accession No. ML090840271), in which the staff further asked the applicant to: (1) provide a detailed description of how the applicant planned to ensure that the static and dynamic properties of the backfill will meet or exceed both the requirements of the ESBWR DCD and the parameter values used in the analyses as described in the application, such as site seismic response analysis, bearing capacity and settlement estimates and SSI analysis; and (2) explain how the applicant plans to confirm that the design criteria of the ESBWR DCD and the parameter values related to backfill will be met during and after construction.

In North Anna 3 Revision 8 of FSAR Section 2.5.4.2.5a, the applicant described the detailed properties of the concrete fill: the minimum strength of 17.2 MPa (2,500 psi), the unit weight of 2,322 kg/m^3 (145 pcf), and a Poisson's ratio of 0.15. FSAR Section 2.5.4.10.1 states that the bearing capacity of the concrete fill is designed as 9,528 kPa (199 ksf) under both static and dynamic loading conditions. The applicant also provided ITAAC in Table 2.4.1-1, "ITAAC for Fill

Concrete Under and Around the Sides of Seismic Category I Structures," in COLA Part 10, "Tier 1/ITAAC," Section 2.4, "Site-Specific ITAAC," of its COLA.

Because structural soil will be backfilled surrounding the seismic Category I structures and the specific backfill soil properties were used in structural stability analyses, the applicant proposed an additional ITAAC for structural fill to ensure the in-place backfill will have the same, or better, engineering properties as designed. Table 2.4.1-2, "ITAAC for Structural Fill Surrounding Seismic Category I Structures," in COLA Part 10, "Tier 1/ITAAC," Section 2.4, "Site-Specific ITAAC" of its COLA presents the proposed ITAAC for structural fill. The staff verified that the appropriate change is incorporated in the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.4-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff reviewed the additional information regarding concrete fill including the minimum strength and bearing capacity, and the ITAACs for concrete fill and structural fill to be used for seismic Category I structure foundations. The specified ITAACs describe the inspection and testing required to ensure the properties of concrete fill and structural fill placed in the field meet the design requirements. Based on the staff's review of the latest FSAR Section 2.5.4.5 and the ITAACs for concrete fill and structural fill presented in the COLA, the staff concludes that the additional information related to excavation and backfill meets the relevant requirements of 10 CFR 100.23 and is acceptable. Accordingly, RAI 02.05.04-12, 02.05.04-13, and 02.05.04-19 are resolved and closed.

During the review of the SSI analysis results for FWSC, the staff noted that the analysis results indicated that although the shear stress capacity of the monolithic concrete fill material is sufficient to withstand the seismic demands for concrete fill under the FWSC foundation, the shear resistance of the construction joints, if needed as part of the detailed design, may not be sufficient to resist the sliding demands under the seismic loading. Because the FWSC is a seismic Category I structure and the stability of the concrete fill beneath it will directly affect the stability of the FWSC, in RAI 02.05.04-26 dated January 12, 2016 (ADAMS Accession No. ML16012A520), the staff requested the applicant to specify which code/standard(s)/procedure(s) will be followed in the construction of the in-place monolithic concrete fill. The staff also requested that the applicant explain under what conditions the construction joints may exceed the shear resistance requirement, and specify necessary ITAAC if shear reinforcements are to be used to ensure the bonding condition of the concrete fill construction joints in consideration of long-term effects in order to meet the required shear resistance capacity.

In its February 02, 2016, response to RAI 02.05.04-26 (ADAMS Accession No. ML16042A247), the applicant confirmed that the maximum seismic shear demand in the horizontal planes of the concrete fill is only about 12 percent of the nominal shear strength (0.39 MPa (56.3 psi) versus 3.26 MPa (473 psi)) even if conservatively neglecting the friction resistance of the mass concrete and using the lowest measured ratio of cohesion to compressive strength based on ACI 207.1R. The applicant then stated that the friction resistance alone is insufficient to achieve a minimum FS of 1.1 against sliding for the FWSC along the unbounded horizontal construction joints. To prevent this undesirable situation from happening in the field, the applicant stated that bonded construction joints will be used by following ACI 207.1R and other standards to ensure the monolithic integration of the concrete fill block under the FWSC.

The applicant proposed a revision to FSAR Section 2.5.4.2.5 to provide further details regarding the concrete fill below the FWSC, and clarify that the provisions of ACI 207.1R and the associated requirements in Part III, Section 1, of the North Anna 3 Quality Assurance Program Description (FSAR Appendix 17AA) will be applied to the concrete fill placed around and below the FWSC, as well as the RB/FB, and CB. The applicant also clarified that no shear reinforcements to the concrete fill will be used. The staff verified that the appropriate clarification is incorporated into the FSAR, Revision 9, and, therefore, Confirmatory Item 2.5.4-2 from the staff's advanced SER for North Anna 3 is resolved and closed.

The staff reviewed the RAI response and related industrial standards, such as ACI 207.1R and USACE EM 1110-2-2200, and concludes the following:

- The shear strength of the monolithic concrete fill under the FWSC foundation is sufficient to withstand the seismic demands with adequate margin; the maximum seismic shear demand of 0.39 MPa (56.3 psi) versus allowable shear strength of 0.54 MPa (7 8.8 psi) that used a proper FS.

- ACI 207.1R states that for bonded joints, the coefficient of internal friction can be taken as 1.0 and the cohesion resistance may approach that of the parent concrete. Therefore, the staff determined that the design concrete fill shear strength can be reached in the field if the ACI 207.1R standard is followed to ensure the construction of the monolithic concrete fill.

- The applicant committed to perform necessary testing during the concrete fill construction to ensure and verify that the as-built concrete compressive strength is equal to or greater than the required design strength. The ITAAC 1 on Table 2.4.1-1 of the North Anna 3 COLA, Part 10 will enforce this planned action to ensure that in-place concrete fill will meet all design requirements.

Based on the staff's review and verification of the proposed revision of the North Anna 3 COLA being incorporated in the FSAR, Revision 9, the staff considers the RAI 02.05.04-26 resolved and Confirmatory Item 2.5.4-3 from the staff's advanced SER for North Anna 3 closed.

Resolution of Permit Conditions 3.E(4) and 3.E(5)

Permit Condition 3.E(4) requires that an applicant for a CP or COL referencing this ESP shall excavate weathered or fractured rock at the foundation level and replace it with lean concrete before the commencement of foundation construction for safety-related structures.
Permit Condition 3.E(5) requires that the permit holder and an applicant for a CP or COL referencing this ESP shall not use an engineered fill with high compressibility and low maximum density, such as saprolite.

The applicant is planning to remove weathered or fractured rock at the foundation level and place concrete fill underneath all seismic Category I structures. The applicant will also place well-graded, highly compacted, angular to sub-angular gravel-sized particles of crushed rock as structural fill surrounding foundations, the concrete and structural materials will have adequate engineering properties to support structures and are non-liquefiable under the given site-specific seismic loading condition. In addition, the applicant proposed ITAACs (Tables 2.4.1-1 and 2.4.1-2 in Section 2.4 of North Anna COLA Part 10) specifically for the concrete and structural fills to ensure its in-place properties. In conjunction with staff's evaluation in Section 2.5.1 of this SER, the staff considers the requirements of Permit Conditions 3.E(4), and 3.E(5) are met.

Because the applicant adequately addressed North Anna 3 site excavation and backfill considerations for seismic Category I structure foundations, the staff concludes that the applicant provided sufficient information to satisfy the relevant requirements of 10 CFR 100.23 and guidance contained in RG 1.132.

2.5.4.4.6 Groundwater Conditions

In FSAR Section 2.5.4.6, the applicant described groundwater measurements and elevations and construction dewatering plans. This section also references FSAR Section 2.4.12 for a more detailed description of the groundwater conditions at the North Anna 3 site. The staff reviewed the groundwater information provided in FSAR Section 2.5.4.6, including conditions before, during, and after excavation and the associated dewatering plan, as well as measures to minimize drawdown effects on the surrounding environment. The staff concludes that this information is acceptable and meets the requirements of 10 CFR Part 100 because it includes sufficient detail on the groundwater conditions at the site such as measurements and elevations, as well as dewatering plans for the excavation and construction, for staff to evaluate the stability of foundations and structures to be built at the site.

Resolution of ESP COL Action Item 2.5-4

ESP COL Action Item 2.5-4 requires the applicant referencing the North Anna ESP to evaluate the groundwater conditions as they affect foundation stability and to provide detailed dewatering plans. In FSAR Section 2.5.4.6.3, the applicant evaluated the effects of groundwater conditions on foundation stability. The applicant concluded that the maximum design allowable groundwater level was at least 0.6 m (2 ft) below the final plant grade, while the maximum predicted groundwater level in the power block area of North Anna 3 is at least 2.3 m (7.5 ft) below design plant grade, and there were no buoyancy issues with deep buried structures. The applicant also stated that no permanent dewatering system will be required. The staff considered this information and agrees with the applicant that due to the groundwater level below the final grade of the site, there will be no buoyancy issues at the site and a permanent dewatering program will not be necessary. Therefore, the staff concludes that the applicant provided sufficient information to address the requirements of ESP COL Action Item 2.5-4. Accordingly, the staff considers ESP COL Action Item 2.5-4 resolved.

The staff also considered the groundwater condition related requirements specified in RG 1.132 and 10 CFR 100.23. Based on the level of detail provided to describe the groundwater conditions at the site, including groundwater elevations, dewatering plans, and the proximity of groundwater to the final plant grade and foundations—as well as the resolution of ESP COL Action Item 2.5-4—the staff concludes that the applicant's assessment of groundwater conditions is acceptable and meets the relevant requirements of 10 CFR Parts 50 and 100.

2.5.4.4.7 Response of Soil and Rock to Dynamic Loading

FSAR Section 2.5.4.7 describes the applicant's V_s design profiles to determine the response of the soil and rock underlying the North Anna 3 site to seismic loading. The applicant also described shear modulus and damping variations with shear strain, and amplification/attenuation analyses performed for rock and soil.

The staff reviewed the applicant's modeling of the variation of soil shear modulus and damping with cyclic shear strain. The staff compared RCTS test results and the generic soil degradation curves used in ESP analyses, which yielded good agreement with the EPRI curves. The staff also reviewed the curves selected for each of the soil and rock zones to determine whether the applicant used the appropriate criteria, such as grain size, cohesiveness, confining pressure, and V_s. The staff concludes that the applicant selected shear modulus and damping degradation curves based on appropriate criteria and are suitable for Zone IIA, IIB, and III soil and rock. The staff further concludes that the damping ratio of 1 percent with a variation of about ± 0.5 percent for the Zone III-IV and Zone IV rock is acceptable because this is a conservative value for this type of rock.

Resolution of ESP COL Action Items 2.5-5 and 2.5-9

ESP COL Action Item 2.5-5 requires the applicant referencing the North Anna ESP to provide soil column amplification/attenuation analyses for the specific selected locations for the nuclear power plant structures. FSAR Section 2.5.4.7.4 describes the rock and soil column amplification/attenuation analyses conducted for North Anna 3 using the P-SHAKE computer program. The applicant illustrated the maximum acceleration versus depth and noted that the peak acceleration was 0.31g and 0.56g for the LF and HF earthquake, respectively. The PGAs occurred about 12.8 m (42 ft) below natural ground surface. The staff concludes that the applicant provided sufficiently detailed descriptions of the amplification/ attenuation analyses for use in the staff's evaluation of the applicant's site seismic response, as discussed in Section 2.5.2.4 of this SER, which also meet the requirements of ESP COL Action Item 2.5-5. Therefore, the staff considers ESP COL Action Item 2.5-5 resolved.

ESP COL Action Item 2.5-9 requires the applicant referencing the North Anna ESP to ensure that the average V_s of the material underlying the foundation for the reactor containment equals or exceeds that of the chosen design. FSAR Section 2.5.4.7.1 describes the V_s determinations that the applicant made for soil, rock, and backfill at the North Anna 3 site. The applicant compared the soil and bedrock profiles to the DCD site parameter values in FSAR Table 2.0-201 and concluded that the V_s values at North Anna 3 were greater than the minimum V_s design values. The ESBWR DCD requires a COL applicant to use the lower bound shear wave velocity value after taking into account uncertainties of soil properties under site-specific seismic loading conditions to determine the equivalent uniform shear wave velocity. Because the applicant initially combined rock layers with soil layers when determining the average soil shear wave velocity within certain depth, in RAI 02.05.04-14 dated March 26, 2009 (ADAMS Accession No. ML090840271**)**, the staff requested the applicant to properly determine the design required soil shear wave velocity.

The applicant's response to RAI 02.05.04-14 dated June 17, 2009 (ADAMS Accession No. ML091700117), revised its calculation by not mixing rock and soil layers and following the design requirement when determining average shear wave velocity. The staff reviewed the information provided in the latest revision of FSAR Section 2.5.4.7 regarding the average V_s of subsurface materials and confirmed that the revised subsurface material properties followed the ESBWR design guide and are presented in the latest revision of the FSAR. The staff therefore concludes that the applicant adequately determined shear wave velocity of subsurface materials and addressed the issue of the RAI 02.05.04-14, as well as the ESP COL Action Item 2.5-9. Accordingly, the staff considers ESP COL Action Item 2.5-9 is resolved and RAI 02.05.04-14 is resolved closed.

Because the applicant adequately addressed the response of the soil and rock to dynamic loading at the North Anna 3 site and resolved ESP COL Action Items 2.5-5 and 2.5-9, the staff concludes that the applicant provided sufficient information to satisfy the relevant requirements of 10 CFR Parts 50 and 100.

2.5.4.4.8 Liquefaction Potential

The staff reviewed FSAR Section 2.5.4.8 and evaluated the applicant's liquefaction analyses for the North Anna 3 site to ensure conformance with the criteria described in RG 1.198. The staff focused its review on the applicant's conclusion that only the Zone IIA saprolite is susceptible to liquefaction, and the applicant's liquefaction analyses for Zone IIA saprolites outside of the power block area for soils that it will not excavate, as well as the parameters used in these analyses.

The staff reviewed the applicant's liquefaction potential assessment for the North Anna 3 site based on SPT data, CPT data, and shear wave velocity data analyses. For each analysis, the applicant used the method proposed by Youd et al. (2001). The staff determined that the applicant used the latest empirical method for the liquefaction analyses in accordance with RG 1.198, and therefore concludes that the North Anna 3 liquefaction potential analysis is acceptable.

The staff reviewed the liquefaction analyses that the applicant performed for the engineered backfill designed to be granular material and possibly saturated due to the design maximum groundwater level being above the bottom of the backfill layer. In RAI 02.05.04-7a dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked why the applicant did not perform a liquefaction analysis for the backfill soil in accordance with the recommendations of RGs 1.206 and 1.198. The applicant's response to RAI 02.05.04-7a dated July 14, 2008 (ADAMS Accession No. ML082050558), stated that the analyses for backfill soil at the North Anna 3 site showed that the soil was non-liquefiable. The applicant further stated that the non-liquefiable nature of the soil was attributable to the fill beneath the FWSC being both dense and gravelly. The applicant cited the results of liquefaction potential analyses based on SPT, CPT and V_s data as further evidence of the non-liquefiable nature of the structural fill. The staff considers the additional information and the staff's previous review of the liquefaction potential for the ESP application to be sufficient to conclude that the applicant provided adequate information to demonstrate that the backfill soil is non-liquefiable. Accordingly, the staff considers RAI 02.05.04-7a resolved and closed.

The staff reviewed the liquefaction-induced dynamic settlement determined by the applicant using the method outlined in Tokimatsu and Seed (1997) to obtain the maximum dynamic settlement of about 41 mm (1.6 in) for the Zone IIA saprolite caused by earthquake shaking. In RAI 02.05.04-10 dated June 19, 2008 (ADAMS Accession No. ML081710161), the staff asked the applicant to explain why this value is significantly smaller than the value determined in the ESP SSAR (127 mm [5 in]). In the applicant's response to RAI 02.05.04-10 dated August 4, 2008 (ADAMS Accession No. ML082200626), the applicant stated that the maximum settlements estimated in the FSAR differed significantly from the ESP SSAR for two reasons: first, the CPT test data, which formed the basis for the FSAR settlements, was collected at some distance apart from the locations where the applicant collected the CPT test data for the ESP SSAR; second, due to the distance separating the locations, the underlying saprolitic soils do not have identical properties, which also contributed to the difference. The applicant also stated that the PGAs used in the FSAR analysis were about 40 percent lower than those used in the ESP SSAR analysis. The applicant noted that the relationship between cyclic stress ratio and dynamic settlement was non-linear, so smaller peak accelerations will give equal or lower dynamic settlement values.

The staff also reviewed this information and considered that although the applicant performed the CPT tests at different locations where soil properties may be different during ESP and COL site investigations, the soil property variation was not significant. The staff compared the strength parameters for the saprolite soil in the FSAR to those in the ESP SSAR and noted that the values presented in the ESP SSAR were higher. The applicant also indicated that "the value of cyclic stress ratio used as input to the dynamic settlement analysis is directly proportional to the peak ground acceleration." However, the staff determined that even though the PGAs used in the FSAR analysis were more than 40 percent lower than those used in the ESP SSAR, the applicant did not explain why the ESP SSAR estimated dynamic settlement was almost 3 times that presented in the FSAR. Therefore, in RAI 02.05.04-18 dated March 26, 2008 (ADAMS Accession No. ML090840271), a supplement to RAI 02.05.04-10, the staff asked the applicant to explain why the estimated dynamic settlement in the ESP SSAR was almost 3 times of that estimated in the FSAR while there is only a 40 percent difference for PGAs used in these two calculations.

In the applicant's response to RAI 02.05.04-18 dated June 17, 2009 (ADAMS Accession No. ML091700117), and in a later version of the FSAR, the applicant explained that for the estimated maximum dynamic settlement of the Zone IIA saprolite due to earthquake induced seismic loading, a significantly smaller value was obtained for the COLA than that calculated in the ESP SSAR is because in the ESP SSAR the dynamic settlement was estimated based on soil encountered in one of the CPTs performed for the ESP investigation, while the new estimate was based on overall site investigation data. Nonetheless, since the applicant chose to use the maximum dynamic settlement of 12.7 cm (5 in) in the FSAR (the same as that presented in the ESP SSAR), which is a conservative approach, the staff concludes that it is acceptable. Accordingly, RAI 02.05.04-18 is resolved and closed.

Resolution of Permit Condition 3.E(7)

This Permit Condition 3.E(7) requires the applicant to improve Zone II saprolitic soils and reduce any liquefaction potential if it will remain under any safety-related structures. Because FSAR Section 2.5.4.8 states that all safety-related structures would be founded on rock or concrete fill placed on rock, and the applicant planned to remove Zone II saprolite and replace it with engineering fills for all safety-related and/or seismic Category I structure foundations at the North Anna 3 site, the staff concludes that the requirements of Permit Condition 3.E(7) are met.

In summary, the staff reviewed FSAR Section 2.5.4.8 and the applicant's response to RAI 02.05.04-7a, regarding the non-liquefiable nature of the backfill, and finds that the applicant's conclusion of liquefaction potential at the site is acceptable because there will be no liquefiable material underneath or surrounding the seismic Category I structures and the methods used in liquefaction potential analyses for soil outside the power block are commonly used methods in engineering practices. The staff further concludes that the removal of potentially liquefiable soil from all seismic Category I structure foundations at the site is sufficient to satisfy Permit Condition 3.E(7).

Therefore, the staff concluded that the assessment of the liquefaction potential at the planned North Anna 3 site is adequate and satisfies the requirements of 10 CFR Part 50, Appendix A; 10 CFR Part 50, Appendix S; GDC 2, and 10 CFR 100.23.

2.5.4.4.9 Earthquake Design Basis

FSAR Section 2.5.2.6 presents the applicant's derivation of the SSE and Operating Basis Earthquake (OBE). Section 2.5.2.4 of this SER summarizes the staff's evaluation and conclusions.

2.5.4.4.10 Static Stability

The staff reviewed FSAR Section 2.5.4.10. The review focused on the applicant's determination of the bearing capacities for each of the soil and rock zones as well as the applicant's settlement and lateral earth pressure analysis. The applicant also presented bearing capacities and earth pressures for each of the zones and described how it obtained those results.

Bearing Capacity

The staff reviewed the initial bearing capacity calculations and identified several concerns. One area of concern was the difference in dynamic bearing capacity for the RB and FB, which was initially stated as 10,200 kPa (214 ksf) in FSAR Table 2.5-215 and 12,401 kPa (259 ksf) in FSAR Table 2.0-201. In RAI 02.05.04-6 dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked the applicant to clarify the values of allowable dynamic bearing capacity for the RB/FB. The applicant's response to RAI 02.05.04-6 dated July 14, 2008 (ADAMS Accession No. ML082050558), stated that the computed dynamic bearing capacity value for concrete was 10,200 kPa (214 ksf) and for Zone III-IV bedrock was 12,401 kPa (259 ksf). The applicant also stated that since the value for the concrete was lower, it will revise FSAR Table 2.0-201 to reflect the concrete dynamic bearing capacity. The applicant also estimated the allowable dynamic bearing capacity as the least value of the allowable bearing capacity of the underlying strata, regardless of thickness. In the case of the RB/FB, this least value stratum is the concrete fill. The staff reviewed the applicant's response regarding how the allowable bearing capacity was determined and concludes that it is acceptable. However, the staff had additional concerns for how the applicant determined the properties of the concrete fill to be used in the analyses, because there is no three dimensional information available about the concrete fill to be placed in the field, nor has the applicant finalized the design of the concrete fill. Therefore, in follow-up RAI 02.05.04-15 dated March 26, 2009 (ADAMS Accession No. ML090840271), the staff asked the applicant to clarify how it determined the properties of the concrete fill, such as engineering properties and thickness underneath the foundation in all directions, and used the results in the allowable bearing capacity calculation without knowing the actual concrete fill design and placement at foundation.

The applicant stated that local failure would not occur in the concrete mat foundation of the FWSC; however, the local failure not occurring in the concrete mat does not exclude the possibility of local failure in the backfill layers beneath the concrete mat. Therefore, in RAI 02.05.04-16 dated March 26, 2009 (ADAMS Accession No. ML090840271), the staff asked the applicant to address the possibility of local failure within the backfill layer beneath the concrete mat in the foundation stability analysis.

As another foundation bearing capacity related issue, in RAI 02.05.04-19 dated March 26, 2009 (ADAMS Accession No. ML090840271), the staff asked the applicant to provide details on what load combinations it used in the dynamic bearing capacity estimate and why it used one and one-third of static bearing capacity as dynamic bearing capacity for this site without actual analysis.

To address the issues identified above, the applicant's response to RAI 02.05.04-15 dated August 20, 2009 (ADAMS Accession No. ML092360773) and in the revised FSAR, the applicant specified that the concrete fill will have a minimum strength of 17,240 kPa (2,500 psi, or 360 ksf), with a unit weight of 2.32 g/cm^3 (145 pcf) and Poisson's ratio of 0.15. The applicant also stated that for the specified concrete fill, it will use 10,244 kPa (214 ksf) (the final design value is specified as 9,528 kPA (199 ksf) as the allowable bearing capacity for both static and dynamic loading conditions, in accordance with the guidelines of ACI 349-01 (2001). Therefore, this issue and RAIs are resolved and closed.

To further address the issues identified by RAI 02.05.04-16, in a response dated June 17, 2009 (ADAMS Accession No. ML091700117), the applicant stated that the large, thick, heavily-reinforced concrete mat used to support the FWSC provides the most stable kind of soil-supported foundation. This type of mat foundation has two distinct advantages: (1) the confinement of the foundation provided to a loaded granular (cohesionless) soil will increase the soil's bearing capacity; and (2) the structural integrity and resulting stiffness of the mat itself. Normally the local failure cannot occur beneath a mat foundation as long as the foundation itself does not fail structurally.

In the applicant's response to RAI 02.05.04-19 dated June 17, 2009 (ADAMS Accession No. ML091700117), the applicant stated that it will build the RB/FB and the CB on bedrock or on concrete fill above bedrock, and thus the increase in bearing capacity for dynamic loads for soils is no longer applicable. Other structures, such as RW and TB, will be supported on either structural fill or on weathered rock and sound rock or on a combination of structural fill and weathered and sound rock. The allowable bearing capacity for those buildings was conservatively determined based on the lowest allowable bearing capacity of any stratum underlying those structures (the Zone III weathered rock). Because the applicant did not use the allowable bearing pressure for soil and the increase in allowable bearing pressure as noted in the International Building Code (IBC) for any of the structures, no IBC-related load combinations are considered.

The staff reviewed the additional information and concludes that there is adequate margin by using 9,528 kPa (199 ksf) as allowable bearing capacity for the 17,240 kPa (360 ksf, or 2,500 psi) concrete fill, and all other rock layers underlying the foundation have higher bearing capacity. The staff, therefore, concludes that this is a conservative approach and acceptable. The staff also concludes that the probability of localized foundation failure at this site is negligible because no safety-related structure will be founded on a soil layer; therefore, there is no mechanism for large local settlements below the FWSC mat or other seismic Category I structures. Finally, the staff agrees with the applicant that because the revised allowable bearing capacity values did not use the IBC code to increase the bearing capacity by one-third, no IBC-related load combination needs to be considered when determine the dynamic bearing capacity.

Based on the review of the bearing capacity calculations provided in the revised FSAR referencing the ESBWR DCD, the staff noted that the applicant calculated the allowable static bearing capacity values for each bedrock zone and concrete fill following the industrial standards. The applicant used values less than 20 percent of the ultimate crushing strength of the rock as allowable static bearing capacity and allowable dynamic bearing capacity, which results in a conservative estimate of the bearing capacity for rock layers. The applicant also used a much smaller than designed concrete fill strength value as bearing capacity for concrete fill. By comparing the estimated bearing capacity values with standard design requirements, the staff finds that the minimum FS is greater than 3.3 for static loading condition; and greater than 7.9 for dynamic loading condition for all structures. The staff further concludes that the applicant conservatively selected bearing capacity values, and these parameters are enveloped by the standard design; therefore, the subsurface materials underneath the safety-related structures at the site are capable of meeting the design bearing capability requirements. The staff also verified that the latest version of the FSAR presents all revised calculation results, accordingly, Open Items previously identified by the staff are closed and the associated RAIs are resolved and closed.

Because the coefficient of friction is one of the engineering properties used for foundation stability evaluation, in RAI 02.05.04-17 dated March 26, 2009 (ADAMS Accession No. ML090840271), the staff asked the applicant to justify the site-specific coefficient of friction used to calculate the site-specific FS against sliding between the basemat and underlying material.

In the applicant's response to RAI 02.05.04-17 dated June 17, 2009 (ADAMS Accession No. ML091700117), the applicant provided the coefficient of friction used for this site. Because all seismic Category I structures will be founded on subgrade materials including Zone IV bedrock, Zone III-IV bedrock or concrete fill; and some buildings will be on compacted structural fill, different values of the coefficient of sliding for a poured concrete foundation on the site subgrade materials were specified with range from 0.55 to 0.7. The staff considers that the applicant specified coefficient of friction values based on typical material properties, and the friction angles corresponding to those coefficients, from 23 to 33 degrees, are normal values for the materials involved. The staff confirmed that the applicant specified coefficients of friction used in foundation stability analyses in Table 2.5.4-208 of the latest revised FSAR; accordingly this RAI is resolved and is closed.

Settlement Analysis

During the review of the settlement analyses performed by the applicant, the staff identified three areas requiring additional information. In FSAR Section 2.5.4.10.2, the applicant estimated settlement using a formula that included the layer elastic modulus E. In RAI 02.05.04-7c dated June 17, 2008 (ADAMS Accession No. ML081690661) and RAI 02.05.04-23, dated February 09, 2011 (ADAMS Accession No. ML110400770), the staff asked the applicant to clarify the types of E values used in the settlement calculations whether they were corresponding to small or large strains. In the July 14, 2008, and March 7, 2011, responses (ADAMS Accession Nos. ML082050558 and ML110680412), the applicant clarified that it used the high-strain elastic modulus in the settlement calculations for the North Anna 3 Seismic Category 1 structure foundations. Because the applicant used an elastic modulus in settlement calculation that would not result in underestimating the settlement at the site, the staff concludes that this approach yielded an adequate settlement estimate. Accordingly, the staff considers RAI 02.05.04-7c and RAI 02.05.04-23 resolved and closed.

Also in FSAR Section 2.5.4.10.2, the applicant initially estimated the differential settlement for the FWSC excluding the weight of the basemat. In RAI 02.05.04-7d dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff sought justification as to why the weight of the basemat was not included in the settlement calculation. In a July 14, 2008 response (ADAMS Accession No. ML082050558) to this RAI, the applicant stated that it excluded the weight of the basemat from the settlement analysis following the guidance in Note 15 of Table 2.0-1 of the ESBWR DCD, which states that the design of the foundation mat accommodates immediate and long-term differential settlements after installation of the basemat. Although DCD Table 2.0-1 excludes the weight of the basemat in the differential settlement calculations, the applicant provided estimated settlements that include the basemat to take all possible loads into consideration. The staff reviewed this response, including the information presented in ESBWR DCD Table 2.0-1 and the latest revision of FSAR Table 2.5.4-212, and concludes that although the DCD does not include the basemat in the settlement calculations, the applicant included the basemat in the settlement calculations and showed that the estimated site-specific settlement of FWSC meets the design requirement; therefore, the applicant provided sufficient information to resolve RAI 02.05.04-7d and the staff considers it closed.

In RAI 02.05.04-7e dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked the applicant to explain why it did not consider the seismic settlement of the FWSC foundation in the settlement analysis. The applicant's response referred to its July 14, 2008 response to RAI 02.05.04-7a (ADAMS Accession No. ML082050558), which described the structural fill as well-graded, highly compacted, angular to sub-angular gravel-sized particles of crushed rock. The applicant stated that the structural fill would be compacted to a high degree of density using a heavy vibratory steel-drummed roller. Although the applicant anticipated some small settlement of the fill under the FWSC due to tank loading, the high relative density of the fill would prevent any significant densification or settlement during a seismic event. Moreover, in the latest revision of the FSAR, the applicant stated that it will replace structural fill with concrete fill under the FWSC, and therefore seismic settlement is no longer an issue. Accordingly, the staff concludes that the applicant adequately addressed RAI 02.05.04-7e and considers the RAI resolved and closed.

Resolution of NAPS COL 2.0-29-A

NAPS COL 2.0-29-A (ESBWR DCD COL Item 2.0-29-A) requires that a COL applicant referring to the ESBWR design to provide site-specific information in accordance with SRP 2.5.4 and address: (1) localized liquefaction potential under other than seismic Category I structures, and (2) settlement and differential settlements. In FSAR Section 2.5.4.8 and Section 2.5.4.10.2, the staff concludes that the applicant provided sufficient information to address liquefaction potential under all structures, both seismic Category I structures and non-seismic Category I structures, and estimated the settlement of those structures using adequate methods to satisfy the requirements specified in NAPS COL 2.0-29-A. Therefore, the staff considers NAPS COL 2.0-29-A (ESBWR DCD COL Item 2.0-29-A) resolved.

Earth Pressures

The staff reviewed FSAR Sections 2.5.4.10.3 and 3.7.2.4.1, and related calculations, and finds that the methods used to estimate dynamic (seismic) and static lateral earth pressure on below-grade walls of the power block structures is consistent with the methodology used in ESBWR DCD. The staff also noted that in the static lateral earth pressure calculation, the applicant considered earth pressures induced by hydrostatic pressure and lateral loads on below-grade walls due to embedment and surcharge loading. In the calculations, the key site characteristics that the applicant used, such as unit weight of structural fill, at-rest pressure coefficient, and groundwater level, are the same as or enveloped by the parameters used for the ESBWR design, which ensures that the design plant static lateral earth pressure loading envelopes the North Anna 3 static lateral earth pressure loading. In the dynamic lateral earth pressure calculation, the applicant considered the active lateral earth pressure generated by earthquake-induced horizontal ground accelerations. For at-rest lateral earth pressure under seismic loading, the applicant used the Wood's soil pressure distributions model as described in ASCE 4-98. Because the lateral earth pressure induced by vertical ground accelerations is very small, the applicant did not consider this component in accordance with common engineering practices. The applicant used a peak acceleration of 0.31g, corresponding to higher magnitude but LF dominated earthquake, to develop the seismic active earth pressure diagram.

Based on the above findings, the staff concludes that the applicant considered all possible loadings, including the site SSE loading that can contribute to lateral earth pressure on plant below-ground walls in this analysis, which follows the guidance of industrial standards and RGs. The staff further concludes that the use of the peak acceleration of 0.31g for LF earthquake when developing the seismic active earth pressure is adequate because it considered higher magnitude of the corresponding earthquake that has higher energy and greater potential for moving the subsurface materials and causing damage. Finally, the staff concludes that the applicant used methods endorsed by industrial standards and commonly used in engineering practices to adequately determine the static and dynamic lateral earth pressure on below-ground walls of the power block structures.

The comparison of estimated site-specific and ESBWR design total (static and dynamic) lateral earth pressure confirms that the design lateral earth pressure diagram envelopes the site-specific estimate; therefore, the staff concludes that the site-specific lateral earth pressure will not affect the stability of foundations and structures.

Resolution of ESP COL Action Item 2.5-6

ESP COL Action Item 2.5-6 requires the applicant referencing the North Anna ESP to analyze the stability of all planned safety-related facilities, including bearing capacity, rebound, settlement, and differential settlements under deadloads of fills and plant facilities, as well as lateral loading in the COLA. FSAR Section 2.5.4.10 describes the static stability of the North Anna 3 site, including the bearing capacity, rebound, settlement, and differential settlement. The applicant also discussed lateral earth pressures at the North Anna 3 site. The staff reviewed this information and concludes that there were sufficient details to satisfy the requirements of ESP COL Action Item 2.5-6. Therefore, the staff considers ESP COL Action Item 2.5-6 resolved.

The staff reviewed FSAR Section 2.5.4.10 and applicant's responses to related RAIs, and concludes that the bearing capacity, settlement and earth pressure analyses and results for the North Anna 3 site are acceptable for satisfying the ESBWR design requirements and meeting the relevant requirements of 10 CFR Parts 50 and 100. The staff also concludes that the stability analyses were adequate to resolve ESP COL Action Item 2.5-6 and NAPS COL 2.0-29-A.

2.5.4.4.11 Design Criteria

In FSAR Section 2.5.4.11, the applicant provided general geotechnical criteria such as an acceptable FS against liquefaction, allowable bearing capacities, acceptable total and differential settlements, and an FS against slope stability failure, sliding, and overturning.

Resolution of ESP COL Action Item 2.5-7

ESP COL Action Item 2.5-7 requires the applicant referencing the North Anna ESP to include the design-related criteria that pertain to structural design in the COLA, such as wall rotation, sliding, and overturning. FSAR Section 2.5.4.11 describes the design criteria that apply to North Anna 3. These criteria include a minimum FS against sliding and overturning of 1.1, as well as an FS against liquefaction, bearing capacity failure and slope stability failure, among others. The staff reviewed this information and concludes that the applicant provided the applicable FS against sliding and overturning, as well as other design criteria, sufficient to satisfy the requirements of ESP COL Action Item 2.5-7. Therefore, the staff considers ESP COL Action Item 2.5-7 resolved.

The staff reviewed the FS used by the applicant and compared these values with those of RG 1.198, the related SRP sections and industry codes and standards, and concludes that those factors of safety are acceptable. The staff reviewed this information, including the resolution of ESP COL Action Item 2.5-7, and concludes that the applicant provided adequate design criteria for the North Anna 3 site, such as estimated settlement and earth pressure values, the factors of safety against liquefaction, bearing capacity failure, slope stability failure, sliding, and overturning to meet the relevant requirements of 10 CFR Parts 50 and 100.

2.5.4.4.12 Techniques to Improve Subsurface Conditions

FSAR Section 2.5.4.12 describes the removal of any Zone IIA saprolite beneath or within the zone of influence of seismic Category I or II structures and the replacement of the saprolite with structural fill for North Anna 3 site. The staff reviewed the plans to improve the Zone IIA saprolite in accordance with the methods described in the ESP SSAR.

Resolution of ESP COL Action Item 2.5-8

ESP COL Action Item 2.5-8 requires the applicant referencing the North Anna ESP to provide specific plans for each proposed ground improvement technique used, for the staff to determine whether the chosen technique will ensure that Zone II saprolitic soils will be able to support a safety-related foundation. In FSAR Section 2.5.4.12, the applicant described the techniques it will use to improve the subsurface conditions at the North Anna 3 site. The applicant described plans to remove the Zone IIA saprolitic soil, the only potentially liquefiable material identified at the site, and replace the excavated material with concrete fill and/or structural fill. The applicant stated that it will also remove zones of fractured or weathered rock from the areas immediately beneath the RB/FB, and FWSC basemat and replace it with concrete. The staff concludes that the applicant described the techniques it will use to improve the site, including the removal of the potentially liquefiable material from the foundation areas of the North Anna 3 structures, which meets the requirements of ESP COL Action Item 2.5-8. Accordingly, the staff considers ESP COL Action Item 2.5-8 resolved.

The staff further concludes that the methods described for subsurface improvements in FSAR Sections 2.5.4.12 and 2.5.4.5 are sufficiently detailed regarding the removal of the potentially liquefiable material and replacement with suitable structural fills at the North Anna 3 site to be acceptable and to satisfy the relevant requirements of 10 CFR Parts 50 and 100.

2.5.4.5 Post Combined License Activities

To ensure the quality of the backfills, either underneath or surrounding the seismic Category I structures, the applicant provided ITAACs in Table 2.4.1-1, “ITAAC for Fill Concrete Under and Around the Sides of Seismic Category I Structures,” Table 2.4.2-1, “ITAAC for Structural Fill Surrounding Seismic Category I Structures,” and Section 2.4, “Site Specific ITAAC,” in NAPS COLA Part 10; “Tier 1/ITAAC/Proposed License Conditions.”

The staff identified a License Condition relating to geologic mapping of both tectonic and non-tectonic surface deformation features at the site. The geologic license condition replaces ESP Permit Condition 3(E)(6) and is described in detail in Section 2.5.1.5 of this SER.

2.5.4.6 Conclusion

The staff reviewed the North Anna 3 COLA and cross checked the referenced ESP SSAR, ESBWR DCD and staff’s ESP SER. The staff’s review confirmed that the applicant addressed the relevant COL items, ESP COL Action items and ESP Permit Conditions, specifically, NAPS COL 2.0-29-A, NAPS ESP COL 2.5-2 through NAPS ESP COL 2.5-9 and ESP Permit Conditions 3.E(4) to 3.E(7). There are no outstanding issues that need to be addressed in the COL FSAR related to this section.

Based on its review, the staff concludes that the applicant conducted sufficient site investigations and performed adequate field and laboratory tests and associated analyses to provide sufficient information describing soil and rock conditions underlying the COL site of North Anna 3; provided sufficient information to characterize the subsurface materials at the site; and presented and substantiated information to assess the stability of subsurface materials and foundations. The staff reviewed the engineering properties of subsurface materials at the proposed site and backfill materials to be used during construction, the assessment of bearing capacity, liquefaction potential, settlement, and lateral earth pressure, as well as the development of a shear wave velocity profile through the site, and concludes that the applicant adequately addressed the related COL items and ESP permit conditions.

Accordingly, the staff concludes that the applicant provided sufficient information to meet the relevant requirements of ESBWR standard design and 10 CFR Part 50, Appendix A (GDC 2); Appendix S of 10 CFR Part 50; and 10 CFR 100.23, and therefore Section 2.5.4 of the North Anna 3 FSAR is acceptable.

2.5.5 Stability of Slopes

2.5.5.1 Introduction

Section 2.5.5 of this SER addresses slope stability information related to the North Anna 3 site. Section 2.5.5.2 of this SER provides a summary of relevant geologic and seismic information contained in FSAR Section 2.5.5 of the North Anna 3 COLA. SER Section 2.5.5.3 provides a summary of the regulations and guidance used by the applicant to perform the investigation. SER Section 2.5.5.4 provides a review of the staff's evaluation of FSAR Section 2.5.5, including any RAIs, open items, and confirmatory analyses. SER Section 2.5.5.5 discusses any post COL activities. Finally, SER Section 2.5.5.6 provides an overall summary of the applicant's and staff's conclusions, restates any bases covered in the application, and confirms that the application has met the requirements or fulfilled the regulations.

2.5.5.2 Summary of Application

In FSAR Section 2.5.5, the applicant provided the following:

COL Items:

- NAPS COL 2.0-30-A

NAPS COL 2.0-30-A addresses the provision in COL Item 2.0-30-A listed in the ESBWR DCD Table 2.0-1, regarding stability of slopes requirements.

- NAPS ESP COL 2.5-10

ESP COL Action Item 2.5-10 requires the COL applicant to perform a more detailed dynamic analysis of the stability of the existing slope and any new slopes using the SSE ground motion for the North Anna site.

- NAPS ESP COL 2.5-11

ESP COL Action Item 2.5-11 requires the COL applicant to provide plot plans and cross-sectional profiles of all safety-related slopes and to specify the measures that would be taken to ensure the safety of the slopes and the adjacent structures.

ESP Variance:

- NAPS ESP VAR 2.5-1

The slope stability analyses for the North Anna 3 site is presented in this FSAR section, which combine reviews of reports for the existing units and the originally planned Units 3 and 4, geotechnical literature, the ESP subsurface investigation, and the North Anna 3 subsurface investigation, and gave results that were different from those presented in ESP SSAR Section 2.5.5. To that end, the applicant also requested a variance from the information in the ESP SSAR relating to the stability of slopes, which was identified as NAPS ESP VAR 2.5-1 in the COLA. In this request, the applicant asked that the information presented in North Anna 3 FSAR Section 2.5.5 be used in place of the information presented in ESP SSAR Section 2.5.5 for the stability of slopes. The applicant stated that this request was based on the differences in slopes near North Anna 3 from the anticipated slopes in the ESP SSAR. Due to these differences, the applicant stated that for the seismic slope stability analysis, the PGA applied at North Anna 3 is also different from the ESP, although the method of analysis remains the same. The main differences are smaller PGA used in the seismic slope stability analysis than that used in ESP SSAR Section 2.5.5 and differences in the changed slope characteristics. Because the same method was used in the analyses, but with a shallower slope and a smaller applied seismic acceleration, the analyses yielded a higher computed FS against failure under both long-term static and short-term seismic conditions.

North Anna 3 FSAR Figure 2.5.5-201 presents the grading plan for North Anna 3. The applicant noted that the design plant grade for the power block area is at an elevation of 88.4 m (290 ft) sloping down to an elevation of 87.7 to 86.6 m (288 to 284 ft) around the perimeter. From the south and southwest of the TB toward the existing Units 1 and 2, the applicant noted that the slope reduces at 5 percent down to elevation 85.3 m (280 ft) at the SW Building. To attain the North Anna 3 elevations, the applicant noted that up to 9.1 m (30 ft) of fill is needed to bring the ground surface up to plant grade, where ground level is presently at around elevation 76.2 m (250 ft).

The applicant stated that there are no slopes that contribute to the support of any seismic Category I or II structures and only instability of the cut slopes at the northern and western edges of the plant could affect North Anna 3. The applicant described the southwesterly-oriented existing slopes to the west of Units 1 and 2 that were originally excavated during construction of the existing units. Additional details of the existing slopes are provided in Section 2.5.5.1.1 of the FSAR. The new slopes in the site area are cut slopes north of the power block that merge into the existing slopes to the west. The applicant noted that these new slopes reach a maximum height of 11.9 m (39 ft).

The applicant also discussed the impact of slope instability as part of ESP VAR 2.5-1, noting that the instability of the slopes surrounding the storm water management pond, as well as the temporary slopes in the site area, do not affect the safety of the plant or any of its structures. The applicant also noted that the nearest point of the existing slopes is more than 30.5 m (100 ft) from the new diesel tanks and even farther from the closest point on the SW cooling tower. The applicant also considered instability of the new 3-horizontal to 1-vertical (3h:1v) slope, but concluded it does not impact the foundation stability because the facilities are founded on concrete fill on top of bedrock.

To address NAPS ESP COL 2.5-11, the applicant discussed the stability of the existing and new slopes at the North Anna 3 site in the following subsections.

2.5.5.2.1 Slope Characteristics

North Anna 3 FSAR Section 2.5.5.1 describes the characteristics of the existing and new slopes, their subsurface conditions, and impacts of the slope instability on the seismic Category I structures at the North Anna 3 site. The applicant performed slope stability analyses for existing slopes and new slopes under static and dynamic (seismic) loadings to demonstrate that the minimum factors of safety meet the requirements defined in the DCD. Figure 2.5.5-1 in this SER illustrates that no slopes will contribute to the support of any of the Unit 3 seismic Category I structures or any of the other major power block structures.

Existing Slope Characteristics

Figure 2.5.5-1 of this report also shows the location and direction of the existing slopes, including Slope ES, a 2.4h:1v slope with a maximum height of 13.7 m (45 ft) to the southeast of the service water reservoir (SWR) for Units 1 and 2.

New Slope Characteristics

FSAR Section 2.5.5.1.2 describes the location of the new 11.9 m (39 ft) Slope SS, a 3h:1v slope to the east of the FWSC shown in plan view in SER Figure 2.5.5-1. The applicant noted that boring B-947 was drilled relatively close to the final location of the top of the slope during the North Anna 3 subsurface investigation. The stability analysis performed for Slope DD conservatively neglected a 4.6 m (15 ft) wide berm in the slope.

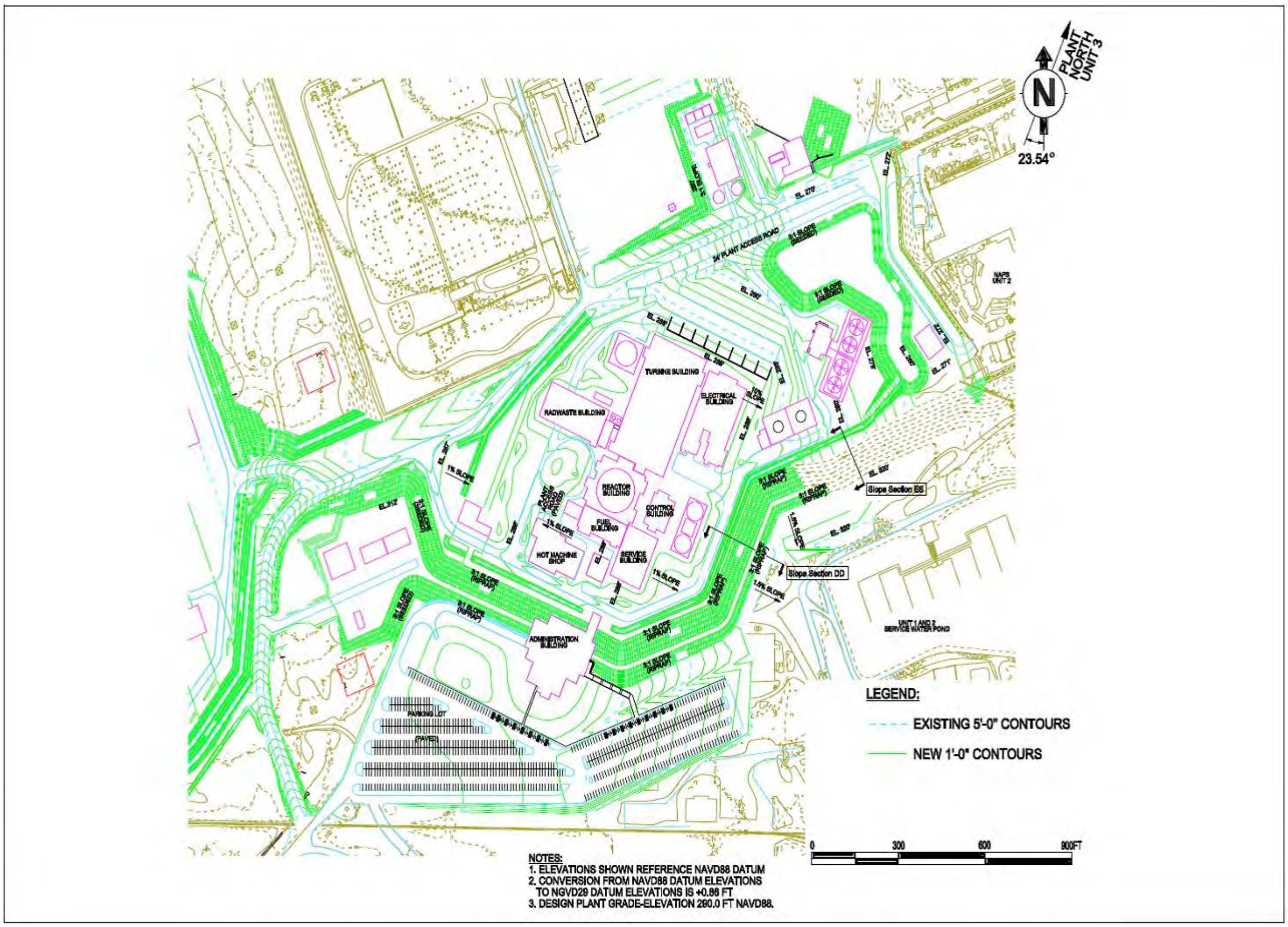


Figure 2.5.5-1. Location of Elevated Slopes (FSAR Figure 2.5.5-201)

Slope Subsurface Conditions

FSAR Section 2.5.5.1.3 describes the slope subsurface conditions at the North Anna 3 site and refers to Section 2.5.4.2.2 for details of the site soils and bedrock. Based on the site investigation data, the applicant determined that the soils in the slope consisted mostly of Zone IIA saprolites and were classified as silty sands. The applicant summarized the engineering properties of the site soils and bedrock, as well as the liquefaction characteristics of all of the Zone IIA saprolites estimated in FSAR Section 2.5.4.8.

New Slope Subsurface Conditions. The applicant also discussed the subsurface conditions of the new slopes in the site area. For the purposes of the stability analyses, the applicant noted that in B-929 Zone IIA saprolite is present down to about 14.2 m (46 ft) below the existing ground level with the remaining 5.4 m (18 ft) being Zone IIB saprolite.

Existing Slope Subsurface Conditions. The applicant summarized boring B-947 which provides information on the subsurface materials on the top of the existing slope and CPT C-916 which is adjacent to B-947. The applicant confirmed that the existing slope materials have the properties of the Zone IIA saprolite down to about 10.7 to 15.2 m (35 to 50 ft) below the existing ground level and the bottom 3.0 m (10 ft) of saprolite above weathered rock has the Zone IIB saprolite properties.

Slope Phreatic Surface

The applicant illustrated the phreatic, or groundwater, surfaces for existing and new slopes in FSAR Figures 2.5.5-202 and 2.5.5-203. The applicant developed these surfaces using water table levels measured in observation well OW-947 and derived in FSAR Section 2.4.12. Based on this information, the applicant concluded that the depth of the phreatic surface precluded any potential for liquefaction of the near-surface soils in the slopes.

2.5.5.2.2 Design Criteria and Analyses

FSAR Section 2.5.5.2 presents the design criteria for the new and existing slopes, as well as an analysis of the static and dynamic (seismic) stability analysis. The applicant presented the required FS, the stability of the existing slope, and analyses for both the existing and new slopes.

Required Factor of Safety

The applicant stated that the design criteria for the slopes are defined in the ESBWR DCD with minimum FS for static and dynamic loading of 1.5 and 1.1, respectively.

Stability of Existing Slope

The applicant stated that the existing slope (2.4h:1v) was thoroughly inspected during the ESP site investigation and shows no signs of distress.

Analysis of Existing Slope

The applicant used the computer program SLOPE/W, a commercial software product that computes the FS of earth and rock slopes, to analyze the static and dynamic stability of the existing slope ES. The properties of soil and rock are provided in FSAR Table 2.5.4-208.

<u>Long-Term Static Analysis</u>. The applicant used the Bishop method, which is available in the SLOPE/W program. The method divides the slope into slices and is based on the moment equilibrium assumption to compute long-term static stability. The applicant noted that the resulting FS of the static analysis for the existing slope was 2.29, which was above the minimum FS of 1.5 for long-term static stability.

Seismic Slope Stability Analysis. For the seismic slope stability analysis, the applicant used a pseudo-static approach that assumed the horizontal and vertical seismic forces act on the slope in a static manner as a constant force. The applicant used an average peak horizontal acceleration of 0.26g and a vertical acceleration of 0.130g in the slope for a LF earthquake, resulting in an FS of 1.30, more than the minimum 1.1 required. For the HF earthquake, the equivalent peak horizontal acceleration used was 0.42g with a vertical acceleration of 0.21g yielding an FS of about 1.04, less than the minimum 1.1. Because an actual seismic event would last only seconds, with the peak motions occurring for a small portion of the total duration, the applicant considered the pseudo-static approach to be conservative.

The applicant also used a pseudo-static approach recommended by Kramer (1996), which uses half of the peak acceleration value rather than a set peak value based on magnitude. The applicant concluded that the resulting FS against slope failure was above the required minimum of 1.1 at 1.61 and 1.41 for the LF and HF earthquake inputs, respectively.

As an alternative to applying the peak acceleration values for the pseudo-static analysis, the applicant applied the acceleration values recommended by Seed (1979) and used horizontal accelerations of 0.10g and 0.15g for HF and LF earthquake inputs with a vertical acceleration of zero. From these inputs, the applicant computed an FS of 1.76 and 1.57 for HF and LF earthquakes, respectively, which the applicant concluded were greater than the required minimum of 1.1.

The results of the applicant's analyses showed that the only case that gave a FS lower than the required minimum was the pseudo-static analysis using the HF peak acceleration. However, the applicant considered that to be an overly conservative approach and concluded that the existing 2.4h:1v slope to the southeast of the SWR will remain stable under long-term static and design seismic conditions.

Analysis of the New Slope

FSAR Section 2.5.5.2.4 analyzes the static and dynamic stability of the new 11.9 m (39 ft) high 3h:1v slope (Slope D-D) to the east of the FWSC, using the same methods as the existing slope analysis.

Long-Term Static Analysis

FSAR Figure 2.5.5-211 presents the input into the SLOPE/W program used in the analysis and the results. For long-term static stability, the applicant concluded that the calculated FS of 2.27 was well above the minimum FS of 1.5 required for safety.

Seismic Slope Stability Analysis

The applicant utilized three different methods to determine the FS for the stability of the new slope under seismic conditions. Using a pseudo-static analysis for the new 11.9 m (39 ft) high slope that incorporated an average PGA of 0.25g with a vertical acceleration of about 0.125g, the applicant determined the FS for the LF earthquake of 1.24. The applicant used an average peak horizontal acceleration of about 0.41g with a vertical acceleration of about 0.205g for the HF earthquake resulting in a FS of 1.00, less than the required minimum of 1.1. The applicant also used Seed's (1979) reduced peak acceleration and determined the FS for LF and HF earthquakes of 1.64 and 1.43, respectively. Finally, the applicant utilized the reduced peak acceleration of Kramer (1996) and determined an FS of 1.59 for the LF earthquake and 1.34 for the HF earthquake. Based on the stability analysis results and the considerations used for the existing slope, the applicant concluded that the new 3h:1v slope to the east of the FWSC will remain stable under long-term static and design seismic conditions.

2.5.5.2.3 Boring Logs

FSAR Section 2.5.5.3 summarizes the boring logs, CPT logs, observation wells, and laboratory test results for two borings, two CPTs, and one groundwater observation well in the area of the existing and new slopes. The applicant stated that borehole B-18 was drilled close to the toe of the existing 2.4h:1v slope to the north of the SWR. The applicant also described the location of boring B-947, CPT C-915 and C-916, and OW-947 as being near the top of the proposed new 3h:1v slope southeast of the FWSC. The applicant performed grain size tests for the saprolites in boring B-947.

2.5.5.2.4 Compacted Fill

FSAR Section 2.5.5.4 states that the existing 2.4h:1v slope and the new 3h:1v slope are cut slopes and do not contain fill materials in any significant quantity.

2.5.5.2.5 Applicant Conclusion

North Anna 3 FSAR Section 2.5.5.5 describes the applicant's conclusions regarding stability of the slopes at the North Anna 3 site. The applicant concluded that the existing slopes and embankments and the new slopes, such as storm water management Pond No. 1 or the temporary slopes and excavations, do not affect the stability of plant structures at North Anna 3, and therefore do not require slope stability analysis. However, the applicant noted that the only existing slope whose failure could adversely affect the safety of North Anna 3 is the 2.4h:1v slope that descends from the north of the SWR down to the southeast of the excavation made for abandoned Units 3 and 4. The applicant indicated the only analysis that gave a FS lower than the required minimum was the pseudo-static analysis, which was overly conservative. The applicant concluded that the 2.4h:1v slope would remain stable under long-term static and design seismic conditions. Based on the results of the stability analyses for the new 3h:1v slope, the applicant also concluded that the slope would remain stable under both long-term static and design seismic conditions.

2.5.5.3 Regulatory Basis

The applicable regulatory requirements for reviewing the applicant's discussion of stability of the slopes are:

- 10 CFR 50.55a, requires that SSCs shall be designed, fabricated, erected, constructed, tested, and inspected in accordance with the requirements of applicable codes and standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 1, requires that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. It also requires that appropriate records of the design, fabrication, erection, and testing of SSCs important to safety be maintained by or under the control of the nuclear power unit licensee throughout the life of the unit.

- 10 CFR Part 50, Appendix A, GDC 2, relates to the consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

- 10 CFR Part 50, Appendix A, GDC 44, "Cooling Water," requires that a system be provided with the safety function of transferring the combined heat load from SSCs important to safety to an UHS under normal operating and accidental conditions.

- 10 CFR Part 50, Appendix B, establishes quality assurance requirements for the design, construction, and operation of those SSCs of nuclear power plants that prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public.

- 10 CFR Part 50, Appendix S, applies to the design of nuclear power plant SSCs important to safety to withstand the effects of earthquakes.

- 10 CFR Part 100, provides the criteria which guide the evaluation of the suitability of proposed sites for nuclear power and testing reactors.

- 10 CFR 100.23, provides the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identify geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants.

The related acceptance criteria are summarized from SRP Section 2.5.5:

- Slope Characteristics: In meeting the requirements of 10 CFR Parts 50 and 100, the discussion of slope characteristics is acceptable if the subsection includes: (1) cross sections and profiles of the slope in sufficient quantity and detail to represent the slope and foundation conditions; (2) a summary and description of static and dynamic properties of the soil and rock comprised by seismic Category I embankment dams and their foundations, natural and cut slopes, and all soil or rock slopes whose stability would directly or indirectly affect safety-related and Category I facilities; and (3) a summary and description of ground water, seepage, and high and low ground water conditions.

- Design Criteria and Analyses: In meeting the requirements of 10 CFR Parts 50 and 100, the discussion of design criteria and analyses is acceptable if the criteria for the stability and design of all seismic Category I slopes are described and valid static and dynamic analyses have been presented to demonstrate that there is an adequate margin of safety.

- Boring Logs: In meeting the requirements of 10 CFR Parts 50 and 100, the applicant should describe the borings and soil testing carried out for slope stability studies and dam and dike analyses.

- Compacted Fill: In meeting the requirements of 10 CFR Part 50, the applicant should describe the excavation, backfill, and borrow material planned for any dams, dikes, and embankment slopes.

In addition, the geologic characteristics should be consistent with appropriate sections from: RG 1.27, RG 1.28, RG 1.132, RG 1.138, RG 1.198, and 1.206.

2.5.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 2.5.5 of the ESBWR DCD Revision 10. The staff reviewed Section 2.5.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic[1].

The staff reviewed the resolution to the COL specific items related to the stability of all earth and rock slopes—natural and manmade—whose failure under any conditions to which they could be exposed during the life of the plant, could adversely affect the safety of the plant. To that end, the staff reviewed the applicant's descriptions of the slope characteristics, design criteria, slope stability analyses, and conclusions drawn by the applicant.

Resolution of NAPS ESP VAR 2.5-1

The staff reviewed the applicant's variance request to use the information in FSAR Section 2.5.5 in place of the information in ESP SSAR Section 2.5.5, as it relates to the stability of slopes. Because of the shallower slopes and a smaller applied seismic acceleration for the North Anna 3 site, as described in the FSAR based on updated information, which results in an increased FS against slope failure, the staff concludes that the use of North Anna 3 FSAR Section 2.5.5 in place of North Anna 3 ESP SSAR Section 2.5.5 is acceptable.

2.5.5.4.1 Slope Characteristics

FSAR Section 2.5.5.1 describes the characteristics of the existing and new slopes, their subsurface conditions, and impacts of slope instability on the seismic Category I structures at the North Anna 3 site. The staff reviewed this information as well as the characterizations of the phreatic surfaces for new and existing slopes. As discussed below, the staff found that the information provided by the applicant meets the minimum requirements for slope characterization in 10 CFR Part 100. The staff further determined that the subsurface investigations adhered to the criteria of RG 1.132.

Resolution of ESP COL Action Item 2.5-11

ESP COL Action Item 2.5-11 requires the applicant referencing the North Anna ESP to provide plot plans and cross sections/profiles of the safety-related slopes and to specify what measures are needed at the site to ensure the safety of the safety-related structures adjacent to the slopes. In FSAR Section 2.5.5.1.2, the applicant described the location of the new 3h:1v slope to the southeast of the FWSC. FSAR Figure 2.5.5-201 illustrates the plan view, while FSAR Figures 2.5.5-202 and 2.5.5-203 show cross-section of those slopes. The staff considered this information, including the plot plans and cross section through the new slope. The staff also considered the physical characteristics of the slope and concludes that the failure of the slope would not affect the safety-related structures at the site. The staff also concludes that the applicant provided adequate plot plans and cross sections of the new slope to satisfy the criteria of ESP COL Action Item 2.5-11. Accordingly, the staff considers ESP COL Action Item 2.5-11 resolved.

The staff also considered the results and interpretations of the borings, CPTs, and observation wells conducted at the site. During the review of FSAR Section 2.5.5.1.3, the staff noted that the applicant identified two different lithologies in the same CPT and borehole analyses. In RAI 02.05.05-1 dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked the applicant to clarify the lithology of CPT C-916, located adjacent to boring B-947, which was alternatively identified as silty clays, clays, and silty sand saprolite. In the response to RAI 02.05.05-1 dated July 14, 2008 (ADAMS Accession No. ML082050558) the applicant stated that although the CPTs provided valuable information about the soil, the test had not obtained samples from the soil. The applicant stated that the interpretation of soil type from the friction ratio was empirical and based on historical interpretations, but the interpretation is not considered exact. Accordingly, although the friction ratio measured during the CPT indicated that the soil was mainly silty clays and clays, the visual observation and grain size testing concluded that the soil was mainly silty sand. The applicant also clarified that the silty sand profile of the soil was the profile used in the slope stability analysis.

The staff reviewed this information, including the applicant's suggestion that the visual inspection of the soil type is more reliable than the empirical interpretation of CPT results. The staff concurs with the applicant's assessment of the visual inspection and laboratory test as a more reliable determination of soil type, and therefore finds the use of the silty sand profile for slope stability analyses to be acceptable. Accordingly, the staff considers RAI 02.05.05-1 resolved and closed.

Based on the slope characterization provided and the response to the RAI, the staff concludes that the applicant's characterization of the slopes at the North Anna 3 site area is acceptable for meeting the relevant requirements of 10 CFR Parts 50 and 100.

2.5.5.4.2 Design Criteria and Analyses

FSAR Section 2.5.5.2 describes the design criteria and analyses performed for the North Anna 3 site. The applicant used SLOPE/W commercial software and three different approaches to slope stability in the analyses: a conservative pseudo-static approach, Seed's approach (1979), and the approach recommended by Kramer (1996). The results of these approaches are summarized in Section 2.5.5.2.2 of this SER. In reviewing FSAR Section 2.5.5.2, the staff focused on the design criteria for adequacy of the applicant's slope stability analyses, both static and dynamic (seismic) stability for existing and new slopes adjacent to the North Anna 3 site. The applicant used the design criteria, as defined in the ESBWR DCD, with a minimum slope stability FS of 1.5 for static (non-seismic) and 1.1 for dynamic (seismic) loading conditions. The staff identified two areas that required additional information.

The applicant stated that for the Long-Term Static Analysis, Bishop's method was the only method used. The staff compared this statement to the criteria in RG 1.206, which state that classic and contemporary methods of analysis should be used to determine slope stability. In RAI 02.05.05-2 dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked the applicant to explain why the only method used for the Long-Term Static Analysis was Bishop's method, which only considers moment magnitude and, depending on the slope geometry, may not yield conservative results. The applicant's July 14, 2008, response stated that although there are various methods of computing slope stability commonly in use, the methods differ mainly in the type and degree of underlying assumptions. In the response to RAI 02.05.05-2 dated July 14, 2008 (ADAMS Accession No. ML082050558), the applicant also stated that a more accurate model will give a higher FS, and lower factors of safety are not indicative of a conservative approach but of a less accurate approach. The applicant concluded that all methods use the same slope geometry and soil parameters. Thus, the applicant chose the Bishop method (Bishop, 1955) for the long-term static analysis because this method is recognized for its high degree of accuracy. Finally, the applicant noted that the use of the Bishop method was previously reviewed and approved in the North Anna ESP.

The staff considered the applicant's statement regarding the Bishop method. However, the reality is that all slope stability analysis methods have their own advantages and limitations, and the Bishop method may or may not give the most conservative results for a specific slope. Accordingly, the staff conducted an independent confirmatory analysis for a selected slope using the information provided in the FSAR. The results from the confirmatory analysis show that there is little variation among the factors of safety for the slope stability—about 7 percent among all six methods used—but higher than the applicant's estimate (about 1 percent); and all FS values are greater than the minimum requirement under the given seismic loads (i.e., the slope will not fail under the given conditions); therefore, the applicant's conclusion regarding the stability of the slopes is acceptable. Accordingly, the staff considers RAI 02.05.05-2 resolved and closed.

The staff also reviewed the assumptions used for the seismic stability analysis of slopes in the North Anna 3 area. Some of the assumptions the applicant stated include (1) no liquefaction was considered in the analysis, (2) the use of average peak acceleration as opposed to peak accelerations at the surface, and (3) the consideration of reduced accelerations. These assumptions are contrary to the guidance in RG 1.206, which states that the applicant should demonstrate the reliable performance of slopes during all conditions during the life of the plant. In RAI 02.05.05-3 dated June 17, 2008 (ADAMS Accession No. ML081690661), the staff asked the applicant to describe the impact of the possible maximum dynamic settlement of the slope soil on slope stability, and to describe how the assumptions used in the pseudo-static method of analysis were verified.

In the response to RAI 02.05.05-3 dated July 14, 2008 (ADAMS Accession No. ML082050558), the applicant stated that the possible maximum dynamic settlement of 41 mm (1.6 in.) calculated for this site, corresponding to a reduction in slope height of between 0.38 and 0.31 percent, would not impact the slope stability. The applicant also stated that the reason for slope failure during a seismic event normally is not a slip failure, but instead because, during a seismic event, the slope loses strength due to liquefaction. Although the applicant noted that liquefaction would weaken the slope, a large portion of the slope is not prone to liquefaction because 8.5 m (28 ft) of the slope is above the groundwater table with maximum slope height of 13.7 m (45 ft). In addition, the applicant concluded that, based on the LF and HF seismic characteristics, the chance of any liquefaction occurring in the Zone IIA saprolitic soils is very low. Due to the low chance of liquefaction, the applicant concluded that the strength loss of the slope from liquefaction was remote. Therefore, the slopes will remain stable during the design basis earthquake at the North Anna 3 site.

The staff also conducted reliability analyses by assigning probability distributions (uncertainties) to each input parameter and examined how the uncertainties affect the reliability of the calculated FS. During the reliability analysis, the staff used different values of coefficients-of-variation, the ratio of standard-deviation to mean-value, and assumptions of normal distribution of variables.

The results of the reliability analysis were three-fold. First, the staff noted that due to uncertainties and variations in soil properties, no single FS can represent the actual site conditions, therefore, when determining FS using deterministic methods, soil parameters should be conservatively estimated to take the uncertainties and variations into consideration. Second, the staff observed that the smaller the variation, the higher degree of confidence in the slope stability calculation. The confirmatory analysis results showed that a reduction of the coefficient of variation from 1.0 to 0.5 for seismic loading input will increase the probability of FS greater than 1.0, or the confidence level from about 42 to 70 percent, although the mean values of FS remain the same at 1.128 as shown in SER Figure 2.5.5-2. Finally, since the seismic loading used in stability analyses is based on the results of the probabilistic analysis of the site specific maximum ground acceleration, the staff concludes that seismic loading has high uncertainty that has been considered when conducting site specific seismic hazard evaluation.

Based on the staff's independent confirmatory analysis, and the applicant's response to RAI 02.05.05-3, particularly the use of the pseudo-static methods to determine the seismic slope stability at the North Anna 3 site, the staff concurs with the applicant that the use of the pseudo-static method was appropriate for the North Anna 3 site. The staff also concurs with the applicant's assessment of the liquefaction potential and slope stability at the North Anna 3 site. Finally, since the applicant's conclusions considered both the groundwater interaction and the weakening of the slope during the design seismic event, the staff considers RAI 02.05.05-3 resolved and closed.

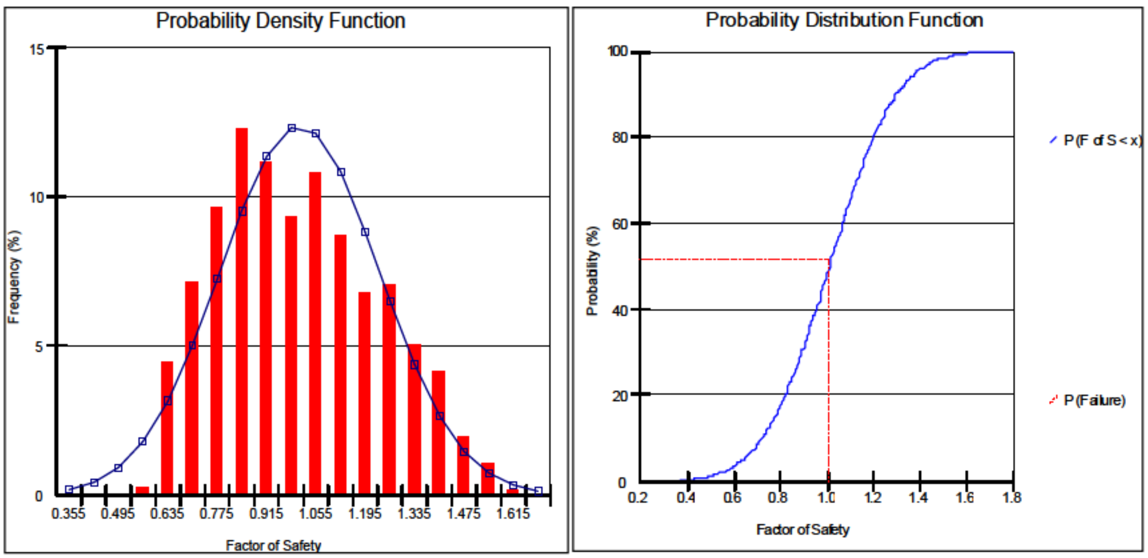


Figure 2.5.5-2. Probability Density and Distribution Functions of FS. Probabilistic Seismic Loading of a_h=0.25g and a_v = 0.125g with COV = 1.0

Resolution of NAPS COL 2.0-30-A and ESP COL Action Item 2.5-10

NAPS COL 2.0-30-A (ESBWR COL 2.0-30-A) requires the COL applicant to provide site-specific information in accordance with SRP 2.5.5 to evaluate stability of slopes at the site.

ESP COL Action Item 2.5-10 requires the applicant referencing the North Anna ESP to conduct a more detailed dynamic analysis for existing and new slopes at the site using the SSE ground motion.

North Anna 3 FSAR Section 2.5.5.2 describes the design criteria and analyses of slope stability performed for the North Anna 3 site. In addition to static slope stability analyses, the applicant presented the seismic slope analysis for the existing 2.4h:1v slope, which used SLOPE/W as part of a pseudo-static approach. From these results, the applicant determined that the existing slope at the site would remain stable under long-term static and design seismic conditions. In North Anna 3 FSAR Section 2.5.5.2.4.b, the applicant described the seismic slope analysis for the new 3h:1v slope, again using the SLOPE/W program as part of the analysis. Based on the analysis results, the applicant concluded that the new slope would also remain stable under long-term static and design seismic conditions. Because the applicant conducted static and dynamic stability analyses for both the new and existing slopes, and the results demonstrated that the slopes meet stability requirements under the design static and seismic loading conditions, the staff concludes that the applicant provided sufficient information to satisfy the requirements of NAPS COL 2.0-30-A and ESP COL Action Item 2.5-10. Accordingly, the staff considers NAPS COL 2.0-30-A and ESP COL Action Item 2.5-10 resolved.

Based on the information provided in the FSAR and the applicant's response to the RAIs listed above, the staff concludes that the applicant's assessments of the design criteria and analyses of the slopes at the North Anna 3 site area are acceptable and meet the criteria of 10 CFR Parts 50 and 100.

2.5.5.4.3 Boring Logs

The applicant provided boring logs, CPT logs, observation wells, and laboratory test results for two borings, two CPTs, and one groundwater observation wells in the existing and new slopes at the North Anna 3 site area, as well as laboratory test results related to the slope materials. The staff reviewed this information to confirm that that the applicant provided sufficient data and used appropriate material and engineering properties of slope materials in slope stability analysis, and concludes that the information provided satisfies the relevant requirements of 10 CFR Parts 50 and 100.

2.5.5.4.4 Compacted Fill

FSAR Section 2.5.5.4 states that the existing 2.4h:1v slope is a cut slope and does not contain fill materials in any significant quantity, while the top of the new 3h:1v slope will contain re-compacted backfill derived from the saprolite on the site. The staff reviewed the applicant's intent to apply the properties of the saprolite to the compacted fill and concluded that this is an acceptable approach because the compacted fill will have better engineering properties than the in-situ saprolite.

2.5.5.4.5 Conclusion

In FSAR Section 2.5.5.5, the applicant summarized the major conclusions of the slope stability analyses. The applicant concluded that the slopes will remain stable under long-term static and dynamic conditions.

The staff noted that this section states that "[e]xisting slopes and embankments that are not impacted by North Anna 3 (such as the SWR embankments) do not require analysis for North Anna 3 and are not addressed here." However, although the SWR embankments were built for Units 1 and 2 and the construction of North Anna 3 will not impact those embankments, the reevaluation of the site seismic hazard for Unit 1 and 2 based on the lessons learned from the Fukushima event determined that the updated site-specific GMRS will exceed the original design basis. Because any breach of the SWR embankment might have an impact on the North Anna 3 site. In RAI 02.05.05-4 dated April 8, 2014 (ADAMS Accession No. ML14098A297), the staff asked for an evaluation of the impact of possible failure of the SWR embankment on the stability of slopes at the North Anna 3 site.

In the response to RAI 02.05.05-4 dated May 9, 2014 (ADAMS Accession No. ML14140A087), the applicant stated that there will be no impact from a possible failure of the SWR embankment on the stability of slopes at the North Anna 3 site because: 1) at the western end of the SWR and the western portion of the northern end of the SWR, a failure of the inside slope would not result in a release of water; 2) an embankment breach of the east portion of the SWR may result in a release of water but it would flow down gradient to the east and away from North Anna 3. The staff reviewed the RAI response and conducted a site audit (ADAMS Accession No. ML14203A179) to confirm the geographic characteristics of the North Anna 3 site, the SWR and Units 1 and 2. The staff also noted that the design plant grade elevation of North Anna 3 is 88.3 m (290 ft) while for Units 1 and 2, this elevation is 82.6 m (271 ft), or about 6.3 m (19 ft) below the North Anna 3; therefore water will flow to Units 1 and 2 site if the SWR embankment fails. Based on the above, the staff concludes that there will be no impact from a possible failure of the SWR embankment on the stability of slopes at the North Anna 3 site, and accordingly, the staff considers RAI 02.05.05-4 resolved and closed.

The staff considered applicant’s conclusions and additional information regarding the stability of SWR embankment, along with the criteria and requirements of 10 CFR Parts 50 and 100. The staff concluded that the information provided in FSAR Section 2.5.5 is sufficient and acceptable for meeting relevant requirements of the ESBWR DCD and 10 CFR Parts 50 and 100.

2.5.5.5 Post Combined License Activities

There are no post COL activities related to this section.

2.5.5.6 Conclusion

The staff reviewed the application with related RAI responses, and checked the referenced ESBWR DCD and North Anna ESP SSAR. The staff’s review confirmed that the applicant addressed the relevant information and there is no outstanding information expected to be addressed in the COL FSAR related to this section.

As set forth above, the applicant presented and substantiated information to establish the stability of all earth and rock slopes - natural or manmade - at the plant site. The staff reviewed the investigations of the slope stability studies and dam and dike analyses, and performed an independent confirmatory analysis. For the reasons given above, the staff concluded the design analyses contain margins of safety that adequately demonstrate both natural and manmade slopes will remain stable under both static and dynamic (seismic) loading conditions and the safety-related earthwork will function reliably at the site to justify the soil and rock characteristics used in the design. The staff further concluded that the design analyses contain adequate margins of safety for the construction and operation of the nuclear power plant. These analyses and results meet the requirements of 10 CFR Part 50, Appendix A (GDC 1, 2, and 44); Appendices B and S of 10 CFR Part 50; and 10 CFR 100.23, and address NAPS COL Item 2.0-30-A. In conclusion, the applicant provided sufficient information for resolving NAPS COL Item 2.0-30-A, NAPS ESP VAR 2.5-1, ESP COL Action Item 2.5-10, and ESP COL Action Item 2.5-11 and for satisfying 10 CFR Parts 50 and 100. Therefore, the staff concludes that the North Anna 3 site is suitable with respect to the criteria governing the stability of slopes.

2.5.6 Embankments and Dams

2.5.6.1 Introduction

Lake Anna is used for normal plant cooling of the existing unit. The North Anna Dam is designed and constructed to meet the requirements for a seismic Category I structure in support of the existing units.

2.5.6.2 Summary of Application

Section 2.5.6, of the North Anna 3 COL FSAR incorporates by reference Section 2.5.6 of ESP SSAR, Revision 9. In addition, in FSAR Section 2.5.6, the applicant added that no embankments and dams were analyzed because Lake Anna is only used as a source of makeup water for North Anna 3. The applicant stated that the North Anna Dam is designed and constructed to meet requirements for a seismic Category I structure in support of the existing Units 1 and 2.

2.5.6.3 Regulatory Basis

FSAR Section 2.5.6 states that the applicant did not reanalyze the North Anna Dam because Lake Anna would be used only as a source of makeup water for North Anna 3. As such, the applicant did not list any regulatory guidance or cite any regulations applicable to this section. Section 2.5.6 of RG 1.70 describes the necessary information and analysis related to the investigation, engineering design, proposed construction, and performance of all embankments used for plant flood protection or for impounding cooling water. Sections 2.4.4 and 2.5.5 in RS-002, "Processing Applications for Early Site Permits," provide similar information and guidance.

2.5.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 2.5.6 of the ESBWR DCD, Revision 10. The staff reviewed Section 2.5.6 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic[1].

Sections 2.4.4 and 2.5.5 of this SER provide the staff's evaluation of potential dam failures and slope stability, respectively.

2.5.6.5 Post Combined License Activities

There are no post COL activities related to this section.

2.5.6.6 Conclusion

Section 2.4.4 and 2.5.5 of this SER present the staff's conclusions regarding dam failures and slope stability, respectively.

References

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3 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS

3 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 design of structures, components, equipment and systems.

3.1 Conformance with NRC General Design Criteria

Section 3.1, "Conformance with NRC General Design Criteria [GDC]," of the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR) Revision 8, incorporates by reference, with no departures or supplements Section 3.1, "Conformance with NRC General Design Criteria," of Revision 10 of the Design Control Document (DCD) for the Economic Simplified Boiling Water Reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." As documented in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor (ESBWR) Standard Design" Agencywide Documents Access and Management System (ADAMS) Accession No. ML14100A304), the staff reviewed and approved Section 3.1 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Conformance with NRC General Design Criteria," that were incorporated by reference have been resolved.

3.2 Classification of Structures, Systems and Components

3.2.1 Introduction

Nuclear power plant structures, systems, and components (SSCs) important to safety should be designed to withstand the effects of earthquakes without losing the capability to perform their safety functions. SSCs important to safety are defined in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," as those SSCs that "provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public." These SSCs include safety-related SSCs whose functions ensure: (1) the integrity of the reactor coolant pressure boundary (RCPB); (2) the capability to shut down the reactor and maintain it in a safe shutdown condition; and (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures. These SSCs are designed to sustain and remain functional for a design basis safe shutdown earthquake (SSE). The SSE is based on an evaluation of the maximum earthquake potential for the site and is an earthquake that produces the maximum vibratory ground motion for which SSCs are designed to remain functional. The regulatory

[1] See "*Finality of Referenced NRC Approvals*," in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

treatment of nonsafety systems (RTNSS) process is applied to define seismic requirements for SSCs that are nonsafety-related but perform risk significant functions.

Nuclear power plant SSCs important to safety are designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. SSCs important to safety are those that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. Risk-significant nonsafety-related fluid systems that are important to safety are evaluated under the RTNSS process.

3.2.2 Summary of Application

Section 3.2, "Classification of Structures, Systems and Components," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.2, "Classification of Structures, Systems and Components," of the ESBWR DCD, Revision 10. Section 3.2 of the ESBWR DCD includes Sections 3.2.1, "Seismic Classification," and 3.2.2, "Quality Group Classification."

The system seismic and quality group classifications, discussed in the ESBWR DCD, address the requirement to design nuclear power plant SSCs important to safety to withstand the effects of earthquakes without a loss of capability to perform their safety functions – that means designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

This requirement is applicable to both pressure-retaining and non-pressure-retaining SSCs that are part of the RCPB, and to other systems important to safety, when reliance is placed on these systems to (1) prevent or mitigate the consequences of accidents and malfunctions originating within the RCPB, (2) permit a shutdown of the reactor and maintain it in a safe shutdown condition, and (3) retain radioactive material.

Regulatory Guide (RG) 1.29, Revision 4, "Seismic Design Classification," describes an acceptable method of identifying and classifying those plant features that should be designed to withstand the effects of SSEs. RG 1.26, Revision 4, "Quality Group Classification and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants," provides the regulatory guidance for designing safety-related SSCs to quality standards commensurate with the importance of the safety functions to be performed. Risk-significant nonsafety-related SSCs that are important to safety are evaluated under the RTNSS process described in FSAR Chapter 19 and reviewed by the staff in the DCD Final Safety Evaluation Report (FSER) Chapter 22, "Regulatory Treatment of Nonsafety Systems," of NUREG–1966.

In addition, North Anna 3 COL FSAR, Section 1.9 includes the following information related to the applicable seismic classification and quality group classification:

- In FSAR Table 1.9-201, "Conformance with Standard Review Plan" (SRP), the applicant added a line stating that the North Anna 3 application conforms to Revision 2 of the SRP for Section 3.2.1. In this table, the applicant added another line stating that the North Anna 3 application conforms to Revision 2 of the SRP for Section 3.2.2.

- In FSAR Table 1.9-202, "Conformance with Regulatory Guides," the applicant added a line stating that the North Anna 3 application conforms to RG 1.26 and 1.29. The applicant further notes that this conformance is evaluated in FSAR Appendix 17AA, "Quality Assurance Program Description" (QAPD), Part IV.

- In FSAR Table 1.9-203, “Conformance with the FSAR Content Guidance in RG 1.206,” the applicant stated that the North Anna 3 application conforms to RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” Regulatory Position C.III.1, Subsection C.I.3.2.1, “Seismic Classification.” The applicant also stated that there are no additional safety-related or RTNSS SSCs subject to seismic classification beyond those addressed in the DCD. In addition the applicant stated that there are no SSCs outside the referenced certified design that are required to be designed for an Operating Basis Earthquake (OBE). In this table, the applicant also stated that the North Anna 3 application conforms to RG 1.206, Position C.III.1, Subsection C.I.3.2.2, “System Quality Group Classification.”

In addition, in the North Anna 3 FSAR, Revision 8, Section 3.2, the applicant provided the following supplemental information:

Site-Specific Information Replacing Conceptual Design Information (CDI)

- STD CDI RTNSS Systems

The applicant stated in FSAR Section 3.2 that there are no site-specific safety-related or nonsafety-related RTNSS systems beyond the scope of the DCD.

- STD CDI Classification Summary-Hydrogen Water Chemistry System (HWCS)

The applicant stated that the site-specific plant design includes the HWCS. The staff reviewed the North Anna 3 HWCS in Section 9.3.9 of this SER.

- NAPS CDI Classification Summary-Zinc Injection System

The applicant stated that the site-specific plant design includes the Zinc Injection System. The staff reviewed the North Anna 3 Zinc Injection System in Section 9.3.11 of this SER.

- NAPS CDI Cold Machine Shop

The applicant stated that the North Anna 3 site-specific plant design does not include the cold machine shop.

3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, FSER related to the certified ESBWR DCD.

In addition, the relevant requirements of Commission regulations for the seismic classification and quality group classification, and the associated acceptance criteria are in Section 3.2.1 and Section 3.2.2 of NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, (LWR Edition),” (SRP).

The applicable regulatory requirements for seismic classification of SSCs are as follows:

10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, “Design bases for protection against natural phenomena,” which requires (in part) that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes.

The related acceptance criteria are as follows:

- RG 1.29 establishes an acceptable regulatory basis for meeting GDC 2 relative to seismic classification and classifies SSCs that are to be designed to withstand earthquakes.

- RG 1.206 states that the applicant should identify those SSCs important to safety that are outside the scope of the referenced certified design and that are designed to withstand the effects of earthquakes without loss of capabilities to perform their safety functions. The applicant should designate plant features that are outside the scope of the referenced certified design and that are designed to remain functional in the event of an SSE or a surface deformation as seismic Category I. The applicant should identify portions of SSCs outside the scope of the referenced certified design that are not required to continue to function, but whose failure could reduce the functioning of any seismic Category I plant feature to an unacceptable safety level or could result in an incapacitating injury to control room occupants. The design and construction of these SSCs should ensure that the SSE would not cause such failures. The applicant should also list or otherwise clearly identify all SSCs or portions thereof that are outside the scope of the referenced certified design and are intended to be designed for an OBE.

The applicable regulatory requirements for the quality group classification of SSCs are as follows:

- 10 CFR Part 50, Appendix A, GDC 1, “Quality standard and records,” which requires (in part) that SSCs important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be supplemented or modified as necessary to assure a quality product consistent with the required safety function.

The related acceptance criteria are as follows:

- RG 1.26 establishes an acceptable regulatory basis for meeting GDC 1 relative to quality group classification. RG 1.26 also classifies fluid systems and their supports that are important to safety, which are to be designed to quality standards commensurate with their safety function.

- RG 1.206 states that the applicant should identify those fluid systems or portions thereof that are important to safety and outside of the certified design scope, as well as the applicable industry codes and standards for each pressure-retaining component.

3.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.2 of the North Anna 3 COL FSAR, Revision 8, and checked the ESBWR DCD, Revision 10, to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

Site-Specific Information Replacing Conceptual Design Information

- STD CDI — RTNSS Systems
- STD CDI — Classification Summary – Hydrogen Water Chemistry
- NAPS CDI — Classification Summary – Zinc Injection System
- NAPS CDI — Classification Summary – Cold Machine Shop

Seismic Classification

The staff determined that the supplements, including site-specific information related to the hydrogen water chemistry, zinc injection systems, cold machine shop, and RTNSS systems do not affect the seismic classifications.

The staff reviewed the COL application information to determine whether the application contains sufficient information on the seismic classification of site-specific SSCs that are outside of the DCD scope. The staff issued several requests for additional information (RAIs) to determine whether the scope of SSCs considered to be site specific is essentially complete, and whether sufficient information concerning the seismic classification of those SSCs is included in the application. The staff reviewed the following technical topics:

Seismic Classification of Site-Specific RTNSS SSCs

GDC 2 identifies, in part, that SSCs important to safety shall be designed to withstand the effects of earthquakes. FSAR Section 3.2.1 identifies no departures or supplements relative to the seismic classification of SSCs, and the standardization matrix identifies no site-specific information that applies to Section 3.2. However, certain potential RTNSS-important SSCs, such as the plant service water system (PSWS) and makeup water system, are identified as site-specific and makeup sources for the ultimate heat sink. Also, initially it was not clear whether there were nonsafety-related SSCs outside of the DCD scope that may be important to safety. Therefore, in RAI 03.02.01-6 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the applicant clarify whether there are any site-specific, nonsafety-related SSCs outside of the DCD scope that are important to safety and, if so, to identify the appropriate seismic classification of those SSCs. For example, certain site-specific defense-in-depth RTNSS SSCs, such as the PSWS and the intake structure, may be considered nonsafety-related but may be important to safety and should be categorized as designed to withstand the effects of earthquakes. This seismic concern for RTNSS SSCs was also identified during the concurrent ESBWR DC review at that time. The applicant decided to resolve this issue in the DCD rather than in the COL for all plant SSCs, including those that are site specific. Therefore, in response to RAI 03.02.01-6 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that there are no nonsafety-related SSCs important to safety (RTNSS SSCs) that are outside of the DCD scope. This response also clarified that the seismic classification of RTNSS SSCs is within the DCD scope, and Appendix 19A of the DCD had undergone substantial changes in DCD, Revision 5. The staff concurred that the seismic classification of site-specific RTNSS SSCs can be evaluated in the DCD which is reflected in the ESBWR DCD, Revision 10. Accordingly, the staff considers all issues associated with RAI 03.02.01-6 resolved and closed.

Seismic Classification of Other Site-Specific SSCs

Section 1 of the DCD identifies only limited site-specific SSCs that are outside the scope of the DCD, and for which the COL applicant is expected to provide site-specific information. COL application Table 1.9-203 indicates that there are no safety-related or RTNSS SSCs that are not included in the DCD. It is not clear, however, whether there are any other nonsafety-related SSCs that are considered important to safety but are not included in the DCD that will be addressed in the COL application.

Therefore, in RAI 03.02.01-5 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify whether there are any site-specific SSCs outside of the DCD scope that are not included in DCD Table 3.2-1 and are to be seismically classified in the COL. For example, site-specific structures such as the stack and miscellaneous items such as the reactor vessel insulation, which may or may not be site specific, are not included in the tables. If so, the RAI requested the applicant to identify the appropriate seismic classification of those SSCs or clarify when those SSCs will be classified. In response to RAI 03.02.01-5 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that there are no nonsafety-related SSCs important to safety (RTNSS SSCs) outside of the DCD scope, and there are no site-specific SSCs not in the DCD that are to be seismically classified. In regard to the stack (changed to three stacks in DCD, Revision 5) and reactor vessel insulation, the applicant clarified that these SSCs are not site specific. Because no site-specific SSCs will be classified in the COL, the staff considers all issues associated with RAI 03.02.01-5 resolved and closed.

Quality Assurance for Seismic Category II SSCs

In an RAI 03.02.01-4 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify the extent to which pertinent Quality Assurance (QA) requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plans and Fuel Reprocessing Plants," to 10 CFR Part 50 in Regulatory Position C.4 of RG 1.29 apply to the activities affecting safety-related functions of those portions of SSCs covered under Regulatory Positions 2 and 3 of RG 1.29, including any site-specific SSCs. This concern was also cited in an RAI for the ESBWR DC review at the time. In response to RAI 03.02.01-4 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that this issue will be resolved in the ESBWR DCD, and GE-Hitachi (GEH) has included this information in DCD Section 3.2 and in DCD Appendix 19A for all SSCs, which is reflected in the ESBWR DCD, Revision 10. The staff concurred that this information has been reviewed in connection with the certified design, and applies to the COL applicants including North Anna 3 that reference that ESBWR design. Accordingly, the staff considers all issues associated with RAI 03.02.01-4 resolved and closed.

Consistency with Regulatory Guidance

FSAR Table 1.9-201 points out that the seismic classification conforms to SRP Section 3.2.1, Revision 2, and that SRP Section 3.2.1 references RG 1.29 (currently Revision 4) for seismic classification. SRP Section 3.2.1 identifies that the applicant should provide a list of SSCs that are necessary for continued safe operation that must remain functional without undue risk to the health and safety of the public and within applicable stress, strain, and deformation limits during and following an OBE, if the applicant has set the OBE ground motion to the value of one-third of the SSE ground motion. The list of SSCs may be addressed either in this section or in the operational programs for pre-earthquake planning in COL FSAR Section 3.7.4. Other than the four CDIs noted above, North Anna 3 Section 3.2 of FSAR, Revision 8, does not identify any departures or supplements relative to the seismic classification in the DCD and the conformance to RG 1.29, Revision 3 in the ESBWR DCD, Revision 10.

In RAI 03.02.01-3 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify the extent to which site-specific seismic classifications of SSCs are consistent with RG 1.29, Revision 4. In response to RAI 03.02.01-3 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant clarified that the FSAR is incorrect. The classification of site-specific SSCs is consistent with the DCD that references RG 1.29, Revision 3, and COL FSAR Table 1.9-202 will be revised accordingly. In addition, the staff has indicated to the applicant that there are no site-specific SSCs requiring classification in the COL application or changes to the methodology. Therefore, the staff finds that use of RG 1.29, Revision 3 is acceptable. The staff verified that the COL FSAR Revision 8, Table 1.9-202 is revised accordingly. Therefore, the staff considers all issues associated with RAI 03.02.01-3 resolved and closed.

List of SSCs Necessary for Continued Safe Operation During and Following an OBE

In RAI 03.02.01-7 dated August 20, 2009 (ADAMS Accession No. ML092360286), the staff indicated to the applicant that, in order to be consistent with the requirements and guidance of 10 CFR Part 50, Appendix S, IV(a)(2)(l) and (3), RG 1.166, “Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post Earthquake Actions,” and SRP Section 3.2.1 Revision 2, a list of SSCs necessary for continued operation when subjected to an OBE should be available for review if the applicant has set the OBE ground motion equal to one-third of the SSE ground motion. Since the COL applicant has not deviated from the DCD, which sets the OBE ground motion equal to one-third of the SSE ground motion, staff requested that the COL applicant provide the list of SSCs necessary for continued safe operation that must remain functional without undue risk to the health and safety of the public and within applicable stress, strain, and deformation, during and following an OBE. In response to RAI 03.02.01-7 dated December 9, 2009 (ADAMS Accession No. ML093490251), the COL applicant stated that as noted in 10 CFR Part 50, Appendix S, Section IV(a)(2)(i)(A), if the OBE ground motion is set to one-third or less of the SSE, then the requirements associated with the OBE ground motion in 10 CFR Part 50, Appendix S, Section IV (a)(2)(i)(B)(I) can be satisfied without the COL applicant performing explicit response or design analyses. Since the ESBWR has set the OBE at one-third of the SSE (as discussed in ESBWR FSAR Tier 2, Section 3.7), no further explicit response is required in accordance with 10 CFR Part 50, Appendix S, Section IV(a)(2)(i)(A).

Those SSCs that are designed to withstand an SSE are classified as seismic Category I and are given in ESBWR DCD, Tier 2, Table 3.2.-1, "Classification Summary." This classification is in accordance with SRP Section 3.2.1. Based on the COL applicant's statement that the list is addressed through ESBWR FSAR Tier 2, Table 3.2.2-1 and the staff finding that the table is acceptable, the staff considers RAI 03.02.01-7 resolved and closed.

Important to Safety SSCs

In the North Anna 3 FSAR, Section 3.2 the applicant states:

> There are no site-specific safety[-]related or non-safety[-]related RTNSS systems beyond the scope of the DCD.

The ESBWR DCD, Section 1, Revision 10, provides for COL Item 17.4-1-A identifying site-specific SSCs outside the scope of the DCD but within the scope of the reliability assurance program. In the North Anna 3 FSAR COL Item 17.4-1-A, the applicant states:

> There are no site[-]specific SSCs within the scope of the Reliability Assurance Program (RAP). The quality elements for all SSCs within the scope of the Design Reliability Assurance Program (D-RAP) are in accordance with the Quality Assurance Program Description (QAPD).

The staff finds that the applicant's response conforms to the guidance in RG 1.206 and the requirements in 10 CFR Part 50, Appendix A, GDC 1, and is therefore acceptable.

List of RTNSS SSCs

DCD, Revision 5, Section 3.2.1 refers to Table 19A-1 for a list of RTNSS SSCs. However, Table 19A-1 in Revision 5 of the DCD has been deleted. It was not clear at that time whether this list included site-specific SSCs. Therefore, in RAI 03.02.01-2 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant identify the appropriate reference for the list of site-specific RTNSS SSCs. In response to RAI 03.02.10-2 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant noted the correct reference for risk-significant RTNSS SSCs is in Table 3 of NEDO-33411. The staff further verified that the list of RTNSS SSCs can be reviewed in the ESBWR DCD, Revision 10, Appendix 19A. Table 19A-3 in addition identifies the structures housing the RTNSS functions identified in DCD Table 19A-2. Accordingly, the staff considers all issues associated with RAI 03.02.01-2 resolved and closed.

RTNSS SSCs Classified as Non-Seismic

DCD, Revision 4, Table 3.2-1 identified various nonsafety-related potential RTNSS SSCs as either Seismic II or non-seismic (NS). DCD Section 19A.8.3 classifies RTNSS Criterion B-SSCs, as a minimum, seismic Category II, and are qualified to the Institute of Electrical and Electronics Engineers (IEEE)-344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations." These SSCs must be available following a seismic event. Therefore, in RAI 03.02.01-1 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify the basis for the Seismic II or NS classification or identify an appropriate departure. In response to RAI 03.02.01-1 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that there are no site specific, RTNSS-important SSCs beyond those identified in the DCD. The staff verified that the ESBWR DCD, Revision 10, Appendix 19A Table 19A-3 identifies the structures housing the RTNSS functions. Accordingly, the staff considers all issues associated with RAI 03.02.01-1 resolved and closed.

Summary

Based on the above evaluation of the applicant's information related to seismic classification, the staff finds that the requirements of GDC 2 are met and the information is consistent with the guidance in RGs 1.29 and 1.206 for all SSCs important to safety.

Quality Group Classification

The staff's review of North Anna 3 COL FSAR, Revision 8, finds that the applicant has incorporated by reference Section 3.2.2 of the ESBWR DCD, Revision 10. The review confirms that the information in the application and the information incorporated by reference address the required information relating to the quality group classification of SSCs.

The staff determined that the site-specific information replacing conceptual design information related to the hydrogen water chemistry and zinc injection systems does not affect the quality group classifications.

The ESBWR DCD, Section 1.10 states that the COL applicant is required to provide site-specific information as COL items.

The staff reviewed the following technical topics:

Consistency with Regulatory Guidance

FSAR Table 1.9-201 shows that the quality group classification conforms to SRP Section 3.2.2, Revision 2 and that SRP Section 3.2.2 references RG 1.26 (currently Revision 4) for quality group classification. Section 3.2 of the North Anna 3 FSAR, Revision 1, did not identify any departures or supplements relative to the quality group classification identified in the DCD and compliance with RG 1.26, Revision 3 in the DCD. But FSAR Table 1.9-202 references conformance to Revision 4, dated March 2007. QA Program AR-NA-30 references Revision 4 to RG 1.26 with the DCD exception, but incorrectly references February 1976 rather than March 2007. Therefore, in RAI 03.02.02-1 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify whether classifications of site-specific SSCs are consistent with RG 1.26, Revision 4.

In response to RAI 03.02.02-1 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant clarified that the FSAR is incorrect. The classification of site-specific SSCs is consistent with the DCD that references RG 1.26, Revision 3. COL FSAR Table 1.9-202 and Appendix 17BB will be revised accordingly. COL applicants should supplement generic DCD information on conformance to RGs to address those that were issued since the time the standard design was approved. There are no site-specific SSCs classified in the COL application, so the effective RGs are appropriately referenced in the DCD. Therefore, the staff finds that use of RG 1.26, Revision 3 is acceptable. The staff verified that the COL FSAR Revision 8, Table 1.9-202 and Appendix 17BB, is revised accordingly. Therefore, the staff considers all issues associated with RAI 03.02.02-1 resolved and therefore Open Item 03.02.02-1 is closed.

Codes and Standards

The staff requirements memorandum (SRM) dated July 21, 1993, concerning SECY-93-087, “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water (ALWR) Designs,” stated that the staff will review passive plant design applications using the newest codes and standards endorsed by the NRC, and unapproved revisions to the codes will be reviewed on a case-by-case basis. Editions of various codes and standards referenced in DCD, Revision 4, Section 3.2.6 are not current, and newer codes and standards are not referenced in COL applicant FSAR Sections 3.2 or 1.9. Therefore, in RAI 03.02.02-2 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the COL applicant clarify the specific code editions the applicant has referenced that are currently endorsed by the NRC. The applicant was also asked to clarify whether current editions of codes and standards will be applied to the detailed design and procurement of ESBWR SSCs, so that these editions may be reviewed on a case-by-case basis. If the applicant decides to resolve this issue in the DCD rather than in the COL for all plant SSCs, including those that are site specific, the staff had asked the applicant to advise the NRC.

In response to RAI 03.02.02-2 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that DCD Table 1.9-22 identifies industrial codes and standards and adjustments that have been made to these codes and standards. The applicant also indicated that questions regarding versions of codes and standards should be addressed to GEH. COL applicants should supplement generic DCD information on compliance with RGs to address those that have been issued since the time the standard design was approved.

The staff recognizes that there are no site-specific SSCs that are not classified in the DCD. However, regulatory guidance for site-specific SSCs should be identified in the COL application so that the correct RG revision is applied to site-specific SSCs, including those added in the future. North Anna 3 FSAR, Revision 8, Table 1.9-204 supplements the ESBWR DCD, Revision 10, Table 1.9-22 to address industrial codes and standards applicable to portions of the design that are beyond the scope of the DCD. The staff found the response acceptable because the COL applicant adequately addressed staff’s concern regarding use of codes and standards. Therefore, the staff considers all issues associated with RAI 03.02.02-2 resolved and therefore Open Item 03.02.02-2 is closed.

Special Treatment for Risk-Significant SSCs

GDC 1 identifies (in part) that SSCs important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. Supplemental quality standards and the QA Program applicable to passive SSCs used in nonsafety-related RTNSS systems that may be important to safety were not clearly defined in the initial North Anna 3 COL application for site-specific SSCs.

Therefore, in RAI 03.02.02-3 dated August 6, 2008 (ADAMS Accession No. ML082190780), the staff requested that the applicant clarify what supplemental quality standards are applied to nonsafety-related, site-specific SSCs that are important to safety to ensure that all SSCs important to safety are designed, fabricated, erected, and tested to quality standards commensurate with the safety function to be performed. This concern was also identified in an RAI for the review of the ESBWR DC at the time. In response to RAI 03.02.02-3 dated September 17, 2008 (ADAMS Accession No. ML082661075), the COL applicant stated that this issue will be resolved in the DCD. The applicant clarified that GEH has included this information in DCD Section 3.2 and Appendix 19A and that these are applicable to site-specific SSCs. The staff verified that the issue was resolved in the ESBWR DCD, Revision 10. Accordingly, the staff considers all issues associated with RAI 03.02.02-3 resolved and closed.

Summary

Based on the above evaluation of the applicant's information related to quality group classification, the staff finds that the requirements of GDC 1 are met and the information is consistent with the guidance in RG 1.26 and RG 1.206.

3.2.5 Post Combined License Activities

There are no post COL activities related to this section.

3.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Sections 3.2.1 and 3.2.2, and the applicable RGs. The staff's review concludes that the applicant has adequately addressed the seismic and quality group classifications. The staff notes that these classifications meet the requirements of GDC 1 and GDC 2 and the guidance of RG 1.26, RG 1.29, and RG 1.206. Therefore the staff also finds that North Anna 3 COL FSAR, Revision 8, Sections 3.2.1 and 3.2.2 are acceptable because they meet NRC regulatory requirements and acceptance criteria in SRP Sections 3.2.1 and 3.2.2.

3.3 <u>Wind and Tornado Loadings</u>

3.3.1 Introduction

Seismic Category I for the ESBWR structures are designed for tornado and extreme wind phenomena. Seismic Category II structures are designed for extreme and tornado wind. Safety-related systems and components are protected within wind-resistant structures and the remainder of plant structures and components not designed for extreme wind loads are arranged or designed such that their failures do not adversely affect the ability of any seismic Category I SSC to perform their safety-related function.

3.3.2 Summary of Application

Section 3.3, “Wind and Tornado Loadings,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with a supplement, Section 3.3, “Wind and Tornado Loadings,” of Revision 10 of the ESBWR DCD.

In addition, in North Anna 3 FSAR, Section 3.3 the applicant provided the following:

<u>*Supplemental Information*</u>

- NAPS SUP 3.3-1 Extreme Hurricane Winds

In FSAR Section 3.3.2.4, the applicant provided the following supplemental information.

> Section 2.3 defines the site-specific extreme hurricane wind speed in accordance with RG 1.221, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants.” The site-specific extreme hurricane wind speed is less than the maximum tornado wind speed listed in Table 2.0-201.

3.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for SSCs protection from natural phenomena and the associated acceptance criteria are in SRP Section 3.3.1, “Wind Loading,” and SRP Section 3.3.2, “Tornado Loadings.”

The applicable regulatory requirements and associated guidance for wind and tornado loadings are as follows:

- 10 CFR Part 50, Appendix A, GDC 2 requires that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, tsunami, floods, and seiches without loss of capability to perform their safety functions as it relates to natural phenomena. The design bases for these SSCs shall reflect appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena.

3.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.3 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the wind and tornado loadings for North Anna 3.

In 2011 the NRC issued new guidance for hurricanes in RG 1.221. This guidance demonstrated that hurricane missiles could be more severe than tornado missiles. In addition, the ESBWR DC rule includes an exclusion from finality for loads on applicable SSCs from hurricane-generated missiles, but only to the extent that such loads are not bounded by other loads analyzed in the ESBWR DCD.

The staff reviewed the relevant information in the COL FSAR as follows:

Supplemental Information

- NAPS SUP 3.3-1 Extreme Hurricane Winds

The staff reviewed NAPS SUP 3.3-1 for extreme hurricane winds in accordance with RG 1.221, Revision 1, which was guidance that was issued following the staff approval of the ESBWR DCD, Revision 10. The applicant for North Anna 3 incorporated this new guidance and therefore included this supplemental COL information to address this RG revision. As stated by the applicant the North Anna 3 site-specific hurricane wind speeds are bounded by the results of the DCD for wind loadings on safety-related structures, and therefore the staff finds that the site-specific generated hurricane wind speed and loading is acceptable for the safety-related structures as defined by the ESBWR DCD.

3.3.5 Post Combined License Activities

There are no post COL activities related to this section.

3.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the wind and tornado loadings, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference are resolved.

In addition, the staff compared the additional North Anna 3 supplemental information in the application including NAPS SUP 3.3-1 and NAPS SUP 3.5-3 from FSAR Section 3.5 to the relevant NRC regulations and regulatory guides. The staff's review concludes that the applicant has provided sufficient information in its supplemental information on wind, extreme hurricane winds, and tornado loadings on safety-related structures. The staff finds that the supplemental information on hurricane wind speed meets the latest guidance of RG 1.221 and the requirements of GDC 2 for SSCs important to safety that are able to withstand the effects of natural phenomena without loss of capability to perform their safety function.

3.4 Water Level (Flood) Design

Section 3.4, "Water Level (Flood) Design," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements, Section 3.4, "Water Level (Flood) Design," of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 3.4 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Water Level (Flood) Design," that were incorporated by reference have been resolved.

3.5 <u>Missile Protection</u>

3.5.1 Introduction

SSCs important to safety are analyzed for and designed to be protected from a wide spectrum of internally generated missiles such as missiles from rotating equipment, high energy fluid systems, and gravitational missiles; externally generated missiles from tornado winds and extreme winds; and missiles from proximate site sources and aircraft hazards.

Methods of protection must be provided for all SSCs that are necessary to perform functions required to attain and maintain safe shutdown or to otherwise mitigate the consequences of an accident. These methods may consist of (1) locating the system or component in a missile-proof structure, (2) separating redundant systems or components in the missile's path or range, (3) providing local shields and barriers for systems and components, or (4) designing the equipment to withstand the impact of the most damaging missile.

The specific reactor site location determines the potential for missile hazards from nearby industrial sources and the hazards from aircraft operating in the region.

3.5.2 Summary of Application

Section 3.5, "Missile Protection," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.5, "Missile Protection," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 3.5, the applicant provided the following:

<u>Supplemental Information</u>

- STD SUP 3.5-1 Site Proximity Missiles

The applicant provided the following supplemental information. The applicant referred to Section 2.2 for information regarding the site-specific missile sources.

- STD SUP 3.5-2 Aircraft Hazards

The applicant provided the following supplemental information. The applicant referred to Section 2.2 for information regarding the site-specific aircraft hazard analyses and site-specific critical areas.

- NAPS SUP 3.5-3 Missiles Generated by Natural Phenomena

The applicant provided the following supplemental information. The applicant referred to FSAR Section 2.3 for information regarding the site-specific extreme hurricane winds in accordance with RG 1.221.

The applicant stated the following:

> The site-specific extreme hurricane wind speed is less than the maximum tornado wind speed listed in Table 2.0-201. Table 3.5-201 lists the NA3 site hurricane missile spectrum and velocities in accordance with the guidance in RG 1.221.

3.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1966, the FSER related to the ESBWR DCD.

In addition, the relevant requirements of the Commission regulations for turbine missiles and the associated acceptance criteria are described in SRP Section 3.5.1.3, and the aircraft hazards and the associated acceptance criteria are described in SRP Section 3.5.1.6.

The applicable regulatory requirements for protection against site proximity missiles and aircraft hazards are as follows:

- GDC 4 of Appendix A to 10 CFR Part 50, "Environmental and Dynamic Effects Design Bases."

3.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to missile protection.

The staff reviewed the information in the COL FSAR as follows:

Supplemental Information

- STD SUP 3.5-1 Site Proximity Missiles

The staff reviewed STD SUP 3.5-1, which states that the site-specific missile sources are addressed in Section 2.2 of the North Anna 3 FSAR.

The staff's technical evaluation of this portion of the application is limited to reviewing the supplemental information pertaining to STD SUP 3.5-1.

The staff reviewed the conformance of Section 3.5 of the North Anna 3 COL FSAR to the guidance in RG 1.206, Regulatory Position C.III.1, Section C.I.3.5.1.3, “Turbine Missiles.” The staff finds that the FSAR appropriately incorporates by reference Section 3.5.1.1.1.2 of the ESBWR DCD, Tier 2, Revision 10.

In addition the staff noted the potential for turbine missile hazard from the proposed North Anna 3 site in proximity of two existing nuclear units. Therefore, the staff requested in RAI 03.05.01.05-1 dated August 11, 2008 (ADAMS Accession No. ML082250417) that the applicant provide an assessment of the potential for the turbine missile generation for existing Units 1 and 2 to affect the safe operation of the proposed Unit 3. The applicant’s response to RAI 03.05.01.05-1 dated September 26, 2008 (ADAMS Accession No. ML082750076), that the planes-of-rotation of the turbine generators in Units 1 and 2 are oriented approximately 90 degrees relative to Unit 3 and are located approximately 1,640 feet from that unit. On the basis of the information the applicant provided the potential for impact from turbine missiles generated as a result of that particular orientation is not considered a possible threat that could affect the safe operation of the proposed North Anna 3. The staff concludes that the applicant has established that the operation of North Anna 3 on the proposed site location is acceptable in terms of the site proximity missile hazard in accordance with the guidance in SRP Section 3.5.1.3 and therefore, RAI 3.5.1.5-1 is resolved and closed.

- STD SUP 3.5-2 Aircraft Hazards

The staff reviewed STD SUP 3.5-2 which states that the site-specific aircraft analysis and site-specific critical areas are addressed in Section 2.2 of the North Anna 3 FSAR.

The staff’s technical evaluation of this portion of the application is limited to reviewing the supplemental information pertaining to STD SUP 3.5-2.

The applicant performed the aircraft hazards evaluation in the North Anna 3 Early Site Permit (ESP) Site Safety Analysis Report (SSAR) because the ESP site lies within 5 miles of the edge of a military route and within 2 miles of the edge of a Federal airway. The applicant in its ESP SSAR addressed and evaluated potential aircraft hazards following the approach and methodology outlined in SRP Section 3.5.1.6, “Aircraft Hazards.” The applicant simulated an aircraft crash into the effective plant areas of the safety-related structures on the site. The applicant further evaluated the probability of aircraft accidents resulting in radiological consequences greater than the 10 CFR Part 100, “Reactor Site Criteria,” exposure guidelines based on the following updated analysis for the COL application:

- A third airport within 10 miles of Unit 3 opened in 2007 following the ESP evaluation. It is a private landing strip approximately 7.6 miles north-northwest of the site. The airport is not licensed for commercial use and has only three small aircraft based on the field. The expected volume of traffic is very light and would not exceed the limiting operations threshold as determined in the ESP SSAR. Therefore, no additional evaluation of potential design basis aircraft event was performed.

- One civil airway (V223) and four military training routes (IR714, IR720, IR760/ VR1754, and VR1755) pass near the North Anna 3 site. The U.S. Federal Aviation Administration (FAA) at Richmond International Airport characterized civil airway V223 as “not heavily used” and estimated the traffic to be no more than 200 aircrafts per day. The U.S. Department of the Navy identified a total of 306 flight operations in the year 2007/2008 for three of the four routes, compared with the ESP SSAR assumption of 6,000 flights per year. As a result, the number of military training flights assumed in the ESP SSAR remains bounding. To estimate the probability calculations, the applicant for the ESBWR design considered the ESBWR reactor building (RB) and fuel building (FB) and the control and radwaste buildings (RWB). The applicant estimated the total effective plant area at 0.038 square miles for civil airways and 0.041 square miles for the military routes and revised the probability calculations.

Utilizing the above revised data as part of the North Anna 3 COL application, the applicant determined that the total probabilities from civilian or military routes is an order of magnitude of 10-7 events per year. The staff obtained updated FAA flight data and determined that the applicant had used conservatively higher values for flight operations to determine the total aircraft hazard probability. On the basis of FAA flight data and the review of the applicant's calculations of the probability of aircraft hazards, the staff considered the applicant's approach reasonable and its conclusion acceptable.

- NAPS SUP 3.5-3 Missiles Generated by Natural Phenomena

The staff evaluated hurricane-generated missiles on safety-related structures in this safety evaluation report (SER) for NAPS SUP 3.3-1, Section 3.3.4 as well as in the SER Chapter 19, Appendix 19A.

3.5.5 Post Combined License Activities

There are no post COL activities related to this section.

3.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the COL supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 3.5, and other NRC RGs. The staff concluded that the supplemental information presented in the COL FSAR is acceptable and meets the requirements of GDC 4 of Appendix A to 10 CFR Part 50. The staff based this conclusion on the following:

- STD SUP 3.5-1, "Site Proximity Missiles," is acceptable because the applicant has identified potential accidents related to the generation of site proximity missiles (except aircraft) in the site vicinity that could affect a nuclear power plant or plants of the specified type that might be constructed on the proposed site. The applicant has appropriately determined those potential accidents that should be considered as design-basis events and has demonstrated that the plant is adequately protected and can be operated with an acceptable degree of safety with regard to the design-basis accidents. The staff reviewed the information in the SSAR and FSAR. For the reasons given above, the staff concluded that the applicant has established that the construction and operation of Unit 3 of the specified type on the proposed site location is acceptable and meets the requirements of 10 CFR 52.79(a)(1)(iv) and 10 CFR 52.79(a)(1)(vi) for compliance with respect to determining the acceptability of the site.

- STD SUP 3.5-2, "Aircraft Hazards," is acceptable because the applicant has identified potential accidents related to the aircraft hazards in the site vicinity that could affect a nuclear power plant or plants of the specified type that might be constructed on the proposed site. The applicant has appropriately determined those potential accidents that should be considered as design-basis events and has demonstrated that the plant is adequately protected and can be operated with an acceptable degree of safety with regard to the design-basis accidents. The staff reviewed the information in the SSAR and FSAR. For the reasons given above, the staff concluded that the applicant has established that the construction and operation of Unit 3 of the specified type on the proposed site location is acceptable and meets the requirements of 10 CFR 52.79(a)(1)(iv) and 10 CFR 52.79(a)(1)(vi) for compliance with respect to determining the acceptability of the site.

3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping

Section 3.6, "Protection against Dynamic Effects Associated with the Postulated Rupture of Piping," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements, Section 3.6, "Protection against Dynamic Effects Associated with the Postulated Rupture of Piping," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 3.6 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Protection against Dynamic Effects Associated with the Postulated Rupture of Piping," that were incorporated by reference have been resolved.

3.7 Seismic Design

Safety-related SSCs are designed to withstand SSE loads and other dynamic loads, including those due to reactor building vibration (RBV) caused by suppression pool dynamics. This section addresses seismic aspects of the design and analysis in accordance with RG 1.206.

3.7.1 Seismic Design Parameters

Seismic Category I SSCs are designed to withstand the effects of an SSE event and to maintain the specified design functions. Seismic Category II and NS structures are designed or physically arranged so that the SSE could not cause unacceptable structural interactions with or the failure of seismic Category I SSCs. The ESBWR standard plant SSE design ground motion is addressed in Section 3.7 of ESBWR DCD, Tier 2, Revision 10. The horizontal and vertical SSE design ground response spectra (for 5 percent damping), also termed certified seismic design response spectra (CSDRS) for the ESBWR design were developed based on enveloping

RG 1.60, Revision 1, "Design Response Spectra for Seismic Design of Nuclear Power Plants," response spectra anchored to 0.3 g peak ground acceleration (PGA) and the high-frequency hard rock spectra anchored to 0.5 g PGA. The CSDRS for the RB/FB and the control building (CB) are shown in ESBWR DCD, Tier 2, Revision 10, Chapter 2.0, Figures 2.0-1 and 2.0-2 for horizontal and vertical directions, respectively. The CSDRS for the firewater service complex (FWSC) is 1.35 times the values shown in DCD Tier 2, Figures 2.0-1 and 2.0-2. The CSDRS have been defined as free-field outcrop spectra at the foundation level (bottom of the base slab) for the seismic design of the Category I structures included in the DC document. The applicant has provided the seismic design parameters for the North Anna 3 site in the North Anna 3 COL FSAR, Revision 9, Section 3.7.1, as documented below.

3.7.1.1 Introduction

The North Anna 3 FSAR, Revision 9, Section 3.7.1 addresses the site-specific design earthquake ground motion used for the seismic analysis and design of the seismic Category I structures. This design earthquake ground motion is based on the seismic and geologic characteristics at the North Anna 3 site and is established in terms of a set of idealized and smooth curves called the design response spectra. At the North Anna 3 site, the site-specific seismic design parameters include the design ground motion in terms of the foundation input response spectra (FIRS), design ground motion time histories, percentage of critical damping values, and the characteristics of the supporting media for seismic Category I structures.

3.7.1.2 Summary of Application

In the North Anna 3 COL FSAR Section 3.7.1, Revision 9, the applicant incorporated by reference Section 3.7.1 of ESBWR DCD, Revision 10.

In addition, in FSAR Section 3.7.1, the applicant provides the following:

Exemption

- Exemption 3 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The North Anna 3 site-specific seismic conditions described in FSAR Chapter 2 and Section 3.7.1 indicate that certain seismic design characteristics are not bounded by the DCD seismic design parameters. Therefore, Unit 3 defines the SSE to include both the CSDRS and the site-specific FIRS for each seismically qualified structure.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

This departure is described in North Anna 3 COL FSAR Part 7, Departures Report. The site-specific horizontal and vertical seismic response spectra as shown in North Anna 3 COL FSAR Figures 2.0-201 through 2.0-204 exhibit exceedances at certain frequencies, when compared to the ESBWR CSDRS. As a result of these exceedances, the applicant performed site-specific soil-structure interaction (SSI) analyses of the RB/FB, CB, and FWSC structures and revised the SSE definition to include both the ESBWR CSDRS and the site-specific FIRS for each seismically qualified structure for use in performing seismic design, analysis, and qualification of SSCs. In addition, FSAR Figure 3.7.1-285 provides the SSI input spectra defining site-specific ground motion for the FWSC at the bottom of the concrete fill (Elevation 220 ft) as discussed in FSAR Section 3.7.1.1.4.2.3.

Because the SSE is defined in DCD Tier 1, Table 5.1-1, this change to the site-specific definition requires the applicant to take a departure from the DCD Tier 1 information. Therefore, a request for exemption from DCD Tier 1 information is also provided in Exemption 3 described in North Anna 3 COL FSAR Part 7. The staff evaluated North Anna 3 Exemption 3 in Section 3.7.1.4 of this SER.

In addition, DCD Section 3.7 defines, as Tier 2* information, the ESBWR OBE as one-third of the SSE ground motion. Because the site-specific SSE is being defined through this departure as consisting of both the CSDRS and FIRS for each structure, two spectra are used to define the North Anna 3 OBE design ground motion as: one-third of the CSDRS and one-third of the site-specific SSE manifestation at grade presented in FSAR Figure 3.7.1-267. The detailed criteria for plant shutdown are evaluated in this SER in Section 3.7.1.4.

Supplemental Information

- NAPS SUP 3.7-7 — Design Ground Motion

As discussed under the departure, NAPS DEP 3.7-1, the site-specific FIRS at North Anna 3 site exceed the CSDRS. For this reason, the applicant supplemented FSAR Section 3.7.1.1 to provide site-specific seismic design parameters (such as SSI input strain-compatible soil profiles, SSI input response spectra, SSI input acceleration time histories) for the site-specific SSI analyses of the RB/FB, CB, and FWSC.

- NAPS SUP 3.7-1 — Site-specific Design Ground Motion Response Spectra

In FSAR Section 3.7.1.1.4, the applicant provided the following:

1. The development of the strain compatible dynamic properties (e.g., compression wave velocities, damping ratios) of the subsurface material profiles used in the site-specific SSI analyses of the RB/FB, CB, and FWSC in FSAR Section 3.7.1.1.4.1.

2. The development of a set of site-specific input response spectra for SSI analyses of the RB/FB, CB, and FWSC in FSAR Section 3.7.1.1.4.2. For each of the buildings, the applicant described how the site-specific SSI input response spectra are obtained from the corresponding FIRS and performance-based surface response spectra (PBSRS) by using the guidance in DC/COL-ISG-017. This supplement also described how the site-specific SSI input response spectra are augmented to obtain the final SSI input response spectra to meet the minimum ground motion requirements of 10 CFR Part 50, Appendix S.

- NAPS SUP 3.7-2 Site-specific Design Ground Motion Time History

In FSAR Section 3.7.1.1.5, the applicant provided information on two sets of three statistically independent acceleration time histories of motions (i.e., two horizontal and one vertical component) developed for the full column and partial column SSI analyses of the RB/FB and CB. For FWSC, one set of acceleration time histories were developed at two elevations, at the bottom of the basemat and at the bottom of the concrete fill. The SSI input acceleration time histories match the final SSI input response spectra developed in FSAR Section 3.7.1.1.4. The applicant used the guidance of SRP Section 3.7.1 in developing these time histories.

- NAPS SUP 3.7-3 Supporting Media for Seismic Category I Structures

This supplement provided information on the supporting media of seismic Category I structures in FSAR Section 3.7.1.3. The seismic Category I structures for North Anna 3 have concrete mat foundations on rock or concrete fill on rock.

3.7.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the seismic design and the associated acceptance criteria are in SRP Section 3.7.1. The specific requirements include the following:

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the seismic design basis to reflect the appropriate consideration of the most severe earthquakes historically reported for the site and surrounding area with a sufficient margin for the limited accuracy, quantity, and period of time in which historical data have been accumulated; and SSCs important to safety be designed to withstand the effects of earthquakes without a loss of capability to perform their intended safety functions.

- 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," as it relates to the SSE ground motion in the free-field at the foundation level of the structures to be an appropriate response spectrum with a PGA of at least 0.1 g; and if the OBE is chosen to be less than or equal to one-third of the SSE ground motion, it will not be necessary to conduct explicit response or design analyses in accordance with Section IV.(2)(i)(A) of 10 CFR Part 50, Appendix S.

In addition, the acceptance criteria and regulatory guidance associated with the review of FSAR Section 3.7.1 include the following:

- SRP Section 3.7.1 for reviewing seismic design parameters to ensure that they are appropriate and contain a sufficient margin so that seismic analyses (reviewed under other SRP sections) accurately and/or conservatively represent the behavior of SSCs during postulated seismic events.

- RG 1.60, to determine the acceptability of design response spectra for input into the seismic analysis of nuclear power plants.

- RG 1.61, Revision 1, “Damping Values for Seismic Design of Nuclear Power Plants,” to determine the acceptability of damping values used in the dynamic seismic analyses of seismic Category I SSCs.

- RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," to review acceptability of the input FIRS.
- DC/COL–Interim Staff Guidance (DC/COL-ISG)-01, "Interim Staff Guidance on Seismic Issues of High Frequency Ground Motion."
- DC/COL-ISG-017, "Interim Staff Guidance on Ensuring Hazard-Consistent Seismic Input for Site Response and Soil Structure Interaction Analyses."
- NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines," to determine the acceptability of the site-specific FIRS used in the site-specific seismic analysis.

3.7.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.7.1 of the ESBWR DCD. The staff reviewed Section 3.7.1 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL Part 7, "Departures Report" and the North Anna 3 COL FSAR, Revision 9:

Exemption

- Exemption 3 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The North Anna 3 horizontal and vertical FIRS for the RB/FB, CB, and FWSC structures are not bounded by the CSDRS at all frequencies. Therefore, the applicant made a Tier 1 Departure from the DCD to accommodate the site-specific seismological and geological conditions for North Anna 3. The applicant's definition of the SSE for North Anna 3 has therefore been revised to include both the DCD CSDRS and the site-specific FIRS for each seismically qualified structure. Site-specific SSI analyses have been performed for the North Anna 3 seismic Category I structures, and the staff evaluation of the results has confirmed the standard design to be adequate with the DCD modifications as outlined in Section 3.7 and 3.8 of the COL FSAR Revision 9. The site-specific definition of SSE will be applied in the inspections, tests, analyses, and acceptance criteria (ITAAC) for ensuring seismic capability of the plant.

The applicant provided the following in its description of this Tier 1 change to the DCD:

> The Unit 3 horizontal and vertical foundation input response spectra for the RB/FB, CB, and FWSC structures are not bounded by the CSDRS at all frequencies. The definition of the SSE for Unit 3 has therefore been revised to include both: 1) the CSDRS, as described in DCD Tier 1, Table 5.1-1, Footnote (4), and DCD Tier 1, Figures 5.1-1 and 5.1-2; and 2) the site-specific FIRS and the SSI input response spectra for the FWSC at the average elevation of the bottom of the concrete fill (Elevation 220 ft NAVD88, 220.86 ft NGVD29), representative of the Unit 3 site seismological and geological conditions. DCD Tier 1, Section 5.1, provides for site-specific soil structure interaction [SSI] analyses to be performed to confirm the seismic adequacy of the certified design using approved methods and acceptance criteria. Site-specific soil structure interaction (SSI) analyses have been performed for Unit 3 seismic Category I structures and evaluation of the results has confirmed the standard design to be adequate. The site-specific definition of SSE will be applied in the ITAAC for ensuring seismic capability of the plant.

In the North Anna 3 COL application, Revision 7, Part 7, "Departures Report," June 2016, the applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix E, Section III.B, "Design Certification Rule for the ESBWR Design, Scope and Contents," which requires an applicant referencing a certified design to incorporate by reference Tier 1 information.

Specifically, in North Anna Part 7, Exemption 3, the applicant proposed to depart from the ESBWR DCD, Tier 1, SSE definition from Table 5.1-1, Footnote (4) of the DCD. This exemption represents the Tier 1 changes that relate to Departure NAPS DEP 3.7-1 for Tier 2 and Tier 2* information regarding site-specific CSDRS partial exceedances. Part 10 of the North Anna 3 COL application reflects these changes to the DCD Tier 1 information regarding the site-specific SSE. This change of the SSE definition is reflected in the revisions to site-specific ITAAC. The site-specific definition of SSE will be applied in the ITAAC for ensuring seismic capability of the plant as designed, as constructed, and for any future potential plant modifications.

<u>Regulations</u>

- 10 CFR Part 52, Appendix E, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). 10 CFR Part 52, Appendix E, Section VIII.A.4 also states that the Commission will deny such a request if it finds that the design change will result in a significant reduction in the level of safety otherwise provided by the design.

- 10 CFR 52.63(b)(1) allows an applicant to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it determines that the request complies with the requirements for specific exemptions in 10 CFR 52.7 and 10 CFR 50.12, and if the special circumstances that 10 CFR 52.7 requires to be present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by 10 CFR Part 52, Appendix E must meet the requirements of 10 CFR 50.12, 10 CFR 52.7, and 10 CFR 52.63(b)(1).

Evaluation of Exemption

As stated in 10 CFR Part 52, Appendix E, Section VIII.A.4, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, as long as the criteria given in 10 CFR 50.12 and required by 10 CFR 52.7 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). 10 CFR 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below. Although the applicant requested an exemption from 10 CFR Part 52, Appendix E, Section III.B, the NRC is treating the requested exemption as one from ESBWR DCD Tier 1, Table 5.1-1, Footnote (4) to define the North Anna 3 SSE.

Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 information. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, Tier 1. The staff determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The purpose of Exemption 3 to ESBWR DCD Tier 1, Table 5.1-1, Footnote (4), for the North Anna 3 COL is to define the site-specific SSE, due to the exceedances of the ESBWR standard plant SSE at certain seismic frequencies. The site-specific SSE is then employed for the purpose of performing site-specific seismic inspections, tests, and analyses. The seismic design and qualification of SSCs are done in accordance with the methods of the standard design in conjunction with the site-specific results of the FIRS and which is then compared to the standard design. The applicant indicated that the exemption changes will augment the North Anna 3 site-specific ESBWR standard design attributes to ensure that the North Anna 3 site-specific seismic conditions are adequate and meet regulatory requirements. The North Anna 3 seismic design and analyses are verified through the appropriate ITAAC. The proposed exemption which defines the site-specific SSE ensures that the as-built plant will be seismically designed, analyzed, and qualified for meeting both the standard design and the site-specific conditions. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the performance of the associated ITAAC. The staff has evaluated the related departure NAPS DEP 3.7-1 in applicable sections of this SER, and concluded that this departure has been addressed adequately in the North Anna 3 site-specific seismic design evaluation of the ESBWR standard design. Therefore, the staff finds Exemption 3 presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to particular Tier 1 information. Subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the North Anna 3 COL Exemption 3 to the ESBWR DCD Tier 1, Table 5.1-1, Footnote (4) is to define the North Anna 3 SSE which will ensure that the safety-related structures that must withstand the effects of earthquakes are designed to the relevant requirements of GDC 2 and comply with Appendix S to 10 CFR Part 50 concerning natural phenomena. Standardized plants such as the ESBWR are designed to envelop the most severe earthquakes that affected a great number of sites where a nuclear plant may be located, with sufficient margin considering the limits of accuracy, quantity, and period of time during which historical data have been accumulated. In the case of North Anna 3, the site-specific horizontal and vertical foundation input response spectra for the RB/FB, CB, and FWSC structures are not bounded by the CSDRS at all frequencies. Therefore the applicant proposed a change to the Tier 1 definition of the SSE to include both the CSDRS and the site-specific FIRS which ensures that the North Anna 3 seismic structures are appropriately qualified and applied to the site-specific ITAAC. In addition, site-specific seismic analysis and design as described in FSAR Revision 9, Sections 3.7 and 3.8, show that the ESBWR standard design with necessary changes is adequate for the North Anna 3 site-specific seismological and geological conditions. Accordingly, special circumstances are present because the certified design information in ESBWR DCD, Tier 1, Table 5.1-1, Footnote (4), is not necessary to achieve the underlying purpose of the rule in view of the site-specific seismological and geological conditions. Therefore, the staff finds that special circumstances exist, as required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from the DCD, Tier 1 information.

Special Circumstances Outweigh Reduced Standardization

This exemption would allow the applicant to change certain ESBWR DCD, Tier 1 information proposed in the North Anna 3 COL application in view of site-specific seismological and geological conditions. The key design functions of seismically qualified structures will nonetheless be maintained, based on the nature of the proposed changes to the generic ESBWR DCD Tier 1, Table 5.1-1, Footnote (4) to define the North Anna 3 SSE, and the understanding that this change ensures that the as-built plant will be seismically designed, analyzed, and qualified for meeting both the standard design and the site-specific seismic conditions. However, this exemption request and the associated changes to North Anna 3 COL Tier 1 information demonstrate that there is a minimal change from the standard information provided in the ESBWR DCD. This change augments the ESBWR DCD for the North Anna 3 site-specific seismic conditions to ensure that the adequacy of the North Anna 3 seismic design and analyses are verified through the appropriate ITAAC. Consequently, the decrease in safety due to reduced standardization would also be minimal. For this reason, the staff determined that even if other ESBWR licensees and applicants do not request a similar exemption, the special circumstances outweigh the potential decrease in safety due to reduced standardization of the ESBWR design, as required by 10 CFR 52.63(b)(1).

No Significant Reduction in Safety

The proposed exemption would not modify the function of the North Anna 3 seismically qualified structures and SSCs. This change will ensure that the adequacy of the Unit 3 seismic design and analyses are verified through appropriate ITAAC. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4.

Conclusion

For the reasons set forth above, the staff has concluded that pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law; (2) presents no undue risk to the public health and safety; (3) is consistent with the common defense and security; (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization; and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff finds that the applicant's request to depart from the information in ESBWR DCD Tier 1, Table 5.1-1, Footnote (4) is acceptable, and the applicant's request for an exemption from these Tier 1 requirements is granted.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

Seismic Design Parameters

The staff reviewed the information presented in NAPS DEP 3.7-1 submitted in North Anna 3 COL FSAR Section 3.7 and in Part 7 of the COL application. This departure described that the site-specific FIRS exceeded the CSDRS at certain frequencies and as such, revised the SSE definition to include the site-specific FIRS in addition to the CSDRS for seismic analyses of seismic Category I and Category II SSCs. Since this departure involves changes to ESBWR

DCD Tier 1, Table 5.1-1, the applicant also requested an exemption (Exemption 3 in Part 7) from the DCD Tier 1 information. This departure also includes redefinition of the OBE for the plant shutdown.

The applicant has developed the site-specific seismic design parameters (FIRS, input acceleration time histories, etc.) using the guidance in SRP Section 3.7.1. Comparisons of site-specific FIRS with the CSDRS are presented in FSAR Figures 2.0-201 through 2.0-204 for RB/FB, CB, and FWSC. These Figures indicate that site-specific FIRS exceed the CSDRS for all these structures. As such, the applicant has performed site-specific SSI analyses consistent with the guidance in SRP Section 3.7.2 to determine the site-specific seismic demand for evaluation of the acceptability of the ESBWR standard plant design at the North Anna 3 site. The applicant also indicated that North Anna 3 seismic design, analyses, and qualification of the SSCs use both the CSDRS and the site-specific FIRS as the SSE. Details of the applicant's development of site-specific FIRS and ground motion time histories are described in the supplementary information to COL FSAR Sections 3.7.1.1.4 and 3.7.1.1.5 (NAPS SUP 3.7-1 & 3.7-2).

Two spectra are used to define the North Anna 3 OBE design ground motion as: (1) one-third of the CSDRS presented in the FSAR Figures 2.0-201 and 2.0-202 and (2) one-third of the 5 percent damped site-dependent SSE spectra manifested at grade as presented in the FSAR Figure 3.7.1-267. Exceedance of the response spectra (1) & (2) is evaluated independently (not through the envelope of these two). Staff's evaluation of the plant shutdown criteria due to OBE exceedance is discussed in Section 3.7.4 of this SER. The staff finds the use of both the CSDRS and the site-specific SSE as the basis of defining the OBE to be acceptable since: (1) safety-related SSCs are designed and qualified to meet both the CSDRS and site-specific FIRS consistent with the PBSRS, (2) the OBE is defined as one-third of the SSE, as such meets the requirement of 10 CFR Part 50, Appendix S, and (3) PBSRS and corresponding FIRS were developed using the guidance in SRP Section 3.7.1 and RG 1.208.

FSAR Section 3.7.2.4 discusses the site-specific SSI analyses of the ESBWR standard plant structures. FSAR Section 3.8 discusses design evaluation of the ESBWR standard plant structures for the site-specific seismic demand. The staff's evaluation of the site-specific FIRS and ground motion time histories is provided below under "Site-Specific Design Ground Motion Response Spectra" and "Site-Specific Design Ground Motion Time History." Staff's evaluation of the plant shutdown criteria is provided in Section 3.7.4.4 of this SER. The staff's evaluation of the site-specific RB/FB, CB, and FWSC SSI analyses and the applicant's assessment of the ESBWR standard plant design adequacy at North Anna 3 site is provided in Sections 3.7.2.4 and 3.8 of this SER.

Since the applicant incorporates both the CSDRS and the site-specific FIRS as the SSE for North Anna 3 seismic design, analyses, and qualification of Category I SSCs, the staff concludes that the seismic design parameters used in site-specific seismic analyses and evaluation of the ESBWR standard design to address FIRS exceedance of the CSDRS at the North Anna 3 site are acceptable.

Single Envelope Ground Motion

DCD Section 3.7.1.1.3 provides information regarding the single envelope ground response spectra which is referred to as the CSDRS. The CSDRS is used for the design of the ESBWR standard plant structures. NAPS DEP 3.7-1 noted that the site parameter comparison indicates exceedance of the CSDRS by the North Anna 3 FIRS and thus a site-specific SSI analysis is performed as presented in COL FSAR Section 3.7.2. The applicant also clarified that SSCs are seismically designed, analyzed, and qualified to both CSDRS and FIRS as described in FSAR Sections 3.7.1, 3.7.2, 3.7.3, and 3.10. The staff finds this clarification in FSAR Section 3.7.1.1.3 to be acceptable. For staff's evaluation of acceptability of the site-specific SSI analysis, refer to this SER in Section 3.7.2.4.

Percentage of Critical Damping Values

NAPS DEP 3.7-1 in COL FSAR Section 3.7.1.2 clarifies that OBE structural damping values consistent with RG 1.61, Revision 1 are used for site-specific SSI analyses unless SSE damping in DCD Table 3.7-1 is justified by stress demand. FSAR Section 3A.13.2 further describes the damping values used in the site-specific SSI analyses. FSAR Section 3A.15 and Tables 3A.15-201 through 3A.15-206 provide details of the use of SSE damping values in specific analyses cases. The staff evaluated the acceptability of the damping values used in the site-specific SSI analyses during its review of the site-specific design basis models as discussed in this SER in Section 3.7.2.4 under the heading "*SSI Analysis Structural Models*." The staff found the applicant's method of assigning the damping values for site-specific SSI analyses acceptable per the guidance in RG 1.61, Revision 1. In addition, the maximum soil damping ratio as specified in the FSAR Tables 3.7.1-201 through 3.7.1-206 is below 15 percent in all cases and is therefore acceptable per the guidance in SRP Acceptance Criterion 3.7.2.II.4.

Supplemental Information

- NAPS SUP 3.7-7 Design Ground Motion

Design Ground Motion

ESBWR CSDRS are discussed in DCD Section 3.7.1.1 and are shown in DCD Figures 2.0-1 and 2.0-2. This supplement to COL FSAR Section 3.7.1.1 describes that the site-specific SSI analysis is carried out using the site-specific seismic design parameters. The site-specific design parameters are developed as described in COL FSAR Sections 3.7.1.1.4 and 3.7.1.1.5. These design parameters include the SSI strain compatible soil profiles, SSI input response spectra, and SSI input acceleration time histories for the Category I structures. The development of the site-dependent SSE manifestation at-grade is discussed in FSAR Section 3.7.1.1.6, which is used to define OBE. The staff's evaluation of the supplementary information is provided below under review of NAPS SUPs 3.7-1 and 3.7-2 in this SER.

- NAPS SUP 3.7-1 Site-specific Design Ground Motion Response Spectra

Site-Specific Design Ground Motion Response Spectra

The applicant in FSAR Section 3.7.1.1.4.2 stated that, for all seismic Category I structures FIRS are presented in FSAR Section 2.5.2.6. The applicant used the results of site response analyses as input to the development of the ground motion response spectra (GMRS), FIRS, and PBSRS. FIRS were developed for both full column outcrop motions and partial column outcrop motions for the RB/FB and CB. The final SSI input response spectra for the RB/FB are shown in the FSAR Figures 3.7.1-218 through 3.7.1-220, and for the CB are shown in the FSAR Figures 3.7.1-229 through 3.7.1-231. For the FWSC, two sets of site-specific SSI input response spectra were developed: one with the control motion defined at the bottom of the FWSC foundation mat (Elevation 282 ft), and the other with the control motion defined at the elevation corresponding to the bottom of concrete fill (Elevation 220 ft) supporting the FWSC foundation mat. The final FWSC SSI input response spectra at the Elevation 282 ft are shown in the FSAR Figures 3.7.1-232 through 3.7.1-234, and those at the Elevation 220 ft are shown in the FSAR Figures 3.7.1-283 through 3.7.1-285.

The applicant used the performance-based methodology as described in the FSAR Sections 2.5.2.5 and 2.5.2.6 in developing the GMRS, FIRS, and PBSRS following the guidance in RG 1.208. The applicant first developed the GMRS, FIRS, and PBSRS for the horizontal component of the motions. In accordance with the guidance in NUREG/CR-6728, Appendix J the applicant used the frequency dependent vertical-to-horizontal (V/H) response spectral ratios appropriate for the North Anna 3 site to obtain the corresponding vertical GMRS, FIRS, and PBSRS from the horizontal spectra.

For the RB/FB and CB, the applicant developed site-specific SSI input response spectra from the corresponding FIRS and PBSRS using the method described in Section 5.2.1 of DC/COL-ISG-017, to ensure hazard-consistent seismic inputs for the deterministic site-specific SSI analyses. For the FWSC, the applicant used the envelope of the results of the two SSI analyses – one with the SSI input response spectra applied at the bottom of the FWSC foundation mat (Elevation 282 ft) and the other input response spectra applied at the bottom of the concrete fill (Elevation 220 ft) – to ensure adequate consideration of the hazard-consistent SSI input for the deterministic SSI analyses.

Development of the SSI input response spectra consists of establishing the three strain compatible deterministic soil profiles for the SSI analyses, adjusting the FIRS to ensure that these three soil profiles will result in PBSRS being bounded by the envelope of the FIRS propagating to the ground surface, and verifying that the seismic input meets the minimum requirement of 10 CFR Part 50, Appendix S. The staff found the applicant's process of developing the SSI input response spectra for the seismic Category I structures acceptable, because the method and procedure used are consistent with the guidance in DC/COL-ISG-017 and SRP Section 3.7.1.II.4.A. For the FWSC, the staff found the use of one set of input control motion defined at the bottom of the FWSC foundation mat and one set at the bottom of the concrete fill to be acceptable as discussed in this SER below under *"SSI Input Response Spectra for the FWSC*".

Details of the staff's evaluation of the development of the SSI strain compatible soil profiles, SSI input response spectra from the FIRS, and the applicant's method of satisfying the minimum design ground motion requirements of 10 CFR Part 50, Appendix S are discussed as follows in this SER.

SSI Strain Compatible Soil Properties

In accordance with DC/COL-ISG-017, the applicant developed from the in-situ soil profiles three deterministic strain compatible soil profiles for the SSI analyses as follows: Best Estimate (BE), Lower Bound (LB), and Upper Bound (UB). These soil profiles were used by the applicant to adjust the FIRS to ensure that the PBSRS is bounded by the envelope of the FIRS propagating to the ground surface, as well as to account for potential effects of the variation of the soil parameters on the site-specific SSI analyses. FSAR Section 3.7.1.1.4.1 describes the methodology used by the applicant to develop these profiles. The methodology follows the guidance in RG 1.208, SRP Acceptance Criterion 3.7.2.II.4, and DC/COL-ISG-17. The methodology is based on the statistics of the strain-iterated soil properties obtained from the probabilistic site response analyses using the randomized full soil column profiles as described in FSAR Sections 2.5.2.5 and 3.7.1.1.4.1. In addition in response to staff RAI 03.07.01-8 dated February 23, 2015 (ADAMS Accession No. ML15056A047), the applicant addressed the following:

- From the probabilistic full column site response analyses of the soil columns described in FSAR 2.5.2.5, a set of 60 strain-compatible soil properties is obtained for each of the 4 input rock cases of 10^{-4} and 10^{-5} annual-frequency-of-exceedance level of low frequency (LF) and high frequency (HF) seismic events. The mean and standard deviation for each of the 4 sets of shear wave velocity (Vs) and damping ratios are calculated. These values are used to establish the mean and standard deviation of the strain compatible soil properties that are consistent with the FIRS motions.

- The UB and LB values of the soil parameters (Vs and damping ratios) are calculated as ± one log-standard deviation from the log-mean values. Maximum strain compatible damping ratios were below 15 percent in all cases and are thus consistent with SRP Acceptance Criterion 3.7.2.II.4.

- The UB and LB Vs profiles were adjusted where necessary to satisfy the minimum variation criteria of SRP Section 3.7.2. According to this criteria, LB Vs profiles should be less than or equal to $(V_S) / (\sqrt{1.5})$ and the UB Vs profile should be greater than or equal to $(V_S) \times (\sqrt{1.5})$ where V_S is the BE strain compatible Vs corresponding to the FIRS level of motion. This approach is consistent with the guidance in SRP Acceptance Criterion 3.7.2.II.4 for a site with well investigated subsurface material properties.

- The compression wave velocity profiles were based on the corresponding Vs profiles and the site-specific Poisson's ratios identified in FSAR Table 2.5.4-208. In the layers below water table, a minimum Primary wave (P-wave) was first set to a velocity of 4800 ft/sec. The Poisson's ratio is adjusted to obtain the minimum P-wave velocity. The maximum value of Poisson's ratio used is 0.48. In the layers of bedrock below the groundwater table, the compression wave velocities exceeded 4800 ft/sec in all cases and no adjustment was necessary.

FSAR Tables 3.7.1-201, 3.7.1-203, and 3.7.1-205 present the values of strain compatible in-situ subsurface material properties used for fully embedded (FE) site-specific SSI analyses for the RB/FB, CB, and FWSC, respectively. The top 7 layers (17 ft) of the RB/FB profile corresponding to saprolite are removed in the partially embedded (PE) SSI analysis of the RB/FB. The top 10 layers (25 ft) of the CB profile representing the saprolite are removed in the PE SSI analysis of the CB. In these tables, a combination of the lower Vs and P-wave velocity along with the higher damping values constitute the LB profile. Similarly, the higher shear and P-wave velocities along with the lower damping values constitute the UB profile.

FSAR Tables 3.7.1-202, 3.7.1-204, and 3.7.1-206 present the UB, BE, and LB Vs, P-wave velocity, and the damping values for the structural fill and concrete fill materials for the RB/FB, CB, and FWSC, respectively. The concrete fill is considered as linear elastic material for the purpose of SSI analyses. These strain compatible (i.e., compatible with the FIRS) fill material properties were also calculated following the same methodology discussed above for the in-situ soil profile. The strain-compatible structural fill and concrete fill materials are used for the near-field finite elements as part of the structural models.

The staff finds the above approach for developing the strain compatible soil properties for the in-situ material, structural backfill material, and the concrete fill material acceptable because these were developed using the guidance in SRP Acceptance Criterion 3.7.2.II.4 and DC/COL-ISG-17.

SSI Input Response Spectra for the RB/FB and CB

- *Nuclear Energy Institute (NEI) Check[2] per DC/COL-ISG-017*

As discussed in FSAR Sections 3.7.1.1.4.2.1 and 3.7.1.1.4.2.2, the site-specific SSI input response spectra are calculated for SSI analyses of the RB/FB and CB structure as FE structure and as PE (i.e., only considering embedment in the rock) structure. FSAR Section 2.5.2.6 described the development of full column and partial column FIRS and the corresponding PBSRS. The corresponding full column FIRS and partial column FIRS for RB/FB are shown in FSAR Figures 2.5.2-307 and 2.5.2-309 and for the CB in FSAR Figures 2.5.2-308 and 2.5.2-310. The corresponding full column PBSRS are shown in FSAR Figure 2.5.2-311. The partial column PBSRS are included in FSAR Figures 3.7.1-216 and 3.7.1-217 for the RB/FB and in FSAR Figures 3.7.1-227 and 3.7.1-228 for the CB.

The applicant used the method described in Section 5.2.1 of DC/COL-ISG-017 to adjust the FIRS to yield SSI input response spectra for the RB/FB and the CB. FSAR Figures 3.7.1-212 and 3.7.1-213 present the envelope of the ground surface response spectra obtained from the horizontal and vertical full column FIRS propagated to the ground surface through the LB, BE, and UB profiles for the RB/FB. Also presented in FSAR Figures 3.7.1-212 and 3.7.1-213 are the corresponding PBSRS and FIRS. As shown from the Figures 3.7.1-212 and 3.7.1-213, the envelope of the LB, BE, and UB ground surface response spectra does not bound the PBSRS at all frequencies. For this reason, the applicant used an adjustment factor to modify the FIRS to develop the SSI input response spectra. The frequency dependent adjustment factor is either unity where the PBSRS is bounded or the ratio of the PBSRS to the envelope of LB, BE, and UB surface response spectra. This conservative bounding adjustment factor is then applied to the corresponding FIRS to obtain the SSI input response spectra.

The applicant also used the same method described in Section 5.2.1 of DC/COL-ISG-017 for developing the input spectra for the PE case for the RB/FB and for the FE and PE cases for the CB. For the RB/FB, the FSAR Figures 3.7.1-212 and 3.7.1-213 include the SSI input response spectra for the full column case and Figures 3.7.1-216 and 3.7.1-217 for the partial column case. For the CB, Figures 3.7.1-223 and 3.7.1-224 show the SSI input response spectra for the FE case and Figures 3.7.1-227 and 3.7.1-228 show those for the PE cases.

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[2] The NEI New Reactor Seismic Issues Resolution Program undertook several studies producing industry white papers. The guidelines developed in ISG-01, the NEI white paper, and the development of the criteria associated with this ISG result from the coordination of the industry initiative, NRC studies, and other stakeholder inputs through interactions in public meetings. In particular, the meeting of September 25–26, 2008, was instrumental in establishing a framework of common understanding (see meeting summary, ADAMS Accession No. ML082950476).

The applicant performed the above NEI check based on the random vibration theory (RVT) method, which did not use the synthetic acceleration time histories. To confirm whether the envelope of the response spectra of the spectrally matched design acceleration time histories also envelopes the PBSRS at the ground surface, the applicant, as discussed in the FSAR Sections 3.7.1.1.5.1.1 and 3.7.1.1.5.1.2, performed additional comparisons of the envelope of the response spectra of the spectrally matched design acceleration time histories to the PBSRS for RB/FB and CB, respectively. These comparisons in FSAR Figures 3.7.1-295 through 3.7.1-306 show that, except at a few locations, the enveloped response spectra at the surface exceeds the PBSRS. In a few instances as discussed below, the raw envelopes of response spectra of the acceleration time histories at the ground surface for the LB, BE, and UB soil cases were below the PBSRS for some frequencies.

For the instances in the horizontal direction, the dips were generally small and occurred in very narrow frequency ranges. These dips correlate to the dips shown on the spectrally matched response spectra, which are still consistent with the SRP Section 3.7.1 guidance. However, since the structural demands were calculated using the design time histories (not directly using the FIRS) in the SSI analysis, the staff requested during Audit 1 (ADAMS Accession No. ML16064A271) that the applicant assess the effect of these dips on the structural response. The applicant performed a sensitivity study as referenced in the North Anna 3 FSAR, Section 3.7.1.1.5.1.1, using the time history for the CB partial column in the horizontal (H1) direction, and the staff also confirmed the results during the North Anna 3 Audit 1. This time history was modified slightly so that its response spectrum was above the final SSI input response spectra around the affected frequency. The in-structure response spectra (ISRS) calculated using this modified time history did not show significant changes over the ISRS calculated using the original time history and those changes did not affect the enveloped and broadened ISRS used in the design. Therefore based on this sensitivity study, the staff concluded that the small dips which occurred in a very narrow frequency range in the raw envelope do not affect the broadened ISRS in the horizontal direction and thus, found the NEI check in the horizontal direction acceptable.

For the instance of RB/FB FE condition in the vertical direction (FSAR Figure 3.7.1-297), where the enveloped response spectrum falls below the PBSRS between 16.6 Hz and 20.4 Hz, the applicant explained during Audit 1 and also in the FSAR Section 3.7.1.1.5.1.1 that the RB/FB structural response transfer functions relative to the outcrop SSI input motion show this dip is outside of the structural frequencies of the RB/FB in the vertical direction so its effect on structural response is negligible. The staff found this justification acceptable because, as also reflected in the FSAR, the vertical input motion to the structure and the load transfer from the building primarily occur at the mat foundation and the surrounding rock interface and consequently the effects of vertical ground motion near the ground surface are insignificant for structural responses in the vertical direction.

The applicant also indicated in the FSAR Section 3.7.1.1.5.1.1 that this dip reflects a difference in the method to calculate the vertical PBSRS (by applying the frequency-dependent V/H ratio) and the method to calculate the acceleration response (through P-wave propagation). In order to understand the effect of this difference, the staff reviewed the pertinent information in DC/COL-ISG-17, FSAR Section 3.7.1.1.5.1.1, and NUREG/CR-6728. The staff confirmed this information during the North Anna 3 Audit 1. The same frequency-dependent V/H ratio was used to obtain the vertical FIRS and PBSRS from the horizontal FIRS and PBSRS, respectively, regardless the difference in the elevations of FIRS (at foundation level) and PBSRS (at ground surface). In addition, the application of V/H ratios is independent of the vertical soil profiles (LB, BE, and UB) that are used to propagate the vertical FIRS up to the ground surface. Therefore, for comparison purposes in the vertical direction, the two methods may not be consistent. The staff also concluded that while the observed difference between the vertical PBSRS and the enveloped response spectra at the ground surface is possible, the effects of these dips on the structural response are considered insignificant since: (1) FSAR Figures 3.7.1-295 through 3.7.1-306 show that, except at a few instances, the enveloped response spectra at surface exceed the PBSRS (for some cases by large margins) and (2) the seismic load transfer in the vertical direction primarily occurs at the foundation-rock interface and not at the free ground surface. For this reason, the staff found the NEI check for the SSI input spectra for the RB/FB and CB to be acceptable.

- *Meeting the Minimum Requirement of 10 CFR Part 50, Appendix S*

10 CFR Part 50, Appendix S, requires that the horizontal component of the SSE ground motion in the free-field at the foundation levels of structures must be an appropriate response spectrum with a PGA of at least 0.1 g. In FSAR Section 3.7.1.1.4.2.1, the applicant described how the final SSI input response spectra were developed from the performance-based input response spectra to meet the minimum requirement of 10 CFR Part 50, Appendix S. The applicant stated that for the full soil column analyses, the final SSI input response spectra are determined by enveloping the full column SSI input response spectra and the minimum required response spectra defined in RG 1.60 anchored at 0.1 g. Similarly, for the partial soil column analyses the final SSI input response spectra are determined by enveloping the partial column SSI input response spectra and the minimum required response spectra defined in RG 1.60 anchored at 0.1 g. The development of final horizontal and vertical SSI input response spectra for RB/FB is shown in FSAR Figures 3.7.1-218 and 3.7.1-219 and for the CB in Figures 3.7.1-229 and 3.7.1-230.

The staff reviewed the results, and notes that the initially adjusted FIRS as discussed above under "*NEI Check*" were further enhanced to ensure that the final input spectra envelop the RG 1.60 spectrum anchored at 0.1 g. For this reason, the staff concluded that the final SSI input response spectra meet the 10 CFR Part 50, Appendix S minimum horizontal ground motion requirement at the foundation level.

The staff found the applicant's final SSI input response spectra for the RB/FB and the CB SSI analyses acceptable because: (a) the method and the procedure used are consistent with the guidance in DC/COL-ISG-017 and SRP Section 3.7, (b) the envelope of the surface response spectra based on the three deterministic soil columns bounds the corresponding PBSRS for the two embedment configurations (i.e., FE and PE) with a few minor exceptions that were determined to be insignificant to structural responses, and (c) the final SSI input spectra meet 10 CFR Part 50, Appendix S minimum 0.1 g horizontal ground motion requirement.

SSI Input Response Spectra for the FWSC

In the initial submittal of FSAR Section 3.7.2, the site-specific SSI analyses considered the FWSC as a surface founded structure at Elevation 282 ft. The control motion used in the SSI analysis was applied at the bottom of the basemat and not at the bottom of the concrete fill at Elevation 220 ft. The applicant did not need to use the methodology in Section 5.2.1 of DC/COL-ISG-017 for ensuring that the SSI input spectra specified at Elevation 282 ft would envelop the PBSRS because FWSC is considered as surface-founded.

The staff, however, noted that the concrete fill below the FWSC basemat was represented as an integral part of the structural model used in the SSI analyses. Staff notes that, from the point of view of the SSI analysis, the combined FWSC-concrete fill is similar to an embedded structure and as such, the control motion for SSI analysis could also be defined at the bottom of the concrete fill. In addition, the control motion specified at the foundation level (Elevation 282 ft) may include the effect of potential de-amplification of the high frequency content of the earthquake motion through the in-situ soil material. For this reason, the staff in RAI 03.07.01-11**,** requested the applicant to provide the technical justification for defining the control motion used in the SSI analysis at the bottom of the basemat and not at the bottom of the concrete fill.

In the response to RAI 03.07.01-11 (ADAMS Accession No. ML15056A047), the applicant supplemented the FSAR Section 3.7.1.1.4.2.3 to include a new control motion at the bottom of concrete fill (Elevation 220 ft). The applicant used two sets of site-specific SSI input response spectra defined at the bottom of the FWSC basemat (Elevation 282 ft) and at the bottom of the concrete fill (Elevation 220 ft). The FIRS corresponding to the control motion applied at the bottom of the FWSC basemat (Elevation 282 ft) represent the PBSRS for the FWSC soil column as shown in FSAR Figure 2.5.2-312. The final SSI input response spectra at Elevation 282 for FWSC are the envelope of the FIRS for FWSC and the RG 1.60 spectra anchored at 0.1 g to meet the minimum requirement of 10 CFR Part 50, Appendix S. Similarly, the final SSI input response spectra at Elevation 220 ft are the envelope of the design response spectra (DRS) at Elevation 220 ft for FWSC and the RG 1.60 spectra anchored at 0.1 g to meet the minimum requirement of 10 CFR Part 50, Appendix S. The applicant calculated the DRS at Elevation 220 ft. using the same method as described in FSAR Section 2.5.2.5 and 2.5.2.6. The final SSI input response spectra at Elevation 282 ft. and at Elevation 220 ft. are respectively presented in FSAR Figures 3.7.1-232 through 3.7.1-234 and in Figures 3.7.1-283 through 3.7.1-285.

The staff reviewed the information provided in the FSAR and found the applicant's final SSI input response spectra for the FWSC SSI analyses acceptable because: (a) the applicant in addition to using the guidance in DC/COL-ISG-017 to apply SSI input response spectra at the foundation level of the FWSC, used another set of site-specific SSI input response spectra applied at the bottom of the concrete fill; (b) the results of the two sets of SSI analyses are enveloped to develop the site-specific seismic demand of the FWSC and as such, the analyses bound any potential effect of de-amplification resulting from a single input analysis with the control motion applied only at the foundation level; and (c) the final input spectra meet the 10 CFR Part 50, Appendix S minimum 0.1 g horizontal ground motion requirement.

Consideration of Backfill Material in RB/FB and CB SSI Analyses

FSAR Section 3.7.1.1.4 indicates that the in-situ saprolite is replaced by structural fill and Zone III rock is replaced by concrete fill. As discussed earlier in this SER the applicant has also developed the engineering properties of the granular fill and concrete fill. However, the applicant did not consider the backfill material (granular structural fill and concrete fill) in developing the FIRS and PBSRS. The staff therefore requested the applicant in RAI 03.07.01-7 to provide a technical basis for computing the FIRS and PBSRS which only considers the in-situ soil/rock columns and not the backfill material that would exist surrounding the seismic Category I structures.

In the response to RAI 03.07.01-7 (ADAMS Accession No. ML15056A047), the applicant stated that the backfill material that is placed below and around the seismic Category I structures is limited in extent. In order to capture the effects of the limited extent of the backfill material on the response of the RB/FB and CB, the dynamic models for the seismic response analyses use near-field elements as part of the SSI structural model representing the dynamic properties of concrete and structural fill materials. LB, BE, and UB dynamic properties of the structural fill materials compatible to strain generated by the design ground motion are developed from the results of the site response analyses as discussed in the FSAR Section 3.7.1.1.4.1. The dynamic properties used for the concrete fill are linear and independent of the strain. The site-specific seismic demand is obtained from the envelope of responses from the SSI analyses of two different embedment configurations: partial column and full column subgrade profiles representing dynamic properties of the far-field in-situ subgrade materials. The applicant used the minimum value of lateral extent of backfill for the RB/FB SSI model as one-half of the distance between the RB/FB and the adjacent Turbine Building (TB) and for the CB SSI model as one-half of the distance between the CB and the adjacent Service Building (SB). The partial and full embedment configurations bound the effect of subgrade stiffness variations related to the lateral extent of the backfill (partial columns also account for the effects of soil separation) and groundwater table variations. The partial column models provide a lower bound stiffness representation whereas the full column models represent the upper bound subgrade stiffness.

The staff reviewed the response and found the response acceptable for the RB/FB and the CB because (a) the effect of the subgrade stiffness variations on the seismic demand due to consideration of limited lateral extent of the backfill material in the SSI model is bounded by the two embedment configurations used in the SSI analyses; and (b) use of the minimum value of the lateral extent of the backfill material in the full column model which conservatively maximizes the subgrade lateral stiffness and minimizes the subgrade damping values.

Consideration of Backfill Material in FWSC SSI Analyses

The applicant in the response to RAI 03.07.01-7 (ADAMS Accession No. ML15056A047) indicated that in the structural part of the SSI model, the concrete fill placed below the FWSC foundation basemat (down to the top of the Zone III/IV rock) was modeled as solid finite elements. While the in-situ soil surrounding the concrete fill was modeled in the SSI analyses of the FWSC, the model did not include the near field structural backfill material surrounding the concrete fill. The applicant justified the backfill material not being explicitly modeled on the basis that the differences between the dynamic properties of the structural backfill and the in-situ soil are small and are not expected to significantly affect the response. This is also because the FWSC is founded on concrete fill which is supported by the in-situ rock material.

The staff reviewed the comparison of the dynamic properties of the structural fill and in-situ material for the FWSC provided in the response to RAI 03.07.01-7. However based on the information provided, the staff could not determine conclusively the potential effect on the SSI response of not including the backfill material as part of FWSC structural model. The applicant subsequently performed additional SSI analyses considering soil separation from the concrete fill, which effectively represent the cases of the lower bound of the structural fill effect. The depths of the soil separation were estimated from static and dynamic lateral soil pressures and are in the range of 4.75 m to 8.83 m, which are close to the range of the partial embedment for RB/FB and CB. The depths of the soil separation are also close to 6 m as per the American Society of Civil Engineers (ASCE) 4-98, “Seismic Analysis of Safety-Related Nuclear Structures and Commentary,” soil separation guidance. These analyses found some exceedances in structural demands and ISRS, and these exceedances are appropriately considered in the applicant’s design evaluation of the ESBWR standard design for the North Anna 3 site. More detailed evaluation of exceedance consideration is provided in this SER in Section 3.7.2. The staff also performed a confirmatory analysis of the FWSC SSI model and confirmed the applicant's conclusions. A summary of this confirmatory analysis is provided in this SER in Section 3.7.2. As discussed in that Section of this SER, the staff found the applicant's analyses and conclusions acceptable because the effect of the structural fill is adequately considered.

Supplemental Information

- NAPS SUP 3.7-2 Site-specific Design Ground Motion Time History

Site-Specific Design Ground Motion Time History

In the North Anna 3 FSAR, Section 3.7.1.1.5, the applicant describes that for each set of horizontal and vertical final SSI input response spectra presented in FSAR Section 3.7.1.1.4.2, a set of three spectrally matched acceleration time histories (two horizontal and one vertical component) were generated. The seed time histories used are those of the 1984 M6.2 Morgan Hill earthquake recorded at the station Gilroy–Gavilan College chosen from the CEUS database of acceleration time histories in NUREG/CR–6728. FSAR Section 3.7.1.1.5.1.1 describes the selection process of the seed time histories and the methodology to develop the spectrally matched time histories.

One set for each elevation of three statistically independent acceleration time histories of motions (i.e., two horizontal and one vertical component) are developed for each of the full column and partial column final SSI input response spectra for the RB/FB and the CB, respectively. For the FWSC, one set of three statistically independent acceleration time histories of motions (i.e., two horizontal and one vertical component) are developed for the final SSI input response spectra applied at each of the foundation level of the FWSC and at the bottom of the concrete fill below the FWSC.

The applicant used SRP Acceptance Criterion 3.7.1.II.1.B, Option 1, Approach 2 in developing the time histories. FSAR Figures 3.7.1-235 through 3.7.1-240 provide comparison between the response spectra of the spectrally matched time histories with the target response spectra and the lower and upper target spectra band (90 percent and 130 percent of the target response spectra). The staff reviewed these comparisons. The comparison indicates that while the response spectra for the time histories are within 90 percent to 130 percent of the target spectra for the frequency range between 0.2 and 100 Hz, under-predictions were observed approximately below a frequency of 0.2 Hz. As such in RAI 03.07.01-12, the staff requested the applicant to provide numerical results of the spectral matching checks specified in SRP Section 3.7.1 acceptance Criteria II.1.B.ii (Option 1, Approach 2) and provide a technical justification for the under predictions below 0.2 Hz. The staff also requested the applicant to provide power spectral density (PSD) functions of the time histories to verify that there are no significant gaps in the frequency content of the acceleration time histories.

The staff reviewed the applicant's response to RAI 03.07.01-12 (ADAMS Accession No. ML15056A047) and verified the following aspects of the spectrally matched time histories as discussed below:

- The cross-correlation coefficients between the three components are less than 0.16, as listed in FSAR Tables 3.7.1-210, 3.7.1-212, 3.7.1-214, and 3.7.1-218 which indicates statistical independence.

- The strong motion durations as defined in SRP Acceptance Criterion 3.7.1.II.1.B as listed in FSAR Table 3.7.1-211, 3.7.1-213, 3.7.1-215, and 3.7.1-219 are longer than the minimum value of 6 seconds.

- The time step of the time histories is 0.005 s, which corresponds to an acceptable Nyquist frequency of 100 Hz. The duration of the time histories is 30 s, which is greater than the 20 s criterion.

- The 5-percent damped response spectra of the time histories were compared with the target spectra in FSAR Figures 3.7.1-235 through 3.7.1-240 for RB/FB, 3.7.1-247 through 3.7.1-252 for the CB, 3.7.1-259 through 3.7.1-261 for FWSC at Elevation 282 ft, and 3.7.1-286 through 3.7.1-288 for FWSC at Elevation 220 ft. The comparison indicates that the response spectra for the time histories are within 90 percent to 130 percent of the target spectra for the frequency range between 0.2 and 100 Hz.

Based on the above review the staff finds that the cross-correlation coefficients, time step, and the duration of the strong motion portion of the time histories meet the guidance in the SRP Section 3.7.1 and thus are acceptable.

Concerning the under-prediction below 0.2 Hz, the applicant identified the sloshing of the water in the Gravity Driven Cooling System Pool and the Isolation Condenser/Passive Containment Cooling Expansion Pools located in the RB/FB are the only responses characterized by frequencies lower than the 0.2 Hz. No other SSCs fall in the frequency range below 0.2 Hz. The applicant also indicated that below the frequency of 0.2 Hz, CSDRS bounds the target spectrum and as such any potential under prediction of the response from site-specific analyses will be bounded by the ESBWR standard plant design. The applicant also indicated that seismic-induced hydrodynamic pressures on the pools associated with convective (sloshing) and impulsive (rigid) modes will be taken to be the larger of the standard design pressures or the North Anna 3 site-specific pressures.

The staff reviewed the Figures 1 through 6 provided in the response to RAI 03.07.01-12 and determined that significant margin exists between the CSDRS and the site-specific target spectrum for RB/FB in the frequency range below 0.2 Hz. Therefore, the staff concludes that the use of time histories which are matched to the site-specific target spectrum in the frequency range between 0.2 Hz to 100 Hz and are under-predicted below the target spectrum at frequencies less than 0.2 Hz is acceptable because (a) at the North Anna 3 site the target response spectra (i.e., final SSI input spectra) is bounded by the CSDRS by a significant margin in the low frequency range and as such (b) seismic-induced hydrodynamic load demands for the Gravity Driven Cooling System Pool and the Isolation Condenser/Passive Containment Cooling Expansion Pools will be bounded by the ESBWR standard plant design envelopes.

The applicant in the FSAR Section 3.7.1.1.5.1.1 described that the characteristics values, i.e., PGV/PGA and PGA*PGD/PGV^2 ratios for the matched time histories, do not fall within the bin values reported in NUREG/CR-6728. The PGA, PGV, and PGD refer to the peak ground acceleration, peak ground velocity, and peak ground displacement, respectively. Since the target spectra used in the spectral matching procedure is a composite of both the high frequency and low frequency earthquakes, the applicant concludes that this difference is acceptable because the time histories are spectrally matched to the final SSI input response spectra, which represent a combination of hazards from both large, distant earthquakes and smaller, closer earthquakes.

The staff further reviewed FSAR Tables 3.7.1-211, 3.7.1-213, 3.7.1-215, 3.7.1-219, and 3.7.1-220, which provided the characteristic values of the matched time histories and the corresponding bin values of the selected seed time histories reported in NUREG/CR-6728. The comparison of the PGV/PGA values of the seed earthquake and the design time histories shows that the design time histories have higher energy content (a greater maximum velocity) and are therefore conservative. The staff further determined that the design input time histories have higher energy content than the FIRS and 0.1 g RG 1.60 spectra. On this basis, the staff found the peak ground motion parameter values associated with the design time histories acceptable.

In response to RAI 03.07.01-12, the applicant performed additional verifications to demonstrate that there are no significant gaps in power for the spectrally matched time histories. To do this, PSDs were calculated for the frequency range of 0.3 to 50 Hz. The PSD plots for the suite of 18 time histories are shown in FSAR Figures 3.7.1-268 through 3.7.1-282 and 3.7.1-292 through 3.7.1-294. The applicant concludes that the PSD functions do not show any significant dip in the frequency content of the input time histories. However, this conclusion was drawn without performing comparison of the estimated PSD functions with some properly developed target PSD. To gain additional confidence on the power adequacy of the time histories, the staff conducted a confirmatory analysis of the 18 time histories by comparing their estimated PSD functions with the target PSDs developed to be compatible with the final SSI input response spectra. Some estimated PSD functions were found to have dips below the 70 percent target PSDs; however, those dips were determined to not significantly affect structural response because they occur outside of the fundamental frequencies of the SSI models. Based on the results of the staff confirmatory analysis, the staff concluded that the spectrally matched time histories are acceptable.

As described in the FSAR Section 3.7.2.4.1.2, based on the method described in DC/COL-ISG-017, the applicant developed in-column motions at the foundation levels of the RB/FB and the CB, and at the bottom of the concrete fill under the FWSC foundation. The in-column motions were developed from the time histories that were spectrally matched to the final SSI input response spectra defined as free-field outcrop response spectra at the foundation levels for the RB/FB and the CB and at the bottom of the concrete fill under the FWSC foundation. In addition, the deterministic SSI strain compatible subsurface profiles (BE, LB, and UB) as discussed before in this SER were used in developing the in-column motions. These in-column motions were used as inputs into the North Anna 3 site-specific SSI analyses described in FSAR Section 3.7.2. This approach is acceptable to the staff because it is consistent with the method described in DC/COL-ISG-17.

Site-Dependent SSE Manifestation At-Grade and OBE Response Spectra

The applicant in the FSAR Section 3.7.1.1.6 established site-dependent SSE manifestation at grade as the envelope of the following two spectra:

1. PBSRS calculated at grade (Elevation 290 ft) from full soil column analyses for RB/FB and CB and,

2. The minimum required response spectra defined as the RG 1.60 broadband horizontal and vertical response spectra at 5 percent damping anchored to 0.1 g.

The site-dependent OBE at grade is defined as one-third of the site-dependent SSE manifestation at grade. The site-dependent SSE manifestation and OBE spectra at grade are shown in the FSAR Figure 3.7.1-267. The staff found the site-dependent SSE manifestation and OBE established at the grade level to be acceptable since (a) they were derived from the PBSRS which is developed following the guidance in RG 1.208 and (b) they meet the requirement of 10 CFR Part 50, Appendix S.

Supplemental Information

- NAPS SUP 3.7-3 Supporting Media for seismic Category I Structures

Supporting Media for Seismic Category I Structures

The applicant stated that the seismic Category I structures for North Anna 3 have concrete mat foundations founded on rock or concrete fill placed on top of rock. FSAR Section 2.5.4.2 describes the static and dynamic engineering properties of the subsurface material at the North Anna 3 site. The dynamic properties used in the SSI analyses are discussed in FSAR Section 3.7.1.1.4.1. The minimum Vs of the supporting foundation material is greater than 1000 ft/sec. The staff determined that this information together with the ESBWR standard plant structural data in the ESBWR DCD, Revision 10, is sufficient per SRP Acceptance Criterion 3.7.1.II.3. The applicant has considered the potential variability of the properties of the subsurface material in the SSI analyses. The staff's review of this information is discussed above in this SER under "*SSI Strain Compatible Soil Properties.*" The staff's evaluation of the site-specific seismic analysis of the seismic Category I structures using the site characteristics described in FSAR Section 3.7.1.1.4.1 is discussed in Section 3.7.2 of this SER.

3.7.1.5 Post Combined License Activities

There are no post COL activities related to this section.

3.7.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the seismic design parameters that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.7.1, other NRC RGs, DC/COL-ISG-017 and DC/COL ISG-1. The staff finds that the applicant has addressed seismic design parameters in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.7.1.3 of this SER.

3.7.2 Seismic System Analysis

3.7.2.1 Introduction

This section addresses the seismic analysis methods and acceptance criteria used for the ESBWR seismic Category I structures. Seismic Category I structures are designed to withstand the effects of the SSE event and to maintain the specified design functions. This section applies to building structures that constitute primary structural systems. The reactor pressure vessel (RPV) is not a primary structural component, but it is considered as part of the RB/FB model for the purpose of dynamic analysis because of its dynamic interaction with the supporting structure. Non-seismic Category I structures (seismic Category II and NS) are designed or physically arranged (or both) to prevent the SSE from causing unacceptable structural interactions with or the failure of seismic Category I SSCs. The ESBWR method for a standard plant seismic analysis of the Category I structures is in Section 3.7.2 of ESBWR DCD, Tier 2, Revision 10.

3.7.2.2 Summary of Application

Section 3.7.2 and Appendices 3A and 3C of the North Anna 3 COL FSAR, Revision 9, incorporate by reference Section 3.7.2 and Appendices 3A and 3C of ESBWR DCD, Revision 10. In addition, in FSAR Section 3.7.2 and Appendices 3A and 3C, the applicant provides the following departure and supplemental information:

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

In North Anna 3 FSAR, Section 3.7.2.2, the applicant described that the natural frequencies of the ESBWR standard plant structures and SSI analyses to develop the seismic demand for the seismic design of the ESBWR standard plant are presented in DCD Appendix 3A, Sections 3A.1 through 3A.9. The site-specific SSI analyses used to develop the site-specific seismic demand for the RB/FB, CB, and FWSC are presented in FSAR Sections 3.7.2.4 and 3A.10 through 3A.19. In FSAR Sections 3C.7.4, 3C.7.6, and 3C.7.7, the applicant describes, respectively, the computer codes SASSI2010, ACS SASSI, and SHAKE2000 used for the North Anna 3 site-specific SSI analysis. The staff reviewed the SSI analyses and the computer programs used in the site-specific analyses as part of its review of FSAR Section 3.7.2.4. The site-specific SSI analysis considers the North Anna 3 site conditions and follows an approach that is consistent with those used for the standard design. The structural models used for the site-specific SSI analyses have the same configuration, stiffness, and the inertia properties as the standard design basis structural models presented in DCD Appendix 3A.

As discussed earlier in this SER, the site-specific horizontal and vertical seismic response spectra as shown in North Anna 3 COL FSAR, Figures 2.0-201 through 2.0-204 exceed the ESBWR CSDRS at certain frequencies. As a result, the applicant has performed site-specific SSI analyses of the RB/FB, CB, and FWSC structures using input ground motion defined by the site-specific FIRS and strain compatible soil properties to establish the site-specific seismic demand. The resulting site-specific seismic demand (e.g., accelerations, enveloping structural loads, and ISRS) is used to demonstrate the applicability of the seismic design of the ESBWR standard design for the North Anna 3 site conditions. This departure is also applicable to the

FSAR Section 3.7.2.8 wherein the applicant addressed site-specific seismic considerations for all NS Category I structures that are within the scope of the standard design.

Supplemental Information

- NAPS SUP 3.7-5 Interaction of Non-Category I Structures with Seismic Category I Structures

The applicant stated that the locations of structures around the North Anna 3 power block area are depicted in the plant layout provided in FSAR Figure 2.1-201 and DCD Figure 1.1-1. In FSAR Section 3.7.2.8, the applicant addresses the requirements for site-specific SSI and seismic structure-soil-structure interaction (SSSI) analyses of non-seismic Category I structures both within and outside the scope of the DCD and including the TB, SB, ancillary diesel building (ADB), and RWB.

- NAPS SUP 3.7-8 Interaction of Non-Category I Structures with Seismic Category I Structures – Radwaste Building

In FSAR Section 3.7.2.8.2, the applicant describes that the RWB exterior walls have a static wall pressure capacity of at least 3 psi. For the RWB, a pressure capacity of 3 psi for the external walls is required to ensure that the safe separation distance of the RWB from the liquid hydrogen storage tanks is maintained.

3.7.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the seismic system analysis and the associated acceptance criteria are in SRP Section 3.7.2. The specific requirements include the following:

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the seismic design basis to reflect appropriate consideration of the most severe earthquakes historically reported for the site and surrounding area with a sufficient margin for the limited accuracy, quantity, and period of time in which historical data have been accumulated. In addition, SSCs important to safety should be designed to withstand the effects of earthquakes without losing the capability to perform their intended safety functions.

- 10 CFR Part 50, Appendix S, as it relates to the horizontal component of the SSE ground motion in the free-field at the foundation level of the structures to be an appropriate response spectrum with a peak ground acceleration of at least 0.1 g; and if the OBE is chosen to be less than or equal to one-third of the SSE ground motion, it is not necessary to conduct explicit response or design analyses in accordance with Section IV.(2)(i)(A) of 10 CFR Part 50, Appendix S, and the requirement of taking into account SSI effects.

In addition, the acceptance criteria and regulatory guidance associated with the review of FSAR Section 3.7.2 include the following:

- SRP Section 3.7.2 guidance to review methods for site-specific seismic analysis and modeling of structures to ensure that they accurately and/or conservatively represent the behavior of SSCs during postulated seismic events.

- DC/COL-ISG-1 and DC/COL-ISG-017 in reviewing the seismic input and the SSI dynamic model acceptability for the North Anna 3 site.

- RG 1.61 to determine the acceptability of the damping values used in the structural model.

- RG 1.122, “Development of Floor Design Response Spectra for Seismic Design of Floor Supported Equipment and Components,” to determine acceptability of development of floor design response spectra for seismic design.

3.7.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.7.2 and Appendices 3A and 3C of the ESBWR DCD. The staff reviewed Section 3.7.2 and Appendices 3A and 3C of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the COL FSAR as follows:

<u>Departure</u>

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to SSI analyses included under FSAR Section 3.7.2, Appendix 3A and 3C of the North Anna 3 COL FSAR as follows:

<u>Natural Frequencies and responses</u>

The applicant presented information on natural frequencies and SSI responses of seismic Category I buildings under the CSDRS and generic site conditions in DCD Sections 3A.1 through 3A.9, which are incorporated by reference in North Anna 3 COL FSAR. The SSI responses for site-specific conditions are provided in North Anna 3 COL FSAR Sections 3.7.2.4 and 3A.10 through 3A.19. The results of staff’s evaluation of the site-specific SSI analyses are discussed below in this SER.

<u>Soil-Structure Interaction (SSI)</u>

The methodology and the results of the SSI analyses for the ESBWR standard plant seismic Category I buildings are presented in the DCD Section 3.7.2, Appendix 3A and Appendix 3C for a range of soil conditions selected for the ESBWR standard plant design. The CSDRS have been applied as the input ground motion at the building foundation level for the seismic design of the Category I structures included in the DC document. The site-specific horizontal and vertical seismic response spectra as presented in North Anna 3 COL FSAR Figures 2.0-201 through 2.0-204 exhibit exceedances at certain frequencies, when compared to the ESBWR CSDRS. As a result of these exceedances, the applicant in accordance with the requirement of DCD Tier 1, Section 5.1 performed site-specific SSI analyses of the RB/FB, CB, and FWSC structures to establish the site-specific seismic demands. FSAR Section 3.7.2.4 and Sections 3A.10 through 3A.19 present the site-specific SSI analyses of the seismic Category I RB/FB, CB, and FWSC. The staff's evaluation of the site-specific SSI analyses is discussed below:

The staff used the guidance of SRP Section 3.7.2, DC/COL-ISG-1, and DC/COL-ISG-017 in reviewing the site-specific seismic analyses. The applicant used the standard design methodology presented in the DCD to perform the North Anna 3 site-specific SSI/SSSI analyses using the computer programs SASSI2010 and ACS SASSI. The coupled soil-structure models for the SSI analyses are based on the structural models developed from the standard design structural model coupled with site-specific strain compatible dynamic subsurface properties. Specifically, the staff reviewed the methods used in the site-specific seismic analysis to account for SSI and SSSI effects including the verification and validation (V&V) of the computer programs used in the site-specific analysis.

For the RB/FB and the CB, site-specific SSI analyses were performed for two different embedment configurations representing: (1) the RB/FB and CB as being PE up to the Zone III rock nominal top elevation, and (2) the RB/FB and CB being FE up to the finished grade elevation accounting for the site-specific SSI effects of the soil above the Zone III rock. In addition, for each embedment configuration, the applicant used BE, LB, and UB soil column profiles resulting in a total of six subgrade profiles to account for the effects of the potential variability in subgrade properties and the potential soil separation from the foundation walls during an SSE event at the North Anna 3 site. The base case site-specific SSI analyses used RB/FB and CB models with uncracked reinforced concrete properties for the concrete members and 100 percent in-fill concrete stiffness contribution considered for the concrete filled steel internal structures. The envelope of responses obtained from these six analyses represent the base case North Anna 3 site-specific seismic demand. The applicant used the DCD structural models for the RB/FB and CB analysis. The applicant has also performed site-specific sensitivity evaluations of the effects of structural stiffness variations and SSSI on the North Anna 3 site-specific demands. These analyses are documented in FSAR Sections 3.7.2.4, and 3A.10 through 3A.19, and in GEH Reports WG3-U71-ERD-S-0001 Revision 4, "Reactor/Fuel Building Complex Seismic Analysis Report" (ADAMS Accession Nos. ML16097A203 and ML16097A204); and WG3-U73-ERD-S-0001 Revision 2, "Control Building Seismic Analysis Report" (ADAMS Accession Nos. ML15357A305, ML15357A312, and ML15357A313). The applicant has used the envelope of the base case analyses and the results of the sensitivity analyses for site-specific structural analysis and design evaluation of the ESBWR standard plant structures at North Anna 3 site.

For the SSI analysis of the FWSC, the applicant used two analyses configurations representing: (1) the FWSC as a surface founded structure with the input control motions applied at the bottom of the FWSC foundation (Elevation 282 ft), and (2) the FWSC together with the concrete fill below the FWSC foundation basemat as an embedded structure with the input control motions applied at the bottom of the concrete fill (Elevation 220-ft). The base case site-specific SSI analyses used FWSC model with uncracked reinforced concrete properties for the concrete members. The applicant used the DCD structural model for this analysis. The applicant has also performed site-specific sensitivity evaluations of the effects of structural stiffness variations and soil separation. The SSSI effect on the FWSC was included in the North Anna site-specific seismic demand. The staff's evaluation of the two SSI inputs for the FWSC is presented earlier in this SER in Section 3.7.1.4 under heading, *"SSI Input Response Spectra for the FWSC."* FWSC SSI analysis method and results are documented in FSAR Sections 3.7.2.4, and 3A.10 through 3A.19 and in GEH Reports WG3-U63-ERD-S-0001, Revision 4, "Firewater Service Complex Seismic Analysis Report" (ADAMS Accession No. ML16148A131).

The staff conducted two on-site seismic audits at the applicant's contractor GEH office in Wilmington, North Carolina. In the first audit during the week of September 28, 2015 (hereinafter referred to as North Anna 3 Audit 1), the staff reviewed the North Anna 3 seismic demand evaluation including the supporting calculations (ADAMS Accession No. ML16064A271). In the second audit held during the week of March 21, 2016 (hereinafter referred to as North Anna 3 Audit 2), the staff reviewed the applicant's evaluation of the structural design for North Anna 3 site-specific seismic demand (ADAMS Accession No. ML16193A047). During North Anna 3 Audit 1, the staff also reviewed calculations pertaining to the V&V of the computer program used in the site-specific SSI and SSSI analyses. The staff's evaluation of the computer program V&V documents are described later in this SER Section 3.7.2.4 under the heading of *"Verification and Validation of SASSI 2010 and ACS SASSI and Bench marking of the MSM."*

Based on its review, the staff confirmed that the applicant addressed the site-specific effects of the SSSI between the ESBWR seismic Category I structures on the site-specific seismic demand obtained from the SSI analysis. The staff reviewed the site-specific SSSI sensitivity evaluations between the RB/FB and CB as well as between the FWSC and CB. The site-specific SSSI evaluations are performed on combined models of the two buildings considering the presence of the structural and concrete fill materials in the interspace between the buildings. Site-specific evaluations of the effects of SSSI between the RB/FB and CB and between the FWSC and CB are documented respectively in GEH Reports WG3-U73-ERD-S-0005, Revision 3, "Control Building and Reactor/Fuel Building Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A271) and WG3-U73-ERD-S-0002, Revision 6, "Control Building and Firewater Service Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A270).

The various SSI and SSSI case analyses performed by the applicant are summarized in the FSAR Tables 3A.15-201 through 3A.15-206. In these tables, DM and MSM refer to the "Direct Method" and "Modified Subtraction Method" of the SASSI2010/ACS SASSI program, respectively (See the discussion below in this SER Section 3.7.2.4 under "*SSI Analysis Method.*"). The staff finds the applicant's consideration of the SSI and SSSI analyses cases acceptable because as shown in these FSAR Tables cited above, in establishing the site-specific seismic demand, the applicant has considered analysis cases to account for the effects of the potential variabilities in the properties of the soil and rock at the site, soil separation, potential stiffness variation of the structures, and SSSI in accordance with SRP Section 3.7.2.II.4.

Strain Compatible Dynamic Subsurface Material Properties

The site-specific SSI analyses considered the three site-specific subsurface material profiles (BE, LB, and UB) for the in-situ materials, structural fill and concrete fill, which are documented in FSAR Tables 3.7.1-201 through 3.7.1-206. The staff finds these profiles acceptable because they are determined to be consistent with design ground motion based on the staff-approved

2013 Ground Motion Model (GMM) and also properly account for the effects of the potential variability in the properties of the soils and rocks at the North Anna 3 site. The development of three deterministic site-specific soil profiles are consistent with the SRP Acceptance Criterion 3.7.2.II.4. The staff further reviewed selected portions of the North Anna 3 calculations and reports pertaining to the development of strain compatible dynamic subsurface material properties during North Anna 3 Audit 1 and confirmed that the approach used by the applicant is consistent with the staff guidance. The staff's detailed review of the above information is in Section 3.7.1.4 of this SER.

The staff also performed a confirmatory analysis to assess the adequacy of the method that the applicant used for calculating the log-standard deviations from the simulated low frequency profiles and the high frequency profiles. These simulated profiles were results of the applicant's probabilistic site response analysis. The log-standard deviations are used to determine the LB and UB soil profiles. The staff confirmatory analysis showed that the results were very similar to those the applicant provided. The staff also determined that the reason for this good agreement in the results from the two different methods is that the low frequency soil profiles and the high frequency profiles are very similar. As such, the staff found that the method used by the applicant to determine the standard deviation for use in calculating the LB and UB soil profiles is acceptable.

The staff finds the strain compatible dynamic subsurface material properties acceptable based on the conclusion in Section 3.7.1.4 of this SER and the conclusion of the staff confirmatory evaluation described above.

Ground Motion Time Histories

As discussed earlier in this SER in Section 3.7.1, for the RB/FB and CB, two sets of three statistically independent acceleration time histories (i.e., two horizontal and one vertical component) are developed for the full column and partial column final SSI input response spectra. For the FWSC, two sets of three statistically independent acceleration time histories (i.e., two horizontal and one vertical component) are developed for the final SSI input response spectra applied at the foundation level of the FWSC (Elevation 282 ft) and at the bottom of the concrete fill below the FWSC (Elevation 220 ft). The staff finds that these ground motion time histories are acceptable for the site-specific SSI analyses performed by the applicant since they were developed in accordance with the guidance in SRP Section 3.7.1 and were confirmed through a staff confirmatory analysis regarding their power adequacy for the frequencies of interest to the structural responses. The staff's detailed review of the above information is in Section 3.7.1.4 of this SER.

SSI Analysis Method

The applicant performed site-specific SSI analyses following the methodology in ESBWR DCD, Tier 2, Section 3A.5.2, which is based on the frequency domain complex response approach using the SASSI 2000 program. Structural responses were computed in terms of maximum absolute accelerations, relative displacements, maximum forces and moments, and ISRS at the key locations in the structures identified in ESBWR DCD, Tier 2, Appendix 3A, as well as seismic lateral soil pressures acting on below-grade exterior walls (seismic soil pressures are reviewed in Section 3.8.4.4 of this SER). The use of the frequency domain complex response approach for site-specific SSI analysis is acceptable to the staff because it is the same methodology applied in the ESBWR DCD and is consistent with SRP Acceptance Criterion 3.7.2.II.4.

The staff, however, noted that the applicant used the SASSI 2010 and ACS SASSI programs in the North Anna 3 site-specific SSI analysis instead of the SASSI 2000 program that was used for the ESBWR DCD. The applicant performed V&V analyses to ensure the acceptability of the SASSI 2010 and ACS SASSI programs for use in the site-specific SSI analyses for the North Anna 3 site. The staff's review of the applicant's V&V of the SASSI programs is described below under the heading, *"Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM."* As concluded there, the use of the SASSI 2010 and the ACS SASSI programs is acceptable for the North Anna 3 site-specific application.

To perform the SSI analysis of embedded structures such as the RB/FB and the CB, the SASSI programs may use the DM ("Direct Method," also known as the "Flexible Volume Method"), the MSM (Modified Subtraction Method), or the SM ("Subtraction Method"). The DM is the numerically accurate but also the most computationally intensive method. The SM, if not implemented properly, could potentially result in erroneous and non-conservative SSI responses when compared to the DM.

FSAR Section 3A.14 indicates that the site-specific SSI analyses were performed using either the DM or the MSM, but not the SM. Current staff guidance regarding the use of the DM versus the MSM is provided in SRP Section 3.7.2, Revision 4 and Acceptance Criterion 3.7.2.II.4. Although the guidance states that the DM should be used to the extent practical, the MSM is also identified as an alternative for very large computer models where it is not feasible to use the DM. The guidance recommends the use of reduced-size computer models (e.g., half/quarter models) to perform direct comparisons between the MSM and the DM solutions and to draw conclusions that can be extrapolated to the full-size models.

For this reason, the staff in RAI 03.07.02-26, requested the applicant to demonstrate the adequacy of the MSM for the North Anna 3 application. In response to RAI 03.07.02-26 (ADAMS Accession No. ML15222A240), the applicant performed additional benchmark studies to include both LB and UB North Anna 3 soil profiles. The result of the bench marking analyses is contained in GEH Report SER-DMN-011, Revision 1, "Benchmarking of SASSI2010 MSM Results from NA3 Site-Specific Analysis" (ADAMS Accession No. ML15222A283). During North Anna 3 Audit 1, the staff reviewed the Benchmarking and other relevant technical reports and confirmed that the analyses results obtained from the MSM are essentially identical to those obtained from the DM analysis for the frequency range of interest to the North Anna 3 site conditions. Based on the review of the results of the Benchmark studies performed by the applicant, the staff concluded that the use of the MSM is acceptable for site-specific SSI analyses at the North Anna 3 site.

SSI Analysis Structural Models

Site-Specific Design Basis RB/FB SSI model

FSAR Section 3A.16 describes the SSI models used for the site-specific SSI analyses. Details of the site-specific design basis SSI model of the RB/FB are described in the GEH Report WG3-U71-ERD-S-0001, Revision 4, "Reactor/Fuel Building Complex Seismic Analysis Report" (ADAMS Accession Nos. ML16097A203 and ML16097A204). The site-specific RB/FB SSI model is shown in FSAR Figures 3A.16.3-201 through 3A.16.3-209. It is based on the three-dimensional lumped-mass stick model that was used for the standard design seismic response analysis in the DCD, which considers shear, bending, torsion, and axial deformations of the building. Single-degree-of-freedom (SDOF) oscillators connected to the stick models are used to represent the significant out-of-plane modes of flexible slabs and walls in the building. The RB/FB lumped-mass stick model is shown in the DCD Figure 3A.7-4. The stick models and the SDOF oscillators used in the site-specific base case SSI models are therefore acceptable because they are the same as those used in the ESBWR DCD for the same purpose and they are consistent with SRP Acceptance Criterion 3.7.2.II.3.C.iii.

The coupled soil-structure SASSI 2010 models used for the site-specific SSI analysis of the RB/FB are shown in the FSAR Figures 3A.16.3-201 through 3A.16.3-204 for the PE model and in Figures 3A.16.3-205 through 3A.16.3-209 for the FE model. The site-specific SSI model of the RB/FB differs from the standard design model in that: (a) the meshing of the below grade portion of the model is modified to match the layering and stiffness properties of the North Anna 3 subgrade, (b) near-field subgrade elements are included in the structural model to represent the structural fill and concrete fill materials surrounding the RB/FB, (c) the lower OBE damping value is used to conservatively reflect the dissipation of energy in the structures, and (d) the rigid massless outriggers are installed at each floor elevation to facilitate calculation of ISRS and displacements at floor edges. A minimum value of 3.13 m is used for the lateral extent of the near-field concrete and structural fill elements for the RB/FB model. Because of the limited lateral extent of the fill material, the staff found the applicant's method of modeling the concrete and structural fill as the near-field structural elements acceptable. Detailed staff evaluation of the item (b) above concerning lateral extent of the near-field elements used in the SSI model is provided in Section 3.7.1.4 of this SER.

The site-specific base case model for the structural portion of the RB/FB consists of the DCD RB/FB stick model based on the uncracked concrete properties, which represents the upper bound stiffness properties of the structural elements. Along with these upper bound stiffness properties, the applicant also assigned lower OBE damping values for the structural members. The use of the OBE damping values reflects lower dissipation of energy in the structures resulting in conservative seismic response determination. Sensitivity analysis to consider concrete cracking was also performed by the applicant and is evaluated later in this section. Therefore, per guidance in SRP Sections 3.7.1 and 3.7.2, and in RG 1.61, the use of uncracked section properties and OBE damping is conservative and thus acceptable for RB/FB base case model.

The exterior walls below grade and the foundation basemat are modeled using plate elements similar to the SASSI model used for the standard design RB/FB SSI analysis except that the vertical and horizontal spacing of the elements were adjusted to closely match the site-specific subsurface profile layers and to address model passing frequencies. Brick elements were used to model the near-field structural fills and the excavated soil volume for the FE and PE structures. To ensure that the dynamic response of the site-specific SSI model is adequate for the frequency range of interest, the applicant adjusted the mesh size of the below-grade portion of the model to ensure that both the horizontal and vertical mesh dimensions do not exceed 20 percent of the length of the shear wave passing through the soil material at the highest frequency of interest. In addition, the aspect ratio of the plate and brick finite elements used in the mesh should not exceed 1:4, which is validated by the applicant in V&V of SASSI 2010 program documented in GEH Report SER-DMN-020, Revision 1, "Validation Summary Report for SASSI 2010 and Appendix with Validation Problems for RAI 03.07.02-10/RAI 03.07.02-26

Response" (ADAMS Accession No. ML15222A280). Per DC/COL-ISG-1, the passing frequency of the SSI models should be at least 50 Hz.

As stated in the FSAR Section 3A.16.3.1 and GEH Report WG3-U71-ERD-S-0001, Revision 4, the maximum aspect ratio of the finite element mesh in the RB/FB embedded models is 1:3.5. The staff finds that this ratio to be acceptable since it does not exceed the aspect ratio limit (1:4) validated in the SASSI 2010 V&V analysis. The staff's evaluation of the SASSI 2010 V&V for North Anna 3 is provided in this SER under the heading *"Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM."* The staff reviewed the finite element meshes of the RB/FB excavated volumes depicted in FSAR Figures 3A.16.3-203 and 3A.16.3-207 and the corresponding passing and cut-off frequencies shown in FSAR Table 3A.15-201. The passing frequencies are calculated based on both the maximum horizontal and vertical dimensions of the excavated volume elements and the near-field elements. The staff concluded that the mesh sizes meet the 50 Hz criteria identified above except for the SSI analysis cases corresponding to the LB full column subsurface profile. For these LB full column cases, the staff found that the passing frequency of the SSI models is 33 Hz and thus deviates from the guidance in DC/COL-ISG-1.

The staff's assessment, however, concluded that the deviation from the guidance identified above is not a concern for the following reasons:

1. The site-specific seismic responses computed for the UB subsurface profile are more susceptible to the higher frequency content of input motions above 33 Hz. These are accurately captured in the analyses because they are based on SSI models that have the required 50 Hz passing frequency.

2. The reduced passing frequency for the SSI analyses with LB full column subsurface profile reflects an insufficient mesh/layer refinement in the soil layers and near-field structural backfill elements of the model only—the mesh/layer dimensions in the rock portions below the soil layers are adequate.

3. The review of site-specific seismic responses in the structures computed from the SSI analyses of the LB full column cases indicates that these cases only bound results for the ISRS envelopes at frequencies below 9 Hz, which is 24 Hz lower than the passing and cutoff frequency 33 Hz, as stated in FSAR Section 3A.15.

4. The reduced passing frequency for the LB full column SSI analyses does not affect the seismic lateral soil pressures computed for these cases because the soil pressures are mainly the result of the low frequency responses (i.e., below 33 Hz).

According to the SRP Acceptance Criterion 3.7.2.II.4, for deep soil sites, the subsurface profile model depth generally should be at least twice the base dimension below the foundation level, which should be verified by parametric studies. For the RB/FB, the staff noted that the model depth below the foundation level is approximately two times the footprint dimension of the RB/FB. Since the computed seismic response may be sensitive to the location of the half-space interface selected, further justification was needed for the model depth selected. As discussed in FSAR Section 3A.16.3.1 and further documented in Appendix H of the GEH Report WG3-U71-ERD-S-0001, Revision 4, the applicant performed sensitivity studies to demonstrate that the lower boundary of the RB/FB site/rock model does not affect the results of SSI analysis. The staff reviewed the results of the sensitivity analysis and confirmed that the selected total depths of the site models used for the site-specific SSI analyses are appropriate and achieve sufficient accuracy of the site-specific SSI analysis results.

The applicant performed site-specific foundation uplift evaluation of RB/FB to show that the ground contact ratio is equal to or greater than 80 percent so that the linear SASSI SSI analyses are acceptable. The 80 percent criterion is provided in SRP Section 3.7.2. The analyses included four combinations of the possible directions of the input motion to consider the non-symmetric effect of the RB/FB model in the east-west (EW) direction. The minimum base contact ratio was determined to be associated with the case of the UB full column subgrade profile. During North Anna 3 Audit 1, the staff reviewed the methods for calculation of basemat uplift, and noted that the stress contours of the basemat showed that uplift occurred only along the exterior walls for RB/FB, which did not appear to be realistic for reinforced concrete structures with a thick basemat and interior walls. A further review of this issue revealed that the RB/FB SSI model does not have interior walls connected to the basemat shell model. This modeling simplification is considered to be adequate for determining the SSI responses (e.g., structural response, ISRS, etc.) because there are rigid beams connecting the super structure (lumped mass stick model (LMSM)) to the exterior walls (shell elements) at all basement floor levels above the top of the basemat. However, because the basemat was modeled as shell elements without the interior walls, which would have increased the out-of-plane stiffness of the basemat, the shell model representation of the basemat is much more flexible than the real basemat construction. Therefore, the staff requested the applicant to perform uplift evaluation to consider the effect of the interior walls.

As discussed in FSAR Section 3A.17.12.5, the applicant performed additional uplift analyses of RB/FB by assuming a rigid foundation as a bounding case. The analyses were based on a closed-form solution from the theory of elasticity using the results of the vertical base reaction and overturning moments obtained from the SSI analyses. The UB partial column and UB full column profiles were identified as critical cases based on results shown in Table 3A.17.12.5-201. The results show that a rigid foundation assumption leads to a minimum base contact ratio of 97.2 percent which is larger than those estimated based on flexible foundation models. The staff finds that the method for the additional uplift evaluation is acceptable and the linear SASSI SSI analyses are acceptable because the potential uplift of the RB/FB was found to be within the 80 percent ground contact ratio limit as recommended in SRP Section 3.7.2, Revision 4.

For the RB/FB, the applicant has performed site-specific sensitivity evaluations of the effects of structural stiffness variation. In addition, potential soil separation from the RB/FB structure is considered through the SSI analysis of partial soil column cases which do not include the softer in-situ saprolite and structural fill material above the Zone III rock. The evaluation considers the effect of concrete cracking on the response of the reinforced concrete members and the out-of-plane vibrations of the flexible slabs and walls. The staff's evaluation of the sensitivity studies including the models used in the analyses are discussed later in this SER Section 3.7.2.4 under the headings of "*Effect of Structural Stiffness Variations on Site-Specific Results"* and *"Soil Separation Analysis."*

Based on the above evaluation, the staff finds that the site-specific design basis SSI model of RB/FB described in FSAR Section 3A.16.3.1 meets the SRP Acceptance Criteria 3.7.2.II.3 and 3.7.2.II.4 and is therefore acceptable.

Site-specific Design Basis CB SSI model

The site-specific design basis CB SSI model is shown in FSAR Figures 3A.16.3-210 through 3A.16.3-213 for the PE model and in FSAR Figures 3A.16.3-214 through 3A.16.3-217 for the FE model. The connection between CB stick model and foundation is shown in the FSAR Figure 3A.16.3-218. Details of the site-specific design basis SSI model of the CB are described in the FSAR Section 3A.16.3.2 and in GEH Report WG3-U73-ERD-S-0001, Revision 2, "Control Building Seismic Analysis Report" (ADAMS Accession Nos. ML15357A305, ML15357A312, and ML15357A313). The CB lumped-mass stick model used in the site-specific CB SSI model is the same model used for the standard design seismic response analysis in the ESBWR DCD, which considers shear, bending, torsion, and axial deformations of the CB. This model is shown in the ESBWR DCD, Figure 3A.7-6 and designated in the ESBWR DCD Table 3A.6-1 as the "base" model. SDOF oscillators connected to the stick models are used to represent the out-of-plane seismic response of flexible slabs in the buildings. The lumped-mass stick model and the SDOF oscillators used in the site-specific CB SSI models are therefore acceptable because they are the same as those used in the ESBWR DCD for the same purpose and they are consistent with SRP Acceptance Criterion 3.7.2.II.3.C.

The site-specific SSI model of the CB differs from the standard design model in that: (a) the meshing of the below grade portion of the model is modified to match the layering and stiffness properties of the North Anna 3 subgrade, (b) near-field subgrade elements are included in the structural model to represent the fill materials (structure and concrete fills) surrounding and below the CB, (c) the lower OBE damping value is assigned to the uncracked concrete members for the purpose of generating site-specific design basis ISRS, and (d) the rigid massless outriggers are installed at each floor elevation to facilitate calculation of ISRS and displacements at floor edges. The staff's evaluation of the above differences between the DCD and the site-specific CB model is discussed below:

The staff reviewed the coupled soil-structure SSI base model of the CB and agreed with the applicant that the adjustment of the meshing of the below-grade portion of the model would be necessary to match the site-specific subsurface profile layers and to address model passing frequencies. A minimum value of 3.13 m is used for the lateral extent in representing the near-field subgrade elements (concrete and structural fill elements) for the CB model. Because of the limited extent of the fill material, as discussed in Section 3.7.1.4 of this SER, the staff found the applicant's method of modeling the concrete and structural fill as the near-field structural elements acceptable. The applicant assigned OBE damping values for the CB model for developing the site-specific ISRS and assigned the SSE damping value for determining the site-specific seismic demand for the CB. The staff finds the method of assigning the OBE and SSE damping values to the CB model to be acceptable since the method is in accordance with the guidance in SRP Sections 3.7.1 and 3.7.2 and in RG 1.61.

SASSI2010 CB model included approximately 4.91 m of fill concrete below the CB foundation bottom as part of the structural model. The input control motion for the CB, however, was established at the bottom of CB foundation instead of the bottom of the fill concrete. To address the potential impact of defining the SSI input control motion at the CB foundation bottom, the applicant in response to RAI 03.07.02-11 (ADAMS Accession No. ML15056A047) presented a comparison of Design Response Spectra for the CB full column and partial column profile at two different elevations (CB foundation bottom and the bottom of fill concrete). The staff reviewed the comparison provided in the response to RAI 03.07.02-11 and concluded that the results do not show any shift in the frequency content of the input or reductions of the high frequency amplitudes during upward propagation of the seismic waves. Therefore, the staff found application of the CB SSI input control motion at the CB foundation bottom acceptable.

The exterior walls below-grade and the foundation basemat are modeled using plate elements similar to the SASSI model used for the standard design CB SSI analysis except that the vertical and horizontal spacing of the elements were adjusted to closely match the site-specific subsurface profile layers and to address model passing frequencies. Solid brick elements were used to model the excavated soil volume for the FE and PE structures. To ensure that the dynamic response of the site-specific SSI model is adequate for the frequency range of interest, the applicant adjusted the mesh size of the below-grade portion of the model to ensure that both the horizontal and vertical mesh dimensions do not exceed 20 percent of the length of the shear wave passing through the soil material at the desired frequency of interest. In addition, the aspect ratio of the plate and brick finite elements used in the mesh should not exceed 1:4 for both the plate and brick elements as validated by the applicant in their V&V of SASSI2010 program documented in the GEH Report SER-DMN-020, Revision 1 In accordance with DC/COL-ISG-1, the passing frequency of the SSI models should be at least 50 Hz.

As stated in the FSAR Section 3A.16.3.2 and GEH Report WG3-U73-ERD-S-0001, Revision 2, “Control Building Seismic Analysis Report” (ADAMS Accession Nos. ML15357A305, ML15357A312, and ML15357A313) the maximum aspect ratio of the finite element mesh in the CB embedded models is 1:1.9. The staff finds this ratio to be acceptable since it did not exceed the aspect ratio limit (1:4) validated in the SASSI2010 V&V analysis.

The staff reviewed the finite element meshes of the CB excavated volumes depicted in FSAR Figures 3A.16.3-212 and 3A.16.3-216 and the corresponding passing and cut-off frequencies shown in FSAR Table 3A.15-202. The passing frequencies are calculated based on both the maximum horizontal and vertical dimensions of the excavated volume mesh and the near-field meshes. The staff concluded that the mesh sizes meet the 50 Hz criteria identified above except for the SSI analysis cases corresponding to the LB full column subsurface profile. For these LB cases, the staff found that the passing frequency of the SSI models is approximately 34 Hz and thus deviates from the guidance in DC/COL-ISG-1.

The staff’s assessment, however, concluded that the deviation from the guidance identified above is not a concern and does not affect the results for the following reasons:

1. The site-specific seismic responses computed for the UB subsurface profile are more susceptible to the higher frequency content of input motions above 34 Hz. These are accurately captured in the analyses because they are based on SSI models that have the required 50 Hz passing frequency.

2. The reduced passing frequency for the SSI analyses with LB full column subsurface profile reflects an insufficient mesh/layer refinement in the soil layers and near-field structural backfill elements of the model only; the mesh/layer dimensions in the rock portions are adequate.

3. The review of site-specific enveloping ISRS responses in the structures computed from the SSI analyses of the LB and BE full column cases indicates that above 18 Hz, these cases are bounded by the other case analyses that have the required 50 Hz passing frequency, as stated in FSAR Section 3A.15. This is because SSI effects at the North

Anna 3 site are dominated by the interaction between the structures and the rock in which they are embedded.

4. The reduced passing frequency for the LB SSI analyses does not affect the seismic lateral soil pressures computed for these cases because the soil pressures are mainly the result of the low frequency responses (i.e., below 34 Hz).

The site-specific base model for the structural portion of the CB consists of the ESBWR DCD CB stick model based on the uncracked concrete properties which represents the upper bound stiffness properties of the concrete structural elements. Along with these upper bound stiffness properties, the applicant also assigned lower OBE structural damping values for the development of the ISRS. The use of the OBE damping values reflects lower dissipation of energy in the structures and ensures that the ISRS peaks envelope the condition when the corresponding stresses in the structure are lower. For development of the site-specific seismic structural load demands, foundation uplift, and stability evaluations, the applicant used the CB base model (with uncracked concrete properties) with the SSE structural damping values. In accordance with the guidance in the RG 1.61 and SRP Section 3.7.2, the staff found the applicant's use of OBE structural damping values for developing ISRS and use of the SSE damping values for developing the structural seismic demand for the CB acceptable. The staff also found the use of SSE damping values for evaluating the potential of foundation uplift and seismic stability acceptable because these cases represent the limiting stress conditions associated with large seismic demand and the resulting foundation reactions are consistent with the structural load demand.

According to the SRP Acceptance Criterion 3.7.2.II.4, the model depth generally should be at least twice the base dimension below the foundation level which should be verified by parametric studies. For the CB, the staff found that the model depth below the foundation level of the CB is more than 88 m, which exceeds two times the maximum footprint dimension (about 30.3 m) of the CB. Based on staff's review earlier of the sensitivity studies performed by the applicant for the RB/FB as documented in Appendix H of the GEH Report WG3-U71-ERD-S-0001, Revision 4, the staff agreed with the applicant's conclusion that the selected total depths of the CB site models used for the site-specific SSI analyses does not affect the results.

The applicant performed site-specific foundation uplift evaluation of CB to show that the ground contact ratio is greater than 80 percent so that the linear SASSI SSI analyses are acceptable. The 80 percent criterion is specified in SRP Section 3.7.2. During North Anna 3 Audit 1, the staff reviewed the methods for calculation of basemat uplift, and as discussed in Section heading, "*Site-Specific Design Basis RB/FB SSI model,*" of this SER, the staff identified a similar issue regarding the appropriateness of the CB foundation model for the uplift calculation.

Therefore, the applicant performed alternative uplift calculations for the CB foundation in Appendix H of the GEH Report WG3-U73-ERD-S-0001, Revision 2. The applicant performed two sets of analyses of the CB PE model by: (1) adding rigid beams in the middle of the CB basemat to account for the effect of the in-plane stiffness of the interior wall on the CB foundation overall stiffness, and (2) assuming a rigid foundation. Appendix H of WG3-U73-ERD-S-0001, Revision 2, also indicates that adding rigid beams to the SSI model had no effect on the critical time that the maximum uplift occurred in the analysis and had very small effect on the estimate of eccentricity, but significantly affected the base stress distribution. The alternative foundation uplift calculations indicated that models with higher overall stiffness for the foundation predicted a reduction in the minimum base contact area, which is less than 80 percent. In particular, the analysis of the more realistic model that accounted for the effect of interior wall showed that the minimum contact ratio was 73 percent for a very short duration of 0.02 seconds. Since the calculation predicted a minimum contact ratio less than the guidance of SRP Section 3.7.2, the applicant provided further justification of the acceptability of the linear CB SSI analysis in the FSAR Section 3A.17.13.5. The applicant stated that the alternative uplift calculations were based on very conservative assumptions which considered the groundwater buoyancy pressure applied uniformly at the bottom of the CB foundation. The actual permeability of the concrete fill supporting the CB foundation is very small and insufficient to generate the assumed uniform buoyancy pressure. In addition, the uplift calculation based on PE configuration neglected the effect of subgrade located above the Zone III rock. Under a more realistic FE condition, additional analysis showed that the CB rigid foundation remained in full contact. In addition, the analysis based on the conservative assumptions showed that the larger uplifts (greater than 20 percent) of the CB basemat are infrequent with very short duration to have an effect on the seismic response of the CB structure.

The staff reviewed the results of alternative analyses performed by the applicant and found the applicant's justification for accepting CB SSI analyses results based on linear elastic SSI model acceptable because: (1) the assumed full permeability of the concrete to result in the full upward ground water buoyancy pressure at the interface between the CB basemat and underlying concrete fill would be unlikely, (2) the applicant's analysis of more realistic, FE conditions indicated that the CB rigid foundation remained in full contact for the entire duration of the ground motion, and (3) the larger uplift (greater than 20 percent) of the CB basemat based on conservative assumptions were infrequent within a very short duration to have any effect on the seismic response.

For the CB, the applicant has performed site-specific sensitivity evaluations of the effects of structural stiffness variation and the site-specific effects of SSSI. The evaluation considers the effect of concrete cracking on the response of the reinforced concrete members and the out-of-plane vibrations of the flexible slabs. The staff's evaluation of the sensitivity studies including the models used in the analyses are discussed in this SER under the headings of "*Effect of Structural Stiffness Variations on Site-Specific Results,*" *"SSSI Analysis,"* and *"Soil Separation Analysis."*

Based on the above evaluations, the staff finds that the site-specific design basis SSI model of CB described in FSAR Section 3A.16.3.2 meet the SRP Acceptance Criteria 3.7.2.II.3 and 3.7.2.II.4 and is therefore acceptable.

Site-specific Design Basis FWSC SSI model:

The coupled soil-structure SASSI2010 models used for site-specific SSI analysis of the FWSC are shown in the FSAR Figures 3A.16.3-219 through 3A.16.3-221. Details of the site-specific design basis SSI model of the FWSC are described in the FSAR Section 3A.16.3.3 and in the GEH Report WG3-U63-ERD-S-0001, Revision 4, "Firewater Service Complex Seismic Analysis Report" (ADAMS Accession No. ML16148A131). The FWSC SSI model is a half model with symmetric and antisymmetric boundary conditions based on the lumped-mass stick model shown in DCD Figure 3A.7-7 which considers shear, bending, torsion, and axial deformations of the structural members and is designated in the DCD Table 3A.6-1 as the "base" model. SDOF oscillators connected to the stick models are used to represent the out-of- plane seismic response of flexible slabs. The stick models and the SDOF oscillators used in the site-specific

SSI models are therefore acceptable because they are the same as those used in the ESBWR DCD for the same purpose and they are consistent with SRP Acceptance Criterion 3.7.2.II.3.C.iii.

The site-specific SSI model of the FWSC differs from the standard design model in that: (a) the model is modified to add the meshing of the below-grade portion that matches the layering and stiffness properties of the North Anna 3 subgrade, (b) a block of near-field solid elements embedded in the in-situ soil and rock is used to model the concrete fill placed below the FWSC basemat, (c) the lower OBE damping value is assigned to the uncracked concrete members for the purpose of generating site-specific design basis ISRS, and (d) rigid outriggers are installed at each floor elevation to facilitate calculation of ISRS and displacements at floor edges. The staff's evaluation of the above differences between the DCD and the site-specific FWSC model is discussed below:

As discussed in Section 3.7.1.4 under "*SSI Input Response Spectra for the FWSC*" of this SER, the staff found the representation of the concrete fill below the FWSC basemat as an integral part of the structural model acceptable because the applicant used two sets of site-specific SSI input with control motions defined at the bottom of the FWSC foundation (Elevation 282 ft) and at the bottom of the concrete fill (Elevation 220 ft). The applicant assigned OBE damping values for the FWSC model for developing the site-specific ISRS. The SSE damping values were assigned for determining other site-specific seismic demand for the FWSC. The staff finds the method of assigning the OBE and SSE damping values to the FWSC model to be acceptable since it is in accordance with the guidance in SRP Sections 3.7.1 and 3.7.2 and in RG 1.61.

The foundation basemat is modeled using plate elements similar to the SASSI model used for the standard design SSI analysis. Solid brick elements were used to model the excavated soil volume as well as the concrete fill for the embedded portion. To ensure that the dynamic response of the site-specific SSI model is adequate for the frequency range of interest, the applicant adjusted the mesh size of the below-grade portion of the model to ensure that both the horizontal and vertical mesh dimensions do not exceed 20 percent of the length of the shear wave passing through the soil material at the highest frequency of interest. In addition, the aspect ratio of the plate and brick finite elements used in the mesh should not exceed 1:4 for both the plate and brick elements as validated by the applicant in their V&V of SASSI2010 program documented in the GEH Report SER-DMN-020, Revision 1, "Validation Summary Report for SASSI 2010" (ADAMS Accession No. ML15222A280). Per DC/COL-ISG-1, the passing frequency of the SSI models should be at least 50 Hz.

As stated in the FSAR Section 3A.16.3.3 and GEH Report WG3-U63-ERD-S-0001, Revision 4, the maximum aspect ratio of the plate elements for the basemat mesh in the FWSC SSI model is 1:1.4 and the maximum aspect ratio of the 3-D solid brick elements is 1:2.9. The staff finds that these ratios are acceptable since they do not exceed the aspect ratio limit (1:4) validated in the SASSI2010 V&V analysis.

The staff reviewed the finite element mesh of the FWSC excavated soil volume depicted in FSAR Figure 3A.16.3-220 and the corresponding passing and cut-off frequencies shown in FSAR Table 3A.15-203. The passing frequencies are calculated based on both the maximum horizontal and vertical dimensions of the excavated volume. The staff concluded that the mesh sizes meet the 50 Hz criteria identified above except for the SSI analysis cases corresponding to the LB subsurface profiles as shown in FSAR Table 3A.15-203. For these LB cases, the staff found that the passing and cut-off frequency of the SSI models is 36 Hz and thus deviates from the guidance in DC/COL-ISG-1.

The staff's assessment of this deviation from the guidance, however, concluded that this deviation identified above is not a concern and does not affect the results for the following reasons:

1. The site-specific seismic responses computed for the UB subsurface profile are more susceptible to the higher frequency content of input motions above 36 Hz. These are accurately captured in the analyses because they are based on SSI models that have the required 50 Hz passing frequency.

2. The reduced passing frequency for the SSI analyses with LB subsurface profile reflects an insufficient mesh/layer refinement in the soil layers of the model only; the mesh/layer dimensions in the rock portions are adequate.

3. The review of site-specific seismic responses in the structures computed from the SSI analyses of the LB cases indicates that these cases only bound the ISRS envelopes for certain frequency ranges below 25 Hz, which is 11 Hz lower than the passing and cutoff frequency of 36 Hz, as stated in FSAR Section 3A.15. This is related to the fact that SSI effects at the North Anna 3 site are dominated by the interaction between the structures and the rock in which they are embedded.

The site-specific base model for the structural portion of the FWSC consists of the DCD FWSC stick model based on the uncracked concrete properties, which represents the upper bound stiffness properties of the concrete structural elements. Along with these upper bound stiffness properties, the applicant also assigned lower OBE structural damping values for the development of the ISRS. The use of the OBE damping values reflects lower dissipation of energy in the structures and ensures that the ISRS peaks envelope the condition when the corresponding stresses in the structure are lower. For development of the site-specific seismic structural load demands, foundation uplift, and stability evaluations, the applicant used the FWSC base model (with uncracked concrete properties) with the SSE structural damping values. In accordance with the guidance in the SRP Sections 3.7.1 and 3.7.2 and in RG 1.61, the staff found the applicant's use of OBE structural damping values for developing ISRS and use of the SSE damping values for developing the structural seismic demand for the FWSC acceptable. The staff also found the use of SSE damping values for evaluating the potential of foundation uplift and seismic stability acceptable because these cases represent the limiting stress conditions associated with large seismic demand and the resulting foundation reactions are consistent with the structural load demand.

According to the SRP Acceptance Criterion 3.7.2.II.4 for deep soil sites, the subsurface profile model depth generally should be at least twice the base dimension below the foundation level, which should be verified by parametric studies. For the FWSC, the staff found that the model depth below the foundation level of the FWSC (about 123 m) is greater than two times the maximum footprint dimension (about 52 m) of the FWSC basemat. Based on staff's review earlier of the sensitivity studies performed by the applicant for the RB/FB as documented in Appendix H of the GEH Report WG3-U71-ERD-S-0001, Revision 4, the staff agreed with the applicant's conclusion that the selected total depth of the FWSC site models used for the site-specific SSI analyses does not affect the results.

Unlike the RB/FB and the CB, the structural fill around the concrete block below the FWSC basemat was considered as part of the in-situ soil and not included as the near-field element in the FWSC SSI model. The staff found this representation to be acceptable because: (a) the properties of the in-situ soil and structural fill around the FWSC are similar as shown in the FSAR Figure 3A.12.2-203, (b) any potential effect of this representation has been captured by the FWSC-CB SSSI analysis since the structural fill is included in the combined FWSC-CB SSSI model, and (c) the FWSC site-specific design basis seismic demand is developed based on the envelope of the results obtained from site-specific SSI analyses of FWSC stand-alone model and SSSI analyses of FWSC-CB combined model.

As discussed in FSAR Section 3A.17.14.4, the applicant performed site-specific foundation uplift evaluation of FWSC to show that the ground contact ratio is equal to or greater than 80 percent so that the linear SASSI SSI analyses are acceptable. The 80 percent ground contact ratio criterion is recommended in SRP Section 3.7.2. During North Anna 3 Audit 1, the staff reviewed supporting calculations related to the FWSC uplift evaluation and confirmed that the SSI model used for the FWSC uplift evaluation is acceptable because the basemat is modeled in a manner that represents the actual structure.

For the FWSC, the applicant has performed site-specific sensitivity evaluations which consider the effect of concrete cracking, soil separation along the upper portion of the concrete block below the FWSC foundation, and SSSI on the response of the FWSC and the out-of-plane vibrations of the flexible slabs. The staff's evaluation of the sensitivity studies including the models used in the analyses are discussed in this SER later under the headings of "*Effect of Structural Stiffness Variations on Site-Specific Results," "SSSI Analysis,"* and *"Soil Separation Analysis."*

Based on the above evaluations, the staff finds that the site-specific design basis SSI model of FWSC described in FSAR Section 3A.16.3.3 meet the SRP Acceptance Criteria 3.7.2.II.3 and 3.7.2.II.4 and is therefore acceptable.

SSI Analyses Cases

The SSI analyses cases for the North Anna 3 site, performed by the applicant, are summarized in FSAR, Revision 9, Tables 3A.15-201 through 3A.15-206 for the RB/FB, CB, and the FWSC. In addition, the FSAR Tables include the North Anna 3 site-specific sensitivity analyses cases which evaluate the effect of structural stiffness variation, soil separation, and SSSI on the site-specific seismic demand. These analysis cases account for the potential variability in the site-specific soil/rock properties by considering three (LB, UB, and BE) subsurface material properties. For the RB/FB and the CB, the site-specific effect of subgrade stiffness variation related to embedment, ground water, and the layering effect of in-situ soils were accounted for by considering two embedment configurations: (1) full soil column subgrade profile and (2) partial soil column subgrade profile as discussed earlier in this SER. For the FWSC, two sets of SSI analyses were performed; one with the control motion applied at the bottom of the basemat and the other with the control motion applied at the bottom of concrete fill below the FWSC foundation, were performed. Finally sensitivity studies were performed to account for, in the SSI analysis results, the effects of the potential stiffness variation in the structural members, soil separation, and SSSI. For the FWSC, the FWSC-CB SSSI together with FWSC SSI analysis cases form the basis for the site-specific seismic demand.

The staff concludes that the SSI and SSSI cases summarized in FSAR Tables 3A.15-201 through 3A.15-206 provide sufficient information for the staff to determine the acceptability of the site-specific seismic demand at the North Anna 3 site for the Category I structures.

SSI Analysis Results – Transfer Functions

GEH Reports WG3-U71-ERD-S-0001, Revision 4, "Reactor/Fuel Building Complex Seismic Analysis," WG3-U73-ERD-S-0001, Revision 2, "Control Building Seismic Analysis," and WG3-U63-ERD-S-0001, Revision 4, "Firewater Service Complex Seismic Analysis," document the transfer functions computed for the site-specific SSI analyses. These reports present results for the following key locations as identified in DCD Appendix 3A:

- RB/FB: top of basemat, refueling floor, reinforced concrete containment vessel (RCCV) top slab, top of vent wall, top of reactor shield wall (RSW), top of RPV.
- CB: top of basemat and top of roof slab.
- FWSC: FWS wall top, FWS base, Fire Pump Enclosure (FPE) top, FPE base.

The staff reviewed the transfer function plots and found them to be generally smooth, with a sufficient density of calculated frequency points in the frequency range of interest. Although some isolated sharp spikes were noted in a few of the plots because of the interpolation scheme used by the SASSI 2010 program, these spikes had no observable impact on the ISRS or other seismic responses as described in FSAR Section 3A.14.2. During North Anna 3 Audit 1, the staff further reviewed supporting calculations for assessing the effect of the spurious peaks in some of the SASSI transfer functions on structural responses as discussed below:

To address the issue, as described in FSAR Section 3A.14.2, the applicant performed additional SASSI analyses with frequencies added near the numerical anomalies for the following cases:

- For RB/FB: UC100 model for LB, BE, UB partial columns; UC100 model LB, BE, UB full columns; CR00 and CR50 models for LB full column
- For CB: UC_OBE full columns
- For FWSC: UC_OBE full columns with input at Elevation 220 ft
- For CB-FWSC: UB full column

The staff confirmed the additional frequencies in the SASSI analyses did not result in any significant effect on the seismic responses during North Anna 3 Audit 1. Therefore, the staff concludes that the interpolated transfer functions are acceptable and the site-specific SSI analyses performed by the applicant with the SASSI 2010 program were implemented in a manner consistent with the frequency domain complex response method described in ESBWR DCD, Tier 2, Appendix 3A.

SSI Analysis Results – Maximum Structural Loads

FSAR Section 3A.17 describes the North Anna 3 site-specific SSI analysis results for the various SSI analyses cases presented in the FSAR Tables 3A.15-201 through 3A.15-206 for the RB/FB, CB, and the FWSC. This FSAR section also describes the results of the site-specific sensitivity studies to address the effects of structural stiffness variation, SSSI, and soil separation from the foundation walls or concrete fill. The applicant compared the results of the site-specific SSI and SSSI analysis of the RB/FB, CB, and FWSC with the standard seismic design envelopes presented in DCD Section 3A.9. The applicant followed the DCD method to develop the site-specific seismic demands for the RB/FB, CB, and FWSC. The applicant provided these comparisons of site-specific enveloping seismic demand for North Anna 3 Category I structures with the DCD envelope in the FSAR Section 3A.18.1.

RB/FB Site-Specific Seismic Load Demand

FSAR Tables 3A.18.1.1-201a through 3A.18.1.1-201f present the envelope of the maximum site-specific seismic forces and moments in the various stick models of the RB/FB complex obtained from the site-specific SSI analysis cases as tabulated in FSAR Table 3A.15-201 and compare these to the corresponding values in the ESBWR DCD. The adequacy of these analysis cases is evaluated above in this SER under the heading of "*SSI Analyses Cases.*" FSAR Tables 3A.18.1.1-203 and 3A.18.1.1-204 present the site-specific enveloping out-of-plane seismic load demands on the RB/FB flexible slabs and walls obtained from the site-specific SSI analyses and the staff compared these to the corresponding values in the ESBWR DCD. FSAR Section 3A.18.1.1 also includes the envelope of the maximum accelerations in the different stick models of the RB/FB complex and the staff compared these to the corresponding design values used in the standard design. The staff reviewed these results and the supporting calculations during North Anna 3 Audit 1 and concluded that the method used in establishing the site-specific seismic demand is consistent with the DCD methodology and is in accordance with the SRP Section 3.7.2 guidance. The SASSI computer programs used to develop the site-specific seismic demand were verified and validated. The staff also determined that site-specific seismic load demands in some instances for the RB/FB exceeded the corresponding loads used for the standard design of the RB/FB structures. The applicant has performed a site-specific evaluation of RB/FB structures using the site-specific seismic demands presented in FSAR Section 3A.18.1.1 that bound the effects of full/partial soil columns and structural stiffness variations to address the exceedances in seismic loads. The staff's assessment of the effect of structural stiffness variations on the site-specific seismic demand is discussed later in this SER Section 3.7.2.4 under the heading of **"***Effect of Structural Stiffness Variations on Site-Specific Results."* The staff's assessment of the site-specific evaluation of the standard design of the RB/FB is documented in this SER in Section 3.8.4.

CB Site-Specific Seismic Load Demand

The applicant followed the method used to develop the standard design enveloping maximum structural loads in developing the structural loads representative of the site-specific seismic demands on the CB. FSAR Table 3A.18.1.2-201 presents the maximum site-specific seismic forces and moments in the stick model of the CB obtained from the site-specific SSI analyses with the upper bound stiffness properties and SSE damping and compare these enveloping loads to the corresponding values in the ESBWR DCD. FSAR Table 3A.18.1.2-203 presents the site-specific out-of-plane seismic load demands on the CB flexible slabs and compare these to the corresponding values in the ESBWR DCD. The staff reviewed and confirmed these results and the supporting calculations during the North Anna 3 Audit 1 and concluded that the method used in establishing the site-specific seismic demand is consistent with the ESBWR DCD methodology and the SRP Section 3.7.2 guidance. The staff also determined that the site-specific seismic load demands for the CB exceeded the corresponding loads used for the standard design of the CB structures. As stated in the FSAR Section 3A.18.1.2, the applicant has performed a site-specific evaluation of the CB structures using the site-specific seismic demands presented in FSAR 3A.18.1.2 that bound the effects of full/partial soil columns and structural stiffness variations. The staff's assessment of the effect of structural stiffness variations on the site-specific seismic demand is discussed later in this SER Section 3.7.2.4 under the heading of **"***Effect of Structural Stiffness Variations on Site-Specific Results."* The staff's assessment of site-specific evaluation of the standard design of the CB is documented in this SER in Section 3.8.4.

FWSC Site-Specific Seismic Load Demand

The applicant followed the method used to develop the standard design enveloping maximum structural loads in developing the structural loads representative of the site-specific seismic demands on the FWSC. The site-specific North Anna 3 enveloping seismic demand on the FWSC are developed as an envelope of the results for maximum member forces and moments from the SSI and SSSI analyses of the FWSC standalone and the FWSC-CB combined SSSI models with uncracked stiffness properties and SSE damping using deep control motion applied at the bottom of the concrete fill at Elevation 220 ft. The analysis with deep control motion yields maximum responses that envelope the results with input motion applied at the surface.

FSAR Table 3A.18.1.3-201 presents the North Anna 3 enveloping seismic demand (member forces and moments) for the FWSC. This FSAR Table also presents the comparison of site-specific seismic demand with standard design enveloping maximum member forces for the FWSC. Table 3A.18.1.3-202 presents the maximum site-specific accelerations at different FWSC lumped mass locations and compare them to the corresponding design values used in the standard design. FSAR Tables 3A.18.1.3-203 and 3A.18.1.3-204 present, respectively, a comparison of the site-specific maximum accelerations of FWSC SDOF oscillators and site-specific out-of-plane load on FWS roof with those of the ESBWR standard plant design. Table 3A.18.1.3-205 presents the site-specific lateral loads on the FWSC shear keys as well as a comparison of these loads with the corresponding standard design values. The staff reviewed and confirmed these results and the supporting calculations during North Anna 3 Audit 1 and concluded that the method used in establishing the site-specific seismic demand is consistent with the DCD methodology and is in accordance with the SRP Section 3.7.2 guidance. The staff also determined that the site-specific seismic load demands in some instances for the FWSC exceeded corresponding loads used for the standard design of the FWSC structures. The applicant has performed a site-specific evaluation of the FWSC structures using the site-specific seismic demands presented in FSAR 3A.18.1.3 that bound the effects of structural stiffness variations, the effect of soil separation, and the SSSI effect of the CB on FWSC. The staff's assessment of site-specific evaluation of the standard design of the FWSC is documented in this SER in Section 3.8.4.

SSI Analysis Results – Site-Specific Design ISRS

The site-specific SSI analyses cases are summarized in FSAR Table 3A.15-201 for the RB/FB, Table 3A.15-202 for the CB, and 3A.15-203 for the FWSC. To account for the variability in the subsurface material properties, BE, LB, and UB profiles were considered. Each analysis case consists of input motions in three orthogonal directions. The site-specific acceleration response spectra (ARS) are developed for responses at the edges of the building by taking into account coupling effects between the three directional input motions. The ARS for nodal responses due to the three input motions are combined using the SRSS method. Floor ISRS are obtained for particular floor elevations as the envelope of ARS at the four outrigger locations. FSAR Figures 3A.17.12.3-201 through 3A.17.12.3-204 present the site-specific ISRS for RB/FB, FSAR Figures 3A.17.13.3-201 through 3A.17.13.3-203 present the site-specific ISRS for CB, and FSAR Figures 3A.17.14.3-201 through 3A.17.14.3-203 present the site-specific ISRS for FWSC at the key locations of the buildings. The ISRS presented in the referenced figures of FASR 3A.17 above are obtained from the site-specific design basis SSI analyses of models with upper bound stiffness properties. Also presented there are comparisons of the site-specific ISRS with the corresponding standard design ISRS. The individual ISRS obtained from the SSI analyses cases are then enveloped. The final site-specific ISRS is calculated by (+)15 percent and (-)15 percent broadening the enveloped ISRS. Details of the development of the ISRS are provided in GEH Reports WG3-U71-ERD-S-0001, Revision 4 for the RB/FB, GEH Report WG3-U73-ERD-S-0001, Revision 2 for the CB, and GEH Report WG3-U63-ERD-S-0001, Revision 4 for the FWSC. The applicant presented the enveloping site-specific design ISRS in the FSAR Figures 3A.18.2-201 through 3A.18.2-203 for RB/FB, CB, and the FWSC.

For the RB/FB and CB, the site-specific design ISRS represent the ISRS results from site-specific SSI analyses of RB/FB and CB model with upper bound stiffness properties and OBE damping (analysis cases 1 to 6 in Table 3A.15-201 for RB/FB and Table 3A.15-202 for CB). These site-specific ISRS are peak broadened and valley filled, and enhanced to bound effects of structural stiffness variations and SSSI as described in FSAR Section 3A.18.2.

Site-specific ISRS for the FWSC represent the envelope of ISRS results from: (1) the site-specific SSI analyses of the FWSC standalone model with uncracked stiffness properties and OBE damping (analysis cases 1 to 6 in FSAR Table 3A.15-203) and (2) site-specific SSSI analysis of the FWSC-CB combined model with uncracked stiffness properties and OBE damping (cases FC1 to FC6 in FSAR Table 3A.15-206). The staff noted that these site-specific design ISRS for the FWSC already include the site-specific SSSI effects of the CB on FWSC response. The FWSC ISRS are also enhanced to bound effects of structural stiffness variations and soil separation as described in FSAR 3A.18.2.

The staff reviewed and confirmed the method of development of the site-specific ISRS and the site-specific ISRS results as presented in the FSAR Sections 3A.17 and 3A.18 and supporting calculations presented during North Anna 3 Audit 1. Based on staff's review of the comparisons provided in the FSAR, the staff concludes that the site-specific ISRS exceed the corresponding standard design ISRS at some frequencies. The applicant stated that the exceedances are addressed in the site-specific evaluation of the standard design. The staff found the method of developing the site-specific ISRS to be acceptable because the method is in accordance with the guidance in the SRP Section 3.7.2 and the RG 1.122.

The applicant has performed sensitivity studies to evaluate the effect of structural stiffness variations, SSSI, and soil separation on the site-specific design envelope ISRS. The site-specific design ISRS for the RB/FB, CB, and FWSC in general envelope the results of the various sensitivity analyses with few exceedances. The staff reviewed the methodology used to address exceedances in the site-specific design ISRS due to the sensitivity studies including the acceptance criteria in FSAR sections 3A.17 and 3A.18, and found them acceptable. The staff's evaluation of the effect of sensitivity studies are discussed below in this SER.

Effect of Structural Stiffness Variations on Site-Specific Results

RB/FB Structural Stiffness Variation Sensitivity Studies

The applicant in the response to RAI 03.07.02-14 (ADAMS Accession No. ML15222A240), stated that site-specific sensitivity evaluations of the effects of structural stiffness variation on the SSI response of the RB/FB have been performed. They are described in the FSAR Section 3A.17.9.1 and in the Appendix B of the GEH Report WG3-U71-ERD-S-0001, Revision 4, "Reactor/Fuel Building Complex Seismic Analysis Report" (ADAMS Accession Nos. ML16097A203 and ML16097A204). As discussed earlier, the site-specific SSI analysis used a RB/FB model with uncracked reinforced concrete properties for the concrete members and 100 percent stiffness contribution of the concrete inside the steel plates for steel internal structures (referred in this report as UC100 model). The analysis was performed for three subsurface profiles and two embedment configurations (analysis cases 1 through 6 in FSAR Table 3A.15-201). The analyses used OBE damping values. The envelope of responses obtained from these six analyses cases constitutes the North Anna 3 site-specific base case seismic demand used for site-specific design and design evaluation of the RB/FB at North Anna 3 site. To evaluate the effect of potential concrete cracking, the applicant performed site-specific sensitivity SSI analyses of models with reduced stiffness properties and SSE damping (analysis cases S1 through S12 in FSAR Table 3A.15-201) and compared the results with those of the North Anna 3 site-specific demand.

The applicant performed the sensitivity analyses of the following two reduced stiffness models:

- CR00: fully cracked reinforced concrete structures with 50 percent reduced shear and bending stiffness along with no (0 percent) contribution of in-fill concrete to the stiffness of the concrete-filled steel structures (VW and D/F); and

- CR50: fully cracked reinforced concrete structures with 50 percent reduced shear and bending stiffness along with 50 percent contribution of in-fill concrete to the stiffness of the concrete-filled steel structures (VW and D/F).

The analyses of CR00 and CR50 models were performed for LB, BE, and UB soil profiles for the two embedment configurations (PE and FE). The CR00 and CR50 models used SSE damping values to be consistent with the cracked concrete assumption. The applicant has used the guidance in ASCE 43-05 to establish the stiffness reduction factors for cracked concrete members, which are in accordance with the SRP Section 3.7.2 guidance.

The staff reviewed Appendix 3A of the FSAR for the modeling approach for the cracked and uncracked cases and the models used by the applicant in the sensitivity analyses for the stiffness variations and found them acceptable because: (a) the method is consistent with the approach used for the standard design, (b) the method is consistent with the guidance in SRP Section 3.7.2, (c) the sensitivity analyses accounted for concrete cracking with the combined effects of the potential variation of the subsurface soil profiles along with the two embedment configurations, and (d) the use of SSE damping for the cracked models is consistent with the high stress conditions that the RB/FB structure would be subjected to during a fully cracked concrete condition.

SDOF oscillators connected to the stick models are used to represent the out-of-plane seismic response of flexible slabs and walls in the buildings. The staff confirmed that SDOF oscillators used in the UC100 model described in the FSAR Section 3A.16 are identical to those of the standard design models. Therefore, the staff finds these models used to capture the out-of-plane vibration mode up to 50 Hz for models with uncracked concrete are acceptable.

Since cracking of the concrete reduces the out-of-plane bending stiffness of the walls and slabs, the frequencies of out-of-plane vibration would be lowered due to cracking. Therefore, the staff requested the applicant in RAI 03.07.02-14(f) to confirm that the frequency ranges of the oscillators selected for the UC100 model are still adequate to capture the out-of-plane seismic response of the walls and slabs for the North Anna 3 site conditions. In the response to RAI 03.07.02-14(f) (ADAMS Accession No. ML15222A240), the applicant, besides applying the 50 percent reduction to the stiffness of all existing SDOF oscillators in the UC100 model, added additional oscillators to the CR00 and CR50 models to capture the modes of out-of-plane vibration of the cracked slabs and walls up to a frequency of 50 Hz. The FSAR Figure 3A.16.2-201 shows the configuration of the CR00 and CR50 stick models with the additional SDOF oscillators shown in red. The development of these additional SDOF oscillators under fully cracked conditions is described in the GEH Report SER-DMN-014, Revision 1, “Additional Oscillators for Fully Cracked Model for RAI 3.7.2-14(f)” (ADAMS Accession No. ML15170A188).

The staff reviewed the information provided in the FSAR Section 3A.17.9 and the GEH Report SER-DMN-014 and found the site-specific representation of the out-of-plane flexibilities of walls and slabs under a cracked condition acceptable because: (a) the applicant added additional oscillators to represent all modes of vibration up to 50 Hz under fully cracked condition, and (b) the additional SDOF oscillators were developed using the same method and eigenvalue analysis that were used for standard design.

In FSAR 3A.17.9.1, Revision 9, the applicant concluded that the site-specific design basis SSI analyses of the UC100 Model with uncracked concrete stiffness and OBE damping provide site-specific seismic demand (loads and ISRS) that envelope concrete cracking effects with few exceptions (e.g., see FSAR Table 3A.17.9.1-201 and Figure 3A.17.9.1-201). The applicant also indicated that the enveloping base case site-specific seismic load demands and site-specific design ISRS are adjusted to bound effects of structural stiffness variations as described in FSAR Section 3A.18.1 and 3A.18.2, respectively. The staff found the applicant’s approach to address any exceedances in the site-specific seismic demand (structural load) due to sensitivity studies for the concrete cracking acceptable because the site-specific seismic demand is enhanced where necessary to address the observed exceedances.

For the site-specific design ISRS, the applicant, however, stated that the North Anna 3 site-specific design and qualification of equipment and components will use enhanced ISRS that envelope all significant (>10 percent) peak exceedance of the site-specific design ISRS observed in the results of the sensitivity analysis cases for concrete cracking at frequencies below 50 Hz. The staff requested the applicant to provide a technical justification for establishing a significance level of 10 percent exceedance in developing the enhanced site-specific design ISRS for equipment and component in the pre-audit public meeting dated September 10, 2015 (ADAMS Accession No. ML15267A062).

The applicant in FSAR Section 3A.17.9 provided justification of using the 10 percent criteria. The applicant stated that sensitivity analysis for concrete cracking is very conservative since the analysis used 50 percent reduction in flexural and shear stiffness for all concrete elements throughout the entire structure. If the SSE were to occur, cracking will be limited in the vicinity of the highly stressed elements only and many concrete elements will not crack. Therefore the use of a significance level of 10 percent for enhancing the ISRS is justified. Staff found this basis acceptable because the use of the 50 percent reduction in flexural and shear stiffness for all concrete elements is very conservative since the cracking will be limited only to highly stressed elements. Therefore, the staff found the applicant's approach to address any exceedances (>10 percent) in the site-specific ISRS due to sensitivity studies for the concrete cracking acceptable because the site-specific ISRS is modified where necessary to address the observed exceedances greater than 10 percent.

The staff reviewed the results of the North Anna 3 site-specific evaluation presented in the responses to RAIs 03.07.02-14 and 03.07.02-17 as well as the supporting documents during North Anna 3 Audit 1 and North Anna 3 Audit 2 (ADAMS Accession No. ML16193A047) to verify that the effect of the stiffness variation studies on the North Anna 3 site-specific demand for the RB/FB has been considered. The North Anna 3 site-specific seismic demands including the effects of base case, concrete cracking, and soil separation are described in FSAR Section 3A.18. FSAR Section 3A.18.1.1 presented the site-specific seismic load demand for the RB/FB structures that are based on the envelope of the base case analyses results further adjusted to bound the effect of stiffness variation. Also presented there are the comparison of the site-specific demand with the standard design. Specifically, the staff verified during North Anna 3 Audit 2 that the applicant used the enveloping site-specific seismic demand in evaluating the ESBWR standard plant structures for acceptability at the North Anna 3 site. Staff's evaluation of the ESBWR standard plant structures for the site-specific demand is described in this SER in Section 3.8.

CB Structural Stiffness Variation Sensitivity Studies

The applicant in response to RAI 03.07.02-14 (ADAMS Accession No. ML15222A240) stated that site-specific sensitivity evaluations of the effects of structural stiffness variation on the SSI response of the CB have been performed. They are described in the FSAR Section 3A.17.9.2 and in the Appendix B of the GEH Report WG3-U73-ERD-S-0001, Revision 2, "Control Building Seismic Analysis Report." The site-specific SSI analysis used a CB model with uncracked reinforced concrete properties for the concrete members using the OBE damping values (referred here as the UC_{OBE} model) for determining the North Anna 3 site-specific ISRS demand and SSE damping values (referred here as the UC_{SSE} model) for determining the North Anna 3 site-specific structural load demand. These analyses cases are shown in the FSAR Table 3A.15-202 as analysis cases 1 to 12. The analysis was performed for three subsurface profiles and two embedment configurations. The envelope of responses obtained from these analyses cases constitutes the North Anna 3 site-specific base case seismic demand used for site-specific design and design evaluation of the CB at the North Anna 3 site. To evaluate the effect of potential concrete cracking, the applicant performed site-specific sensitivity SSI analyses of models with reduced stiffness properties and SSE damping (referred here as CR_{SSE} model). These sensitivity analysis cases are shown in the FSAR Table 3A.15-202 as analysis cases S1 through S6. The effect of the concrete cracking on the CB site-specific structural load demand is evaluated by comparing the enveloping seismic load demand obtained from the analysis of the UC_{SSE} models with those obtained from the analysis of the CR_{SSE} models. The effect of concrete cracking on the CB site-specific ISRS is evaluated by comparing the 5 percent damped ISRS results obtained from the analysis of the UC_{OBE} models with those obtained from the analysis of the CR_{SSE} models.

The analyses of CR_{SSE} models were performed for LB, BE, and UB soil profiles for the two embedment configurations (PE and FE). The applicant has used the guidance in ASCE 43-05 to establish the stiffness reduction factors for cracked concrete members which is in accordance with the SRP Section 3.7.2 guidance.

The staff reviewed the modeling approach for the cracked and uncracked cases and the models used by the applicant in the sensitivity analyses for the stiffness variations and found them acceptable because: (a) the method is consistent with the approach used for the standard design (b) the method is consistent with the guidance in SRP Section 3.7.2, (c) the sensitivity analyses accounted for concrete cracking with the combined effects of the potential variation of the subsurface soil profiles along with the two embedment configurations, and (d) the use of SSE damping for the cracked models is consistent with the high stress conditions that the CB structure would be subjected to during a fully cracked concrete condition.

SDOF oscillators connected to the stick models are used to represent the out-of- plane seismic response of flexible slabs and walls in the buildings. In accordance with the ESBWR DCD, use of the SDOF oscillators in the UC_{OBE} and UC_{SSE} models described in the FSAR Section 3A.16 is acceptable to capture the out-of-plane vibration mode up to 50 Hz. Since cracking of the concrete reduces the out-of-plane bending stiffness of the walls and slabs, the frequencies of out-of-plane vibration would be lowered due to cracking. Therefore, the staff requested in RAI 03.07.02-14(f) that the applicant confirm that the frequency ranges of the existing oscillators are still adequate to capture the out-of-plane seismic response of the walls and slabs for the North Anna 3 site conditions. In the response to RAI 03.07.02-14(f) (ADAMS Accession No. ML15222A240), the applicant, besides applying the 50 percent reduction to the stiffness of all existing SDOF oscillators in the UC_{OBE} and UC_{SSE} models, added additional oscillators to the CR_{SSE} models to capture the modes of out-of-plane vibration of the cracked slabs up to a frequency of 50 Hz. FSAR Figure 3A.16.2-202 shows the configuration of the CR_{SSE} stick models for the CB with the additional SDOF slab oscillators shown in red. The development of these additional SDOF oscillators under fully cracked conditions is described in the GEH Report SER-DMN-014, Revision 1. No SDOF oscillators are added to the CR_{SSE} models to represent the out-of-plane vibrations of cracked wall since the fully cracked wall frequencies are above the 50 Hz range.

The staff reviewed the information provided in the FSAR Section 3A.17.9 and the GEH Report SER-DMN-014 and found the site-specific representation of the out-of-plane flexibilities of the slabs under a cracked condition for the CB acceptable because: (a) the applicant added additional oscillators to represent all modes of slab vibration up to 50 Hz under fully cracked condition, and (b) the additional SDOF oscillators were developed using the same method and eigenvalue analysis that were used for the standard design.

In FSAR 3A.17.9.2, Revision 9 the applicant concluded that the site-specific design basis SSI analyses of the CB Model with uncracked concrete stiffness and SSE damping provide site-specific seismic load demand that envelope concrete cracking effects with few exceptions of local out-of-plane loads on some CB slabs (e.g., see FSAR Table 3A.17.9.2-201). The applicant indicated that the enveloping site-specific seismic load demands and site-specific design ISRS are adjusted to bound effects of structural stiffness variations. The applicant also stated that North Anna 3 site-specific design and qualification of equipment and components will use enhanced ISRS that envelope all significant (>10 percent) peak exceedance of site-specific design ISRS observed in the results of the sensitivity analysis cases at frequencies below 50 Hz. As discussed earlier in this SER, the staff found the use of 10 percent criteria for enhancing the design ISRS to be acceptable. The staff found the applicant's approach described in FSAR 3A.18.1.2 and 3A.18.2 to address any exceedances in the site-specific seismic demand due to sensitivity studies for the concrete cracking acceptable because the site-specific seismic demand is modified where necessary to address the observed exceedances.

The staff further reviewed the results of the North Anna 3 site-specific evaluation presented in the responses to RAI 03.07.02-14 as well as the supporting documents during North Anna 3 Audit 1 and North Anna 3 Audit 2 to verify that the effect of the stiffness variation studies on the North Anna 3 site-specific demand for the CB has been considered. The site-specific demand based on the upper bound stiffness and OBE and SSE damping values provide site-specific seismic demands on the CB that in general envelope the effect of structural stiffness variations with some exceedances. Only the local out-of-plane loads on some of the CB slabs exceed the loads obtained from the analyses of the CB model with full stiffness and SSE damping as shown on FSAR Table 3A.17.9.2-201. There are small sharp peak exceedances observed in some of the SDOF oscillator ISRS. The staff reviewed the methodology of addressing ISRS exceedances as discussed above and found them acceptable.

The North Anna 3 site-specific seismic demands including the effects of base case, SSSI, concrete cracking, and soil separation are described in FSAR Section 3A.18. FSAR Section 3A.18.1.2 presented the site-specific seismic load demand for the CB structures that are based on the envelope of the base case analyses results further adjusted to bound the effect of stiffness variation. Also presented, is a comparison of the site-specific demand with that of the standard design. Specifically, the staff verified during North Anna 3 Audit 2 that the applicant used the enveloping site-specific seismic demand in evaluating the ESBWR standard plant CB structures for acceptability at the North Anna 3 site. The staff's evaluation of the ESBWR standard plant CB structures for the site-specific demand is described in this SER in Section 3.8.4.

FWSC Structural Stiffness Variation Sensitivity Studies

The applicant in the response to RAI 03.07.02-14 (ADAMS Accession No. ML15222A240) stated that site-specific sensitivity evaluations of the effects of structural stiffness variation on the SSI response of the FWSC have been performed. They are described in the FSAR Section 3A.17.9.3 and in the Appendix B of the GEH Report WG3-U63-ERD-S-0001, Revision 4, "Firewater Service Complex Seismic Analysis Report" (ADAMS Accession No. ML16148A131). The site-specific SSI analysis used a FWSC model with uncracked reinforced concrete properties for the concrete members using the OBE damping values (referred here as UC_{OBE} model) for determining the North Anna 3 site-specific ISRS demand and SSE damping values (referred here as UC_{SSE} model) for determining the North Anna 3 site-specific structural load demand. These analyses cases are shown in the FSAR Table 3A.15-203 as analysis cases 1 to 9. The analysis was performed for three subsurface profiles with the two input control motions, one applied at the bottom of the FWSC basemat at Elevation 282 ft and the other applied at the bottom of the concrete fill located at Elevation 220 ft. The UC_{SSE} model was analyzed only for the deep control motion applied at the bottom of the concrete fill because the use of UC_{SSE} with Elevation 220 ft motion was based on comparison of results of the UC_{OBE} models with motion applied at the two different elevations.

The envelope of responses obtained from appropriate combinations of these analyses cases constitutes the North Anna 3 base case for the site-specific seismic demand of the FWSC. The ISRS envelopes are based on six UC_{OBE} cases and load demand envelopes are based on three UC_{SSE} cases.

To evaluate the effect of potential concrete cracking, the applicant performed site-specific sensitivity SSI analyses of models with reduced stiffness properties and SSE damping (referred to here as CR_{SSE} model). These analysis cases are shown in the FSAR Table 3A.15-203 as analysis cases S1 through S6. The effect of the concrete cracking on the FWSC site-specific structural load demand is evaluated by comparing the enveloping seismic load demand obtained from the analysis of the UC_{SSE} models with those obtained from the analysis of the CR_{SSE} models. The effect of concrete cracking on the FWSC site-specific ISRS is evaluated by comparing the 5 percent damped broadened and valley filled ISRS results obtained from the SSI analysis of the UC_{OBE} models with those obtained from the analysis of the CR_{SSE} models.

The analyses of CR_{SSE} models were performed for BE, LB, and UB soil profiles for both the surface control motion applied at the FWSC basemat and the deep control motion applied at the bottom of the concrete fill. The applicant has used the guidance in ASCE 43-05 to establish the stiffness reduction factors for cracked concrete members, which is in accordance with the SRP Section 3.7.2 guidance.

The staff reviewed the modeling approach for the cracked and uncracked cases and the models used by the applicant in the sensitivity analyses for the stiffness variations and found them acceptable because: (a) the method is consistent with the approach used for the standard design, (b) the method is consistent with the guidance in SRP Section 3.7.2, (c) the sensitivity analyses accounted for concrete cracking with the combined effects of the potential variation of the subsurface soil profiles along with the two input control motions, and (d) the use of SSE damping for the cracked models is consistent with the high stress conditions that the FWSC structure would be subjected to during a fully cracked concrete condition.

According to the DCD, SDOF oscillators connected to the stick models are used to represent the out-of-plane seismic response of flexible slabs and walls in the buildings. Therefore, the use of SDOF oscillators in the UC_{OBE} and UC_{SSE} models are acceptable to capture the out-of-plane vibration mode up to 50 Hz for models with uncracked concrete. The staff reviewed the issue of SDOF oscillators for cracked-concrete models for the FWSC and confirmed that, as in the case of RB/FB and CB, the applicant decreased the stiffness properties of existing oscillator and added additional oscillators to the CR_{SSE} model to capture the modes of out-of-plane vibration of the cracked slabs up to a frequency of 50 Hz. FSAR Figure 3A.16.2-203 shows the configuration of the CR_{SSE} stick models for the FWSC with the additional SDOF slab oscillators shown in red. The development of these additional SDOF oscillators under fully cracked conditions is described in the GEH Report SER-DMN-014, Revision 1, "Additional Oscillators for Fully Cracked Model for RAI 3.7.2-14(f)." No SDOF oscillators are added to the CR_{SSE} models to represent the out-of-plane vibrations of cracked wall because the fully cracked wall frequencies are above the 50 Hz range.

The staff reviewed the information provided in the FSAR Section 3A.17.9 and the GEH Report SER-DMN-014 and found the site-specific representation of the out-of-plane flexibilities of the slabs under a cracked condition for the FWSC acceptable because: (a) the applicant added additional oscillators to represent all modes of slab vibration up to 50 Hz under fully cracked condition, and (b) the additional SDOF oscillators were developed using the same method and eigenvalue analysis that were used for the standard design.

The staff reviewed the results of the North Anna 3 site-specific evaluation presented in the response to RAI 03.07.02-14 and the supporting documents during North Anna 3 Audit 1 to verify that North Anna 3 site-specific demand with upper bound stiffness and OBE/SSE damping values provide site-specific seismic demands on the FWSC that envelop the effect of structural stiffness variations. FSAR Sections 3A.18.1.3 and 3A.18.2 respectively present the approach used for enhancing the site-specific base case seismic load demand and the ISRS to account for the effect of SSSI, concrete cracking, and soil separation. Specifically, the staff verified during North Anna 3 Audit 2 that the applicant used the enhanced site-specific seismic demand in evaluating the ESBWR standard plant FWSC structures for acceptability at the North Anna 3 site. Staff's evaluation of the ESBWR standard plant FSWC structures for the site-specific demand is described in this SER in Section 3.8.4.

SSSI Analysis

To ensure that the site-specific seismic design basis envelopes the site-specific effects of SSSI, the staff requested in RAI 03.07.02-16 (ADAMS Accession No. ML14156A460), that the applicant provide in the FSAR an evaluation of the site-specific effect of SSSI on the North Anna 3 site-specific seismic demand. In the response to RAI 03.07.02-16 (ADAMS Accession No. ML15222A240), the applicant performed SSSI sensitivity analyses as described in the FSAR Section 3A.17.11. Evaluations are performed using the combined models of: (a) CB-RB/FB for evaluations of SSSI effects of the heavy RB/FB on the response of CB, (b) CB-FWSC for evaluations of SSSI effects of FWSC on the response of CB, and (c) FWSC-CB for evaluations of SSSI effects of CB on the response of FWSC. FSAR Table 3A.15-204 lists the cases used in the analyses for the SSSI effect of the RB/FB on the CB. FSAR Table 3A.15-205 and Table 3A.15-206 list the cases used in analyses for the SSSI effects of the FWSC on the CB and CB on the FWSC, respectively. These analyses cases and the results are documented in detail in the GEH Reports WG3-U73-ERD-S-0005, Revision 3, "Control Building and Reactor/Fuel Building Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A271) and WG3-U73-ERD-S-0002, Revision 6, "Control Building and Firewater Service Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A270).

The staff notes that the RB/FB is considerably more massive than the CB, so the potential SSSI effect of the RB/FB on the CB is more significant than the effect of the CB on the RB/FB. On this basis, the applicant did not evaluate the SSSI effect of the CB on the RB/FB. The staff reviewed the ESBWR DCD and determined that the basis provided by the applicant for neglecting the SSSI effect of the CB on the RB/FB is consistent with the seismic analysis methodology described in the ESBWR DCD, Tier 2, Section 3A.8.11 and is therefore acceptable.

SSSI Combined Models of the CB and RB/FB

The applicant performed the SSSI analyses of the combined model designated as "CB-RB/FB" to evaluate the interaction effect of RB/FB on CB as described in the FSAR Section 3A.17.11. The combined model is shown in the FSAR Figure 3A.17.11-201. The combined model provides an explicit representation of the North Anna 3 site conditions between the two buildings and includes the effects of dynamic interaction between the RB/FB and CB. The details of the analyses and the results for the CB-RB/FB are documented in the GEH Report WG3-U73-ERD-S-0005, Revision 3, "Control Building and Reactor/Fuel Building Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A271). The SSSI analyses used the SASSI 2010 program with the MSM where only selected nodes of the excavated volume elements are specified as interaction nodes. GEH Report SER-DMN-011, Revision 1 provides the benchmarking evaluation of the accuracy of the MSM solutions for the North Anna 3 site-specific application. Staff's evaluation of benchmarking of the MSM of the SASSI 2010 computer program is provided earlier in this section under the heading "*SSI Analysis Method*."

The combined models consist of the lumped mass beam models of the CB and RB/FB described in the ESBWR DCD Section 3A.5.1 coupled with the finite element soil model of the subgrade with the site-specific strain compatible dynamic properties. The combined model also includes the Access Tunnel that is isolated from the RB/FB and CB and the near-field solid elements representing the structural and concrete fill materials placed below the Access Tunnel and surrounding the CB. The Access Tunnel is modelled using the shell elements. For comparison purposes, the subgrade dynamic properties and input motions used for the CB-RB/FB SSSI analysis are identical to those used for the SSI analysis of the CB standalone model. The passing frequencies used for the CB-RB/FB combined models shown in the FSAR Tables 3A.15-204 meet the 50 Hz criteria specified in DC/COL-ISG-1 guidance.

Based on staff's review of the information provided in the FSAR, the technical reports, and the supporting calculations during North Anna 3 Audit 1, the staff finds the SSSI model representation of the CB and the RB/FB acceptable because: (a) the SSSI models explicitly capture the effects of dynamic coupling between the RB/FB and CB at the Unit 3 site, (b) the SSSI models use the same lumped mass beam models as the ones used in the EBSWR DCD, (c) the site-specific subgrade properties and the input motions used in the SSSI CB-RB/FB models are identical to the corresponding subgrade properties and input motion used for the stand alone SSI model of the CB, which the staff reviewed and accepted as discussed earlier in this SER, (d) the selection of interaction nodes for the MSM is based on the conclusions of the North Anna 3 benchmarking GEH Report SER-DMN-011, Revision 1, and (e) the maximum aspect ratio of the finite elements was within the aspect ratio limit of the SASSI2010 computer program which the staff found acceptable as discussed later in this SER.

SSSI Effect of RB/FB on CB (CB-RB/FB)

As discussed in the FSAR Section 3A.17.11, analyses of the CB-RB/FB SSSI models were performed for the UB and LB partial columns, and UB full column subgrade profiles representing strain-compatible dynamic soil/rock properties at the CB location, and corresponding in-layer input motions applied at the bottom of the CB foundation.

The site-specific SSSI effects of the RB/FB on the CB site-specific design basis were evaluated by comparing the results of site-specific analysis of CB-RB/FB SSSI model cases listed in the FSAR Table 3A.15-204 with the corresponding CB site-specific seismic design basis structural loads and ISRS that were developed as envelope of the results of design basis SSI analysis of the CB standalone models. Comparisons are also made with the corresponding design basis loads used for the standard design. These comparisons are shown in GEH Report WG3-U73-ERD-S-0005, Rev 3, "Control Building and Reactor/Fuel Building Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A271).

The staff reviewed the structural responses computed from the site-specific SSSI analyses in terms of the maximum forces and moments, lateral soil pressure on the below-grade exterior walls, and the 5-percent damped ISRS at the key locations in the CB identified in ESBWR DCD, Tier 2, Appendix 3A. These results are documented in the GEH Report WG3-U73-ERD-S-0005, Revision 3. Based on staff's review of the GEH report and audit of the supporting calculations during North Anna 3 Audit 1, the staff noted that the site-specific seismic structural load demand for the CB does not always envelope the SSSI effects of the RB/FB on the CB. However, the applicant in the FSAR Section 3A.17.11 stated and the staff verified that the site-specific SSSI induced shear demand (including the shear induced by torsion) is enveloped by the site-specific enveloping design basis loads specified in FSAR Section 3A.17.13.2. The staff also concluded that the exceedance of the lateral pressure on the CB west wall facing the RB/FB has no effect on the CB below-grade wall design based on the supporting configuration of the CB west wall and the location of the lateral pressure exceedance as discussed in the FSAR Section 3A.17.11. With regard to any exceedance in the ISRS, the applicant stated in FSAR Section 3A.17.11 that any exceedance in the ISRS up to 50 Hz due to SSSI effect will be incorporated in the site-specific design ISRS envelope. Since the CB site-specific ISRS are enhanced as described in FSAR Section 3A.18.2 for any exceedance due to SSSI effect, the staff found the applicant's approach acceptable.

SSSI Combined Models of the FWSC and CB

The applicant performed the SSSI analyses of the combined model designated as "CB-FWSC" to evaluate the interaction effect of FWSC on CB and the combined model designated as "FWSC-CB" to evaluate the interaction effect of CB on the FWSC as described in the FSAR Section 3A.17.11. The combined models are shown in the FSAR Figures 3A.17.11-202 and 3A.17.11-203. The details of the analysis and the results are documented in the GEH Report WG3-U73-ERD-S-0002, Revision 6, "Control Building and Firewater Service Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A270).

The SSSI analyses used the SASSI 2010 program with the MSM where only selected nodes of the excavated volume elements are specified as interaction nodes. GEH Report SER-DMN-011, Revision 1, provides the benchmarking evaluation of the accuracy of the MSM solutions for the North Anna 3 site-specific application. The staff's evaluation of benchmarking of the MSM of the SASSI2010 computer program is provided below under the heading *"Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM"* in this SER.

The combined models consist of the lumped mass beam models of the CB and FWSC described in the ESBWR DCD Section 3A.5.1 coupled with the finite element soil model of the subgrade with the site-specific strain compatible dynamic properties. The combined model includes the structural and concrete fill materials placed around the CB exterior walls and concrete fill placed below the CB and FWSC basemat. Structural and concrete fill materials surrounding the exterior of the CB and between the two structures are represented in the combined model as the near-field solid elements. For comparison purposes, the subgrade dynamic properties and input motions used for the CB-FWSC SSSI analysis are identical to those used for the SSI analysis of the CB standalone model. Similarly, the subgrade dynamic properties and input motions used for the FWSC-CB SSSI analysis are identical to those used for the SSI analysis of the FWSC standalone model. The passing frequencies used for the CB-FWSC and FWSC-CB combined models are shown in FSAR Tables 3A.15-205 and 3A.15-206.

Based on staff's review of the information provided in the FSAR and the technical reports and supporting calculations during North Anna 3 Audit 1, the staff finds the SSSI model representation of the CB and the FWSC acceptable because: (a) the SSSI models use the same lumped mass beam models as the one used in the EBSWR DCD, (b) the site-specific subgrade properties and the input motions used in the two SSSI models (CB-FWSC and FWSC-CB) are identical to the corresponding subgrade properties and input motion used for the stand alone SSI model of the CB and FWSC, which the staff reviewed and accepted as discussed earlier in this SER, (c) the selection of interaction nodes for the MSM is based on the conclusions of the North Anna 3 GEH Report SER-DMN-011, Revision 1, and (d) the maximum aspect ratio of the finite elements was within the aspect ratio limit of the SASSI2010 computer program which the staff found acceptable as discussed below under the heading *"Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM"* in this SER.

SSSI Effect of FWSC on CB (CB-FWSC)

As discussed in the FSAR Section 3A.17.11, analysis of the CB-FWSC SSSI model was performed for the UB and LB full column profiles and corresponding in-layer input motions applied at the bottom of the CB foundation. The site-specific SSSI effects of the FWSC on the CB site-specific design basis were evaluated by comparing the results of site-specific analysis of CB-FWSC SSSI model cases listed in the FSAR Table 3A.15-205 with the corresponding CB site-specific seismic design basis structural loads and ISRS that were developed as envelope of the results of design basis SSI analysis of the CB standalone models. Comparisons are also made with the corresponding design basis loads used for the standard design.

The staff reviewed the structural responses computed from the site-specific SSSI analyses in terms of the maximum forces and moments and the 5-percent damped ISRS at the key locations in the CB identified in ESBWR DCD, Tier 2, Appendix 3A. These results are documented in the GEH Report WG3-U73-ERD-S-0002, Revision 6 (ADAMS Accession No. ML16076A270). Based on review of this report, the staff concluded that the site-specific North Anna 3 design basis seismic structural load demand for the CB envelope the SSSI effects of the FWSC on the CB response with the exception of the torsional demands on the CB. To address this exceedance the applicant performed calculations to demonstrate that the additional torsion-induced shear in the CB walls are enveloped by the enveloping shear load demands obtained from the site-specific design basis SSI analysis of the CB standalone model. During North Anna 3 Audit 1, the staff reviewed the supporting information and confirmed that the additional torsion-induced shear in the CB walls are enveloped by the enveloping shear load demands obtained from the site-specific SSI analysis of the CB standalone model.

GEH Report WG3-U73-ERD-S-0002, Revision 6 indicates that North Anna 3 site-specific design ISRS based on stand-alone SSI analyses in general envelope the results of the site-specific SSSI analyses of the CB-FWSC combined model. The staff noted that there was one exceedance in the ISRS at the top of the CB basemat in vertical direction near 50 Hz. The applicant in response revised FSAR Section 3A.17.11 to indicate that the CB site-specific ISRS are enhanced as described in FSAR Section 3A.18.2, if any of the sensitivity SSSI analyses of the CB-RB/FB and the CB-FWSC combined models yield 5 percent damped ISRS that exceed the corresponding CB site-specific design ISRS based on stand-alone SSI analyses up to 50 Hz. Since the CB site-specific ISRS are enhanced as described in FSAR Section 3A.18.2 for any exceedance due to SSSI effect, the staff found the applicant's approach to include the effect of SSSI in the site-specific design envelop acceptable.

SSSI Effect of CB on FWSC (FWSC-CB)

FSAR Section 3A.17.11 and the GEH Report WG3-U73-ERD-S-0002, Revision 6 describe the site-specific evaluation of the SSSI effects of the CB on the FWSC seismic response. The evaluation is based on the comparison of the results of site-specific analysis of the FWSC-CB SSSI model cases (analysis cases FC1 through FC9) listed in the FSAR Table 3A.15-206 with the corresponding FWSC site-specific seismic design basis structural loads and ISRS that were developed as an envelope of the results of SSI analysis of the FWSC standalone model for all profiles. The SSSI effects of the CB on the FWSC site-specific design basis loads (structural load demand) are evaluated by comparing the results of the site-specific analysis of FWSC-CB SSSI model with uncracked concrete and SSE damping values (cases FC7 through FC9) with the corresponding seismic demand obtained from the results of the standalone FWSC SSI analyses with the control motion applied at Elevation 220 ft. The effects of SSSI on the site-specific design ISRS (obtained from the standalone SSI analysis of the FWSC) are evaluated based on the ISRS results obtained from the SSSI analysis of the FWSC-CB model with uncracked concrete and OBE damping values (cases FC1 through FC6) with the control motion applied both at Elevation 282 ft and 220 ft.

The staff reviewed the comparisons provided in the GEH Report WG3-U73-ERD-S-0002, Revision 6 of SSSI envelopes (cases FC7 through FC9) with the site-specific SSI enveloping maximum horizontal and vertical load demands obtained from the FWSC standalone site-specific SSI analyses with uncracked properties and SSE damping values with deep input motion at Elevation 220 ft. Also presented in the report are comparisons of the site-specific seismic demand with those used in the standard design. These comparisons show that the SSSI effect of the CB amplifies some of the site-specific FWSC seismic demands obtained from the standalone SSI analysis and in some instances resulted in exceedance of the loads used in the standard design. The structural design evaluation of the FWSC under site-specific seismic loads exceeding those of the standard design is discussed in SER Section 3.8.4.

The staff reviewed FSAR Figures 3A.17.11-207 through 3A.17.11-209 which provide a comparison of the 5 percent damped ISRS obtained from the site-specific SSSI analysis of the FWSC-CB combined model with the corresponding 5 percent damped North Anna 3 site-specific SSI enveloping ISRS and the standard design ISRS. These Figures show that the SSSI effects of the CB result in significant exceedances in some of the North Anna 3 FWSC site-specific SSI enveloping ISRS.

Based on the above review of the site-specific SSSI effects of the CB on the FWSC response, the staff concluded that the seismic responses obtained from the standalone site-specific design basis SSI analysis of the FWSC do not envelope potential SSSI-induced amplification of the FWSC responses. The applicant in the FSAR Section 3A.17.11 indicated that the results obtained from the analysis of FWSC-CB SSSI model will be used to develop the FWSC site-specific design basis that will envelop the amplifications of the FWSC response due to the SSSI effect of the CB on FWSC. Since the applicant incorporated the results from the FWSC-CB SSSI analysis into the seismic design basis, the staff found this approach acceptable.

Soil Separation Analysis

Soil Separation Consideration for RB/FB and CB

In the FSAR Section 3A.12.2, the applicant stated that consideration of the partial and full embedment configuration in the RB/FB and CB SSI analyses bounds the effects of subgrade stiffness variation related to any potential soil separation. The staff concludes that the SSI analysis with a partial embedment configuration for the RB/FB and the CB bounds the effect of any soil separation because the partial embedment configuration (without the backfill) essentially represents a condition with complete soil separation.

Soil Separation Consideration for FWSC

To evaluate the effect of soil separation between concrete fill below the FWSC foundation and the surrounding soil, the applicant has performed additional evaluation and SSI/SSSI analyses for the FWSC. These analyses are described in Section 3A.17.14.5 of the FSAR and in the GEH Report WG3-U63-ERD-S-0001, Revision 4. The applicant estimated the separation depth from the results of SSI/SSSI analyses of FWSC and FWSC-CB models using the deep input motion at Elevation 220 ft that provides bounding seismic load demands on the FWSC structures. The resultant separation depths vary from case to case in a range of 3.90 m to 8.83 m. The applicant then performed sensitivity analyses to consider the effect of soil separation using the uncracked full column FWSC SSI model (see Table 3A.15-203) and the uncracked FWSC-CB SSSI model. These analyses considered the LB, BE, and UB soil profiles and were performed with concrete fill nodes disconnected from surrounding soils at elevations above the estimated soil separation depths. The applicant used the seismic demand obtained from the soil separation sensitivity analyses to evaluate the acceptability of the site-specific seismic demand established without the consideration of soil separation.

The staff reviewed and confirmed the analytical assumptions and the results obtained from the soil separation sensitivity analyses during North Anna 3 Audit 1 and North Anna 3 Audit 2. The staff found the estimated soil separation depths acceptable because the results generally agree with the ASCE 4-98 provision for soil separation, which is 6 m. The soil separation analyses showed that the maximum increase in structural demands was about 7 percent and the maximum increase in ISRS was about 30 percent, as indicated in FSAR Section 3A.17.14.5.

The applicant also evaluated the sliding stability of the FWSC foundation using the results of the sensitivity analyses of the FWSC standalone and FWSC-CB models, representing fully separated soil conditions and FSAR Table 3A.17.14.5-202 presents a summary of the stability analyses of the FWSC foundation against sliding at the basemat-concrete fill interface. Table 3A.17.14.5-202 also compares the results for lateral load demands on the FWSC shear keys obtained from the calculations accounting for the effect of soil separation with the results obtained from the design basis analyses of the fully bonded models (without soil separation). The comparison shows that the separation between the concrete fill and surrounding soil can amplify the lateral load demand on the FWSC shear keys up to 47 percent. The staff evaluation of the design of the FWSC shear keys against site-specific load demand is presented in SER Section 3.8.5.4.A.3.

These exceedances were not initially considered for the site-specific seismic demand established for the FWSC. The applicant subsequently revised FSAR Section 3A.17.14.5 to indicate that the site-specific evaluations of FWSC structures, basemat, and shear keys use the input seismic loads presented in FSAR Section 3A.18.1.3 which incorporate enhancements to bound all exceedances due to potential separation between the concrete fill and surrounding soil. For ISRS, the FWSC site-specific design ISRS are enhanced if any of the sensitivity analysis cases for soil separation yield 5 percent damped ARS that exceed the corresponding broadened ISRS by more than 10 percent at frequencies up to 50 Hz. The FSAR states that the use of the 10 percent criterion is reasonable considering the conservatism introduced by assuming fully separated condition on all four sides of the concrete fill at all times, which is unlikely during an actual SSE. The staff finds this basis to be acceptable because of the conservatism in the analyses.

The staff's evaluation of the capacity of the concrete fill below the FWSC is discussed in Section 2.5.4 of this SER.

Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM

In response to RAI 03.07.02-10 and RAI 03.07.02-13 (ADAMS Accession No. ML15222A240) the applicant indicated that the V&V of SASSI2010 program modules used in the North Anna 3 SSI analysis are performed in accordance with the Shimizu Quality Assurance Program. FSAR Section 3C.7.4 describes SASSI2010 and its V&V. In addition, the applicant also submitted to the staff the Shimizu Engineering Report SER-DMN-011, Revision 0, "Benchmarking of SASSI 2010 MSM Results from North Anna 3 Site-Specific SSI Analysis" (designed herein as the North Anna 3 MSM Benchmark Report). The applicant has used the MSM of the SASSI programs because of the computational limitations with the size of the computer models using direct method (DM) for the North Anna 3 SSI and SSSI analyses of models embedded in softer in-situ soil.

The staff reviewed the North Anna 3 V&V and the MSM Benchmark reports. The North Anna 3 V&V Report includes 14 test problems; all were solved using the direct method of SASSI. The North Anna 3 MSM Benchmark report indicated that MSM is used for the North Anna 3 SSI and SSSI analyses of FE models. The staff review focused on problems that are applicable to the North Anna 3 site-specific SSI analyses.

In summary, three main issues were identified with regard to SASSI2010 V&V: (1) models are not fine enough to validate the SASSI 2010 solutions up to 50 Hz and the report did not include a test problem to validate the SASSI kinematic SSI solutions for frequencies up to 50 Hz on a layered soil profile such as North Anna 3 site, (2) the results using the models with symmetry/anti-symmetry conditions are different from the full model, and (3) the validation of element aspect ratio is insufficient.

With regard to MSM Benchmarking, the staff identified one issue. To demonstrate the adequacy of MSM for the North Anna 3 application, the FWSC model was analyzed with FE and the UB soil profile only. Since the LB and BE soil profiles lead to lower fundamental frequencies for the excavated soil volume than the UB soil profile with the same interaction nodes, they represent a higher potential that MSM could produce spurious results at lower frequencies. Therefore, the staff requested that the applicant justify why the MSM provides adequate solutions compared with DM for the LB soil profile.

Therefore in a follow-up RAI 3.7.2-26 (ADAMS Accession No. ML15222A240), the staff requested additional information to address the above issues for the SASSI2010 V&V and MSM Benchmark. In response to this RAI, the applicant provided as reference a non-proprietary report to support the ESBWR DCD, Shimizu Engineering Report, SER-DMN-020, Revision 1, "*Validation Summary Report for SASSI 2010 and Appendix with Validation Problems for RAI 03.07.02-10 / RAI 03.07.02-26 Response.*" (ADAMS Accession No. ML15222A280). The staff reviewed this summary report prior to the North Anna 3 Audit 1. The staff also reviewed and confirmed the evaluation in the detailed proprietary V&V report, S/VTR-SAS, Revision 1, "Validation Test Report for SASSI 2010 Version 1" during the North Anna 3 Audit 1.

The North Anna 3 V&V test problems were revised to use a refined model and a higher Vs to be consistent with the North Anna 3 site condition, resulting in a passing frequency up to 70 Hz. FSAR Section 3C.7.4.2 was revised to indicate the passing frequency of the validation report to be 70 Hz. Additional soil layers are added to reach a depth of 325 ft in order to achieve a better comparison with "Day's solution."[3] The response also indicates that both translational and rocking responses are in good agreement with "Day's solution." Since the model passing frequency is higher than 50 Hz, the staff concludes that this RAI is closed and the issue is resolved.

To justify the applicability of SASSI2010 for the SSI analyses to the North Anna 3 layered profiles, the North Anna 3 RAI response references the DTE Energy Company Fermi 3 Reference RCOL in its response to RAI 03.07.02-11, dated July 9, 2013, (ADAMS Accession No. ML13192A302) which also utilizes SASSI2010. Because both sites are similarly layered sites and the contrast in stiffness between the soft soil and the underlying rock is more pronounced at the Fermi 3 site than at the North Anna 3 site, the staff found the response acceptable.

For the issue of correct application of symmetry/anti-symmetry conditions, the RAI response indicates that the observed differences in the responses of the full model and the half model were due to the different coordinate system: the full model using the orthogonal coordinate system and the half model using a cylindrical coordinate system. The revised results using a consistent coordinate system show the difference is negligible. As such, the staff found the response acceptable.

For the issue of validation of the maximum element aspect ratio, the North Anna 3 V&V report is revised to include comparison of maximum absolute acceleration and 5 percent damped ARS for additional locations pertaining to the 3D solid brick elements and thin shell elements that have the largest aspect ratios, in addition to the locations at the top of the CB LMSM and on the top of the CB basemat. The RAI response indicates that the difference of the maximum acceleration is less than 2 percent and the 5 percent-damped ARS shows good agreement at all nodal locations. The staff concludes that this issue is resolved.

The RAI response indicates that the MSM benchmark study of the FWSC model has been expanded to include an additional case for the LB soil profile besides the original UB soil profile. Section 4 of the MSM benchmark report summarizes the results of the SASSI2010 benchmarking analysis of the FWSC model with the revised 2013 GMPE-based subgrade properties. The benchmark analysis of the FWSC model was performed up to a passing frequency of 36 Hz, while the case of UB soil profile was analyzed up to 70 Hz. The passing frequency of 36 Hz, although lower than 50 Hz, is consistent with the cases of the North Anna 3

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[3] *Day, S. M. 1977, "Finite Element Analysis of Seismic Scattering Problem," Doctoral dissertation, University of California, San Diego.*

FWSC LB soil profile, which do not dominate the enveloping response beyond 25 Hz. The comparison of DM and MSM indicates that the differences in the transfer functions, ISRS, and other seismic responses are very small, indicating that MSM is accurate as compared to DM to the FWSC model. As such, the staff finds the use of SASSI2010 MSM acceptable.

ACS SASSI was used to perform sensitivity analyses for Unit 3 site-specific SSI analysis for seismic Category I structures. Both the SASSI2010 and ACS SASSI use the same frequency-domain complex-response methodology. FSAR Section 3C.7.6 describes ACS SASSI and its V&V. The V&V of ACS SASSI is also documented in Appendix I to WG3-U71-ERD-S-0001, Revision 4, “Reactor/Fuel Building Complex Seismic Analysis Report” (ADAMS Accession No. ML16097A203, ML16097A204). During the North Anna 3 Audit 1, Dominion discussed ACS SASSI Product Acceptance Test and other relevant documentation. The verification was performed utilizing the RB/FB model with upper bound structural stiffness properties and OBE damping values for the UB full column profile. Comparisons of transfer functions, ISRS, and other seismic responses with SASSI 2010 indicate that the differences are generally small. The ACS SASSI MOTION module algorithm produces slightly higher ISRS results at higher frequencies than the SASSI2010. Overall, the level of differences do not affect the conclusions made from the structural stiffness variation study. The applicant documented the comparison of SASSI2010 and ACS SASSI results in FSAR Section 3A.10.1. Based on the above evaluation, the staff concludes that the use of ACS SASSI for North Anna 3 stiffness variation sensitivity analyses is acceptable.

FWSC SSI Confirmatory Analysis

The staff performed a confirmatory SSI analysis of the FWSC using the model provided by the applicant. The purpose of the staff’s confirmatory analysis was to assess some of the calculations reported by the applicant. The confirmatory analysis consisted of a base case and a case for soil separation between the concrete fill and surrounding soils. The base-case represents the uncracked concrete properties, OBE damping, the UB soil profile, and full embedment. The in-column control motion at the bottom of the concrete fill (at Elevation 220 ft) was used as the input ground motion. The analysis was performed separately for each of the three directional components of the input ground motion and the results were combined in a manner consistent with what was used by the applicant for comparison purposes. The staff used ACS SASSI (V. 3.0.0) whereas the applicant used SASSI 2010. Both programs were verified and validated by the applicant for use in North Anna 3 SSI analysis as discussed under the heading *“Verification and Validation of SASSI 2010 and ACS SASSI and Benchmarking of the MSM”* above. The staff compared the results of the staff’s base-case analysis with the corresponding results reported by the applicant in the FWSC SSI analysis report (GEH Report WG3-U63-ERD-S-0001, Revision 4 (ADAMS Accession No. ML16148A131) and found the results were in good agreement.

In order to assess the impact of soil separation on the seismic responses of the FWSC superstructure and concrete fill, the staff performed an analysis of a case that considers soil separation by removing from the base-case model the spring elements connecting the concrete fill elements and the excavated soil volume elements for an assumed separation depth. In the staff’s confirmatory analysis, the soil separation depth was assumed to be 6 m below grade on all four sidewalls of the concrete fill based on the ASCE 4-98 guideline, which is different from the values used by the applicant and serves for the purpose of confirmatory analysis using reasonably simplified assumptions. The applicant used varying depths of separation based on soil pressure estimates (8.83 m for the North-South (N.S.) walls and 3.90 m for the East-West

(E.W.) walls for the UB subgrade profile). Also, the model provided to the staff was based on the OBE damping values whereas the model actually used by the applicant in soil separation analysis was based on the SSE damping values. Considering these modeling differences, the staff found there was an acceptable agreement between the analyses of the soil-separation case by the applicant and the staff.

Supplemental Information / Departure

- NAPS SUP 3.7-5 — Interaction of Non-Category I Structures with seismic Category I Structures
- NAPS SUP 3.7-8 — Interaction of Non-Category I Structures with seismic Category I Structures – RWB Wall Capacity Pressure
- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

Interaction of Non-Seismic Category I Structures with Seismic Category I Structures

The staff reviewed NAPS SUP 3.7-5 and NAPS DEP 3.7-1 as they relate to North Anna 3 COL FSAR Section 3.7.2.8 on seismic interactions of non-seismic Category I structures with seismic Category I structures as follows:

As supplemental information to ESBWR DCD 3.7.2.8, the applicant refers to the FSAR Figure 2.1-201 and ESBWR DCD Figure 1.1-1 for the locations of site structures. FSAR Section 3.7.2.8 indicates that site-specific non-seismic Category I structures (outside the scope of the ESBWR DCD) are separated from seismic Category I structures by at least a distance equal to their height above grade. Therefore, the collapse of any site-specific non-seismic Category I structure will not cause the non-seismic Category I structure to strike a seismic Category I structure. The locations of structures are depicted in FSAR Figure 2.1-201. The staff concludes that this is consistent with SRP Acceptance Criterion 3.7.2.II.8.A and is therefore acceptable.

FSAR Section 3.7.2.8 states that two sets of site-specific seismic response analyses are performed using the North Anna 3 site-specific design ground motion and subgrade dynamic properties to demonstrate the adequacy of the ESBWR standard plant:

- Site-specific SSI analyses of the standalone TB, RW, SB, and ADB structures following methodology consistent with the site-specific seismic SSI analyses of the seismic Category I structures presented in the FSAR Section 3.7.2.4.

- Site-specific seismic SSSI analyses to evaluate any adverse effects of seismic interaction between the TB, RW, SB, and ADB structures and adjacent seismic Category I structures.

Results of these site-specific seismic SSI and seismic SSSI analyses will be discussed as part of the ITAAC completion package for the TB, RW, SB, and ADB structures to demonstrate that acceptance criteria in FSAR Tier 1, ITAAC Tables 2.4.15-1, 2.4.16-1, 2.4.17-1, and 2.4.18-1, respectively, are met.

The design and analysis of the non-seismic Category I structures (TB, SB, and ADB) and the RW-IIa identified in ESBWR DCD, Tier 2, Section 3.7.2.8 will be completed as part of the detailed design phase for the ESBWR standard plant design, per DCD Tier 2, Section 3.7.2.8.1 for the TB, Section 3.7.2.8.2 for the RWB, Section 3.7.2.8.3 for the SB, and Section 3.7.2.8.4 for the ADB; and DCD Tier 1, ITAAC Tables 2.16.8-1 for the TB, 2.16.9-1 for the RW, 2.16.10-1 for the SB, and 2.16.11-1 for the ADB.

The staff found the applicant's approach to address the site-specific effects on the seismic analysis and design of non-seismic Category I buildings acceptable because: (a) the site-specific SSI analysis and seismic evaluation of these structures are performed following the same method as the one used for the seismic Category I buildings described in the FSAR Section 3.7.2.4 which the staff found acceptable and (b) the site-specific effects of SSSI with adjacent seismic Category I structures are evaluated following an approach consistent with the approach used for the seismic Category I structures which the staff found acceptable.

Interaction of Non-Seismic Category I Structures with Seismic Category I Structures – RWB Wall Capacity Pressure

The staff reviewed NAPS SUP 3.7-8 related to the dynamic pressure capacity of the RWB exterior walls in meeting the requirements of safe separation distance from the liquid hydrogen storage tanks as follows:

In FSAR Section 2.2.3.1.3, the applicant provided the licensing basis to ensure that the nearest key structures meet the safe separation distance to the liquid hydrogen tank. To meet the requirement for safe separation distance, the nearest key structures should have a static wall pressure capacity of 3 psi. In order to assess that the static wall pressure capacity for the applicable structures are met, the staff in RAI 02.02.03-10 (ADAMS Accession No. ML14283A550), requested the applicant to provide in the FSAR an analysis demonstrating that the ESBWR standard plant static wall pressure capacity is at least 3.0 psi for the applicable structures.

In response to RAI 02.02.03-10 (ADAMS Accession No. ML15051A288), the applicant stated that the key structures nearest to the liquid hydrogen tank are the FB (seismic Category I) and the RWB. The applicant performed calculation for the FB based on the design input (e.g., wall size, span, etc.) determined from the ESBWR DCD, Figure 3G.3-5 to demonstrate that the static wall pressure capacity is at least 3 psi. The staff reviewed the calculation included in the response to the RAI and agreed with the applicant's determination that the static wall pressure capacity for the FB is at least 3.0 psi. The staff also confirmed that the design input (e.g., area of tension reinforcement, dimensions of the wall, span, specified yield strength of reinforcement and concrete, etc.) used for establishing the wall pressure capacity for the FB is consistent with the design information provided in the ESBWR DCD.

For the RW, the applicant stated that the detailed design of the RWB has not been finalized. The applicant stated that the final design of the RWB will be verified through ITAAC. In the FSAR 3.7.2.8.2, the applicant stated that the RWB exterior walls will have a static wall pressure capacity of at least 3 psi. ACI 349-01, "Code Requirement for Nuclear Safety Related Concrete Structures," will be used in the final design. The staff reviewed the pertinent portion of the

FSAR and the proposed site-specific ITAAC (FSAR Tier 1 ITAAC Tables 2.4.16-1) for the RWB. The staff confirmed that the applicant has added under the design commitment a specific requirement that the RW will have an exterior wall static pressure capacity of at least 3.0 psi. On the above basis the staff found the resolution of this issue acceptable.

3.7.2.5 Post Combined License Activities

Site-specific ITAAC and corresponding acceptance criteria for non-seismic Category I structures within the scope of the ESBWR DCD are described in the COLA Part 10 Tables 2.4.2-1, 2.4.15-1, 2.4.16-1, 2.4.17-1, and 2.4.18-1. The review of these site-specific ITAAC is in Section 3.7.2.4 of this SER.

3.7.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the seismic system analysis that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.7.2, other NRC RGs, and the Interim Staff Guidance. The staff finds that the applicant has addressed the seismic system analysis in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.7.2.3 of this SER.

3.7.3 <u>Seismic Subsystem Analysis</u>

3.7.3.1 Introduction

This North Anna 3 FSAR section addresses the seismic analysis methods and acceptance criteria used for the ESBWR seismic Category I and non-seismic Category I subsystems (equipment and piping) that are qualified to satisfy the performance requirements according to their seismic Category I or seismic Category II designations. Input motions in the form of ISRS and displacements for the analysis and qualification are usually obtained from the primary system dynamic analysis described in the FSAR Section 3.7.2. Non-seismic Category I systems are designed or physically arranged (or both) to prevent the SSE from causing unacceptable structural interactions with or the failure of seismic Category I systems. The ESBWR method for a standard plant seismic analysis of the seismic Category I and non-seismic Category I subsystems is in Section 3.7.2 of ESBWR DCD, Tier 2, Revision 10.

3.7.3.2 Summary of Application

Section 3.7.3 of the North Anna 3 COL FSAR, Revision 9, incorporates by reference Section 3.7.3 of ESBWR DCD, Revision 10. In addition, in FSAR Section 3.7.3.13, Revision 9, the applicant provides the following:

Departure

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

This departure is described in North Anna 3 COL FSAR Part 7, Departures Report. The site-specific horizontal and vertical seismic response spectra as shown in North Anna 3 COL FSAR Figures 2.0-201 through 2.0-204 exhibit exceedances at certain frequencies, when compared to the ESBWR CSDRS. Therefore, the applicant In FSAR Section 3.7.3.13 indicated that the seismic input for the analysis of the seismic Category I buried piping and tunnels will consist of both the single envelope design response spectra defined in DCD Table 3.7-2, using applicable scale factors, as well as the site-specific FIRS.

3.7.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the seismic subsystem analysis, and the associated acceptance criteria, are in SRP Section 3.7.3. The specific requirements include the following:

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the seismic design basis to reflect appropriate consideration of the most severe earthquakes historically reported for the site and surrounding area with a sufficient margin for the limited accuracy, quantity, and period of time in which historical data have been accumulated. In addition, SSCs important to safety should be designed to withstand the effects of earthquakes without losing the capability to perform their intended safety functions.

- 10 CFR Part 50, Appendix S, as it relates to the horizontal component of the SSE ground motion in the free-field at the foundation level of the structures to be an appropriate response spectrum with a peak ground acceleration of at least 0.1g; and if the OBE is chosen to be less than or equal to one-third of the SSE ground motion, it is not necessary to conduct explicit response or design analyses in accordance with Section IV.(2)(i)(A) of 10 CFR Part 50, Appendix S, and the requirement of taking into account SSI effects.

In addition to the acceptance criteria and regulatory guidance associated with the review of FSAR Section 3.7.3, the basis includes the following:

- SRP Section 3.7.1, 3.7.2, and 3.7.3 guidance as applied to seismic Category I subsystems and components for site-specific seismic analysis.

- DC/COL-ISG-1 and DC/COL-ISG-017, in reviewing the seismic input and the SSI dynamic model acceptability for the North Anna 3 site.

- RG 1.61 to determine the acceptability of the damping values used in the structural model.

3.7.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.7.3 of the ESBWR DCD. The staff reviewed Section 3.7.3 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the NA3 FSAR as follows:

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

Seismic Category I Buried Piping, Conduits and Tunnel

FSAR Section 3.7.3.13 describes analysis procedure for seismic Category I buried piping, conduits, and tunnels, as well as buried Safety Class RW-IIa radwaste piping installed in trenches or tunnels. This FSAR section indicates that "Seismic input motions for the portions located below ground are based on the single envelope design response spectra as defined in DCD Table 3.7-2, using applicable scale factors, and site-specific SSE FIRS." Since site-specific seismic input were not established in the FSAR Section 3.7.1, Revision 6 for the buried SSCs, the applicant was requested in RAI 03.07.03-1 (ADAMS Accession No. ML14156A456), to describe in the FSAR how the seismic input motions for the applicable buried structures would be developed. The applicant was also requested to provide site-specific ITAAC to address the verification of implementation of the commitment that a site-specific analysis following the method as specified in the FSAR for seismic Category I structures has been conducted demonstrating that the as-built seismic Category I buried piping, conduits, and tunnels conform to their design.

In response to RAI 03.07.03-1 (ADAMS Accession No. ML14204A459), the applicant revised the FSAR Section 3.7.3.13 to describe the development of the seismic input motions for the applicable buried structures. FSAR Section 3.7.3.13, Revision 9 states that the site-specific FIRS will be used to define the design input ground motion at the bottom elevations of seismic Category I buried piping, conduits, and tunnels following the same methodology as used for the development of full column FIRS for the design of seismic Category I buildings as described in FSAR Sections 2.5.2 and 3.7.1. These FIRS will consider, as applicable, the variations of subgrade conditions and the strain-compatible dynamic properties of in-situ subgrade or backfill materials under and above these structures and components. The FIRS will be amplified as necessary to include the effects of the adjacent heavy foundations on the free field motion and to address the effects of SSSI on the seismic response of these buried piping, conduits, and tunnels. The applicant also added site-specific ITAAC in FSAR Tier I Sections 2.4.20 through 2.4.22 to verify that site-specific analyses, following the method as specified in the FSAR for seismic Category I structures, have been conducted and to demonstrate that the as-built applicable buried structures conform to their design. The staff found the applicant's approach to develop the site-specific input used for analysis and design of seismic Category I and safety class RW-IIa buried piping conduits, and tunnels acceptable because: (a) the site-specific seismic input is developed following the same method as the one used for the seismic Category I structures, (b) the site-specific SSE FIRS are amplified to address the effect of adjacent heavy foundations on the seismic input to the buried piping, conduits, and tunnels, (c) the input for the seismic analysis of the buried piping and tunnels consist of both the single envelope design response spectra defined in DCD Table 3.7-2, using applicable scale factors, as well as the site-specific FIRS, and (d) FSAR Tier 1, ITTAC Tables 2.4.20-1, 2.4.21-1, and 2.4.22-1 have been added to verify that a site-specific analyses, following the method as specified in FSAR Section 3.7.1 have been conducted for these as-built buried structures.

3.7.3.5 Post Combined License Activities

The applicant identifies the following site-specific ITAAC for as-built verification of Category I buried structures:

- FSAR Part 10 Table 2.4.20-1, "ITAAC for Seismic Category I Buried Piping, Conduits and Tunnels."

- FSAR Part 10 Table 2.4.21-1, "ITAAC for Access Tunnel"

- FSAR Part 10 Table 2.4.22-1, "ITAAC for Radwaste Tunnel"

3.7.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the seismic subsystem analysis that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.7.3, other NRC RGs, and the Interim Staff Guidance. The staff finds that the applicant has addressed seismic subsystem analysis in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.7.3.3 of this SER.

3.7.4 Seismic Instrumentation

3.7.4.1 Introduction

The seismic instrumentation program provides time history data on the seismic response of the free-field containment structure and other seismic Category I structures. The seismic instrumentation program is annunciated in the control room when triggered by a seismic event. Installation of instrumentation that is capable of adequately measuring the effects of an earthquake at the plant site is also addressed. The criteria for the seismic instrumentation include the following:

- Comparison with RG 1.12, "Nuclear Power Plant Instrumentation for Earthquakes"
- Location and description of the instrumentation
- Control room operator notification

- Comparison of measured and predicted responses
- Tests and inspections

3.7.4.2 Summary of Application

Section 3.7.4 of the NAPS 3 COL FSAR, Revision 9, incorporates by reference Section 3.7.4 of the ESBWR DCD, Revision 10. In addition, in Section 3.7.4, the applicant provided the following:

Supplemental Information

- NAPS DEP 3.7-1

NAPS DEP 3.7-1 describes the SSE ground motion for both the ESBWR standard plant and the site-specific SSE representative of the site-specific seismological and geological conditions.

- NAPS SUP 3.7-6

In NAPS SUP 3.7-6, the applicant committed to implementing the seismic monitoring program prior to receiving fuel on site. In addition, the applicant provided details about how the location of the free-field seismic sensor will be selected, and appropriate transfer functions will be determined, to ensure that ground motions recorded at the sensor location are consistent with the geologic conditions under the facility.

Overall Summary

The applicant specified that the SSE for the proposed facility is defined by two separate spectra: the CSDRS for ESBWR SSCs and the site-specific FIRS representative of the site-specific geologic and seismological conditions. Based on the development of two SSE spectra, the applicant used two spectra to define the plant shutdown OBE. For the purposes of exceedance checks used to determine if plant shutdown is required, the applicant defined the OBE as (1) one-third of the CSDRS that define the free-field ground motion at the bottom of the RB/FB and CB foundations and (2) one-third of the site-specific SSE at-grade as described in FSAR Section 3.7.1.1.6. The applicant specified that recorded ground motions must exceed both OBE spectra for the plant to shut down.

As described in Section 2.5.4 of the FSAR, the site subsurface is characterized by significant topographic relief in weathering and subsurface geology. Therefore, the applicant provided a description of how it will select the location of the free-field seismic instrument at the site. In addition, the applicant stated that it applied the appropriate spectral ratios to recorded ground motions to account for potential differences between subsurface geologic conditions at the location of the free-field instrument and the power block area.

3.7.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the seismic instrumentation, and the associated acceptance criteria, are in SRP Section 3.7.4. The specific requirements include the following:

- 10 CFR Part 50, Appendix S, requires instrumentation to be provided so that the seismic response of safety-related nuclear plant features can be evaluated promptly after an earthquake.

- 10 CFR Part 50.55a, “Codes and standards.”

In addition, the acceptance criteria and regulatory guidance associated with the review of FSAR Section 3.7.4 is documented below:

- RG 1.12, Revision 2

- EPRI Report NP-6695, “Guidelines for Nuclear Plant Response to an Earthquake”

- EPRI Report NP-5930, “A Criterion for Determining Exceedance of the Operating Basis Earthquake”

- EPRI Technical Report TR-100082, “Standardization of the Cumulative Absolute Velocity,” as permitted by RG 1.166

- RG 1.166

- RG 1.167, “Restart of a Nuclear Power Plant Shut Down by a Seismic Event”

3.7.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.7.4 of the ESBWR DCD, Revision 10. The staff reviewed Section 3.7.4 of the NAPS 3 COL FSAR, Revision 9 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following supplemental information in the COL FSAR:

Supplemental Information

- NAPS DEP 3.7-1

The site-dependent SSE at grade is defined by enveloping the following two spectra:

1. PBSRS calculated at grade (Elevation 290 ft) from full soil column analyses for RB/FB and CB and,

2. The minimum required response spectra defined as the RG 1.60 broadband horizontal and vertical response spectra at 5 percent damping anchored to 0.1g at PGA to satisfy the requirements of SRP Section 3.7.1.

The applicant defined the site-dependent OBE at grade as one-third of the site-dependent SSE at grade. The site-dependent OBE response spectra at grade are one reference against which the applicant will perform OBE exceedance checks for the purpose of plant shutdown, as described in Section 3.7.1 of the FSAR. FSAR Section 3.7.4.4 includes the criteria used to determine whether a plant shutdown is required following a seismic event.

FSAR Section 2.5.2.6 presents the horizontal and vertical PBSRS at grade. The horizontal and vertical 5 percent damped site-dependent SSE spectra at grade are presented in FSAR Figures 3.7.1-265 and 3.7.1-266, respectively.

The applicant calculated the horizontal and vertical free-field site-dependent OBE at grade as one-third of the site-dependent SSE at grade and presented in FSAR Figure 3.7.1-267.

The 5 percent damped pseudo velocity response spectra for site-dependent OBE at grade is determined by dividing the ARS values at each frequency point (f) by $2\pi f$. The digital values for the site-dependent SSE and OBE at grade are presented in FSAR Tables 3.7.1-216 and 3.7.1-217, respectively.

The plant is shut down if the walkdown inspections discover damage to equipment that would affect the safe operation of the plant, or the recorded motion in the free-field in any of the three directions (two horizontal and one vertical) exceeds both the certified design and site-specific response spectrum limits and the cumulative absolute velocity limit as follows:
Certified design response spectrum limit is exceeded if:

- at frequencies between 2 and 10 Hz, the recorded response spectral accelerations of 5 percent damping exceed one-third of the corresponding CSDRS values or 0.2g, whichever is greater; or

- at frequencies between 1 and 2 Hz, the recorded response spectral velocities of 5 percent damping exceed one-third of the corresponding CSDRS values or 6 in/sec (152.4 mm/sec), whichever is greater.

Site-specific response spectrum limit is exceeded if:

- at frequencies between 2 and 10 Hz, the recorded response spectral accelerations of 5 percent damping exceed the corresponding site dependent OBE at grade presented in FSAR Table 3.7.1-216 or 0.2g, whichever is greater; or

- at frequencies between 1 and 2 Hz, the recorded response spectral velocities of 5 percent damping exceed the corresponding OBE values presented in FSAR Table 3.7.1-217 or 6 in./sec (152.4 mm/sec), whichever is greater, or

- cumulative absolute velocity limit is exceeded if the cumulative absolute velocity value calculated according to the procedures in EPRI TR-100082 (“Standardization of the Cumulative Absolute Velocity”, EPRI, Palo Alto, CA, December 1991) is greater than 0.16g/sec.

In RAI 3.7.4-2, the staff noted that the applicant considers two different spectra, the site-specific SSE and the CSDRS, when determining if a recorded ground motion exceeds the OBE ground motion. The staff requested that the applicant specify how this definition of OBE exceedance meets the requirements of Appendix S to 10 CFR Part 50, and is consistent with the guidance in DC/COL-ISG-1.

In its response, the applicant stated that all safety-related SSCs are designed, analyzed, and qualified to meet both the ESBWR CSDRS and the site-specific FIRS (Figure 3.7.4-1). The applicant also clarified that an OBE exceedance is declared when a recorded ground motion exceeds both the (a) CSDRS-derived and (b) site-specific OBE, but that these exceedances need not occur at the same frequency (i.e., envelope of (a) and (b) are not considered). For example, an earthquake response spectrum that falls below the envelope of (a) and (b), but exceeds (b) at low frequency and (a) at high frequency, would be considered an OBE exceedance, requiring plant shutdown if other criteria, as discussed in FSAR Section 3.7.4.4, are also met. Finally, the applicant stated that the consideration of (a) for determining the OBE at grade is conservative, because this selection neglects the effects of ground motion amplification or site response between the elevation of the RB/FB and CB foundations and plant grade.

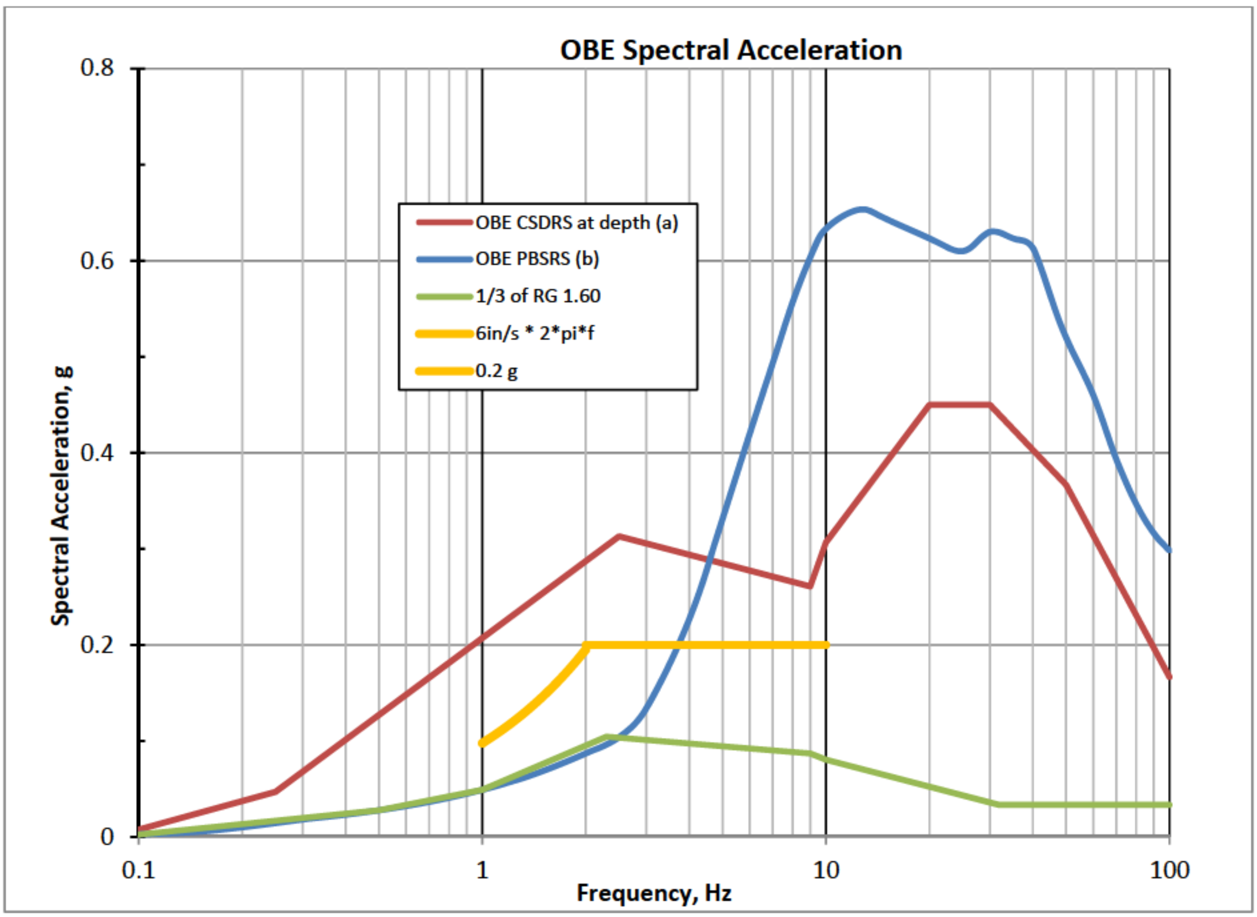

Figure 3.7.4-1. Plot comparing the CSDRS derived OBE (a) and the site-specific OBE (b) with the other requirements used to determine an OBE exceedance.

In Section 3.7.1 of Revision 9 the applicant stated that the response spectra of the 2011 **M** 5.8 Mineral, Virginia earthquake recorded at the Unit 1 containment mat, are closely representative of the Unit 3 site-specific partial column outcrop FIRS. The applicant provided comparisons confirming that the Unit 3 CSDRS envelopes the earthquake recorded motions in East-West, North-South, and vertical directions. Since the horizontal and vertical CSDRS are included in the Unit 3 SSE as the licensing basis for all seismic Category I SSCs, the August 23, 2011, **M** 5.8, Mineral, Virginia earthquake Unit 1 containment mat recordings are considered within the OBE criteria defined above for the Unit 3 SSCs.

The staff reviewed the applicant's RAI response and FSAR modifications. The applicant's response and proposed modifications adequately explain that the OBE for the site is not defined by the envelope of spectra (a) and (b), but by the individual exceedance of both. In addition, the applicant's response and proposed modifications clarify that all safety-related SSCs are designed to both spectra. Therefore, the staff agrees that the proposed OBE criteria for the North Anna site meet the criteria in Appendix S of 10 CFR Part 50 and the guidance in DC/COL-ISG-1and considers RAI 3.7.4-2 resolved and closed.

- NAPS SUP 3.7-6 Seismic Instrumentation

The seismic sensor located in the free field near the power block structures is used to determine OBE exceedance. Because of the complex subsurface stratigraphy of the site, the staff requested in RAI 3.7.4-3 (ADAMS Accession No. ML14288A724), that the applicant describe how it would select a site such that recorded ground motions in the free field adequately characterize ground motions experienced by the power block structures.

In its response to RAI 3.7.4-3 (ADAMS Accession No. ML14337A117), the applicant stated that the subsurface geologic structure of the site is considered in determination of the location of the free-field seismic instrument at the site, and the appropriate spectral ratios will be applied to the ARS and velocity response spectra of the recorded motion to account for potential differences between the subsurface geologic conditions at the location of the free-field instrument and the power block area.

The staff reviewed the applicant's RAI response and proposed FSAR changes. Based on the fact that the free-field data will be scaled using the spectral transfer function to the appropriate level at the power block area, the staff finds the response acceptable. Therefore, the staff considers RAI 3.7.4-3 resolved and closed.

The staff reviewed NAPS SUP 3.7-6 related to the seismic instrumentation included under Section 3.7.4 of the North Anna 3 COL FSAR. The staff concluded that because the seismic instrumentation and monitoring program will be installed and operational before receiving fuel at the NAPS site, and the subsurface geologic structure of the site is considered in determination of the location of the free-field seismic instrument at the site, NAPS SUP 3.7-6 is acceptable.

3.7.4.5 Post Combined License Activities

There are no post COL activities related to this section.

3.7.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to seismic instrumentation, and no outstanding information is expected to be addressed in the COL FSAR related to this section. There are no unresolved nuclear safety issues relating to the seismic instrumentation that were incorporated by reference.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.7.4, and other NRC regulatory guides. The staff finds that the applicant addressed seismic instrumentation in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant satisfied the relevant requirements of the regulations described in Section 3.7.4.3 of this SER. In addition, the staff concludes that the relevant information presented in the COL FSAR is acceptable, because the installation and operability of the seismic monitoring program will be demonstrated before receiving fuel at the North Anna 3 site.

3.7.5 Site-Specific Information

3.7.5.1 Introduction

Section 3.7.5 of the ESBWR DCD references FSAR Chapter 2, Table 2.0-1 which defines the envelope of site-related parameters that the ESBWR standard plant is designed to accommodate. These parameters envelope most potential sites in the United States.

The ESBWR DCD, Table 2.0-2 references the guidance in the SRP, and defines the limits imposed on the acceptance criteria in Section II of the various SRPs by (1) the envelope of site-related parameters that the ESBWR plant is designed to accommodate, and (2) the assumptions, both implicit and explicit, related to site parameters that were employed in the evaluation of the ESBWR design.

3.7.5.2 Summary of Application

In the North Anna 3 COL FSAR Section 3.7.5, Revision 9, the applicant incorporated by reference Section 3.7.5 of ESBWR DCD, Revision 10.

In addition, in FSAR Section 3.7.5, the applicant provides the following:

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

3.7.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

In addition, the relevant requirements of the Commission regulations and the associated acceptance criteria are given in the NRC SRP.

3.7.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.7.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.7.5 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to this site-specific information.

In addition the staff reviewed the information in the COL FSAR as follows:

Supplemental Information

- NAPS DEP 3.7-1

The NAPS DEP 3.7.1 is a result of the North Anna site-specific FIRS exceeding the CSDRS at certain frequencies. Therefore, the applicant revised the definition for the SSE to include the site-specific FIRS for each seismically qualified structure. These changes are identified in FSAR Sections 1.3, 1.11, 2.0, 3.7, 3.8, 4.2, 9.1, 19.1, 19.2, and 19.5, and FSAR Appendices 3A, 3C, 3G, and 19A. This departure also involves redefinition of the OBE. The changes to the OBE definition are identified in FSAR Section 3.7.1.

In North Anna 3 FSAR, Section 3.7.5 the applicant replaced the Tier 2* information in the standard Table 2.0-1 that reflects the envelope of ESBWR standard plant site parameters including seismic parameters, with the North Anna 3 site-specific seismology requirements and site-specific SSI analyses for the seismic Category I structures to reflect the North Anna 3 site-specific SSE definition that is applied to the seismic analysis for North Anna 3 as described in FSAR Sections 3.7, 3.8, and 2.5.4.

The staff evaluated the NAPS DEP 3.7-1 for each applicable Section of the North Anna 3 FSAR in this staff SER under the applicable SER chapters. Each FSAR section that required this NAPS DEP 3.7-1 due to the change in the North Anna 3 site-specific SSE definition was evaluated to ensure these proposed departures from the DCD met the Commission's regulations as discussed under their respective SER sections.

3.7.5.5 Post Combined License Activities

There are no post COL activities related to this section.

3.7.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to seismology and SSI analyses for seismic Category 1 structures as addressed in primarily in this SER in Sections 3.7 and 3.8, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, and the guidance in the SRP. The staff completed evaluations on NAPS DEP 3.7-1 as applicable in this SER in accordance with the Commission regulations, guidance in accordance with the SRP and applicable regulatory guides and industry standards. On this basis, the staff concludes that the applicant satisfied the relevant requirements of the regulations and find that the change to Tier 2* information from the ESBWR DCD in Section 3.7.5 of the North Anna 3 FSAR is acceptable.

3.8 Seismic Category I Structures

Seismic Category I structures included in the North Anna 3 design consist of the RB/FB complex, CB, and FWSC. In FSAR Revision 9, Section 3.8 and Appendix 3G, the applicant described the structural analysis and design evaluations of these seismic Category I structures for the North Anna 3 site-specific loads. This FSAR Section incorporates by reference Section 3.8 of the DCD with the departure given below.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the CSDRS as described in the DCD. For this reason, the applicant performed new seismic SSI and SSSI analyses with the site-specific ground response spectra and the site-specific subgrade properties. In some cases, the seismic structural loads were found to be higher than those used for in the standard design, and thus, a structural evaluation of the ESBWR standard plant structures for acceptability at the North Anna 3 site was performed. In a few instances where necessary, the standard design was modified to ensure seismic adequacy as described in the FSAR. The structural evaluations of the seismic Category I structures are described in DCD Appendix 3G, Sections 3G.1 through 3G.6 for the evaluations using the CSDRS seismic demands, and in North Anna 3 FSAR Chapter 3, Appendix 3G, Sections 3G.7 through 3G.10 for the evaluations using the site-specific seismic demands.

3.8.1 Concrete Containment

3.8.1.1 Introduction

Section 3.8.1 and Appendix 3G, Section 3G.7 of the North Anna 3 FSAR, Revision 9, describe the structural analysis and design of the RCCV, which is integrally connected to the RB/FB complex. The RCCV includes the reinforced concrete structure and the containment liner. Other metal components of the containment that are not backed by concrete are addressed under FSAR Section 3.8.2.

The RCCV is designed to house and support the nuclear reactor system and other internal systems and components. It is also designed to act as an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment. The RCCV is designed to withstand various operating loads; environmental loads such as wind, seismic, and tornado; and abnormal loads such as the loss of coolant accident (LOCA). The ESBWR design approach for the standard plant design of RCCV is provided in Section 3.8.1 and Appendix 3G, Section 3G.1 of ESBWR DCD, Tier 2, Revision 10.

3.8.1.2 Summary of Application

Section 3.8.1 and Appendix 3G of the North Anna 3 FSAR, Revision 9, incorporate by reference Section 3.8.1 and Appendix 3G of the ESBWR DCD, with the departure and supplement given below.

Supplemental Information

- NAPS SUP 3.8-1 — ASTM Standards C1260 and C1293 are used in testing aggregates for potential alkali-silica reactivity (ASR).

This supplement in the FSAR Section 3.8.1.6.1 relates to the potential degradation effects associated with alkali-silica reaction in reinforced concrete structures.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the DCD CSDRS. As a result, the applicant performed new site-specific seismic SSI and SSSI analyses with the site-specific ground response spectra and the site-specific subgrade properties. In some cases, the site-specific seismic structural loads were found to be higher than those used for the standard design, and thus, a structural assessment of the ESBWR standard plant structures for acceptability at the North Anna 3 site was performed. In a few instances as required for site-specific conditions, the standard design is modified to ensure seismic adequacy.

In FSAR Appendix 3G, Section 3G.7, the applicant described the site-specific structural evaluation of the RB/FB complex. Since the RCCV is integral with the RB and both the RB and FB are supported by a common basemat, the analysis of the RCCV is coupled with the RB and FB. The analytical models used for the RB/FB are described in FSAR Section 3G.7.4. In Section 3G.7.5, the applicant described the structural analysis and design. This includes the site design parameters used in the structural evaluation, design loads, load combinations, and material properties. FSAR Section 3G.7.5.4 describes the structural design evaluation which includes the RCCV wall, RCCV top slab and suppression pool slab, and RCCV foundation mat. The foundation stability evaluation is described in FSAR Section 3G.7.5.5, which includes the evaluation for seismic sliding and overturning, and soil bearing pressure.

The results in terms of RCCV member forces, from the evaluations performed for the site-specific seismic loads, are presented in FSAR Tables 3G.7-202 through 3G.7-204. The combined member forces and moments for selected load combinations that include seismic loads are presented in FSAR Tables 3G.7-205a through 3G.7-205e. The calculated stresses of the concrete and steel reinforcement and their comparison to code limits are presented in FSAR

Tables 3G.7-206a through 3G.7-206e. The calculated transverse shear and tangential shear, and their comparison to code limits are presented in FSAR Tables 3G.7-207 and 3G.7-208, respectively. The calculated RCCV liner strains and its comparison to code limits are presented in FSAR Table 3G.7-210.

For stability evaluation, the factors of safety for the RB/FB foundation stability for overturning and sliding are presented in FSAR Table 3G.7-225. The maximum calculated soil dynamic bearing pressure demand for the RB/FB is presented in FSAR Table 3G.7-231.

The results of the evaluation for the site-specific seismic loads show that, although some of the forces on the RCCV are higher than those from the DCD design, the stresses and strains of the RCCV meet the code limits. For foundation stability a factor of safety (FOS) of 1.1 for sliding and overturning is met in accordance with SRP 3.8.5. The soil dynamic bearing pressures are determined to be less than the allowable dynamic bearing pressures provided in FSAR Table 2.5.4-211.

3.8.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the concrete containment, and the associated acceptance criteria, are in SRP Section 3.8.1. The specific requirements include the following:

- 10 CFR 50.55a and 10 CFR Part 50, Appendix A, GDC 1, as they relate to concrete containment being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the design of the concrete containment being able to withstand the most severe natural phenomena such as winds, tornadoes, hurricanes, floods, and earthquakes and the appropriate combination of all loads.

- 10 CFR Part 50, Appendix A, GDC 4 as it relates to the concrete containment being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

- 10 CFR Part 50, Appendix A, GDC 16, “Containment Design,” as it relates to the capability of the concrete containment to act as a leak-tight membrane to prevent the uncontrolled release of radioactive effluents to the environment.

- 10 CFR Part 50, Appendix A, GDC 50, “Containment Design Basis,” as it relates to the concrete containment being designed with sufficient margin of safety to accommodate appropriate design loads.

- 10 CFR Part 50, Appendix B, as it relates to the QA criteria for nuclear power plants.

- 10 CFR 50.44, “Combustible gas control for nuclear power reactors,” as it relates to demonstrating the structural integrity of BWRs with Mark III type containments, all

PWRs with ice condenser containments, and all containments used in future water-cooled reactors for loads associated with combustible gas generation.

- 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

In addition, the acceptance criteria, regulatory guidance, and industry codes/standards associated with the review of FSAR Section 3.8.1 include the following:

- SRP Section 3.8.1 guidance to review the design, construction, and testing of the concrete containment to ensure that the containment maintains its structural integrity and can perform its intended safety function during all loading conditions.

- RG 1.7, "Control of Combustible Gas Concentrations in Containment"

- RG 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants"

- RG 1.136, "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments"

- RG 1.216, "Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design-Basis Pressure"

- RG 1.61 to determine the acceptability of the damping values used in the structural model.

- RG 1.221

- 2004 ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsection CC, "Code for Concrete Reactor Vessels and Containments"

3.8.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.8.1 and Appendix 3G of the ESBWR DCD. The staff reviewed Section 3.8.1 and Appendix 3G of the North Anna 3 FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic[1]. The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the North Anna 3 FSAR as discussed below.

In addition, the staff conducted an audit (ADAMS Accession No. ML16193A047) (hereinafter referred to as North Anna 3 Audit 2) during the week of March 21, 2016 at the Wilmington, North Carolina offices of the applicant's contractor GEH. The purpose of this audit was to (1) review detailed analysis reports and design calculations performed by the applicant that support the information in the FSAR, (2) confirm the basis supporting the applicant's RAI responses, and (3) review the draft FSAR revisions from RAI responses to ensure consistency with the applicant's design basis information. The staff held almost weekly public meetings with the applicant and GEH starting from the public meeting held on April 15, 2015 up through Audit 2 and some weeks after where the applicant's technical reports, draft FSAR responses and RAI responses were discussed to ensure resolution of all staff issues. An issue resolution table was developed and discussed during these numerous public meeting interactions with the applicant.

The results of the staff's technical review of the North Anna 3 FSAR is given below.

Supplement Information

- NAPS SUP 3.8-1 ASTM Standards C1260 and C1293 are used in testing aggregates for potential alkali-silica reactivity (ASR).

The staff reviewed NAPS SUP 3.8-1 related to the addition of ASTM Standards C1260 and C1293 for testing aggregates for potential ASR. The use of these ASTM standards is intended to prevent the degradation of reinforced concrete due to ASR. The potential degradation from ASR and the use of these ASTM standards to prevent ASR are described in NRC Information Notice 2011-20 (ADAMS Accession No. ML112241029). The staff finds the addition of these ASTM standards to be acceptable because they are intended to prevent potential ASR in the reinforced concrete containment.

Departure

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to the applicant's structural evaluation of the RCCV for the site-specific seismic loads applied to the RCCV. These evaluations are described in FSAR Section 3G.7. The staff's technical evaluation of the RCCV design considering these site-specific loads is given below. As described earlier in this report, the model and analyses of the RCCV are included in the RB/FB evaluation because the RCCV is integrally connected to the RB and these structures are on a common basemat. Therefore, the RB/FB evaluation includes the RB, FB, RCCV, and containment internal structures (CIS).

As indicated in FSAR Appendix 3G, Section 3G.7.1, DCD Appendix 3G, Section 3G.1 remains applicable for the analysis and design of the RB, RCCV, and CIS with the seismic loads based on the CSDRS. The evaluation of the RCCV for the site-specific seismic loads is provided in FSAR Section 3G.7 in order to address the exceedances from the standard design seismic loads.

Analytical Models

FSAR Section 3G.7.4.1 states that the North Anna 3 site-specific structural models are based on the standard design structural models described in DCD Sections 3G.1.4.1 for the RB and 3G.3.4 for the FB. FSAR Section 3G.7.4.2 indicates that the North Anna 3 site-specific foundation models are based on the standard design foundation models described in DCD Section 3G.1.4.2. Since the RCCV, CIS, RB, and FB are on a common basemat and the RCCV and RB are integrally connected, the structural models for these structures, including their foundations, are combined into a single integrated RB/FB global model. Therefore, the staff evaluations of the analytical models of the RCCV, CIS, RB, and FB are discussed in this SER in Section 3.8.1.4 under the heading of "*Analytical Models*," rather than evaluating the models of the CIS, RB, and FB separately in SER Sections 3.8.3.4 and 3.8.4.4.

FSAR Section 3G.7.5.2 indicates that the standard design model with the updates to address updated LOCA thermal loads also included standard design changes in the pool gate and upper pools. This updated DCD global finite element model (FEM) is used for the North Anna 3 structural evaluations that include dead load, pressure loads, temperature loads in the RB upper pools, and North Anna 3 seismic loads. FSAR Section 3G.7.5.2 also indicates that other North Anna 3 load cases are used with the original global FEM, because these cases are not affected by design changes in the pools and are the same as those considered in the standard design, DCD Section 3G.1.5.2.1.6.

In addition to the information provided in FSAR Section 3G.7, the staff reviewed the following GEH reports with regard to the analytical models used for the North Anna 3 structural evaluations for the combined RB/FB, RCCV, and CIS:

1. WG3-U71-ERD-S-0004, Revision 2, "Reactor Building Structural Design Report" (ADAMS Accession No. ML16148A081, ML16148A146 Non-public)

2. WG3-T12-ERD-S-0001, Revision 0, "Structural Design Report for Containment Internal Structures" (ADAMS Accession No. ML15342A146)

3. WG3-U97-ERD-S-0001, Revision 2, "Fuel Building Structural Design Report" (ADAMS Accession No. ML16148A128, ML16148A169 Non-public)

4. WG3-T11-DRD-S-0001, Revision 2, "RCCV Structural Design Report" (ADAMS Accession No. ML16148A049, ML16148A169 Non-public)

5. WG3-T11-DRD-S-0002, Revision 0, "Structural Design Report for Containment Liner Plate," (ADAMS Accession No. ML15357A308)

6. DE-ES-0096, Revision 0, "Liner Anchorage Evaluation" (ADAMS Accession No. ML16167A447)

The staff reviewed GEH Report WG3-U71-ERD-S-0004, Revision 2 regarding the modeling of the RB/FB global FEM. The RB/FB complex, including the fully enclosed RCCV and CIS, consists of mostly reinforced concrete slabs/walls and some steel members such as roof trusses and liners. The major structural components include the basemat, RCCV, floor slabs, external walls, shear walls, frame members, and major CIS such as the vent wall, the diaphragm floor slab, the gravity-driven cooling system (GDCS) pool, the RSW, and the RPV support brackets. The part of the FB located above Elevation 22.5 m is not included in the model, because that part is seismic Category II; however, the weights of this part of the FB are applied to the nodes at the positions of columns supporting the roof slab. This is consistent with the approach used in the standard design. Major penetrations in the RCCV are included in the model in order to consider local reduction of the wall stiffness.

The RB/FB complex is modeled and is analyzed using the NASTRAN computer code. Thick shell elements are used to model the RCCV, basemat, pools, walls, and slabs, which consider the membrane force, in-plane and transverse shear forces, and bending moment. Membrane elements are used to model liners that consider the membrane force and in-plane shear. Bar elements (i.e., beam elements) are used to model columns, girders, and roof trusses, which consider the axial force, bending moment, and transverse shear force. Rigid bar elements are used to connect the basemat and the bottom of the shear walls, as well as the shear walls and the liners. Rod elements (i.e., truss elements) are used to model penetration sleeves, which consider only the axial force.

In the North Anna 3 and standard design evaluations, the ground is modeled with spring elements. Three independent spring elements, one vertical and two horizontal, are attached to each of the basemat nodal points. The spring constants are calculated based on the generic soft site condition considered for the ESBWR standard design. The ground is assumed to be elastic and the basemat uplift is not considered in the model. The validities of using generic soft site condition for the North Anna 3 rock site and of neglecting the basemat uplift are evaluated in this SER section under the "*Structural Analysis*" heading.

Based on the review of the information provided in FSAR Section 3.8 and Appendix 3G, the GEH reports identified above, and NRC North Anna 3 Audit 2 (ADAMS Accession No. ML16193A047), the staff concluded that the analytical models used for the North Anna 3 structural evaluation of the RB/FB complex are based on the DCD analytical global FEMs. Therefore, the use of these analytical models for the site-specific structural evaluations is considered to be acceptable.

<u>Site Design Loads, Load Combinations, and Material Properties</u>

The description of the site design loads, load combinations, and material properties for the RCCV is provided in FSAR Appendix 3G, Section 3G.7.5.2. The FSAR indicates that with the exception of seismic loads, the site-specific structural evaluations utilize the loads, load combinations, and acceptance criteria that were used in the standard design. The FSAR lists the various loads and the corresponding sections in the ESBWR DCD where these are described. In addition, the staff did not identify any changes or deviations from the material properties identified in the standard design.

FSAR Appendix 3G, Section 3G.7.5.2 also indicates that North Anna 3 seismic loads are developed from the site-specific SSI analyses results described in FSAR Appendix 3A, Section 3A.18.1.1. These seismic loads consider the effects of structural stiffness variations described in FSAR Appendix 3A, Section 3A.17.9.1. The effects of SSSI and structure soil separation on the overall RB/FB complex are discussed in SER Section 3.8.4 below.

Based on the review of the information provided in FSAR Section 3.8 and Appendix 3G, the GEH reports identified above, and the North Anna 3 Audit 2, the staff concluded that for the NS loads, the North Anna 3 structural evaluation utilized the same NS loadings, the same load combinations, and the same material properties as the standard design. For the seismic loads, the staff reviewed and confirmed that the site-specific seismic bounding load results presented in FSAR Appendix 3A, Section 3A.18.1.1 for the RCCV were used for the RCCV structural evaluation. Therefore, the North Anna 3 site design loads, load combinations, and material properties are considered to be acceptable.

Structural Analysis

During its review of Revision 8 of FSAR Section 3.7.2.4.1.6.1, the staff noted that the North Anna 3 site-specific enveloping seismic loads computed from the site-specific SSI analyses of the RB/FB, CB, and FWSC exceed the corresponding standard design loads at a number of locations in the RB/FB and CB. FSAR (Revision 8) Section 3.7.2.4.1.6.1 also describes a design evaluation method that utilizes the “stress ratios” (i.e., the standard design stress demand over capacity) and “scale factors” (i.e., maximum ratios of site-specific enveloping seismic loads over standard design enveloping seismic loads). Following this method, if the products of the stress ratios and the scale factors are less than 1.0 for a given location in the structure and for the governing load combination, that location in the structure would be identified as passing the design evaluation.

The staff’s review found that the applicant’s simplified approach proposed in FSAR Revision 8, may not be appropriate because its required linear dependence of the seismic stress ratios with respect to all seismic load components may not be valid for some design situations and load combinations. Since adequate calculation of the member forces with proper consideration of the individual member force components is essential in design to ensure the structural integrity, the staff requested, in RAI 03.07.02-17, that the applicant provide the results of detailed stress checks for the seismic Category I structures without using the stress factors and scale factors, where the site-specific seismic loads exceed the corresponding ESBWR standard design.

In the response to this RAI question (ADAMS Accession No. ML16146A789), and as described in the applicant’s Seismic Closure Plan (SCP), submitted to the NRC by letter dated October 22, 2014 (ADAMS Accession No. ML14297A199), the applicant indicated that design margins will be explicitly calculated based on the site-specific seismic stress demands obtained from finite element analyses using the same methodology as used for the standard design. FSAR Revision 9 Sections 3.7, 3.8, Appendix 3A, and Appendix 3G present the updated North Anna 3 site-specific structural evaluations of the seismic Category I structures of the ESBWR standard design at the North Anna 3 site. Staff’s assessment of this evaluation is presented later in this SER Section.

The applicant in Revision 8 of the FSAR also did not consider the structural fill above the top of the Zone III rock in the SSI analysis of the RB/FB and CB models. Therefore, as part of the RAI 03.08.04-37, the staff requested the applicant to provide a justification on the adequacy of their design evaluation of the walls below grade to resist lateral soil pressure. In response to this RAI question (ADAMS Accession No. ML15364A384), the applicant performed additional SSI analysis with full embedment considering the structural fill and in-situ saprolite soil and revised appropriate sections of the FSAR to document the results. Staff’s evaluation of the SSI analysis of the FE models is presented in SER Sections 3.7.2.4. FSAR, Revision 9, Appendix 3A, Section 3A.18 presents the bounding seismic loads used in the North Anna 3 site-specific design evaluation that envelops the partial and full embedment cases. Bounding dynamic lateral soil pressures are described in FSAR Revision 9, Appendix 3G. Staff’s evaluation of the use of the bounding seismic loads in evaluating the adequacy of ESBWR standard plant structures is described later in this SER Section.

As discussed in FSAR Revision 9, Appendix 3G, Sections 3G.7.4, 3G.7.5, and 3G.9.4, the structural models for the RCCV, CIS, RB, and FB are integrated into a single RB/FB global model. Therefore, the staff evaluation of the structural analysis of the RCCV, CIS, RB, and FB is presented in this SER under the "*Structural Analysis*" heading.

The description of the structural analysis for the design evaluation of the RB/FB complex is provided in FSAR Revision 9, Sections 3.8.1, Appendix 3G, Sections 3G.7, and 3G.9, and GEH reports listed in Section 3.8.1.4 under the heading "*Analytical Models*," of this SER. The FSAR indicates that the North Anna 3 site-specific design evaluation uses the same standard design methodologies, standard design load combinations and selected elements, and the standard design loads, except that the standard design seismic loads are replaced with the North Anna 3 site-specific seismic loads. The standard design structural evaluations continue to apply and remain valid for the CSDRS seismic response. FSAR Appendix 3G also indicates that the site-specific structural evaluations supplement the standard design evaluations to address site-specific conditions including the site-specific seismic input motion exceeding the CSDRS in some frequency ranges and that the standard design of the seismic Category I structures is maintained, except where the standard design is modified by providing additional reinforcement to ensure seismic adequacy.

The staff reviewed the information provided in FSAR Appendix 3G, Sections 3G.7.5 and 3G.9.5, and GEH reports as described in SER Section 3.8.1.4B.1 above with regard to the structural analysis used for the site-specific structural evaluations of the RB/FB global model. Based on this review, the staff confirmed that the North Anna 3 site-specific structural analysis of the RB/FB global model was performed consistently with the procedure used for the standard design and utilized the NASTRAN finite element computer code, which is the same computer code used for the standard design as described in DCD Section 3.8.1.4.1.1. The global stress analysis model of the RB/FB complex is the same as the updated DCD model used for the standard design, and the site-specific seismic loads applied to the RB/FB global model for the site-specific stress analyses are determined from the design site-specific seismic loads as described in FSAR Appendix 3A, Section 3A.18. As described in FSAR Appendix 3G, Section 3G.7.5.2, the seismic loads applied to the model include all bounding seismic response loads (two horizontal, one vertical, one torsional, and two overturning moments applied at each floor elevation).

Based on staff's review above and as confirmed during the North Anna 3 Audit 2, the staff found the North Anna 3 site-specific NASTRAN analysis of the updated RB/FB model acceptable because the applicant (a) performed an explicit site-specific FEM analysis to calculate the site-specific stress demand using an approach consistent with the DCD approach, and (b) applied the site-specific bounding seismic load obtained from the site-specific seismic analysis to the NASTRAN model following the same method as used for the standard design.

The staff further evaluated the following site-specific issues in more detail related to the structural analysis of the RB/FB model: (1) the use of DCD soft-soil subgrade properties, (2) the application of bounding seismic loads to the NASTRAN design model, and (3) application of RCCV thermal loads.

Use of DCD soft-soil subgrade properties for North Anna 3 NASTRAN analysis

FSAR Appendix 3G, Sections 3G.7.5.1 and 3G.9.5.1 indicate that the North Anna 3 structural evaluation utilizes the key site design parameters identified in DCD Appendix 3G, Section 3G.1.5.1, based on soft site subgrade stiffness conditions, which are considered conservative for the Unit 3 hard rock site.

DCD Section 3.8.5.4 indicates that the worst case scenario for foundation basemat design is the soft soil because it results in the largest mat deformation. In order to confirm the appropriateness of this condition, this DCD Section provided a comparison of the basemat deformation and sectional moment between the soft soil case [Vs = 300 m/sec (984 ft/sec)] and the hard rock case [Vs = 1700 m/sec (5577 ft/sec)]. Basemat deformation for the soft soil condition was found to be much larger than that of the hard rock condition. Bending moments for the soft soil were found to be larger than the moments for the hard rock condition with few exceptions. The DCD concluded that the higher bending moments at some locations for the hard rock site have no effect on the design because they are much less than the maximum moments of the soft soil site on which rebar sizing is based.

Although North Anna 3 site-specific structural evaluations use the same generic “soft-soil” subgrade stiffness properties as those used in the standard design and the generic soft soil was justified for the standard design, the staff requested the applicant to provide a justification for using DCD generic soft-soil subgrade stiffness in evaluating the ESBWR seismic Category I structures for the North Anna 3 rock site. The rationale for this staff request is to consider the few exceptions for the hard rock conditions that are observed above in the DCD evaluation and the fact that the North Anna 3 seismic loads exceed the standard design seismic loads in some instances.

In response to this request, the applicant in FSAR Appendix 3G explains that the site-specific evaluations are based on the results of static analyses performed on NASTRAN FEMs that are identical to those used for the standard design described in DCD Appendix 3G, Section 3G.1.4, including the use of the same linear elastic spring elements and subgrade stiffness properties. Dominion also explained during the North Anna 3 Audit 2 that the design of the basemat for the soft-soil conditions is conservative because the reinforcement in a given region of the basemat is based on the maximum moments calculated in that region rather than specifying different reinforcement to closely match the moment diagram across the basemat. The design evaluation using the generic soft-soil subgrade stiffness provides design demands that envelop the effects of the stiffer site-specific rock subgrade and foundation uplift with a few exceptions that nevertheless do not affect the conclusions of the site-specific structural evaluations. For these exceptions, FSAR Appendix 3G also indicates that the results of sensitivity evaluations show that amplifications at some locations due to the higher site-specific subgrade stiffness and foundation uplift are small and that the basemat design has sufficient margin to envelop the effects of the small amplifications due to the higher site-specific subgrade stiffness or foundation uplift.

The staff reviewed the information in FSAR Appendix 3G, and confirmed this information during North Anna 3 Audit 2. The staff review concludes that the applicant’s use of the generic soft soil for North Anna 3 design evaluations is acceptable because the resultant basemat design has higher capacities than the seismic demands due to the North Anna 3 site-specific seismic input motions, North Anna 3 rock site conditions and effect of uplift.

Application of Bounding Seismic Loads to NASTRAN Design Model

In order to review how the site-specific seismic demands described in FSAR Section 3.7 and FSAR Appendix 3A, Section 3A.18 are translated into input loads for the detailed NASTRAN FEMs used in the structural design evaluation described in FSAR Section 3.8, the staff requested the applicant provide relevant information and explanation of the process involved. In response, the applicant made a presentation during a public meeting dated March 3, 2016 (ADAMS Accession No. ML16204A243), on how the site-specific bounding seismic demands obtained from seismic analyses using the LMSMs are applied to the NASTRAN FEMs for static stress analyses. The applicant explained that the methodology used to convert North Anna 3 site-specific seismic loads from LMSMs to NASTRAN FEMs is identical to the methodology used in the standard design. The applicant also explained that the loads applied to the NASTRAN models represent the same distribution of the seismic load demands as those presented in the bounding reports which were reviewed during the North Anna 3 Audit 2 and are described in the staff's Audit Summary Report (ADAMS Accession No. ML16193A047). Section 6.2.3.9.1 of the RB structural design report (WG3-U71-ERD-S-0004, Rev. 2) describes how seismic loads are developed from RB/FB LMSMs and applied to RB/FB FEMs. The same methodology is used for the CB and FWSC. The global seismic loads from LMSMs are applied to the NASTRAN FEMs at floor elevations that correspond to the LMSM nodal elevations. Dynamic soil pressure loads are applied on external below-grade walls and hydrodynamic loads are applied on walls and slabs of pools at their corresponding elevations. The applicant showed comparisons between the demands calculated from LMSM seismic analyses and the loads actually applied to the NASTRAN FEMs, which provides a check that the LMSM to NASTRAN FEM load translations are acceptable.

Based on staff's review above and as discussed during a public meeting dated March 3, 2016, and as confirmed during North Anna 3 Audit 2, the staff found the application of bounding seismic loads to the NASTRAN design model acceptable because (a) the approach of applying the bounding seismic loads is the same as the DCD approach, and (b) the applicant confirmed that the applied site-specific seismic loads to the NASTRAN model are consistent with the bounding seismic loads calculated from the LMSM seismic analyses.

Application of RCCV Thermal Loads

FSAR Sections 3.8.1 and FSAR Appendix 3G, Section 3G.7.5.2 describe that for the RCCV thermal loads, the method using 3D nonlinear analyses that was utilized in the standard design, is not used for the site-specific structural evaluation. These FSAR Sections indicate that the effects of concrete cracking due to the thermal load are considered by reducing the thermal stress using the SSDP-2D computer code described in DCD Appendix 3G, Section 3G.1.5.4. The use of SSDP-2D in the site-specific structural evaluations was possible because the design changes for the RB upper pools, described in DCD Appendix 3G, Section 3G.5.3, provided increased strength in the structures so that the thermal forces did not need to be redistributed through the 3D nonlinear program. The FSAR concludes that since the method using SSDP-2D is more conservative than the 3D nonlinear method, and because the SSDP-2D method is used for normal operating loads, it is acceptable to use the SSDP-2D method for the reduction of thermal stresses in the RCCV structural evaluation.

The staff noted that the 3D nonlinear analysis approach was utilized in the standard design in order to reduce the effects of thermal loading beyond what the SSDP computer code would provide. This occurs because the 3D nonlinear analysis method is able to redistribute member forces when cracking occurs, whereas the SSDP code does not do that. Therefore, the staff agreed that the use of the SSDP method rather than the 3D nonlinear method is conservative, and thus, acceptable for the North Anna 3 design assessment.

In summary, based on the review of the structural analysis approach used for the RCCV, CIS, RB, and FB described in FSAR Section 3.8 and Appendix 3G, the GEH reports identified above, and as confirmed in the North Anna 3 Audit 2, the staff concludes that the North Anna 3 structural analysis approach is essentially the same method as in the standard design and in the instances where they differed, as discussed above, the North Anna 3 structural analysis approach was determined to be conservative and thus, acceptable.

Structural Design

Reinforced Concrete Sections

The description of the structural design evaluation for the RCCV is provided in FSAR Appendix 3G, Section 3G.7.5.4 and GEH Report WG3-T11-DRD-S-0001, Revision 2. FSAR Appendix 3G, Section 3G.7.5.4 indicates that site-specific evaluations use the standard design models, analysis methods, loads (as described in FSAR Appendix 3G, Section 3G.7.5.2), load combinations, and acceptance criteria. However, the standard design seismic loads are replaced with the seismic loads determined from the site-specific seismic analyses described in FSAR Appendix 3A, Sections 3A.10 through 3A.19.

As described in FSAR Appendix 3G, Section 3G.7.5.4.1, the site-specific evaluations show that the RCCV standard design is adequate to resist the North Anna 3 site-specific seismic loads in combination with NS standard design loads. Furthermore, the FSAR indicates that the results of the site-specific stress checks demonstrate that the stresses of the concrete and rebar are less than the allowable stresses specified in the code and the cross sectional areas of the primary and shear reinforcement, which have been provided, meet the required values.

The staff reviewed the information in FSAR Appendix 3G, Section 3G.7.5.4 and GEH Report WG3-T11-DRD-S-0001, Revision 2. The staff found that the industry codes and standards, structural materials and their properties, loads and load combinations used in the design evaluations, and the method for checking the design of the RCCV were consistent with those used in the standard design. The staff also reviewed the results of the design evaluation for seventeen representative locations of the RCCV and found that the calculated stresses of the concrete and steel reinforcement were below allowable values. In addition, the provided reinforcement is shown to be greater than the required reinforcement for the primary and shear reinforcement. Therefore, the staff concluded that the site-specific structural design evaluation for the reinforced concrete portion of the RCCV is acceptable.

Containment Liner and Liner Anchorage

The staff reviewed FSAR Appendix 3G, Section 3G.7.5.4.1 and GEH Reports WG3-T11-DRD-S0002, Revision 0 and DE-ES-0096, Revision 0, regarding the site-specific evaluation of the containment liner plate and liner anchorage. These documents indicate that an evaluation of the structural integrity of the liner plate utilized the same methodology and acceptance criteria as that used for the standard design. The strain of the liner plate was obtained using the NASTRAN model analysis for the site-specific seismic loads combined with the NS standard design loads. The results of this evaluation, which are presented in FSAR Appendix 3G,

Table 3G.7-210, demonstrate that the maximum strains of the containment liner plate are less than the allowable limits. The staff concluded that the structural design evaluation is acceptable on the basis that it utilized the same methodology and acceptance criteria that were used in the standard design and because it demonstrated that the calculated strains are less than the code limits.

In the case of the liner anchorage, GEH Report DE-ES-0096, Revision 0, describes the evaluation of the containment liner anchorage for the North Anna 3 site-specific loadings. The evaluation approach was based on the Bechtel Topical Report BC-TOP-1, "Containment Building Liner Plate Design Report," and ACI 349-01. The effect of the fabrication/erection tolerances on the liner anchor displacement was also evaluated. Since the liner plate anchorage system was shown to satisfy the force and displacement allowable values in the ASME Code Section III, Division 2, Subsection CC, the staff concluded that the evaluation of the containment liner and liner anchorage for the North Anna 3 site-specific loadings is acceptable.

3.8.1.5 Post Combined License Activities

There are no post COL activities related to this section. ITAAC in DCD Tier 1, Revision 10, with the modification of the SSE definition will address the as-built verification of the concrete containment for the North Anna 3 seismic demand.

3.8.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the North Anna 3 application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the concrete containment that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.8.1, and other NRC RGs. The staff finds that the applicant has addressed the areas related to concrete containment in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.8.1.3 of this SER.

3.8.2 Steel Components of the Reinforced Concrete Containment

3.8.2.1 Introduction

Section 3.8.2 and Appendix 3G, Section 3G.7 of the North Anna 3 FSAR, Revision 9, describe the structural analysis and design of the steel components of the RCCV that are not backed by concrete. These components include the drywell head, penetrations, personnel air locks, equipment hatches, and passive containment cooling system (PCCS) condenser. The ESBWR design approach for the standard plant design of steel components of the RCCV is provided in Section 3.8.2 and Appendix 3G, Section 3G.1 of ESBWR DCD, Tier 2, Revision 10.

3.8.2.2 Summary of Application

Section 3.8.2 and Appendix 3G of the North Anna 3 FSAR, Revision 9, incorporate by reference Section 3.8.2 and Appendix 3G of the ESBWR DCD, with the departure given below.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the DCD CSDRS. As a result, the applicant performed new site-specific seismic SSI and SSSI analyses with the site-specific ground response spectra. In some cases, the seismic structural loads were found to be higher than those obtained in the standard design, and thus, a structural evaluation of the ESBWR standard plant structures for acceptability at the North Anna 3 site was performed. In a few instances as required for site-specific conditions, the standard design is modified to ensure seismic adequacy. Including as discussed in FSAR Appendix 3G, Section 3.G.7.5.4.1 the PCCS condenser support saddle bolts and their embedment are designed to withstand the site-specific seismic loads.

In FSAR Appendix 3G, Section 3G.7, the applicant described the site-specific structural evaluation of the RB/FB complex including the evaluation of the steel components of the RCCV. The loads, load combinations, and material properties are provided in FSAR Appendix 3G, Section 3G.7.5.2, and the analysis and design evaluation are provided in FSAR Appendix 3G, Section 3G.7.5.4.1. The analysis approach and the results of the drywell head evaluation are described in FSAR Appendix 3G, Section 3G.7.5.4.1.4. The analysis approach and the results of the PCCS condenser evaluation are described in FSAR Appendix 3G, Section 3G.7.5.4.1.5.

The results of the evaluation for the drywell head show that the calculated stresses meet ASME Code limits using the standard design process. The results of the evaluation for the PCCS condenser show that although certain loads are higher than the standard design loads, the PCCS stresses remain below the allowable stress limits. The evaluation also indicated that the PCCS condenser saddle support bolt tension load due to the North Anna 3 seismic demand has increased. These bolts and their embedment will be designed to withstand the increased tension load during the final embedment design.

3.8.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the steel portions of the containment, and the associated acceptance criteria, are in SRP Section 3.8.2. The specific requirements include the following:

- 10 CFR 50.55a and 10 CFR Part 50, Appendix A, GDC 1, as they relate to designing, fabricating, erecting, testing, and inspecting steel containments to quality standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to designing steel containments to be capable of withstanding the most severe natural phenomena such as winds, tornados, floods, and earthquakes and the appropriate combination of all loads.

- 10 CFR Part 50, Appendix A, GDC 4, as it relates to the capability of steel containments to withstand the dynamic effects of equipment failures, including missiles, pipe whipping, and blowdown loads associated with LOCAs.

- 10 CFR Part 50, Appendix A, GDC 16, as it relates to the capability of the steel containment to act as a leak-tight membrane to prevent the uncontrolled release of radioactive effluents to the environment.

- 10 CFR Part 50, Appendix A, GDC 50, as it relates to designing steel containments with sufficient margin of safety to accommodate appropriate design loads.

- 10 CFR Part 50, Appendix B as it relates to the QA criteria for nuclear power plants.

- 10 CFR 50.44, as it relates to the capability of the steel containment of existing plants and new plants to resist those loads associated with combustible gas generation from a metal-water reaction of the fuel cladding.

- 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

In addition, the acceptance criteria, regulatory guidance, and industry codes/standards associated with the review of FSAR Section 3.8.2 include the following:

- SRP Section 3.8.2 guidance to review the design, construction, and testing of the steel components of the containment to ensure that the containment maintains its structural integrity and can perform its intended safety function during all loading conditions.

- RG 1.7

- RG 1.57, “Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components”

- RG 1.216

- 2004 ASME Code, Section III, Division 1, “Nuclear Power Plant Components,” Subsection NE, Class MC

3.8.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.8.2 and Appendix 3G of the ESBWR DCD. The staff reviewed Section 3.8.2 and Appendix 3G of the North Anna 3 FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the North Anna 3 FSAR as given below.

In addition, the staff conducted a structural audit (North Anna 3 Audit 2) during the week of March 21, 2016 at the applicant's contractor GEH office in Wilmington, North Carolina. The purpose of this audit was to (1) review detailed analysis reports and design calculations performed by the applicant that support the information in the FSAR, (2) confirm the basis supporting the applicants' RAI responses, and (3) review the draft FSAR revisions from RAI responses to ensure consistency with the applicant's design basis information.

<u>Departure</u>

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to the applicant's structural evaluation of the steel components of the RCCV for the site-specific seismic loads applied to the RCCV. These evaluations are described in FSAR Appendix 3G, Section 3G.7. The staff's technical evaluation of the steel components of the RCCV design considering these site-specific loads is given below.

As indicated in FSAR Appendix 3G, Section 3G.7.1, DCD Appendix 3G, Section 3G.1 remains applicable for the analysis and design of the RB, RCCV, and CIS with the seismic loads based on the DCD CSDRS. The evaluation of the RCCV for the site-specific seismic loads is provided in FSAR Appendix 3G, Section 3G.7 in order to address the exceedances from the standard design seismic loads.

<u>Analytical Models</u>

The steel components of the RCCV consisting of the drywell head, penetrations, personnel air locks, equipment hatches, and PCCS condenser were not discretely modeled in the global FEM. Each of the steel component was evaluated separately. Therefore, the specific analytical models used for each of the steel components of the RCCV are addressed below under the heading, "*Structural Design*," of this SER.

<u>Site Design Loads, Load Combinations, and Material Properties</u>

The description of the site design loads, load combinations, and material properties is provided in FSAR Appendix 3G, Section 3G.7.5.2. The FSAR indicates that with the exception of seismic loads, the site-specific structural evaluations utilize the loads, load combinations, and acceptance criteria that were used in the standard design. The FSAR lists the various loads and the corresponding sections in the ESBWR DCD where these are described. In addition, the staff did not identify any changes or deviations from the material properties used in the standard design.

FSAR Appendix 3G, Section 3G.7.5.2 also indicates that North Anna 3 seismic loads are developed from the site-specific SSI analyses described in FSAR Appendix 3A, Section 3A.18.1.1. These seismic loads consider the effects of structural stiffness variations described in FSAR Appendix 3A, Section 3A.17.9.1. The effects of seismic SSSI and structure soil separation on the overall RB/FB complex are discussed in SER Section 3.8.4 below.

In addition to the information provided in FSAR Appendix 3G, Section 3G.7.5.2, the staff reviewed the GEH reports listed below related to steel components of the RCCV that are not backed by concrete.

1. WG3-T11-DRD-S-0003, Revision 0, “Structural Design Report for Containment Metal Components” (ADAMS Accession No. ML15362A008, ML15362A013 Non-public)

2. DE-ES-0089, Revision 0, “Stress Analysis Report for Drywell Head” (ADAMS Accession No. ML15362A012)

3. 002N8530, Revision 4, “North Anna 3 PCCS Condenser Seismic Analysis” (ADAMS Accession No. ML16125A366)

The information provided in FSAR Appendix 3G, Section 3G.7.5.2, regarding loads, load combinations, and material properties is acceptable because, with the exception of the seismic loads, the standard design loads, load combinations, and material properties were used. The staff also reviewed the GEH reports and found that for these components, the NS loads, load combinations, and material properties are the same as those in the standard design. The site-specific seismic loads were found to be acceptable because they correspond to the seismic loads described in FSAR Appendix 3A, Section 3A.18.

Structural Analysis

Since the steel components of the RCCV were not discretely modeled in the RB/FB global FEM, the steel components were evaluated separately. Therefore, the site-specific structural analysis used for the steel components of the RCCV is addressed below under the heading of “Structural Design.”

Structural Design

In FSAR Section 3.8.2, the applicant only made one change which is to replace the last paragraph in DCD Section 3.8.2.4.1.5 regarding the PCCS. The change made to this paragraph was to indicate that the details of the site-specific analysis of the PCCS condenser, which uses the same approach as the DCD but with North Anna 3 seismic loads, can be found in GEH Report 002N8530, Revision 4.

The staff notes that other changes to the DCD regarding the steel components of the RCCV are described in FSAR Appendix 3G, Section 3G.7, and these are also discussed below for each of the RCCV steel components.

PCCS

In response to RAI 03.07.02-21 (North Anna 3-15-037, ADAMS Accession No. ML15364A384), the applicant described the site-specific seismic evaluation of the PCCS condenser in FSAR Appendix 3G, Sections 3G.7, 3G.7.5.4.1, and 3G.7.5.4.1.5. The staff reviewed these sections regarding the evaluation of the PCCS. These sections indicate that a site-specific structural evaluation was performed for the PCCS condenser and its support, using the standard design models and methods, and the North Anna 3 site-specific seismic ISRS as input. Results of the site-specific analyses indicated that some of the site-specific loads were higher than the standard design loads. However, the PCCS condenser stresses were bounded by the standard design stresses or were shown to be below allowable stresses. For the North Anna 3 PCCS condenser support, an increase in the tension load was calculated in the support saddle bolts and this increased load will be used in the design of the bolts and the embedment.

The staff further reviewed the information in FSAR Sections 3.8.2 and FSAR Appendix 3G, Section 3G.7, GEH Report 002N8530, Revision 4, and other supporting documents during North Anna 3 Audit 2. The staff found that the analysis approach, industry codes and standards, structural materials and their properties, loads and load combinations, and the method for checking the design of the steel components were consistent with those used in the standard design. The staff verified that the response spectra used for the analysis are the North Anna 3 bounding design ISRS obtained from the site-specific bounding SSI analysis described in FSAR Appendix 3A, Section 3A.18.2. The staff also reviewed the results of the design evaluation for the steel components and the anchor bolt loads. The staff noted that with the exception of the tension load on the support saddle bolts, the calculated stresses and loads were below allowable values. Since the PCCS anchor bolts are designed during the detailed design phase, the applicant indicated that the support saddle bolts will be designed for the increased tension load due to the increased North Anna 3 seismic demand. In addition, the applicant stated that further assurance of the as-built PCCS condenser and its support to withstand the site-specific seismic load is provided through performance of ITAAC 5 of DCD Tier 1, Table 2.15.4-2.

The staff found the site-specific evaluation of the PCCS condenser and its anchorage due to increase in the North Anna 3 site-specific seismic demand acceptable because: (a) the site-specific evaluation is based on the same methodology as the standard design, but with the North Anna 3 seismic demand, (b) the PCCS saddle bolts will be designed for the increased tension load due to the North Anna 3 seismic demand, (c) the as-built PCCS condenser and its support to withstand the seismic load will be verified through ITAAC 5 of DCD Tier 1, Table 2.15.4-2, and (d) the definition of SSE for the performance of the ITAAC is changed in COLA Part 10 to include both the CSDRS and the North Anna 3 response spectra to ensure ITAAC verification for DCD CSDRS and the North Anna 3 seismic load.

RCCV Drywell Head

The staff reviewed FSAR Appendix 3G, Sections 3G.7.5.4.1 and 3G.7.5.4.1.4 regarding the evaluation of the RCCV drywell head. These sections describe the analysis and design of the drywell head using the NASTRAN finite element computer code. These sections also indicate that the stresses developed from the combination of applicable loads and the North Anna 3 site-specific seismic load were shown to be below allowable stresses except for one case under ASME Service Levels A and B, as in the standard design. In this case, it was shown to be acceptable based on the simplified elastic-plastic analysis approach in NE-3228.3 of the ASME

Boiler and Pressure Vessel Code (BPVC), Section III, using the same process as in the standard design.

The staff reviewed FSAR Appendix 3G, Table 3G.7-211 which contains the summary of the drywell head stresses and confirmed that the calculated stresses were less than the allowable stresses, and in the one exception, the simplified elastic-plastic approach in NE-3228 was utilized.

The staff also reviewed the information in two GEH reports related to the drywell head. GEH Report WG3-T11-DRD-S-0003, Revision 0 provides the site-specific evaluation for the overall drywell head. GEH Report DE-ES-0089, Revision 0 provides the site-specific evaluation of subcomponents of the drywell head consisting of the drywell head flange and flange plates, gusset plates of the flange plates, and concrete portion at the flange plates. The staff found that the structural model; loads, load combinations, and material properties; acceptance criteria; and design approach for the drywell head were consistent with those used in the standard design.

Since the North Anna 3 evaluation for the site-specific seismic loads used the same methodology as the standard design and it was demonstrated that the code limits were satisfied, the design of the drywell head is considered acceptable.

Air Lock, Hatches and Penetrations

The description, typical details, loads and load combinations, design and analysis procedures, and acceptance criteria for the air lock, hatches, and penetrations are provided in DCD Sections 3.8.2 and DCD Appendix 3G, Section 3G.1. While procedures are provided for the analysis and design of the air lock, hatches, and penetrations, the design results for these components were not provided because the DCD only provided the analysis and design results for representative/critical structural sections/components. The remaining structural sections/components would be performed as part of the detailed design stage. In the case of components such as penetrations, the loading from connecting piping were not known at the time. Similarly, in the North Anna 3 FSAR, the analysis and design results were provided for the same critical sections/components that were considered in the standard design, which did not include the air lock, hatches, and penetrations. To address the analysis and design results of these components, as well as the remaining structural members and components, the staff relies on the ITAAC for containment which are given in Table 2.15.1-2 of DCD Tier 1, Revision 10. In the case of North Anna 3, an evaluation will need to be performed considering the North Anna 3 site-specific seismic demand and this will be ensured by the ITAAC on containment which requires an ASME Code Design Report to ensure the design is acceptable.

3.8.2.5 Post Combined License Activities

There are no post COL activities related to this section. ITAAC in DCD Tier 1, Revision 10, with the modification of the SSE definition will address the as-built verification of the steel components of the RCCV for the North Anna 3 seismic demand.

3.8.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the North Anna 3 application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the steel components of the concrete containment that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.8.2, and other NRC RGs. The staff finds that the applicant has addressed the areas related to steel components of the concrete containment in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.8.2.3 of this SER.

3.8.3 Concrete and Steel Internal Structures of the Concrete Containment

3.8.3.1 Introduction

Section 3.8.3 and Appendix 3G of the North Anna 3 FSAR, Revision 9, describe the structural analysis and design evaluation of the concrete and steel internal structures of the RCCV. These components include the diaphragm floor, vent wall, GDCS pool walls, RSW, RPV support brackets, and miscellaneous platforms. The ESBWR design approach for the standard plant design of the CIS is provided in Section 3.8.3 and Appendix 3G of ESBWR DCD, Tier 2, Revision 10.

3.8.3.2 Summary of Application

Section 3.8.3 and Appendix 3G of the North Anna 3 FSAR, Revision 9, incorporate by reference Section 3.8.3 and Appendix 3G of the ESBWR DCD, with the departure given below.

Departure

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the DCD CSDRS. As a result, the applicant performed new site-specific seismic SSI and SSSI analyses with the site-specific ground response spectra and the site-specific subgrade properties. In some cases, the site-specific seismic structural loads were found to be higher than those used for the standard design, and thus, a structural evaluation of the ESBWR standard plant structures for acceptability at the North Anna 3 site was performed. In a few instances as required for site-specific conditions, the standard design is modified to ensure seismic adequacy.

In FSAR Appendix 3G, Section 3G.7, the applicant described the site-specific structural evaluation of the RB/FB complex including the evaluation of the CIS. The loads, load combinations, and material properties for the CIS are provided in FSAR Appendix 3G, Section 3G.7.5.2, and the structural analysis and design evaluation of the CIS are provided in FSAR Appendix 3G, Section 3G.7.5.4.2.

FSAR Appendix 3G, Section 3G.7.5.4.2 indicates that the site-specific evaluations of the CIS are performed using the same methodology as the standard design. No design changes from the standard design were needed. Also, the CIS are within the acceptance criteria of the standard design with the exception of the diaphragm floor. However, as discussed in FSAR Appendix 3G, Section 3G.7.5.4.2.1 and FSAR Appendix 3G, Table 3G.7-212, the standard design of the diaphragm floor is acceptable. Thus, no design change is required.

3.8.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the CIS and the associated acceptance criteria are in SRP Section 3.8.3. The specific requirements include the following:

- 10 CFR 50.55a and 10 CFR Part 50, Appendix A, GDC 1, as they relate to the design, fabrication, erection, and testing of CIS in accordance with quality standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the ability of the CIS without loss of capability to perform their safety function, to withstand the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and the appropriate combination of all loads.

- 10 CFR Part 50, Appendix A, GDC 4, as it relates to the protection of CIS against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

- 10 CFR Part 50, Appendix A, GDC 5, “Sharing of Structures, Systems, and Components,” as it relates to safety-related structures not being shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

- 10 CFR Part 50, Appendix A, GDC 50, as it relates to the design of CIS with sufficient margin of safety to accommodate appropriate design loads.

- 10 CFR Part 50, Appendix B as it relates to the QA criteria for nuclear power plants.

- 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

In addition, the acceptance criteria, regulatory guidance, and industry codes/standards associated with the review of FSAR Section 3.8.3 include the following:

- SRP Section 3.8.3 guidance to review the design, construction, and testing of the CIS to ensure that the CIS maintain their structural integrity and can perform their intended safety function during all loading conditions.

- RG 1.69, “Concrete Radiation Shields for Nuclear Power Plants”

- RG 1.142, “Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)”

- RG 1.160, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”

- RG 1.199, “Anchoring Components and Structural Supports in Concrete”

- ANSI/AISC N690-1994 and Supplement 2, “Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities” and Supplement 2

3.8.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.8.3 and Appendix 3G of the ESBWR DCD. The staff reviewed Section 3.8.3 and Appendix 3G of the North Anna 3 FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the North Anna 3 FSAR as given below.

In addition, the staff conducted a structural audit (North Anna 3 Audit 2) during the week of March 21, 2016 at the applicant’s contractor GEH office in Wilmington, North Carolina. The purpose of this audit was to (1) review detailed analysis reports and design calculations performed by the applicant that support the information in the FSAR, (2) confirm the basis supporting the applicants’ RAI responses, and (3) review the draft FSAR revisions from RAI responses to ensure consistency with the applicant’s design basis information.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to the applicant’s structural evaluation of the CIS for the site-specific seismic loads applied to seismic Category I structures. These evaluations are described in FSAR Appendix 3G, Section 3G.7.5.4.2. The staff’s technical evaluation of the design of CIS considering the site-specific seismic loads is given below.

As indicated in FSAR Appendix 3G, Section 3G.7.1, DCD Appendix 3G, Section 3G.1 remains applicable for the analysis and design of the RB, RCCV, and CIS with the seismic loads based on the DCD CSDRS. The evaluation of the CIS for the site-specific seismic loads is provided in

FSAR Appendix 3G, Section 3G.7 in order to address the exceedances from the standard design seismic loads.

Analytical Models

FSAR Appendix 3G, Section 3G.7.4.1 indicates that the North Anna 3 site-specific structural models are based on the standard design structural models described in DCD Appendix 3G, Sections 3G.1.4.1 for the RB and DCD Appendix 3G, Section 3G.3.4 for the FB. Since the RCCV, CIS, RB, and FB are on a common basemat and the RCCV and RB are integrally connected, the structural models for these structures are combined into a single integrated RB/FB global model.

In addition to the information provided in FSAR Appendix 3G, Section 3G.7, the staff reviewed the following GEH reports with regard to the analytical models used for the North Anna 3 structural evaluations for the CIS:

1. WG3-T12-ERD-S-0001, Revision 0

2. DE-ES-0090, Revision 0, "Local Analysis Model for GDCS Pool" (ADAMS Accession No. ML16022A115)

The RB/FB global model, which includes the CIS, is analyzed as one integrated structure utilizing the finite element computer code NASTRAN. The description and staff's technical evaluation of the RB/FB global FEM is provided in this SER Section 3.8.1.4 under the heading "*Analytical Models*."

In the case of the GDCS pools, separate local models are utilized to perform a detailed stress analysis. Both the large and small pools are analyzed using the same analysis methodology as the standard design. The staff reviewed GEH Report DE-ES-0090, Revision 0, and confirmed that the FEMs of the GDCS pools are the same as those used in the standard design. On this basis, the staff finds the analytical models to be acceptable.

Site Design Loads, Load Combinations, and Material Properties

The description of the site design loads, load combinations, and material properties for the CIS is provided in FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.7.5.4.2. The FSAR indicates that with the exception of seismic loads, the site-specific structural evaluations utilize the same loads, load combinations, and acceptance criteria as those used in the standard design. The FSAR lists the various loads and the corresponding sections in the ESBWR DCD where these are described. In addition, the staff did not identify any changes or deviations from the material properties used in the standard design.

The site-specific seismic loads for the CIS are presented in FSAR Appendix 3A, Section 3A.18.1.1. FSAR Appendix 3G, Section 3G.7.5.2 also indicates that North Anna 3 site-specific seismic loads are developed from the site-specific SSI analyses based on the site-specific GRMS and the RB/FB FIRS. The site-specific seismic structural load demand in some cases exceeds the corresponding load demand of the standard design. These site-specific seismic loads consider the effects of structural stiffness variations described in FSAR Appendix 3A, Section 3A.17.9.1. The effects of seismic SSSI and structure soil separation on the overall RB/FB complex are discussed in SER Section 3.8.4 below.

The staff reviewed FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.7.5.4.2, GEH Report WG3-T12-ERD-S-0001, Revision 0, and the other supporting information during North Anna 3 Audit 2. Based on this review, the staff concluded that the information provided in FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.7.5.4.2, regarding loads, load combinations, and material properties is acceptable because the standard design NS loads, load combinations, and material properties, along with the North Anna 3 site-specific seismic loads were used.

Structural Analysis

Since the CIS are included and analyzed as part of the RB/FB global model, the description and staff technical evaluation of the CIS structural analysis is provided under the "*Structural Analysis*" heading of this SER.

In the case of the three GDCS pools, separate local models are utilized to perform a detailed structural analysis. These pools are analyzed using the same analysis methodology as the standard design. On this basis, the staff concluded that the structural analysis approach for the GDCS pools is acceptable.

Structural Design

The description of the structural design evaluation for the CIS is provided in FSAR Appendix 3G, Section 3G.7.5.4.2 and GEH Report WG3-T12-ERD-S-0001, Revision 0. FSAR Appendix 3G, Section 3G.7.5.4.2 indicates that site-specific evaluations of the CIS are performed using the same methodology used in the standard design. FSAR Appendix 3G, Section 3G.7.5.4 indicates that the standard design seismic loads are replaced with the seismic loads determined from the site-specific seismic analyses described in FSAR Appendix 3A, Sections 3A.10 through 3A.19.

The site-specific seismic loads for the CIS are presented in FSAR Appendix 3A, Section 3A.18.1.1. As described in FSAR Appendix 3G, Section 3G.7.5.4.2, the site-specific evaluations show that, with the exception of some diaphragm floor steel members, the CIS are within the acceptance criteria of the standard design. The applicant stated that the standard design of the diaphragm floor is still acceptable based on a refined calculation for the diaphragm floor. The refined calculation uses equivalent average acceleration for the diaphragm floor instead of the maximum acceleration load applied on the total weight of the diaphragm floor slab. The method used for calculating the site-specific equivalent average acceleration for the diaphragm floor in the refined calculation is consistent with the DCD method used for the development of out-of-plane loads for other flexible slabs. Application of maximum acceleration to the total weight of the diaphragm floor slab, as was done for the DCD evaluation, results in overly conservative load demand. The refined calculation using the average acceleration yields a significantly lower demand on the slab and reduces the stress demands below the code allowable values.

The staff reviewed FSAR Appendix 3G, Section 3G.7.5.4.2, FSAR Appendix 3A, Table 3A.18.1.1-203 and other supporting documents during North Anna 3 Audit 2, and concluded that no design change for the diaphragm floor is necessary at North Anna 3 based on the following: (1) the refined method used by the applicant to calculate the equivalent average acceleration for the diaphragm floor is acceptable because the maximum acceleration level is not uniform throughout the slab and is consistent with the DCD methodology used for other flexible slabs, (2) the use of maximum acceleration applied on the total weight of the diaphragm floor slab in the DCD evaluation is overly conservative because the slab does not experience the maximum acceleration at every location, and (3) the refined calculation using the average acceleration yields a significantly lower demand on the slab and reduces the stress demands below the code allowable values.

The staff also reviewed GEH Reports WG3-T12-ERD-S-0001, Revision 0, and DE-ES-0090, Revision 0, and other supporting information confirmed by the staff during North Anna 3 Audit 2 regarding the structural evaluation of the CIS and the GDCS pools, respectively. Based on this review, the staff confirmed that the structural design evaluation for the CIS is consistent with the approach used for the standard design. For the other structural members comprising the CIS (vent wall, GDCS pool walls, RSW, and RPV support brackets), the staff also reviewed GEH Report WG3-T12-ERD-S-0001, Revision 0, and confirmed that the calculated stresses are below the allowable values, deformation limits were satisfied, and calculated anchorage loads are less than allowable values. Therefore, the site-specific structural design evaluation for the CIS is acceptable.

3.8.3.5 Post Combined License Activities

There are no post COL activities related to this section. ITAAC in DCD Tier 1, Revision 10, with the modification of the SSE definition will address the as-built verification of the CIS for the North Anna 3 seismic demand.

3.8.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the North Anna 3 application and checked the referenced DCD. The staff’s review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to the CIS that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.8.3, and other NRC RGs. The staff finds that the applicant has addressed the areas related to CIS in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.8.3.3 of this SER.

3.8.4 Other Seismic Category I Structures

3.8.4.1 Introduction

Section 3.8.4 and Appendix 3G of the North Anna 3 FSAR, Revision 9, describe the structural analysis and design of other seismic Category I structures. These include the RB, FB, CB, and FWSC. The ESBWR design approach for the standard plant design of these structures is provided in Section 3.8.4 and Appendix 3G of ESBWR DCD, Tier 2, Revision 10.

3.8.4.2 Summary of Application

Section 3.8.4 and Appendix 3G of the North Anna 3 FSAR, Revision 9, incorporate by reference Section 3.8.4 and Appendix 3G of the ESBWR DCD, with the departure given below.

Departure

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the DCD CSDRS. As a result, the applicant performed new site-specific seismic SSI and SSSI analyses with the site-specific ground response spectra and the site-specific subgrade properties. In some cases, the seismic structural loads were found to be higher than those used for the standard design, and thus, a structural evaluation of the ESBWR standard plant structures for acceptability at the North Anna 3 site was performed. In a few instances as required for site-specific conditions, the standard design is modified to ensure seismic adequacy.

Summary of RB and FB

In FSAR Appendix 3G, Sections 3G.7 and 3G.9, the applicant describes the site-specific structural evaluation of the RB/FB complex. Since the RB and FB are supported by a common basemat with the RCCV and CIS, and are integrated at higher elevations with each other and with the RCCV, a global integral model was analyzed for the RCCV, CIS, RB, and FB. The analytical models used for the RB and FB are described in FSAR Appendix 3G, Sections 3G.7.4 and 3G.9.4, respectively. In FSAR Appendix 3G, Sections 3G.7.5 and 3G.9.5, the applicant describes the structural analysis and design. The description includes the site design parameters used in the structural evaluation, design loads, load combinations, and material properties. FSAR Appendix 3G, Sections 3G.7.5.4 and 3G.9.5.4 describes the structural design evaluations of RB and FB including the basemat, respectively. The foundation stability evaluation is described in FSAR Appendix 3G, Sections 3G.7.5.5 and 3G.9.5.5. These FSAR sections include the evaluation for seismic sliding and overturning, and soil bearing pressure.

The results in terms of member forces for the RB, from the evaluations performed for the site-specific seismic loads, are presented in FSAR Appendix 3G, Tables 3G.7-202 through 3G.7-204. The combined member forces and moments for selected load combinations that include seismic loads are presented in FSAR Appendix 3G, Table 3G.7-220. FSAR Appendix 3G, Table 3G.7-221 shows the sectional thicknesses and rebar ratios used in the evaluation of the RB. The calculated stresses of the concrete and steel reinforcement and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.7-222. The calculated transverse shear and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.7-223.

For the FB, the results in terms of member forces, from the evaluations performed for the site-specific seismic loads, are presented in FSAR Appendix 3G, Table 3G.9-201. The combined member forces and moments for a selected load combination that includes seismic loads are presented in FSAR Appendix 3G, Table 3G.9-202. FSAR Appendix 3G, Table 3G.9-203 shows the sectional thicknesses and rebar ratios used in the evaluation of the FB. The calculated stresses of the concrete and steel reinforcement and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.9-204. The calculated transverse shear and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.9-205. FSAR Appendix 3G, Table 3G.9-206 shows the maximum stress ratios for flexure and membrane forces and identifies the element with an overstress condition that requires the application of an alternative approach to meet the ASME Code requirement.

For stability evaluation, the factors of safety for the RB/FB foundation stability for overturning and sliding are presented in FSAR Appendix 3G, Table 3G.7-225. The maximum calculated soil dynamic bearing pressure demand for the RB/FB is presented in FSAR Appendix 3G, Table 3G.7-231.

FSAR Appendix 3G, Table 3G.7-232 shows the dynamic lateral pressure loads on the RB/FB below-grade walls that were considered in the seismic structural analysis of the RB/FB global model.

<u>Summary of CB</u>

In FSAR Appendix 3G, Section 3G.8, the applicant described the site-specific structural evaluation of the CB. The analytical models used for the CB are described in FSAR Appendix 3G, Section 3G.8.4. In FSAR Appendix 3G, Section 3G.8.5, the applicant described the structural analysis and design of the CB. This section includes the site design parameters used in the structural evaluation, design loads, load combinations, and material properties. FSAR Appendix 3G, Section 3G.8.5.4 describes the structural design evaluation of the CB including the basemat. The foundation stability evaluation is described in FSAR Appendix 3G, Section 3G.8.5.5. This section includes the evaluation for seismic sliding and overturning as well as soil bearing pressure.

The NASTRAN analysis results in terms of CB member forces, from evaluations performed for the site-specific seismic loads, are presented in FSAR Appendix 3G, Tables 3G.8-202 through 3G.8-204. The combined member forces and moments for a selected load combination that includes seismic loads are presented in FSAR Appendix 3G, Table 3G.8-205. The calculated stresses of the concrete and steel reinforcement and comparison to code limits are presented in FSAR Appendix 3G, Tables 3G.8-206a and 3G.8-206b. The calculated transverse shear and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.8-207.

For stability evaluation, the factors of safety for the CB foundation stability for overturning and sliding are presented in FSAR Appendix 3G, Tables 3G.8-208, 3G.8-209a, and 3G.8-209b. The stresses and calculated transverse shear of CB external wall against wall capacity passive pressure for a selected load combination and the comparison to code limits are presented in FSAR Appendix 3G, Tables 3G.8-210a and 3G.8-210b.

The maximum calculated soil dynamic bearing pressure demand for the CB is presented in FSAR Appendix 3G, Tables 3G.8-211a and 3G.8-211b. The dynamic lateral pressure loads on CB below-grade walls are presented in FSAR Appendix 3G, Table 3G.8-212.

Summary of FWSC

In FSAR Appendix 3G, Section 3G.10, the applicant described the site-specific structural evaluation of the FWSC. The analytical models used for the FWSC are described in FSAR Appendix 3G, Section 3G.10.4. In FSAR Appendix 3G, Section 3G.10.5, the applicant described the structural analysis and design. This includes the site design parameters used in the structural evaluation, design loads, load combinations, and material properties. FSAR Appendix 3G, Section 3G.10.5.4 describes the structural design evaluation of the FWSC including the basemat. The foundation stability evaluation is described in FSAR Appendix 3G, Section 3G.10.5.5, which includes the evaluation for seismic sliding and overturning as well as soil bearing pressure.

The NASTRAN analysis results in terms of FWSC member forces, from evaluations performed for the site-specific seismic loads, are presented in FSAR Appendix 3G, Table 3G.10-202. The combined member forces and moments for a selected load combination that includes seismic loads are presented in FSAR Appendix 3G, Table 3G.10-203. FSAR Appendix 3G, Table 3G.10-204 shows the sectional thicknesses and rebar ratios of the FWSC used in the evaluation. The calculated stresses of the concrete and steel reinforcement and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.10-205. The calculated transverse shear and comparison to code limits are presented in FSAR Appendix 3G, Table 3G.10-206. For stability evaluation, the factors of safety for the FWSC foundation stability for overturning and sliding are presented in FSAR Appendix 3G, Table 3G.10-214. The maximum calculated soil dynamic bearing pressure demand for the FWSC is presented in FSAR Appendix 3G, Table 3G.10-215.

3.8.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for other seismic Category I structures, and the associated acceptance criteria, are in SRP Section 3.8.4. The specific requirements include the following:

- 10 CFR 50.55a and 10 CFR Part 50, Appendix A, GDC 1, as they relate to SSCs being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the design of the safety-related structures being able to withstand the most severe natural phenomena such as wind, tornadoes, hurricanes, floods, and earthquakes and the appropriate combination of all loads.

- 10 CFR Part 50, Appendix A, GDC 4, as it relates to safety-related structures being appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

- 10 CFR Part 50, Appendix A, GDC 5, as it relates to safety-related structures not being shared among nuclear power units, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions.

- 10 CFR Part 50, Appendix B as it relates to the QA criteria for nuclear power plants.

- 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

In addition, the acceptance criteria, regulatory guidance, and industry codes/standards associated with the review of FSAR Section 3.8.4 include the following:

- SRP Section 3.8.4 guidance to review the design, construction, and testing of other seismic Category I structures to ensure that these structures maintain their structural integrity and can perform its intended safety function during all loading conditions.

- RG 1.69

- RG 1.91

- RG 1.115, “Protection Against Low-Trajectory Turbine Missiles”

- RG 1.136

- RG 1.142

- RG 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in LWR Plants”

- RG 1.160

- RG 1.199

- RG 1.221

- 2004 ASME Boiler and Pressure Vessel Code, Section III, Division 2, Subsection CC, “Code for Concrete Reactor Vessels and Containments”

- ACI 349-01,

- ANSI/AISC N690-1994 and Supplement No. 2.

3.8.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.8.4 and Appendix 3G of the ESBWR DCD. The staff reviewed Section 3.8.4 and Appendix 3G of the North Anna 3 FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the North Anna 3 FSAR as given below.

In addition, the staff conducted a structural audit (North Anna 3 Audit 2) during the week of March 21, 2016, at the applicant's contractor GEH office in Wilmington, North Carolina. The purpose of this audit was to (1) review detailed analysis reports and design calculations performed by the applicant that support the information in the FSAR, (2) confirm the basis supporting the applicants' RAI responses, and (3) review the draft FSAR revisions from RAI responses to ensure consistency with the applicant's design basis information.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to the applicant's structural evaluation of other seismic Category I structures for the site-specific seismic loads. These evaluations are described in FSAR Appendix 3G, Sections 3G.7 through 3G.10 for the RB, CB, FB, and FWSC, respectively. The staff's technical evaluation of the design of other seismic Category I structures considering these revised loads is given below.

Evaluation of RB and FB

The staff reviewed FSAR Sections 3.8.4, FSAR Appendix 3A, Section 3A.18, FSAR Appendix 3G, Section 3G.7, and 3G.9, as well as the following GEH reports with regard to the North Anna 3 structural evaluations for the RB and FB:

1. WG3-U71-ERD-S-0004, Revision 2
2. WG3-U97-ERD-S-0001, Revision 2

Analytical Models (RB and FB)

The RB/FB global model, which includes the RCCV and CIS, is analyzed as one integrated structure utilizing the finite element computer code NASTRAN. Therefore, the description and staff's technical evaluation of the RB/FB global FEM is provided in this SER Section 3.8.1.4 under the heading "*Analytical Models.*"

Site Design Loads, Load Combinations, and Material Properties

The description of the site design loads, load combinations, and material properties for the RB/FB is provided in FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.9.5.2, and GEH Reports WG3-U71-ERD-S-0004, Revision 2 and WG3-U97-ERD-S-0001, Revision 2, respectively for the RB and FB. The FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.9.5.2 indicate that with the exception of seismic loads, the site-specific structural evaluations utilized the same loads and load combinations as those used in the standard design. The seismic loads in the standard design was replaced with the North Anna 3 site-specific seismic loads. The same acceptance criteria used in the ESBWR standard design were also used for the North Anna 3 site-specific design evaluation, with a few elements that required a refined evaluation following an alternative approach that is also allowed by the ASME Code. This alternative approach is evaluated in more detail later under the heading, "*Evaluation of the Alternative Approach for Concrete Element Overstress*," in this SER below. The FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.9.5.2 list the various loads and the corresponding sections in the ESBWR DCD where these loads are described.

FSAR Appendix 3G, Sections 3G.7.5.2 and 3G.9.5.2 also indicate that North Anna 3 site-specific seismic loads described in FSAR Section 3A.18.1.1 are developed from the site-specific SSI analyses results. The bounding seismic loads for the design evaluation of the RB/FB complex are provided in FSAR Appendix 3A, Section 3A.18 and FSAR Appendix 3G, Section 3G.7.5.6, the latter of which describes the site-specific dynamic lateral soil pressures imposed on the RB/FB exterior below grade walls. The site-specific bounding seismic loads are used as input in the structural evaluation of the RCCV, CIS, and RB/FB. The bounding structural responses include: bounding maximum forces and moments, maximum accelerations, maximum accelerations at slabs and roofs, and maximum dynamic lateral pressures. The supporting information for the development of bounding seismic loads was reviewed and confirmed by the staff during North Anna 3 Audit 2.

FSAR Appendix 3G, Section 3G.7.5.2 indicates that the site-specific evaluations of the RB/FB global model utilized the bounding dynamic soil pressure loads (shown in FSAR Appendix 3G, Table 3G.7-232) obtained from the SSI analyses described in FSAR Appendix 3A, Section 3A.17.12 and the lateral at-rest soil pressures that are the same as those used for the standard design shown in DCD Appendix 3G, Figure 3G.1-19. The site-specific evaluations also considered the lateral passive resistance pressures (shown in FSAR Appendix 3G, Figure 3G.7-207) obtained from the results of the sliding stability analyses in FSAR Appendix 3G, Section 3G.7.5.5. The applicant found that lateral passive resistance pressures on RB/FB walls are enveloped by the corresponding standard design loads.

The staff reviewed the information provided in FSAR Section 3.8 and Appendix 3G, the GEH reports identified above, and the North Anna 3 Audit 2. The staff's review confirmed that the bounding seismic loads envelop the effects of structural stiffness variations, structure-soil separation, and variations in the subgrade material properties. The bounding seismic design loads for the RB/FB complex in some instances exceed the seismic design loads of the standard design. These seismic loads consider the effects of structural stiffness variations (cracked vs uncracked concrete) as described in FSAR Appendix 3A, Section 3A.17.9.1. The effects of seismic SSSI of the CB on RB/FB are expected to be minimal as the RB/FB is larger and heavier than the CB. This is consistent with the ESBWR standard design which does not consider the SSSI effect of CB on the RB/FB. In addition, the interaction of RB/FB with the nearby non-seismic Category I structures, namely the TB, RWB, SB, and ADB, will be addressed through the ITAAC completion package as described in FSAR Section 3.7.2.8. The SSI analysis of RB/FB includes cases of full embedment and partial embedment (by removing the saprolite soil layer to 5.2 m below the ground surface), the latter of which represents the maximum structure soil separation on the overall RB/FB complex. Variations in subgrade material properties and structural fill and concrete fill are also considered explicitly by using three deterministic soil profiles (LB, BE, and UB). The detailed staff evaluation of seismic analysis cases to consider various loading environments is presented in SER Section 3.7.2.

In particular, in the SSI analyses of the uncracked model, OBE damping instead of SSE damping was conservatively used for developing structural responses in addition to the ISRS.

This conservatism can contribute to the few overstress conditions for RB and FB that are identified in the FSAR. However, the applicant's reconciliation of these overstress conditions does not rely entirely on this conservatism. The overstress conditions are evaluated using an alternative approach that is also allowed by the ASME Code to meet the code limits. The evaluation of this alternative approach is described under "*Structural Design (RB and FB),*" below in this SER.

In summary, the staff review confirmed that except for the seismic loads, the North Anna 3 site-specific structural evaluation utilized the same NS loadings, the same load combinations, and the same material properties as those used in the standard design. In the case of the site-specific seismic loads, the staff reviewed and confirmed during North Anna 3 Audit 2 that the site-specific seismic bounding load results presented in FSAR Appendix 3A, Section 3A.18 and FSAR Appendix 3G, Section 3G.7.5.6 were used for the RB/FB structural evaluation. The staff review concluded that the applicant's development of seismic loads for the design evaluation of the RB/FB complex considered applicable loading/site condition variations and conservatively used the OBE damping in the uncracked model for structural response calculation. In addition, the staff did not identify any changes or deviations from the material properties used in the standard design for concrete, reinforcing steel, and structural steel. Therefore, the staff concluded that the North Anna 3 site design loads, load combinations, and material properties are acceptable.

Structural Analysis (RB and FB)

Since the RB/FB global model includes the RB, FB, RCCV, and CIS and is analyzed as an integral FEM using the NASTRAN code, the description and staff technical evaluation of the RB/FB structural analysis is provided in this SER under the "*Structural Analysis*" heading.

Structural Design (RB and FB)

The applicant's structural design evaluation of the RB/FB complex utilized an alternative approach to evaluate the overstress conditions at a few locations, and included more locations in the structures than the DCD locations where the North Anna 3 site-specific structural responses are expected to be higher based on the characteristics of the North Anna 3 input motion. These aspects are evaluated below under the headings, "*Evaluation of the Alternative Approach for Concrete Element Overstress"* and "*Evaluation of the Sensitivity Study of NA3 Selected Elements,"* as generic procedures for structural design evaluation. Some of the following staff evaluation is also applicable to the CB.

Staff evaluation of the applicant's structural design evaluations of the RB and FB is provided in this SER under the headings, "*Design of the RB"* and "*Design of the FB,"* respectively.

Evaluation of the Alternative Approach for Concrete Element Overstress

FSAR Section 3.8.4.5 and FSAR Appendix 3G, Sections 3G.7.5.4 and 3G.9.5.4 indicate that the structural acceptance criteria for the site-specific structural evaluations of the RB and FB are the same as the acceptance criteria for the standard design, with an exception that the site-specific structural evaluations may use a refined evaluation (hereinafter referred to as an *alternative approach*). Most of the design evaluation was performed using the SSDP-2D computer program for the RB/FB to satisfy both ASME BPVC, Section III 2004 and ACI 349-01, which are consistent with the DCD design criteria. The FSAR also indicates that for cases where an element exceeds the ASME acceptance criteria using the SSDP-2D analysis, additional reinforcing steel is added or the element is evaluated using axial load-moment interaction curves which satisfy both ACI 349-01 and the alternative ASME acceptance criteria. The alternative approach allowed by the ASME Code involves the parabolic concrete stress-strain relationship and applicable ASME allowable stresses for a cross section subjected to membrane loads and moments due to factored loads. As compared to this alternative approach, the SSDP-2D analysis is considered more conservative because it utilizes an approach for meeting ASME Code requirements for factored loads based on the linear concrete stress-strain relationship and the concrete principal stress for comparison with the code allowable stress.

Most of the DCD selected elements and the North Anna 3 additional selected elements satisfy both ACI 349-01 and the ASME standard through the application of the SSDP-2D computer program. However, a few elements were found to exceed the ASME allowable stress in the design evaluation using the SSDP-2D program. Therefore, the approach used to design non-containment reinforced concrete members was reviewed by the applicant regarding the modification of the structural acceptance criteria identified in North Anna 3 FSAR, Section 3.8.4. More specifically, the need to revise the criteria arose because the site-specific structural evaluations indicate that one segment of the FB external wall experiences compression stress demand under combined flexure and membrane forces that exceeds the acceptance criteria of the ASME BPVC for allowable compressive stress based on the linear concrete stress-strain relationship. Similarly, among the North Anna 3 selected elements in the sensitivity study (evaluated under the heading in this SER, "*Evaluation of the Sensitivity Study of North Anna 3 Selected Elements",* below), there are three elements in the RB external wall that also exceed the ASME allowable compressive stress in concrete and allowable tensile stress for rebar. These exceedances occurred as a result of using the SSDP-2D computer program, which was used in the standard design. As indicated by the applicant, the SSDP-2D computer program is more conservative than the parabolic or nonlinear stress distribution that is also accepted by ASME BPVC, Section III, Division 2, Subsection CC.

More details on the alternate approach are discussed in the applicant's response to RAI 7536 Question 03.07.02-17 (ADAMS Accession No. ML16146A789). The staff reviewed the related information and GEH reports that support the applicant's RAI response during North Anna 3 Audit 2. The alternative approach, also allowed by the ASME Code, ensures that the more limiting acceptance criteria of the ASME Code and the ACI 349-01 Code are met. During the audit, the applicant discussed with the staff in more detail this alternative approach and the conservatism in the SSDP-2D program. Based on this review, the staff found this alternative approach for design evaluation acceptable because it is in accordance with the ASME Code and the ACI 349-01 Code.

Evaluation of the Sensitivity Study of North Anna 3 Selected Elements

FSAR Appendix 3G indicates that the adequacy of the seismic Category I structures for the North Anna 3 site-specific conditions is demonstrated by comparing the site-specific demands with the structural members section capacities for the same set of selected elements as those considered for the standard design.

In addition to the DCD selected elements, FSAR Section 3G also indicates that the applicant performed a sensitivity study to evaluate additional elements for North Anna 3. During the public meeting on November 20, 2014 on Dominion's SCP, the staff discussed with Dominion that given the North Anna 3 seismic ground motion exceeds the CSDRS at some frequencies, whether some other locations in addition to the DCD selected elements should be evaluated during the North Anna 3 design evaluation. As discussed in the March 3, 2016 public meeting and documented in FSAR Section 3G, a sensitivity study was performed for the design evaluation of additional elements in RB/FB and CB particularly at locations where North Anna 3 site-specific bounding seismic loads exceed the corresponding DCD seismic loads. There was no need for additional North Anna 3 site-specific elements for RCCV, CIS and FWSC as the DCD elements evaluated for these structures are considered sufficient. Design evaluations were performed for 96 North Anna 3 additional selected elements (62 for RB, 27 for FB, and 7 for CB). The applicant concluded that no changes to the standard design concrete member dimensions are necessary and most of the North Anna 3 selected elements were adequate by simply using the SSDP-2D approach that is also used in the DCD. However, the applicant did find three of the North Anna 3 selected elements in the RB that did not meet the ASME allowable stress using the SSDP-2D approach. The design evaluation of these elements required the use of the alternative approach, i.e., using the parabolic concrete stress-strain relationship that is also allowed by ASME, and the applicable ASME allowable stresses for a cross section subjected to membrane loads and moments due to factored loads. In addition, 12 new rebar schedules have been designed and incorporated into the structural drawings.

More details on this sensitivity study are discussed in the applicant's response to RAI 7536 Question 03.07.02-17 (ADAMS Accession No. ML16146A789). The staff reviewed the related information and GEH report that support the applicant's RAI response during North Anna 3 Audit 2. Based on this review, the staff finds the North Anna 3 sensitivity study acceptable since it evaluates additional locations in the seismic Category I structures where the North Anna 3 site-specific seismic demands are higher than the DCD demands, and provides additional confidence in the ESBWR standard design at the North Anna 3 site. The staff notes that for the design of the remaining structural members, not included in the design of the DCD selected elements and North Anna 3 additional selected elements reviewed by the staff, will be designed during the detailed design stage using the same methodology described in the DCD and FSAR.

Design of the RB

The description of the structural design evaluation for the RB is provided in FSAR Appendix 3G, Section 3G.7.5.4.3 and GEH Report WG3-U71-ERD-S-0004, Revision 2. FSAR Appendix 3G, Section 3G.7.5.4 indicates that with the exception of seismic loads, site-specific evaluations of the RB use the same standard design models, analysis methods, loads (as described in FSAR Appendix 3G, Section 3G.7.5.2), load combinations, and acceptance criteria that were used in the standard design. However, the standard design seismic loads are replaced with the seismic loads determined from the North Anna 3 site-specific seismic analyses described in FSAR Appendix 3A, Sections 3A.10 through 3A.19.

As described in FSAR Appendix 3G, Section 3G.7.5.4.3, the site-specific evaluations show that the RB standard design is adequate to resist the North Anna 3 site-specific seismic loads in combination with NS standard design loads, with the exception of a change in the arrangement of shear ties for a single wall to withstand the North Anna 3 site-specific seismic loads. The affected wall section is at the exterior wall of the RB, Elevation 22.50 m to Elevation 24.60 m, column line R7/F1. With this change in the arrangement of shear ties, the FSAR indicates that the stresses of the concrete and rebar are less than the allowable stresses specified in the codes and the areas of the primary and shear reinforcement, which have been provided, meet the required values. FSAR Appendix 3G, Section 3G.7.5.4.3 also indicates that the stresses of steel members are less than the allowable stresses specified in the code. Furthermore, as an overall conclusion, the FSAR indicates that there is no need for any change to the standard design concrete member properties (e.g., wall and slab thicknesses, beam and column sizes) to meet the standard design structural acceptance criteria.

The staff reviewed the information in FSAR Appendix 3G, Section 3G.7.5.4 and GEH Report WG3-U71-ERD-S-0004, Revision 2 regarding the structural design evaluation of the RB. The staff's review found that the analysis model and approach, the industry codes and standards, structural materials and their properties, loads and load combinations used in the design evaluations, and the method for checking the design of the RB were consistent with those used in the standard design. The staff reviewed the results of the design evaluation for 109 representative locations of the RB (including 47 DCD-selected elements and 62 North Anna 3-selected elements), which included shear walls, basemat outside containment, floor slabs, pool girders, main steam tunnel floors and walls, and IC/PCCS pool. The staff also reviewed the change in the arrangement of shear ties for one wall and the applicant's use of the alternative approach (i.e., using the parabolic concrete stress-strain relationship and applicable ASME allowable stresses for a cross section subjected to membrane loads and moments due to factored loads). The staff found that the calculated stresses of the concrete and steel reinforcement were below allowable values, the areas of the provided primary and shear reinforcement meet the required values, and the stresses of steel members are less than the allowable stresses specified in the code. Therefore, the staff concluded the site-specific structural design evaluation for the RB is acceptable.

Design of the FB

The description of the structural design evaluation for the FB is provided in FSAR Appendix 3G, Section 3G.9.5.4 and GEH Report WG3-U97-ERD-S-0001, Revision 2. FSAR Appendix 3G, Section 3G.9.5.4 indicates that with the exception of seismic loads, site-specific evaluations use the same standard design models, analysis methods, loads (as described in FSAR Appendix G, Section 3G.9.5.2), load combinations, and acceptance criteria that were used in the standard design. However, the standard design seismic loads are replaced with the seismic loads determined from the site-specific seismic analyses described in FSAR Appendix 3A, Sections 3A.10 through 3A.19.

FSAR Appendix 3G, Section 3G.9.5.4 describes the site-specific evaluations which show that the FB standard design is adequate to resist the North Anna 3 site-specific seismic loads in combination with NS standard design loads, with the following exceptions:

1. An overstress condition at the exterior wall element (Element 72004 from Elevation 4.65 m to Elevation 6.60 m), which exceeds the allowable SSDP-2D stresses by 3 percent for the axial-flexural behavior and is resolved using the alternative approach that is described in FSAR Section 3.8.4.5. This alternative approach that is also allowed in the ASME Code is evaluated above under the heading, "*Evaluation of the Alternative Approach for Concrete Element Overstress*," of this SER;

2. A change in the arrangements of reinforcements in two FB exterior wall segments (Elements 72001 and 72004, at the exterior wall, between Elevations 4.65 m and 6.60 m between columns FA and FF); and

3. A change in the arrangement of exterior wall shear ties (Element 72004) at exterior FB wall between Elevations 4.65 m and 6.60 m between columns FA and FF).

With these changes in reinforcement and the resolution of the overstress condition, the FSAR indicates that the results of the site-specific stress checks demonstrate that the stresses of the concrete and rebar are less than the allowable stresses specified in the codes and the areas of the primary and shear reinforcement, which have been provided, meet the required values. The FSAR also indicates that the stresses of steel members are less than the allowable stresses specified in the code. Furthermore, as an overall conclusion, the FSAR indicates that there is no need for any change to the standard design concrete member properties (e.g., wall and slab thicknesses, beam and column sizes) to meet the standard design structural acceptance criteria.

The staff reviewed the information in FSAR Appendix 3G, Section 3G.9.5.4 and GEH Report WG3-U97-ERD-S-0001, Revision 2. The staff found that the industry codes and standards, structural materials and their properties, loads and load combinations used in the design evaluations, and the method for checking the design of the FB were consistent with those used in the standard design. The staff also reviewed the results of the design evaluation for 53 representative locations of the FB (including 26 DCD-selected elements and 27 North Anna 3-selected elements), which included shear walls and spent fuel pool walls, floor slabs, and basemat. The staff also reviewed the three changes in the arrangement of rebar and shear ties and the applicant's use of the alternative approach (i.e., using the parabolic concrete stress-strain relationship and applicable ASME allowable stresses for a cross section subjected to membrane loads and moments due to factored loads). The staff found that the calculated stresses of the concrete and steel reinforcement were below allowable values and the provided reinforcement was greater than the required reinforcement for the primary and shear reinforcement. Therefore, the staff concluded the site-specific structural design evaluation for the FB is acceptable.

Evaluation of CB

The staff reviewed FSAR Sections 3.8.4, FSAR Appendix 3A, Section 3A.18, and FSAR Appendix 3G, Section 3G.8, as well as the following GEH report with regard to the North Anna 3 structural evaluations for the CB:

1. WG3-U73-ERD-S-0004, Revision 3, "Control Building Structural Design Report" (ADAMS Accession No. ML16148A051, ML16148A126 Non-public).

Analytical Model (CB)

The description of the analytical model for the CB is provided in FSAR Appendix 3G, Section 3G.8.4. FSAR Appendix 3G, Section 3G.8.4.1 indicates that site-specific structural model for the CB is based on the standard design structural model described in DCD Appendix 003G, Section 3G.2.4.1. FSAR Appendix 3G, Section 3G.8.4.2 also indicates that the site-specific foundation model for the CB is based on the standard design foundation model described in DCD Appendix 3G, Section 3G.2.4.2. The staff noted in FSAR Appendix 3G, Section 3G.8.5.1 that the site-specific foundation model for the CB uses spring elements based on generic soft soil conditions considered for the ESBWR DCD. GEH Report WG3-U73-ERD-S-0004, Revision 3 provides more details of the analytical model used for the site-specific structural evaluations for the CB.

The staff reviewed FSAR Appendix 3G, Sections 3G.8.4 and 3G.8.5.1, DCD Appendix 3G, Section 3G.2.4, and GEH Report WG3-U73-ERD-S-0004, Revision 3. The staff also reviewed the supporting information on the site-specific GEH analytical model during North Anna 3 Audit 2. Based on this review, the staff confirmed that the site-specific structural model and foundation model for the CB are consistent with the models used for the standard design. The staff's conclusions on the acceptability of using generic soft soil conditions for North Anna 3 site is discussed in SER Section 3.8.1.4 under the heading *"Structural Analysis."* The staff found that the results of the study for site subgrade stiffness conditions performed for RB/FB also apply to the CB because the site subgrade stiffness conditions for both CB and RB/FB are similar. Therefore, the staff concluded that the use of the CB analytical model as described in FSAR Appendix 3G, Section 3G.8.4 for the site-specific structural evaluations is acceptable.

Site Design Loads, Load Combinations, and Material Properties (CB)

The description of the site design loads, load combinations, and material properties for the CB is provided in FSAR Appendix 3G, Section 3G.8.5.2 and GEH Report WG3-U73-ERD-S-0004, Revision 3. FSAR Appendix 3G, Section 3G.8.5.2 indicates that with the exception of seismic loads, the site-specific structural evaluations of the CB utilize the same loads, load combinations, and acceptance criteria that were used in the standard design. The seismic loads in the standard design were replaced with the North Anna 3 site-specific seismic loads. FSAR Appendix 3G, Section 3G.8.5.2 lists the various loads and the corresponding sections in the ESBWR DCD where these loads are described. In addition, FSAR Appendix 3G, Section 3G.8.5.2 indicates that the site-specific structural evaluations for the CB utilize the same material properties of concrete, reinforcing steel, and structural steel as those used in the standard design. The staff did not identify any changes or deviations from the material properties used in the standard design.

The bounding site-specific seismic structural load demand for the CB is provided in FSAR Appendix 3A, Section 3A.18.1.2. This section indicates that site-specific seismic loads for the CB are developed from the site-specific SSI analyses of CB stand-alone model with full stiffness and SSE damping properties. The site-specific seismic structural load demand in some cases exceeds the corresponding load demand of the standard design. These site-specific seismic loads consider the effects of soil separation (PE and FE conditions) described in FSAR Appendix 3A, Section 3A.16.3.2 and structural stiffness variations (concrete cracking) described in FSAR Appendix 3A, Section 3A.17.9.2. However, the CB bounding site-specific seismic structural load demand does not include SSSI effects of the FWSC and RB/FB on the CB. The site-specific evaluations of effects of seismic SSSI of the FWSC and RB/FB on the seismic response of CB in FSAR Appendix 3A, Section 3A.17.11 show a few small exceedances in some of the local load demand, which have a negligible effect on the CB. Therefore, these exceedances are not included in the site-specific evaluation of the CB. In addition, the interaction of CB with the nearby non-seismic Category I structures will be addressed through the ITAAC completion package as described in FSAR Section 3.7.2.8. Variations in subgrade material properties and structural fill and concrete fill are considered explicitly by using three deterministic soil profiles (LB, BE, and UB).

FSAR Appendix 3G, Section 3G.8.5.2 indicates that the site-specific structural evaluations of the CB consider: (1) at-rest static soil pressure loads same as the ones used for the standard design shown in DCD Appendix 3G, Figure 3G.2-12, (2) site-specific lateral dynamic pressure loads (shown in FSAR Appendix 3G, Table 3G.8-212) obtained from the site-specific SSI analyses described in FSAR Appendix 3A, Section 3A.17.13.4, and (3) site-specific passive resistance pressures (shown in FSAR Appendix 3G, Table 3G.8-213) obtained from the sliding stability calculations in FSAR Appendix 3G, Section 3G.8.5.6.

The staff reviewed FSAR Appendix 3G, Section 3G.8.5.2, GEH Report WG3-U73-ERD-S-0004, Revision 3, and other supporting information as confirmed during North Anna 3 Audit 2. Based on this review, the staff determined that with the exception of seismic loads, the site-specific structural evaluations of the CB utilize the same loads, load combinations, acceptance criteria, and material properties as those used in the standard design. The staff also confirmed that the bounding site-specific seismic load demand for the CB was used as input to the CB structural evaluations. The staff further confirmed that the bounding structural loads envelop the effects of: (1) soil separation (PE and FE conditions) described in FSAR Appendix 3A, Section 3A.16.3.2, and (2) structural stiffness variations (concrete cracking) described in FSAR Appendix 3A, Section 3A.17.9.2. In addition, the staff reviewed SSSI effects of the FWSC and RB/FB on the CB, and determined that a few small exceedances in some of the local load demand have no effect on the CB structural evaluation. The staff confirmed that at-rest static soil pressure loads for the CB site-specific structural evaluation were consistent with those at-rest static soil pressure loads used in the standard design. The staff also confirmed that site-specific lateral dynamic pressure loads shown in FSAR Appendix 3G, Table 3G.8-212 and site-specific passive resistance pressures shown in FSAR Appendix 3G, Table 3G.8-213 along with at-rest static soil pressure loads were used as input to the CB structural evaluations. Therefore, the staff concluded that the North Anna 3 site design loads, load combinations, and material properties used for the CB site-specific structural evaluations are acceptable.

Structural Analysis (CB)

The description of the structural analysis performed for the CB is provided in FSAR Appendix 3G, Section 3G.8.5 and GEH Report WG3-U73-ERD-S-0004, Revision 3. The structural analysis of the CB is performed consistently with the procedure used for the standard design, and the CB model is analyzed using the same NASTRAN finite element computer program used for the standard design, as described in DCD Section 3C.2.

Section 6.2.3.6 of the CB structural design report (WG3-U73-ERD-S-0004, Rev. 3) describes how site-specific seismic loads are developed from the CB LMSM and applied to the CB FEM. The methodology used to convert North Anna 3 site-specific seismic loads from LMSM to NASTRAN FEM is identical to the methodology used in the standard design. The staff's acceptability of applying bounding site-specific seismic loads to the NASTRAN design model is discussed in this SER Section 3.8.1.4 under the heading "*Structural Analysis*." The combined member forces and moments for a selected load combination that include site-specific seismic loads are presented in FSAR Appendix 3G, Table 3G.8-205.

The staff reviewed FSAR Appendix 3G, Section 3G.8.5, GEH Report WG3-U73-ERD-S-0004, Revision 3, and other supporting information was confirmed by the staff during the North Anna 3 Audit 2. Based on this review, the staff determined that: (1) the NASTRAN FEM for the CB is the same model as one used for the standard design, (2) with the exception of seismic loads, the site-specific structural evaluations of the CB utilize the same analysis methods, loads, load combinations, and material properties as those used in the standard design, (3) site-specific seismic loads developed from the CB site-specific seismic analyses are used to replace DCD seismic loads, and (4) the site-specific seismic forces applied to the CB model for the structural evaluation are the same as the bounding site-specific seismic load demand discussed in this

SER Section 3.8.4.4 under the heading "*Site Design Loads, Load Combinations, and Material Properties (CB)*." Therefore, the staff concluded that the structural analysis performed for the CB is acceptable.

Structural Design (CB)

The description of the structural design evaluation for the CB is provided in FSAR Appendix 3G, Section 3G.8.5.4 and GEH Report WG3-U73-ERD-S-0004, Revision 3. FSAR Appendix 3G, Section 3G.8.5.4 indicates that the site-specific structural evaluation of the CB utilizes the same models, analysis methods, loads (other than seismic loads), load combinations, and acceptance criteria as those used in standard design. However, the standard design seismic loads are replaced with the seismic loads (as described in FSAR Appendix 3G, Section 3G.8.5.2) determined from the site-specific seismic analyses described in FSAR Appendix 3A, Sections 3A.10 through 3A.19. The FSAR also indicates that the site-specific structural evaluation of the CB utilizes the same methodology used for the DCD structural evaluation described in DCD Appendix 3G, Section 3G.2.5.

The site-specific evaluations in FSAR Appendix 3G, Section 3G.8.5.4 show that the standard design CB, with a design change in steel girder SG23 (NASTRAN FEM CBAR ID 21016, Elevation 4.65 m on Column-Row CB), is adequate to resist the site-specific seismic load demands in combination with the NS ESBWR standard plant loads.

The results of site-specific stress check in FSAR Appendix 3G, Section 3G.8.5.4 also indicate that: (1) the stresses of the concrete and rebar are less than the allowable stresses specified in the code, and the areas of the primary and shear reinforcement satisfy the required values, and (2) the stresses of steel members are less than the allowable stresses specified in the code with the change in steel girder SG23.

As discussed in this SER Section 3.8.4.4 under the heading "*Evaluation of the Sensitivity Study of NA3 Selected Elements,"* regarding North Anna 3 selected elements, the sensitivity study of the CB identified seven additional elements for further site-specific structural evaluation in addition to the elements selected in the DCD. The staff reviewed FSAR Appendix 3G and confirmed supporting information during North Anna 3 Audit 2. The staff determined that the additional site-specific structural evaluation results from the sensitivity study do not change the standard design member properties (e.g., wall and slab thickness, beam and column sizes) except for adding localized reinforcement as part of the detailed design.

The staff reviewed FSAR Appendix 3G, Section 3G.8, GEH Report WG3-U73-ERD-S-0004, Revision 3, and other supporting information confirmed during North Anna 3 Audit 2. Based on this review, the staff determined that with the exception of seismic loads, the CB analysis model and approach, industry codes and standards, structural materials and their properties, loads and load combinations, acceptance criteria used in the design evaluations, and the method for applying loads were consistent with those used in the standard design. The staff also confirmed that the North Anna 3 structural design evaluation of CB utilizes the same methodology as the DCD and uses the same SSDP-2D computer program, which in addition to ACI 349-01, also follows the 2004 ASME Code. According to DCD Table 3.8-15, the acceptance criteria for CB section strength are based on the strength design method per ACI 349-01. The staff found that the CB section design is conservatively taken to be more limiting of ACI 349-01 and 2004 ASME Section III, Division 2, Subsection CC requirements. For the reinforced concrete structures of the CB, the staff reviewed the calculated stresses of the concrete and steel reinforcement and comparison to code limits for a selected load combination shown in FSAR Appendix 3G, Tables 3G.8-206a and 3G.8-206b; the staff also reviewed the calculated transverse shear and comparison to code limits shown in FSAR Appendix 3G, Table 3G.8-207. Based on this review, the staff confirmed that: (1) the stresses of the concrete and rebar are less than the allowable stresses specified in the code, and (2) the areas of the primary and shear reinforcement satisfy the required values. For the steel structures of the CB, the staff reviewed the selected calculations of steel structures including design change for one structural steel girder SG23 during the North Anna 3 Audit 2. Based on this review, the staff confirmed that the stresses of the steel members are less than the allowable stresses specified in the code, with the change in steel girder SG23.

In conclusion, the staff found that the standard design CB, with the change in the steel girder SG23, is adequate to resist the site-specific seismic load demand at North Anna 3 site.

Evaluation of FWSC

The staff reviewed FSAR Section 3.8.4, FSAR Appendix 3A, Section 3A.18, FSAR Appendix 3G, Section 3G.10, as well as the following GEH report with regard to the North Anna 3 structural evaluations for the FWSC:

1. WG3-U63-ERD-S-0003, Revision 2, "Firewater Service Complex Structural Design Report" (ADAMS Accession Nos. ML16148A050, and ML16148A125 Non-public)

Analytical Model (FWSC)

The description of the analytical model for the FWSC is provided in FSAR Appendix 3G, Section 3G.10.4. FSAR Appendix 3G, Section 3G.10.4.1 indicates that the North Anna 3 site-specific structural model for the FWSC is based on the standard design structural model described in DCD Appendix 3G, Section 3G.4.4.1. FSAR Appendix 3G, Section 3G.10.4.2 indicates that the North Anna 3 site-specific foundation model for the FWSC is based on the standard design foundation model described in DCD Appendix 3G, Section 3G.4.4.2. The staff noted in FSAR Appendix 3G, Section 3G.10.5.1 that the site-specific foundation model for the FWSC is based on the generic soft soil conditions considered for the ESBWR DCD. GEH Report WG3-U63-ERD-S-0003, Revision 2 provides more details of the analytical model used in the site-specific structural evaluations of the FWSC.

The staff reviewed the information in FSAR Appendix 3G, Section 3G.10, DCD Appendix 3G, Section 3G.4, and GEH Report WG3-U63-ERD-S-0003, Revision 2. The staff also reviewed and confirmed the supporting information on analytical model during North Anna 3 Audit 2. Based on this review, the staff determined that the site-specific structural model and foundation model for the FWSC are consistent with the corresponding models for the standard design. The staff's acceptability of using the generic soft soil conditions for the North Anna 3 site is discussed in this SER 3.8.1.4 under the heading "*Structural Analysis."* The staff found that the results of the study for site subgrade stiffness conditions performed for RB/FB also apply to the FWSC because the site subgrade stiffness conditions for both FWSC and RB/FB are similar. Therefore, the staff concluded that the use of the FWSC analytical model as described in FSAR Appendix 3G, Section 3G.10.4 for the site-specific structural evaluations of the FWSC is acceptable.

Site Design Loads, Load Combinations, and Material Properties (FWSC)

The description of the site design loads, load combinations, and material properties for the FWSC is provided in FSAR Appendix 3G, Section 3G.10.5.2 and GEH Report WG3-U63-ERD-S-0003, Revision 2. FSAR Appendix 3G, Section 3G.10.5.2 indicates that, with the exception of seismic loads, the site-specific structural evaluations of the FWSC utilize the same loads, load combinations, and acceptance criteria that were used in the standard design. The seismic loads in the standard design were replaced with the North Anna 3 site-specific seismic loads. FSAR Appendix 3G, Section 3G.10.5.2 lists the various loads and the corresponding sections of the ESBWR DCD where these loads are described. In addition, FSAR Appendix 3G, Section 3G.10.5.2 indicates that the site-specific structural evaluations of the FWSC utilize the same material properties of concrete, reinforcing steel, and structural steel as those used in the standard design. The staff did not identify any changes or deviations from the material properties used in the standard design.

FSAR Appendix 3G,Section 3G.10.5.2 also indicates that the seismic loads used for the structural evaluations of the FWSC are based on the site-specific seismic demands presented in FSAR Appendix 3A, Section 3A.18.1.3. This section indicates that the site-specific seismic demands bound the effects of structural stiffness variations described in FSAR Appendix 3A, Section 3A.17.9.3, SSSI with the CB described in FSAR Appendix 3A, Section 3A.17.11, and separation between the concrete fill and surrounding soil described in FSAR Appendix 3A, Section 3A.17.14.5. In addition, the interaction of FWSC with the nearby non-seismic Category I structures will be addressed through the ITAAC completion package as described in FSAR Section 3.7.2.8.

The staff reviewed FSAR Appendix 3G, Section 3G.10.5.2, WG3-U63-ERD-S-0003, Revision 2, and confirmed the supporting information during North Anna 3 Audit 2. Based on this review, the staff determined that, with the exception of seismic loads, the site-specific structural evaluations of the FWSC utilized the same loads, load combinations, acceptance criteria, and material properties as those used in the standard design. The staff also confirmed that the bounding site-specific seismic load demands for the FWSC were used in the structural evaluations of the FWSC. The staff further confirmed that the bounding site-specific seismic demands envelop the effects of: (1) the variation of subgrade material conditions, (2) separation between the concrete fill and surrounding soil, (3) structural stiffness variations (concrete cracking), and (4) SSSI with the CB. Therefore, the staff concluded that the North Anna 3 site design loads, load combinations, and material properties used for the FWSC site-specific structural evaluations are acceptable.

Structural Analysis (FWSC)

The description of the structural analysis performed for the FWSC is provided in FSAR Appendix 3G, Section 3G.10.5 and GEH Report WG3-U63-ERD-S-0003, Revision 2. The structural analysis of the FWSC is performed consistently with the procedure used for the standard design, and the FWSC model is analyzed using the same NASTRAN finite element computer program used for the standard design, as described in DCD Section 3C.4.

Section 6.2.3.6 of the FWSC structural design report (WG3-U63-ERD-S-0003, Rev. 2) describes how site-specific seismic loads are developed from the FWSC LMSM and applied to the FWSC FEM. The methodology used to convert North Anna 3 site-specific seismic loads from LMSM to NASTRAN FEM is identical to the methodology used in the standard design.

The staff's acceptability of applying the bounding site-specific seismic loads to the NASTRAN model is discussed in this SER Section 3.8.1.4 under the heading "*Structural Analysis.*" The combined member forces and moments for a selected load combination that include site-specific seismic loads are presented in FSAR Appendix 3G, Table 3G.10-203. Section 5.6 of FWSC structural design report (WG3-U63-ERD-S-0003, Rev. 2) describes that the site-specific hydrodynamic pressures on the FWS walls and floors due to the seismic ground motions are developed following the same methodology as used in the standard design and that the site-specific lateral pressure loads applied along the FWSC shear keys are considered in the site-specific structural evaluations of the FWSC.

The staff reviewed FSAR Appendix 3G, Section 3G.10.5, GEH Report WG3-U63-ERD-S-0003, Revision 2, and confirmed the supporting information during the North Anna 3 Audit 2. Based on this review, the staff determined that: (1) the NASTRAN FEM for the FWSC is the same model as the one used for the standard design, (2) with the exception of seismic loads, the site-specific structural evaluations of the FWSC utilize the same analysis methods, loads, load combinations, and material properties as those used in the standard design, (3) site-specific seismic loads developed from the FWSC site-specific seismic analyses are used to replace the DCD seismic loads, and (4) the site-specific seismic loads applied to the FWSC model for the structural evaluations are consistent with the bounding site-specific seismic load demands discussed in this SER Section 3.8.4.4 under the heading "*Site Design Loads, Load Combinations, and Material Properties (FWSC)*." Therefore, the staff concluded that the structural analysis performed for the FWSC is acceptable.

Structural Design (FWSC)

The description of the structural design evaluation for the FWSC is provided in FSAR Appendix 3G, Section 3G.10.5.4 and GEH Report WG3-U63-ERD-S-0003, Revision 2. FSAR Appendix 3G, Section 3G.10.5.4 indicates that the site-specific structural evaluation of the FWSC utilizes the same models, analysis methods, loads (other than seismic loads), load combinations, and acceptance criteria as those used in the standard design . However, the standard design seismic loads are replaced with the seismic loads determined from the site-specific seismic analyses as described in FSAR Appendix 3A, Sections 3A.10 through 3A.19. The FSAR also indicates that the site-specific structural evaluations of the FWSC utilize the same methodology as used for the DCD structural evaluations of the FWSC described in DCD Appendix 3G, Section 3G.4.5.

The site-specific evaluations presented in FSAR Appendix 3G, Section 3G.10.5.4 show that the standard design FWSC is adequate to resist the site-specific seismic load demands in combination with the NS ESBWR standard plant loads except for a few instances in which a design change is required. Specifically, the applicant modified the standard design by changing steel reinforcement and shear ties to the following structural elements of the FWSC:

- Basemat (Element 227): primary reinforcement ratio in the E-W direction is increased from 0.604 percent to 0.705 percent.

- Shear Key (Element 72008): primary reinforcement ratio in the E-W direction is increased from 0.377 percent to 0.629 percent; shear tie reinforcement ratio is increased from 0.177 percent to 0.484 percent.

- Shear Key (Element 73017): shear tie reinforcement ratio is increased from 0.177 percent to 0.484 percent.

The staff confirmed that the details of changed reinforcement and shear ties to these elements are provided in FSAR Appendix 3G, Table 3G.10-204.

With the change of rebar in the basemat and rebar and shear ties in the shear key as discussed above, site-specific stress check calculations for the FWSC are performed to evaluate the adequacy of the FWSC at the North Anna 3 site. This design check is performed in accordance with SSDP-2D, following the same methodology as that used for the standard design. The site-specific stress checks demonstrated that the FWSC structures are adequate to resist site-specific seismic load demands in combination with NS ESBWR standard plant loads. Specifically, the stresses of the concrete and rebar are less than the allowable stresses specified in the code, and the provided area of primary and shear reinforcement, including the reinforcement changes as described above, satisfy the required values.

The staff reviewed FSAR Appendix 3G, Section 3G.10, GEH Report WG3-U63-ERD-S-0003, Revision 2, and confirmed the supporting information during North Anna 3 Audit 2. Based on this review, the staff determined that with the exception of seismic loads, the FWSC analysis model and approach, industry codes and standards, structural materials and their properties, loads and load combinations, acceptance criteria used in the design evaluations, and the method for applying loads are consistent with those used in the standard design. The staff also confirmed that the North Anna 3 structural design evaluations of the FWSC utilize the same methodology as the standard design. For the reinforced concrete structures of the FWSC, the staff reviewed the calculated stresses of the concrete and steel reinforcement and comparison to code limits for a selected load combination shown in FSAR Appendix 3G, Table 3G.10-205. The staff also reviewed the calculated transverse shear and comparison to code limits shown in FSAR Appendix 3G, Table 3G.10-206. Based on this review, the staff confirmed, with enhanced steel reinforcement and shear ties to the basemat and shear keys as described in FSAR Appendix 3G,Table 3G.10-204, that: (1) the stresses of the concrete and rebar are less than the allowable stresses specified in the code, and (2) the areas of the primary and shear reinforcement satisfy the required values.

In conclusion, the staff found that the standard design FWSC, with changes of steel reinforcement and shear ties to the basemat and shear keys, is adequate to resist the site-specific seismic load demand in combination with the NS ESBWR standard plant loads at the North Anna 3 site.

Fuel Rack and Spent Fuel in Spent Fuel Rack

The staff reviewed FSAR Section 9.1, as well as the following GEH reports with regard to the North Anna 3 structural evaluations for the fuel rack and spent fuel in the spent fuel rack:

1. 002N8467, Revision 4, “North Anna 3 Fuel Rack Seismic Analysis” (ADAMS Accession No. ML16125A364)

2. 003N0526, Revision 1, “North Anna 3 Seismic Qualification of Spent Fuel in the Spent Fuel Racks” (ADAMS Accession No. ML16153A388, ML16125A367 Non-public)

As a result of the staff's review of the prior FSAR Revision 8, the staff noted that FSAR Section 9.1 provides the structural assessment of the new and spent fuel storage racks in the buffer pool and spent fuel pool, based on the DCD seismic demands, and not the North Anna 3 site-specific seismic loadings. Therefore, the staff requested, in RAI 03.07.02-20, that the applicant provide a site-specific structural assessment of the acceptability of the new and spent fuel storage racks for the site-specific departure (NAPS DEP 3.7-1), related to any exceedances in the seismic inputs at the North Anna 3 site. In response to this RAI (ADAMS Accession No. ML15364A384), the applicant revised FSAR Sections 9.1.1 and 9.1.2 to describe the site-specific seismic evaluations of the structural design of the new fuel storage racks and the spent fuel storage racks, respectively. The revised FSAR Section 9.1.2.4 also provides evaluations of the adequacy of the spent fuel stored in the spent fuel racks to withstand the site-specific North Anna 3 SSE. Details of the site-specific assessments are described in GEH Reports 002N8467, Revision 4 and 003N0526, Revision 1.

In FSAR Revision 9, Section 9.1, the applicant stated that the site-specific assessment of the structural design of the spent and new fuel storage racks was performed using the same method as the standard design evaluations, but used the North Anna 3 seismic demand. The applicant used the guidance of Appendix D of SRP Section 3.8.4 in its assessment. Based on its site-specific evaluation for the fuel racks, the applicant concluded that: (1) the standard design of the spent fuel racks in the spent fuel pool is adequate for the site-specific seismic demand, (2) for the spent fuel racks in the buffer pool deep pit, changes in the size of the anchor bolts and the welds from the enveloping plate to the base stiffener plate are necessary to ensure seismic adequacy of these racks for North Anna 3 seismic demand, (3) for the new fuel storage racks located only in the buffer pool, changes in the size of the anchor bolts are necessary to ensure seismic adequacy of these racks for North Anna 3 site-specific seismic demand, and (4) for both the spent fuel racks in the buffer pool deep pit and the new fuel storage racks in the buffer pool, the site-specific embedment design loads for the concrete anchors are higher than the corresponding standard design embedment loads. The applicant also indicated that the increase in North Anna 3 embedment loads due to increase in site-specific seismic demand will be accommodated during the detailed design phase.

In addition to the information provided in FSAR Section 9.1, the staff reviewed the GEH Report 002N8467, Revision 4, to confirm the basis for the FSAR results. In addition the staff reviewed the response to RAI 03.07.02-20 (ADAMS Accession No. ML15364A384) and confirmed the supporting analysis used during the North Anna 3 Audit 2. GEH Report 002N8467, Revision 4 summarizes the analysis of all three fuel rack designs: spent fuel storage racks in the spent fuel pool, spent fuel storage racks in the buffer pool deep pit, and the new fuel storage racks in the buffer pool. The fuel racks were reanalyzed using the North Anna 3 site-specific ISRS. A comparison of the North Anna 3 site-specific ISRS to the standard design input response spectra used previously was presented in the report. There were some increases in the North Anna 3 ISRS at certain frequency ranges, with the more significant increases occurring primarily in the vertical direction.

The staff noted that both the transient analysis approach and the response spectra analysis approach were used for the analysis of the fuel storage racks. The transient analysis approach requires developing synthetic acceleration time histories whose spectra should envelop the input response spectra. The staff reviewed the applicant's approach for developing the synthetic time histories used in the transient analysis of the fuel racks from the site-specific input response spectra. The staff noted that for the spent fuel storage racks in the spent fuel pool and the new fuel storage racks in the buffer pool, the synthetic time histories were developed from the site-specific bounding ISRS at the corresponding locations obtained from the site-specific SSI analyses of the RB/FB. The staff also verified during North Anna 3 Audit 2 that the response spectra generated from these time histories envelop the site-specific ISRS. However, the staff noted that the site-specific buffer pool response spectra, used to develop the synthetic time histories for the evaluation of the spent fuel storage racks in the buffer pool deep pit (at a lower elevation), do not envelop the response spectra at the location of the buffer pool deep pit.

As a result of this issue as well as questions related to the review of earlier revisions of GEH Reports 002N8467 and 003N0526, the staff raised several concerns related to the spent fuel racks, new fuel racks, and spent fuel in the spent fuel racks during a public meeting on March 3, 2016 (ADAMS Accession No. ML16204A243). The staff's technical evaluation of these concerns and issues is described below.

Fuel Storage Racks - Synthetic Time Histories

The first question was to demonstrate the adequacy of the synthetic time histories used to perform the nonlinear dynamic analyses of the fuel racks. During the North Anna 3 Audit 2, the applicant provided and the staff reviewed Equipos Nucleares, S.A. (ENSA) Technical Note "ESBWR Fuel Building Pool Bottom Synthesized SSE Accelerations Time Histories," Document 5926ATN02, Revision 3 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047). For the spent fuel racks in the spent fuel pool, this report showed a spectral comparison between the spectra corresponding to the synthetic time histories and the required North Anna 3 floor response spectra for the spent fuel rack analysis. The staff noted that there were significant margins in the spectra comparison for the X (horizontal) direction for frequencies above the lowest rack frequency. In the Y (other horizontal direction) and Z (vertical) directions there were some small margins. The staff also noted that the stress results for the racks were substantially smaller than the allowable stress limits. Thus, the synthetic time histories were considered to be acceptable for the spent fuel rack time history analyses in terms of spectral matching to the corresponding input response spectra.

For the spent fuel racks in the buffer pool deep pit, the applicant explained that the spent fuel racks are anchored to the pool floor and thus, a response spectrum analysis is performed for evaluation of the racks. The time history analysis is only performed for evaluation of the fuel in the rack and to obtain the horizontal and vertical impact forces onto the rack due to the gaps between the fuel and the rack. For this set of time histories, the staff reviewed Empresarios "Design Report of the Spent Fuel Storage Racks in Reactor Building for North Anna 3," Document 092-175-F-M-00003, Revision 1 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047). Based on the spectral matching comparisons of the spectra corresponding to the synthetic time histories and the required response spectra, the substantial margin in the rack bottom plate stress, and the margins in the acceleration values for the fuel, the synthetic time histories used as input in the time history analyses were considered to be acceptable in terms of spectral matching to the corresponding input response spectra.

For the new fuel racks in the buffer pool, the fuel racks are also anchored to the pool floor and thus, a response spectrum analysis is performed for evaluation of the racks. The time history analysis is only performed for evaluation of the fuel in the rack and to obtain the horizontal and vertical impact forces onto the rack due to the gaps between the fuel and the rack. For this set of time histories, the staff reviewed Empresarios "Design Report of the New Fuel Storage Racks in the Reactor Building for North Anna 3," Document 092-322-F-M-00002, Revision 2 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047). Based on the spectral matching comparisons of the spectra corresponding to the synthetic time histories and the required response spectra, the substantial margin in the rack bottom plate calculated stress, and the margins in the acceleration values for the fuel, the synthetic time histories used as input in the time history analyses were considered to be acceptable in terms of spectral matching to the corresponding input response spectra.

Fuel Storage Racks - Correlation Coefficients of Seismic Synthetic Time Histories

For the new fuel racks in the buffer pool, and the spent fuel in the buffer pool deep pit the seismic time history correlation coefficients were determined to be 0.14 which are less than the 0.16 acceptance criterion provided in SRP Section 3.7.1, Revision 4, and thus, are considered to be acceptable. However, for the spent fuel racks in the spent fuel pool some of the correlation coefficients are greater than 0.16. During the North Anna 3 Audit 2, the applicant provided additional technical information to address this issue, which was included as an update in GEH Report 002N8467, Revision 4. The information provides justification based on very small coupling between horizontal and vertical response, conservative method of utilizing the peak impact dynamic loads obtained from the time history analyses and applying them to the FEM as static forces, and the substantial margins in the calculated stresses. On this basis, the staff concluded that the exceedances in correlation coefficients between pairs of synthetic time histories are acceptable.

Fuel Storage Racks - Use of Buffer Pool Response Spectra for Time History Analysis of Spent Fuel Racks in Buffer Pool Deep Pit

For the seismic time history analysis of the spent fuel racks in the buffer pool deep pit, the synthetic time histories were developed based on the response spectra of the buffer pool (at a higher elevation) rather than the elevation of the buffer pool deep pit, or the envelope of the two elevations of the two buffer pools. The applicant explained that based on the spectra comparison of the two elevations, exceedances in the spectra for the lower elevation occur only in the horizontal direction. Also, the time history analysis is only performed for evaluation of the fuel in the rack and to obtain the horizontal and vertical impact forces from the fuel onto the fuel rack due to the gaps between the fuel and the rack. The horizontal forces at the top of the rack are negligible, and the vertical spectrum used in developing the vertical time history was larger than the spectrum at the deep buffer pool elevation, and thus acceptable. Lastly, the stress analysis of the bottom plate of the rack shows substantial margin, and as discussed below, the fuel assembly qualification shows sufficient margin as well. Therefore, the staff concluded that the use of the buffer pool response spectra for evaluation of the spent fuel racks in the buffer pool deep pit is acceptable.

Spent Fuel Stored in the Spent Fuel Racks

The staff reviewed GEH Report 003N0526, Revision 0, and discussed with the applicant several questions that arose from this review. The seismic qualification methodology for the spent fuel was the same as the approach used in the ESBWR standard plant except that the results were generated using the North Anna 3 site-specific seismic input. The results of this North Anna 3 site-specific analysis provided the maximum horizontal and vertical accelerations of the fuel in the rack and compared these demand accelerations with the acceleration limits previously determined for the fuel. In the horizontal direction, the maximum accelerations in the two perpendicular directions were combined by the SRSS method to obtain the resultant horizontal peak acceleration. To demonstrate adequacy of the fuel in the rack, Table 2 in GEH Report 003N0526, Revision 0 provides comparisons between the fuel accelerations in the spent fuel pool and the buffer pool and the GE14 fuel acceleration acceptance limits. The horizontal and vertical demand acceleration values were less than the corresponding acceleration acceptance limits. However, the potential for interaction of the horizontal and vertical demand acceleration values was not considered; therefore, the staff requested the applicant to consider the interaction effects that would exist for the GE fuel. As a result, the applicant provided a figure showing the interaction curve for the GE fuel acceptance limit. The calculated demand horizontal and vertical acceleration values fell within the interaction acceptance curve demonstrating the fuel is qualified. This information was included in the GEH Report 003N0526, Revision 1 which was reviewed and information confirmed during the North Anna 3 Audit 2. Based on the above evaluation, the staff concluded that the spent fuel stored in the spent fuel racks are structurally adequate.

<u>Summary of Staff Evaluation for Fuel Racks and Spent Fuel in Spent Fuel Racks</u>

Based on the staff review of the information provided in the North Anna 3 FSAR, GEH reports, North Anna 3 Audit 2, and the above discussion, the staff found that the analysis approach, industry codes and standards, structural materials and their properties, loads and load combinations, and the method for checking the design of the steel components were consistent with those used in the standard design. The staff verified that the site-specific input response spectra used for the analysis are the North Anna 3 bounding design ISRS obtained from the site-specific bounding SSI analysis described in FSAR Appendix 3A, Section 3A.18.2. With the several design changes as described in this SER under the heading "*Fuel Rack and Spent Fuel in Spent Fuel Rack,"* above, which will be addressed in detailed design for North Anna 3 plant, the results of the reanalysis of the fuel racks show that the forces, displacements, component stresses, and maximum reactions on the bearing pads in the pool liner are either bounded by the results presented in NEDO-33373, Revision 5, "Dynamic Load-Drop and Thermal-Hydraulic Analyses for ESBWR Fuel Racks," September 2010 (GEH report for the ESBWR standard design of the racks, ADAMS Accession No. ML102990229) or are below their code allowable values. For the spent fuel stored in spent fuel racks, the applicant demonstrated that the calculated North Anna 3 site-specific demand horizontal and vertical acceleration values for the fuel fell within the interaction acceptance limits, demonstrating the fuel integrity.

3.8.4.5 Post Combined License Activities

There are no post COL activities related to this section. ITAAC in DCD Tier 1, Revision 10, with the modification of the SSE definition will address the as-built verification of the other seismic Category I structures for the North Anna 3 seismic demand.

3.8.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the North Anna 3 application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to other seismic Category I structures that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.8.4, and other NRC RGs. The staff finds that the applicant has addressed the areas related to other seismic Category I structures in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concludes that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.8.4.3 of this SER.

3.8.5 Foundations

3.8.5.1 Introduction

FSAR Section 3.8.5 and Appendix 3G address the structural analysis and design of foundations for the RB/FB, CB, and FWSC structures. The ESBWR design approach for the standard plant design of these structures is provided in Section 3.8.5 and Appendix 3G of ESBWR DCD, Tier 2, Revision 10.

3.8.5.2 Summary of Application

FSAR Section 3.8.5 and Appendix 3G of the North Anna 3 FSAR, Revision 9, incorporate by reference Section 3.8.5 and Appendix 3G of the ESBWR DCD, with the departure given below.

Departure

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra.

This departure relates to the North Anna 3 site-specific horizontal and vertical seismic ground response spectra. These spectra result in exceedances at certain frequencies when compared to the DCD CSDRS. As a result, the applicant performed new site-specific seismic SSI and SSSI analyses with the site-specific ground response spectra and the site-specific subgrade properties. In some cases, the seismic structural loads were found to be higher than those used for the standard design, and thus, a structural evaluation of the North Anna 3 structures was performed. As a result of the increased seismic loads, a number of additions and deletions were made to Appendix 3G related to the analysis and design of the foundations.

FSAR Appendix 3G, Section 3G.7 provides the site-specific structural evaluation of the RB foundation which is part of the RB/FB complex. FSAR Appendix 3G, Section 3G.8 provides the site-specific structural evaluation of the CB foundation. FSAR Appendix 3G, Section 3G.9 provides the site-specific structural evaluation of the FB foundation. FSAR Appendix 3G, Section 3G.10 provides the site-specific structural evaluation of the FWSC foundation. The loads, load combinations, material properties, analysis and design evaluations are provided within each of these FSAR sections.

3.8.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the foundations of seismic Category I structures, and the associated acceptance criteria, are in SRP Section 3.8.5. The specific requirements include the following:

- 10 CFR 50.55a and 10 CFR Part 50, Appendix A, GDC 1, as they relate to safety-related structures being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

- 10 CFR Part 50, Appendix A, GDC 2, as it relates to the design of the safety-related structures that are capable of withstanding the most severe natural phenomena, such as wind, tornadoes, hurricanes, floods, and earthquakes and the appropriate combination of all loads.

- 10 CFR Part 50, Appendix A, GDC 4, as it relates to appropriately protecting safety-related structures against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit.

- 10 CFR Part 50, Appendix A, GDC 5, as it relates to not sharing safety-related structures among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions..

- 10 CFR Part 50, Appendix B as it relates to the QA criteria for nuclear power plants.

- 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the Commission's rules and regulations.

In addition, the acceptance criteria and regulatory guidance associated with the review of FSAR Section 3.8.5 include the following:

- SRP Section 3.8.5 guidance to review the design, construction, and testing of foundations to ensure that these structures maintain their structural integrity and can perform their intended safety function during all loading conditions.

- RGs listed in SER Section 3.8.1.3 and Section 3.8.4.3 as applicable.

3.8.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.8.5 and Appendix 3G of the ESBWR DCD. The staff reviewed Section 3.8.5 and Appendix 3G of the North Anna 3 FSAR, Revision 9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information relating to this section. The staff reviewed the information in the North Anna 3 FSAR as given below.

In addition, the staff conducted a structural audit (North Anna 3 Audit 2) during the week of March 21, 2016 at the applicant's contractor GEH office in Wilmington, North Carolina. The purpose of this audit was to (1) review detailed analysis reports and design calculations performed by the applicant that support the information in the FSAR, (2) confirm the basis supporting the applicants' RAI responses, and (3) review the draft FSAR revisions from RAI responses to ensure consistency with the applicant's design basis information.

Departure

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 related to the applicant's structural evaluation of foundations for the site-specific seismic loads applied to seismic Category I structures. These evaluations are described in FSAR Appendix 3G, Sections 3G.7 through 3G.10 for the RB, CB, FB, and FWSC, respectively. The staff's technical evaluation of the design of foundations considering these site-specific loads is given below.

Foundation Evaluation of RB and FB

As described in this SER Section 3.8.1.4 for the RB/FB complex, the foundations of the RB and FB are included in the modeling, analysis, and design of the RB/FB. Therefore, the staff technical evaluation of the analytical model; site design loads, load combinations, and material properties; structural analysis; and structural design of the foundations for the RB/FB is provided in this SER Section 3.8.1.4.

The staff evaluation of other aspects of the site-specific structural evaluations for the RB/FB foundations is described in this SER Section below under the heading of "*Dynamic Bearing Pressures.*" These include site-specific evaluations performed for stability, dynamic bearing pressure beneath the foundations, and lateral subgrade pressures on embedded walls. The site-specific evaluations for these items are described in FSAR Appendix 3G, Sections 3G.7.5.5 and 3G.7.5.6 and in the GEH report identified below:

1. WG3-U71-ERD-S-0003, Revision 1, "Reactor/Fuel Building Complex Stability Analysis Report" (ADAMS Accession No. ML15362A009)

Stability Evaluation

The staff reviewed FSAR Appendix 3G, Section 3G.7.5.5 and GEH Report WG3-U71-ERD-S-0003, Revision 1, which contain the site-specific stability evaluation of the RB/FB for overturning and sliding when subjected to the site-specific seismic loading. As stated in FSAR Appendix 3G, Section 3G.7.5.5 and this GEH report, for the overturning stability evaluation, the energy approach described in DCD Tier 2, Section 3.7.2.14 was used. This approach calculated the maximum kinetic energy imparted on the RB/FB from the seismic event and the energy that is needed to overturn the structure. The energy needed to overturn the structure is equivalent to the maximum potential energy of the structure as it rotates about a pivot point before it tips over. The effect of buoyancy due to groundwater is included to reduce the weight of the structure, which reduces the potential energy. The staff also noted that the effects of embedment in providing some resistance to overturning were conservatively neglected in the calculations. The FOS was defined as the ratio of the energy needed to overturn the structure to the kinetic energy imparted on the RB/FB.

The calculations for overturning, as well as sliding stability, dynamic bearing pressure, and lateral soil pressures, were performed for the LB, BE, and UB of the partial and full column soil profiles. Each of these calculations considered pairs of N.S. and vertical and then E.W. and vertical seismic motions, which result in a total of 12 overturning cases. The results, as presented in FSAR Appendix 3G, Table 3G.7-225(a), show that the minimum FOS for all of these cases was 924 which is substantially larger than the minimum FOS of 1.1 used as the acceptance criterion. The staff noted that the minimum FOS criterion of 1.1 and the load combination used for the overturning stability evaluation are in accordance with SRP Section 3.8.5.

During the public meeting on March 3, 2016 (ADAMS Accession No. ML16204A243) prior to the North Anna 3 Audit 2, the staff questioned the applicant about the use of the North Anna 3 site-specific seismic loading corresponding to the RB/FB upper bound stiffness (uncracked) concrete properties and OBE damping values for the seismic demand in the various stability evaluations. The applicant explained that the analyses of models with the upper bound stiffness properties provide seismic demands that bound the effects of structural stiffness variations on the stability, dynamic bearing pressures beneath the structure foundation, and lateral pressure demands on the embedded walls. In addition, there is no need to check the seismic demand from SSSI analyses because as discussed in this SER Section 3.8.4.4 under the heading "*Site Design Loads, Load Combinations, and Material Properties*," the RB/FB is much more massive than the adjacent CB, and thus the seismic SSSI effects would not significantly affect the seismic SSI loads. Lastly, considering the very large FOS values calculated the use of only the SSI seismic loads are considered to be acceptable.

For sliding stability evaluation, the approach used is consistent with the methodology utilized for the standard design presented in DCD Tier 2, Section 3.8.5.5. The RB/FB sliding stability evaluations consider the critical sliding plane located at the bottom of the RB/FB basemat. The sliding evaluation is performed separately for N.S. and vertical directions and then E.W. and vertical directions, using a linear time history analysis approach. At each time step the FOS is calculated, and the minimum value obtained during the duration of the site-specific ground motion is identified as the sliding stability FOS. The sliding stability evaluation considered the frictional resistance at the bottom of the basemat, and if needed, the lateral resistance pressure on the embedded exterior wall and basemat opposite to the direction of the seismic motion. The staff notes that the calculations conservatively neglected the skin friction resistance provided by the (a) vertical surfaces of the basemat side and shear key side parallel to the direction of motion, (b) lateral resistance pressure on the shear key opposite to the direction of motion, and (c) lateral resistance from the structural fill above the Zone III rock (i.e., upper 17 ft).

The coefficient of friction value of 0.6 was used in the sliding evaluation which the staff confirmed is consistent with the value for the foundation to Zone III-IV rock interface presented in FSAR Section 2.5.4. The FOS was calculated as the ratio of the friction resistance force at the bottom of the RB/FB basemat to the time history results of the horizontal seismic driving (demand) force. The friction resistance force considered the seismic gravity load as the sum of the dead load and 25 percent of live load. In addition, the effect of buoyancy due to the ground water, in reducing the gravity load, was considered. The seismic driving force did consider the effect of the lateral soil force on the RB due to the turbine building surcharge load, which would increase the driving force. Thus the staff concludes that all applicable loads were included in the calculation of the FOS.

At a particular instance of time, if the base friction resistance beneath the basemat alone was not sufficient to develop the minimum FOS of 1.1 against sliding, the additional lateral resistance force acting on the embedded exterior wall and basemat opposite to the direction of motion was calculated. These passive lateral pressure calculations conservatively assume that the lateral resistance against sliding is provided only by the concrete fill and the Zone III rock, and neglects the lateral resistance that could be provided above the upper 17 ft of structural fill and the Zone III rock.

As in the overturning stability evaluations discussed above, the sliding stability evaluations also were performed for the LB, BE, and UB of the partial and full column soil profiles. The results, as presented in FSAR Appendix 3G, Table 3G.7-225(b), show that the minimum FOS of 1.1 is satisfied in some of the 12 cases analyzed when relying only on the friction resistance force beneath the basemat and in the other cases some passive lateral pressure resistance is needed to maintain the FOS of 1.1. As discussed below in this SER section under the heading of "*Dynamic Bearing Pressures*," these lateral passive pressures are used in the design evaluations of the RB/FB foundation walls which are enveloped by the corresponding standard design loads.

Based on the above discussion, the staff concluded that the seismic overturning and sliding stability evaluations are acceptable.

Dynamic Bearing Pressures

The staff reviewed FSAR Appendix 3G, Section 3G.7.5.5 and GEH Report WG3-U71-ERD-S-0003, Revision 1, which contain the site-specific evaluation of the RB/FB for developing the dynamic bearing pressures on the Zone III-IV rock beneath the RB/FB basemat. As stated in the above FSAR section and the GEH report, the maximum dynamic bearing pressure demands from the RB/FB basemat on the supporting Zone III-IV rock at the North Anna 3 site are evaluated using the Energy Balance/Modified Energy Balance (EB/MEB) method consistent with the methodology used in the standard design. The SASSI2010 analysis results for the spring forces at the bottom of the RB/FB basemat from the SSI analyses of RB/FB for the partial and full column LB, BE, and UB subsurface profiles were used to determine the dynamic bearing pressures. The dynamic bearing pressure evaluation considered the seismic weight of the RB/FB that consists of the building dead load and 25 percent of the design live loads. Since this method of analysis is consistent with the standard design and the criteria in SRP 3.8.5, the staff considers this approach acceptable.

As shown in FSAR Appendix 3G, Table 3G.7-231, the calculations of the maximum dynamic bearing pressure demand beneath the RB/FB foundation, results in a maximum toe bearing pressure demand of 1.37 MPa (28.6 ksf) which is lower than the maximum toe bearing pressure demand of 2.7 MPa (56.4 ksf) determined by the standard design (DCD Appendix 3G, Table 3G.1-58). In addition, the maximum calculated dynamic bearing pressure demand is also lower than the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock underlying the RB/FB foundation. The staff confirmed that the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock matches the allowable value given in FSAR Table 2.5.4-211. Therefore, the staff concluded that the calculated maximum site-specific dynamic bearing pressure is considered to be acceptable, with a large margin.

Lateral Pressures on Exterior Embedded Walls

The staff reviewed FSAR Appendix 3G, Section 3G.7.5.6 and GEH Report WG3-U71-ERD-S-0003, Revision 1, which contains the site-specific evaluation of the RB/FB for developing the lateral pressures acting on below grade exterior walls. The plots of the vertical distribution of lateral pressures acting on the various walls due to the at-rest static pressure, seismic dynamic pressure, sum of the static and dynamic pressure, as well as the passive pressure distributions are shown in FSAR Appendix 3G, Figures 3G.7-205 through 3G.7-212. These figures also show the lateral pressure distributions from the standard design to enable comparisons to be made.

The GEH report indicates that the site-specific lateral pressure demands on the embedded exterior walls were developed following the same approach that was used for the standard design. The distribution of the static pressure includes the at-rest static soil pressure and the hydrostatic pressure from the groundwater using the North Anna 3 site-specific values of the at-rest soil coefficients of lateral earth pressure and the groundwater level depth.

The dynamic pressure distributions are developed based on the SSI analysis results for horizontal forces of the contact springs located at the wall-subgrade interfaces. FSAR Appendix 3G, Figures 3G.7-205 through 3G.7-212 show the envelope of the lateral pressure results obtained from the SSI analyses of the LB, BE and UB subgrade profiles. The site-specific static and dynamic lateral pressure demands are compared with the corresponding static and dynamic lateral pressure loads used for the standard design of the RB/FB.

In addition, total lateral pressures corresponding to the sum of the site-specific static and dynamic lateral pressures are presented in FSAR Appendix 3G, Figures 3G.7-205 through 3G.7-212 and the GEH report. These plots also present the distributions of the maximum site-specific passive lateral pressures that are determined from the results of the sliding stability evaluation discussed above in order to satisfy the sliding FOS of 1.1. These two sets of site-specific lateral pressures are compared with the corresponding total lateral soil pressures calculated in the standard design and the standard design wall capacity passive resistance pressures.

The comparisons of the lateral soil pressure distributions presented in FSAR Appendix 3G, Figures 3G.7-205 through 3G.7-212 show that near the floor slab at Elevation 270.3 ft, the site-specific total lateral pressures exceed the lateral pressures used for the standard design. Therefore, for seismic loads, the North Anna 3 site-specific seismic demand pressures were used for design evaluation of the exterior embedded walls. The lateral passive pressures, needed to maintain sliding stability, were also considered in the structural evaluations. For the static lateral pressures, the higher standard design static lateral pressure loads were used in the design evaluation.

Based on the above discussion, the staff considers that the approach to calculate the lateral soil pressures is acceptable, and where the lateral pressures exceed the pressures used in the standard design, these higher demand loads are also acceptable because they are used in the site-specific design evaluations.

Foundation Evaluation of CB

The foundation for the CB is included in the modeling, analysis, and design of the CB structure. Therefore, the staff evaluation of the analytical model; site design loads, load combinations, and material properties; structural analysis; and structural design of the foundation for the CB is provided in SER Section 3.8.4.4.

The staff evaluation of other aspects of the site-specific structural evaluations for the CB foundation is described in this SER sections that follow below. These include site-specific evaluations performed for stability, dynamic bearing pressure beneath the foundation, and lateral soil pressures on embedded walls. The site-specific evaluations for these items are described in FSAR Appendix 3G, Sections 3G.8.5.5 and 3G.8.5.6 and in the GEH report identified below:

1. WG3-U73-ERD-S-0003, Revision 3, "Control Building Stability Analysis Report," (ADAMS Accession No. ML16148A129)

Stability Evaluation

The staff reviewed FSAR Appendix 3G, Section 3G.8.5.5 and GEH Report WG3-U73-ERD-S-0003, Revision 3, which contain the site-specific stability evaluation of the CB for overturning and sliding when subjected to the site-specific seismic loading. As stated in this GEH report, for the overturning stability evaluation, the energy approach described in DCD Tier 2, Section 3.7.2.14 was used. This approach calculated the maximum kinetic energy imparted on the CB from the seismic event and the energy that is needed to overturn the structure. The energy needed to overturn the structure is equivalent to the maximum potential energy of the structure as it rotates about a pivot point before it tips over. The effect of buoyancy due to groundwater is included to reduce the weight of the structure, which reduces the potential energy. The staff also noted that the effects of embedment in providing some resistance to overturning were conservatively neglected in the calculations. The FOS was defined as the ratio of the energy needed to overturn the structure to the kinetic energy imparted on the CB.

The calculations for overturning, as well as sliding stability, dynamic bearing pressure, and lateral soil pressures, were performed for the LB, BE, and UB of the partial and full column soil profiles. Each of these calculations considered pairs of N.S. and vertical and then E.W. and vertical seismic motions, which result in a total of 12 overturning cases. The results, as presented in FSAR Appendix 3G, Table 3G.8-208, show that the minimum FOS for all of these cases was 519 which is substantially larger than the minimum FOS of 1.1 used as the acceptance criterion. The staff noted that the minimum FOS criterion of 1.1 and the load combination used for the overturning stability evaluation are in accordance with SRP Section 3.8.5.

During the public meeting on March 3, 2016 (ADAMS Accession No. ML16204A243) prior to the North Anna 3 Audit 2, the staff questioned the applicant about the use of the North Anna 3 site-specific seismic loading corresponding to the CB upper bound stiffness (uncracked) concrete properties and SSE damping values for the seismic demand in the various stability evaluations. The applicant explained that the analyses of models with the upper bound stiffness properties provide seismic demands that bound the effects of concrete cracking on the seismic demands on the CB foundation and below grade exterior walls. Regarding the need to consider seismic

SSSI loads, the applicant indicated that with a few exceptions, the SSI analyses of the CB standalone model with full stiffness and SSE damping properties also provide seismic demands that bound the SSSI effects of RB/FB and FWSC on the CB foundation stability, foundation dynamic bearing pressures and below grade exterior wall lateral pressure demands. In the few exceptions, the exceedances in the lateral pressure demands on the CB wall facing the RB/FB have negligible effects on the results of the site-specific evaluations. Lastly, considering the very large FOS values calculated, the use of only the SSI seismic loads are considered to be acceptable.

For sliding stability evaluation, the approach used for the CB is consistent with the methodology utilized for the standard design presented in DCD Tier 2, Section 3.8.5.5. The CB sliding stability evaluations consider two critical sliding planes located at the bottom of the CB basemat and the bottom of the concrete fill block supporting the CB basemat. The sliding evaluation is performed separately for N.S. and vertical directions and then E.W. and vertical directions, using a linear time history analysis approach. At each time step the FOS is calculated, and the minimum value obtained during the duration of the site-specific ground motion is identified as the sliding stability FOS.

For the sliding stability evaluation located at the bottom of the CB basemat, the sliding evaluation considered the frictional resistance at the bottom of the basemat, and if needed, the lateral passive pressure resistance provided by the concrete fill and Zone III rock subgrade materials surrounding the CB embedded exterior walls and the CB basemat in the opposite direction of the seismic motion. The staff notes that the calculations conservatively neglected the skin friction resistance provided by the vertical surfaces of the CB embedded exterior walls and basemat sides parallel to the direction of seismic motion, as well as the lateral passive pressure resistance provided by the structural fill and in-situ saprolite material on the face of the embedded exterior wall in the opposite direction of the seismic motion.

For the sliding stability evaluation located at the bottom of the concrete fill supporting the CB foundation, the sliding evaluation considered the frictional resistance at the bottom of the concrete fill block, and if needed, the lateral passive pressure resistance provided by the surrounding concrete fill and Zone III rock subgrade materials. The staff notes that the calculations conservatively neglected the skin friction resistance provided by the vertical surfaces of the CB embedded exterior walls, basemat, and concrete fill block sides parallel to the direction of seismic motion. The calculations also conservatively neglected the lateral passive pressure resistance provided by the structural fill and in-situ saprolite material above the Zone III rock on the face of the embedded exterior wall in the opposite direction of the seismic motion.

The coefficient of friction value of 0.6 was used in the sliding evaluation which the staff confirmed is consistent with the value for the foundation to concrete fill and to rock interface presented in FSAR Section 2.5.4. The FOS was calculated as the ratio of the friction resistance force at the bottom of the CB basemat or bottom of the concrete fill to the time history results of the horizontal seismic driving force. The friction resistance force considered the seismic gravity load as the sum of the dead load and 25 percent of live load. In addition, the effect of buoyancy due to the ground water, in reducing the gravity load, was considered. Thus the staff concluded that all applicable loads were included in the calculation of the FOS.

At a particular instance of time, if the base friction resistance beneath the basemat and beneath the concrete fill block alone was not sufficient to develop the minimum FOS of 1.1 against sliding, the additional lateral resistance force acting on the embedded exterior wall and basemat opposite to the direction of motion was calculated.

As in the overturning stability evaluations discussed above, the sliding stability evaluations were also performed for the LB, BE, and UB of the partial and full column soil profiles. The results, as presented in FSAR Appendix 3G, Table 3G.8-209, show that the minimum FOS of 1.1 is satisfied in all 12 cases analyzed; however, to achieve this, passive lateral pressure resistance is needed to maintain the FOS of 1.1. As discussed below in this SER section, these lateral passive pressures are used in the site-specific design evaluations to confirm that the standard design envelopes the site-specific exceedances.

Based on the above discussion, the staff concluded that the seismic overturning and sliding stability evaluations are acceptable.

Dynamic Bearing Pressures

The staff reviewed FSAR Appendix 3G,Section 3G.8.5.5 and GEH Report WG3-U73-ERD-S-0003, Revision 3, which contain the site-specific evaluation of the CB for developing the dynamic bearing pressures on the concrete fill block and on the Zone III-IV rock beneath the concrete fill. As stated in the above FSAR section and the GEH report, the maximum site-specific dynamic bearing pressure demands from the CB basemat on the concrete fill and the Zone III-IV rock are evaluated using the EB/MEB method consistent with the methodology used in the standard design. The SASSI2010 analysis results for the spring forces at the bottom of the CB basemat from the SSI analyses of CB for the partial and full column LB, BE, and UB subsurface profiles were used to determine the dynamic bearing pressures. The dynamic bearing pressure evaluation considered the seismic weight of the CB that consists of the building dead load and 25 percent of the design live loads. Since this method of analysis is consistent with the standard design and the criteria in SRP Section 3.8.5, the staff considers this approach acceptable.

As shown in FSAR Appendix 3G, Table 3G.8- 211a, for the case of the maximum dynamic bearing pressure demand of the CB basemat on the concrete fill block, the maximum calculated toe bearing pressure demand of 1.46 MPa (30.5 ksf) is lower than the maximum toe bearing pressure demand of 2.19 MPa (45.7 ksf) determined by the standard design. In addition, the maximum calculated dynamic bearing pressure demand is also lower than the allowable dynamic bearing pressure of 8.0 MPa (167 ksf) for the concrete fill material based on ACI 318-05.

As shown in FSAR Appendix 3G, Table 3G.8- 211b, for the case of the maximum dynamic bearing pressure demand of the CB and the concrete fill block on the underlying Zone III-IV rock, the maximum calculated toe bearing pressure demand of 0.73 MPa (15.2 ksf) is lower than the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock. The staff confirmed that the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock matches the allowable value given in FSAR Section 2.5.4.

Therefore, the staff concluded that the calculated maximum site-specific dynamic bearing pressure demands of the CB are acceptable, with large margins against allowable values.

Lateral Pressures on Exterior Embedded Walls

The staff reviewed FSAR Appendix 3G, Section 3G.8.5.6 and GEH Report WG3-U73-ERD-S-0003, Revision 3, which contain the site-specific evaluation of the CB for developing the lateral soil pressures on below grade exterior walls. The plots of the vertical distribution of lateral pressures acting on the various walls due to the at-rest static pressure, seismic dynamic pressure, sum of the static and dynamic pressure, as well as the passive pressure distributions are shown in FSAR Appendix 3G, Figures 3G.8-203 through 3G.8-210. These figures also show the lateral pressure distributions from the standard design to enable comparisons to be made.

The GEH report indicates that the site-specific lateral pressure demands on the embedded exterior walls were developed following the same approach that was used for the standard design. The distribution of the static pressure includes the at-rest static soil pressure and the hydrostatic pressure from the groundwater using the North Anna 3 site-specific values of the at-rest soil coefficients and the groundwater level depth.

The dynamic pressure distributions are developed based on the SSI analysis results for horizontal forces of the contact springs located at the wall-subgrade interfaces. FSAR Appendix 3G, Figures 3G.8-203 through 3G.8-210 show the envelope of the lateral pressure results obtained from the SSI analyses of the LB, BE, and UB subgrade profiles. The site-specific static and dynamic lateral pressure demands are compared with the corresponding static and dynamic lateral pressure loads used for the standard design of the CB.

In addition, total lateral pressures corresponding to the sum of the site-specific static and dynamic lateral pressures are presented in FSAR Appendix 3G, Figures 3G.8-203 through 3G.8210 and the GEH report. These plots also present the distributions of the maximum site-specific passive lateral pressures that are determined from the results of the sliding stability evaluation discussed above in order to satisfy the sliding FOS of 1.1. These two sets of site-specific lateral pressures are compared with the corresponding total lateral soil pressures calculated in the standard design and the standard design wall capacity passive resistance pressures.

The comparisons of the lateral soil pressure distributions presented in FSAR Appendix 3G, Figures 3G.8-203 through 3G.8-210 show that near the floor slab at Elevation 267.9 ft and near the top of the CB basemat, the site-specific total lateral pressures exceed the total lateral pressures used for the standard design. The comparisons also indicate that the lateral passive pressures needed to ensure the stability of the CB against sliding in the EW direction exceed the pressures used in the standard design of the CB wall capacity check. Therefore, the North Anna 3 site-specific seismic demand pressures were used for the site-specific structural evaluation. The lateral passive pressures, needed to maintain sliding stability, were also considered in the structural evaluations. For the static lateral pressures, the higher standard design pressure loads were used.

Based on the above discussion, the staff considers that the approach to calculate the lateral soil pressures is acceptable, and where the lateral pressures exceed the pressures used in the standard design, these higher demand loads are also acceptable because they are used in the site-specific design evaluations.

Foundation Evaluation of FWSC

The foundation for the FWSC is included in the modeling, analysis, and design of the FWSC structure. Therefore, the staff evaluation of the analytical model; site design loads, load combinations, and material properties; structural analysis; and structural design of the foundation for the FWSC is provided in SER Section 3.8.4.4.

The staff evaluation of other aspects of the site-specific structural evaluations for the FWSC foundation is described in this SER section. These include site-specific evaluations performed for stability and dynamic bearing pressure beneath the foundation as described in FSAR Appendix 3G, Section 3G.10.5.5 and the GEH report identified below:

1. WG3-U63-ERD-S-0002, Revision 1, "Firewater Service Complex Stability Analysis Report" (ADAMS Accession No. ML15362A011)

Stability Evaluation

The staff reviewed FSAR Appendix 3G, Section 3G.10.5.5 and GEH Report WG3-U63-ERD-S-0002, Revision 1, which contain the site-specific stability evaluation of the FWSC for overturning and sliding when subjected to the North Anna 3 seismic loading. As stated in FSAR Appendix 3G, Section 3G.10.5.5 and this GEH report, for the overturning stability evaluation, the energy approach described in DCD Tier 2, Section 3.7.2.14 was used. This approach calculated the maximum kinetic energy imparted on the FWSC from the seismic event and the energy that is needed to overturn the structure. The energy needed to overturn the structure is equivalent to the maximum potential energy of the structure as it rotates about a pivot point before it tips over. The FOS was defined as the ratio of the energy needed to overturn the structure to the kinetic energy imparted on the FWSC.

The calculations for overturning stability, as well as sliding stability and dynamic bearing pressure were performed for the site-specific SSI analysis stand-alone model and separately for the site-specific SSSI analysis of the FWSC-CB combined model. For each of these two cases, the evaluation considered full (uncracked concrete) stiffness properties and SSE damping values for the LB, BE, and UB subgrade profiles using the deep input control motion applied at the bottom of the underlying concrete fill block. The overturning evaluations considered pairs of N.S. and vertical and then E.W. and vertical seismic motions, which result in a total of 12 overturning cases. The results, as presented in FSAR Appendix 3G, Table 3G.10-214(a), show that the minimum FOS against overturning for all of these cases was 902 which is substantially larger than the minimum FOS of 1.1 used as the acceptance criterion. The staff noted that the minimum FOS criterion of 1.1 and the load combination used for the overturning stability evaluation are in accordance with SRP Section 3.8.5.

During the public meeting on March 3, 2016 (ADAMS Accession No. ML16204A243) prior to the North Anna 3 Audit 2, the staff questioned the applicant about the use of the North Anna 3 site-specific seismic loading corresponding to the FWSC upper bound stiffness (uncracked) concrete properties and SSE damping values for the seismic demand in the various stability evaluations. The applicant explained that the analyses of models with the upper bound stiffness properties provide seismic demands that bound the effects of concrete cracking on the seismic demands on the FWSC foundation. Also, the staff noted the very large FOS values calculated, and thus this approach is considered to be acceptable.

For sliding stability evaluation, the approach used for the FWSC is consistent with the methodology utilized for the standard design presented in DCD Tier 2, Section 3.8.5.5. The FWSC sliding stability evaluations consider two critical sliding planes; one located at the bottom of the FWSC basemat and the other at the bottom of the concrete fill block supporting the FWSC basemat. The sliding evaluation is performed separately for N.S. and vertical directions and then E.W. and vertical directions, using a linear time history analysis approach. At each time step the FOS is calculated, and the minimum value obtained during the duration of the site-specific ground motion is identified as the sliding stability FOS.

For the sliding stability evaluation at the critical sliding plane located at the bottom of the FWSC basemat, the sliding evaluation considered the frictional resistance between the bottom of the basemat and the top of the supporting concrete fill, and the lateral resistance provided by the shear keys which are embedded in the concrete fill placed under the FWSC. The staff notes that the calculations conservatively neglected the (a) skin friction resistance provided by the sides of the basemat parallel to the direction of the seismic motion, (b) lateral passive resistance provided by the structural fill along the face of the basemat perpendicular to the direction of motion, and (c) skin friction provided by the shear key side parallel to the direction of motion.

For the sliding stability evaluation at the critical sliding plane located at the bottom of the concrete fill supporting the FWSC foundation, the sliding evaluation considered the frictional resistance at the bottom of the underlying concrete fill block, and if needed, the lateral passive pressure resistance provided by the surrounding concrete fill and Zone III rock. The staff notes that the calculations conservatively neglected the lateral resistance provided by the (a) structural fill and in-situ saprolite acting on the FWSC basemat and concrete fill block under the basemat perpendicular to the direction of motion, (b) skin friction resistance acting on the vertical surfaces of the basemat and concrete fill block sides parallel to the direction of motion, and (c) pull-out resistance of the shear keys that contribute to the base friction resistance by resisting the upward forces that would reduce the base friction.

The coefficient of friction value of 0.6 was used in the sliding evaluation which the staff confirmed is consistent with the value for the foundation to concrete fill and concrete fill to Zone III-IV rock interfaces presented in FSAR Section 2.5.4. The FOS was calculated as the ratio of the friction resistance force at the bottom of the FWSC basemat or bottom of the concrete fill to the time history results of the horizontal seismic driving force. The friction resistance force considered the seismic gravity load as the sum of the dead load and 25 percent of live load. In addition, the effect of buoyancy due to the ground water, in reducing the gravity load, was considered. Thus the staff concludes that all applicable loads were included in the calculation of the FOS.

For sliding at the bottom of the FWSC basemat, if the base friction resistance beneath the basemat alone was not sufficient to develop the minimum FOS of 1.1 against sliding, the additional lateral resistance force provided by the shear keys is calculated. Similarly, at the bottom of the concrete fill, if the base friction resistance beneath the concrete fill alone was not sufficient to develop the minimum FOS of 1.1 against sliding, the additional lateral resistance provided by Zone III rock is calculated.

As in the overturning stability evaluations discussed above, the sliding stability evaluations also were performed for a total of 12 cases (combinations of SSI/SSSI, LB/BE/UB subgrade conditions, and N.S./E.W. directions). The lateral resistance force demands on the shear keys or subgrade surrounding the concrete fill under the FWSC are computed if, at a particular instance of time, the friction resistance on a sliding plane analyzed is not sufficient to achieve a minimum FOS of 1.1 against sliding.

Sliding stability calculations showed that the separation between the concrete fill and surrounding soil can amplify the lateral force demands on the FWSC keys. The staff confirmed that the site-specific structural evaluation of the FWSC shear keys used amplified lateral pressure loads that bound the effects of soil separation. FSAR Appendix 3G, Table 3G.10-214(b) presents a summary of the sliding stability analysis at the bottom of the FWSC basemat based on the site-specific lateral force demands on the FWSC shear keys under fully bonded conditions between the concrete fill and surrounding soil. FSAR Appendix 3A, Table 3A.17.14.5-202 presents similar results but under the condition of separation between the concrete fill and surrounding soil. FSAR Appendix 3A, Table 3A.17.14.5-202 further shows that the maximum lateral resistance pressure demand on the concrete fill from the shear key is 1.26 MPa, which is below the allowable lateral bearing pressure of the concrete fill of 8.0 MPa.

FSAR Appendix 3G, Table 3G.10-214(c) presents a summary of the calculations of the FWSC sliding stability at the critical sliding plane at the bottom of the concrete fill. For the instances of time the friction resistance at the bottom of the concrete fill alone is not sufficient, the lateral passive pressure demand required to achieve a minimum FOS of 1.1 against sliding is calculated. FSAR Appendix 3G, Table 3G.10-214(c) shows that the maximum site-specific lateral passive pressure demand on the surrounding subgrade is 0.89 MPa, which is below the allowable dynamic lateral bearing pressure of 1.44 MPa of Zone III rock at the FWSC location as specified in FSAR Appendix 3G, Table 3G.10-201.

The results of the evaluations of sliding stability for the FWSC show that the minimum FOS of 1.1 is satisfied in all 12 cases analyzed, taking into account the lateral resistance force demands (1) on the shear keys at the critical sliding plane at the bottom of the FWSC basemat, and (2) on the surrounding subgrade at the critical sliding plane at the bottom of the concrete fill. The staff noted that the maximum lateral pressure demand on the concrete fill exerted by the shear keys and the maximum passive pressure demand on the subgrade surrounding the concrete fill are below their respective allowable bearing pressures.

Based on the above discussion, the staff concludes that the seismic overturning and sliding stability evaluations for the FWSC foundation are acceptable.

Dynamic Bearing Pressures

The staff reviewed FSAR Appendix 3G, Section 3G.10.5.5 and GEH Report WG3-U63-ERD-S-0002, Revision 1, which contain the site-specific evaluation of the FWSC for developing the dynamic bearing pressures on top of the concrete fill block and on the Zone III-IV beneath the concrete fill. As stated in the above FSAR section and the GEH report, the maximum site-specific dynamic bearing pressure demands from the FWSC basemat on the concrete fill and on the Zone III-IV rock are evaluated using the EB/MEB method consistent with the methodology used in the standard design. The SASSI2010 analysis results for the spring forces at the bottom of the FWSC basemat from the SSI FWSC standalone model and the SSSI analyses of the FWSC-CB combined model for the LB, BE, and UB subsurface profiles were used to determine the dynamic bearing pressures. The dynamic bearing pressure evaluation considered the seismic weight of the FWSC that consists of the building dead load and 25 percent of the design live loads. Since this method of analysis is consistent with the standard design and the acceptance criteria in SRP Section 3.8.5, the staff considers this approach acceptable.

As shown in FSAR Appendix 3G, Table 3G.10-215 for the case of the maximum dynamic bearing pressure demand of the FWSC basemat on the concrete fill block, the maximum calculated site-specific toe bearing pressure demand of 0.89 MPa (18.6 ksf) is lower than the maximum toe bearing pressure demand of 1.2 MPa (25.1 ksf) determined by the standard design. In addition, the maximum calculated dynamic bearing pressure demand is also lower than the allowable dynamic bearing pressure of 8.0 MPa (167 ksf) for the concrete fill material based on ACI 318-05.

As shown in FSAR Appendix 3G, Table 3G.10-215 for the case of the maximum dynamic bearing pressure demand of the FWSC and the concrete fill block on the underlying Zone III-IV rock, the maximum calculated toe bearing pressure demand of 1.85 MPa (38.6 ksf) is lower than the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock. The staff confirmed that the allowable dynamic bearing pressure of 12.4 MPa (259 ksf) for the Zone III-IV rock matches the allowable value given in FSAR Section 2.5.4.

The staff review of the adequacy of the concrete fill as foundation material, including its bearing and shear capacities, is presented in SER Section 2.5.4.

Therefore, the staff concluded that the calculated maximum site-specific dynamic bearing pressure demands of the FWSC are acceptable, with large margins against allowable values.

Lateral Pressures on Exterior Embedded Walls

Since the FWSC is a surface mounted structure there are no embedded walls, and thus, there is no lateral soil pressures that need to be evaluated.

3.8.5.5 Post Combined License Activities

There are no post COL activities related to this section.

3.8.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 FSAR related to this section. All nuclear safety issues relating to foundations that were incorporated by reference have been resolved.

The staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.8.5, and other NRC RGs. The staff found that the applicant has addressed the areas related to foundations in accordance with the acceptance criteria delineated in these guidance documents. On this basis, the staff concluded that the applicant has satisfied the relevant requirements of the regulations delineated in Section 3.8.5.3 of this SER.

3.9 Mechanical Systems and Components

3.9.1 Introduction

This section addresses the structural integrity and functional capability of safety-related and nonsafety-related mechanical SSCs for seismic Category I components and supports, including both those designated as ASME BPVC, Section III and those not covered by the ASME BPVC as discussed in SPR Section 3.9.1. The design includes issues such as load combinations, allowable stresses, methods of analysis, summary of results, and preoperational testing. The evaluation of this section focuses on determining whether there is adequate assurance that mechanical systems and components will perform their safety-related functions under all postulated combinations of normal operating conditions, system operating transients, postulated pipe breaks, and seismic events.

Following the issuance of the ESBWR FSER on March 9, 2011, the staff identified issues applicable to the ESBWR steam dryer structural analysis based on information obtained during the NRC review of a license amendment request for a power uprate at an operating boiling-water reactor nuclear power plant. As a result of resolving those issues, GEH revised the DCD to withdraw the licensing topical reports addressing the ESBWR steam dryer structural evaluation, and to reference new engineering reports that describe the updated ESBWR steam dryer analysis methodology. The staff reviewed the revised DCD sections, the new GEH engineering reports, and the RAI responses. NUREG–1966, Supplement 1, the Supplemental FSER related to the certified ESBWR DCD, Tier 2, Section 3.9.5 replaces in its entirety Section 3.9.5, "Reactor Pressure Vessel Internals," of the DCD FSER issued on March 9, 2011. Information related to ESBWR RPV internals other than the steam dryer (such as core support structures) was copied from the FSER and placed in the Supplemental FSER to provide the description of the staff's review of all ESBWR RPV internals in one location.

3.9.2 Summary of Application

Section 3.9, "Mechanical Systems and Components," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.9, "Mechanical Systems and Components," of the ESBWR DCD, Revision 10.

In addition, in North Anna 3 COL FSAR, Revision 8, the applicant provides the following:

COL Items

- CWR COL 3.9.9-1-A — Reactor Internals Vibration Analysis, Measurement and Inspection Program

To address COL Item 3.9.9-1-A, the North Anna 3 COL applicant provides the following supplemental information in FSAR Section 3.9.2.4:

> For reactor internals other than the steam dryer, the vibration assessment program, as specified in RG 1.20, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing," is provided in DCD Appendix 3L and the following referenced GEH Report:

- NEDE-33259P-A, “Reactor Internals Flow Induced Vibration Program” (ADAMS Accession No. ML091660434)

The classification of the North Anna 3 reactor internals in accordance with RG 1.20 is dependent on ESBWR status, i.e., if North Anna 3 is the initial ESBWR to perform testing of the reactor internals, or if testing is performed at another reactor prior to North Anna 3 testing. There are two different scenarios:

a. A valid prototype for the Unit 3 reactor internals does not exist. Under this scenario, Unit 3 reactor internals classification is a prototype per RG 1.20.

b. A valid prototype for Unit 3 reactor internals does exist. If the prototype testing is performed outside the United States, the guidance in RG 1.20, Revision 3, Regulatory Position 1.2, would need to be satisfied in order for this reactor to be considered a “valid prototype.” Assuming that Unit 3 reactor internals are substantially similar to the valid prototype and that the valid prototype does not experience inservice problems that result in component or operational modifications, Unit 3 reactor internals will be classified as non-prototype Category I. If a change to the classification for Unit 3 reactor internals is later determined to be necessary, the classification change will be addressed at the time the change is proposed with proper evaluation/justification and documented in a revision to the FSAR.

Specific to the steam dryer, the comprehensive vibration assessment program (CVAP), as specified in RG 1.20, is provided in DCD Appendix 3L and the following referenced GEH Reports:

- NEDE-33312P, “ESBWR Steam Dryer Acoustic Load Definition” (ADAMS Accession No. ML13344B157; ML13344B163 Non-Public)

- NEDE-33313P, “ESBWR Steam Dryer Structural Evaluation” (ADAMS Accession No. ML13344B158; ML13344B164 Non-Public)

- NEDE-33408P, “ESBWR Steam Dryer- Plant Based Load Evaluation Methodology, PBLE01 Model Description” (ADAMS Accession No. ML13344B159; (ML13344B175 and ML13344B176 Non-Public)

The steam dryer is definitively classified as a prototype according to RG 1.20, Revision 3. Section 10.2 of NEDE-33313P provides four elements of a steam dryer CVAP that must be addressed. The following describes the approach for the steam dryer CVAP elements, consistent with RG 1.20 and Section 10.2 of NEDE-33313P:

a. The ESBWR steam dryer CVAP is described in DCD Section 3.9, DCD Appendix 3L, and NEDE-33313P, Section 10.0, which includes a description for preparing and submitting to the NRC a Steam Dryer Monitoring Plan (SDMP) no later than 90 days before startup.

b. The detailed design of the steam dryer will follow the methodology described in DCD Appendix 3L and the incorporated engineering reports. As described in NEDE-33313P, Section 10.2(b), an example of a steam dryer predicted analysis that concludes the steam dryer will not exceed stress limits with applicable bias and uncertainties and the minimum alternating stress ratio (MASR) of 2.0 is provided in NEDE-33408P. The final detailed design of the ESBWR steam dryer has not yet been completed. Therefore, the example of an as-designed steam dryer that has been subject to the predicted analysis process and successful startup testing described in NEDE-33408P serves as the design analysis report for the steam dryer and provides sufficient information for licensing. The post licensing commitments in ITAAC and license conditions will confirm the acceptability of the ESBWR steam dryer design.

c. The startup program and associated license conditions that include appropriate notification points during power ascension, providing data to the NRC at certain hold points and at full power, and providing to the NRC a full stress analysis report and evaluation within 90 days of reaching the full power level, are established in accordance with NEDE-33313P, Section 10.2(c).

d. Periodic steam dryer inspection during refueling outages is as described in NEDE-33313P, Section 10.2(d), and associated license conditions.

In addition, in FSAR Section 3.9.2.4, the applicant identifies a CVAP that will be developed as described in DCD Appendix 3L with no departures and that will comply with guidance specified in RG 1.20, Revision 3. These programs will be prepared as stated in this section of the North Anna 3 FSAR.

- STD COL 3.9.9-2-A — ASME Class 2 or 3 or Quality Group D Components with 60-Year Design Life

To address COL 3.9.9-2-A, the North Anna 3 COL applicant adds the following discussion in FSAR Section 3.9.3.1:

> The equipment stress reports identified in this DCD section will be completed within six months of completion of DCD ITAAC Table 3.1-1 [following plant construction]. The FSAR will be revised as necessary in a subsequent update to address the results of this analysis [on the as-built North Anna 3 power station].

- STD COL 3.9.9-3-A — Inservice Testing of Pumps and Valves

To address COL Item 3.9.9-3-A, the North Anna 3 COL applicant specifies FSAR provisions to supplement ESBWR DCD, Tier 2, Section 3.9.6, “Inservice Testing of Pumps and Valves.” For example, the North Anna 3 FSAR specifies that in addition to the provisions in ESBWR DCD, Tier 2, Section 3.9.6, milestones for implementing the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) preservice and inservice testing (IST) programs are defined in FSAR Section 13.4.

In addition to the provisions in ESBWR DCD, Tier 2, Section 3.9.6.1, “Inservice Testing of Valves,” the North Anna 3 FSAR specifies that valves are subject to preservice testing (PST). In addition to the provisions in ESBWR DCD, Tier 2, Section 3.9.6.1.4, “Valve Testing,” the North Anna 3 FSAR provides additional provisions for valve exercise tests.

The North Anna 3 FSAR also specifies additional provisions for the design and qualification process for explosively actuated valves. In addition to the power-operated valve test provisions in ESBWR DCD, Tier 2, Section 3.9.6.1.5, “Specific Valve Test Requirements,” the North Anna 3 FSAR refers to Section 3.9.6.8 for additional (non-Code) testing of power-operated valves as discussed in Regulatory Issue Summary (RIS) 2000-03, “Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions.” In addition to the check valve exercise test provisions in ESBWR DCD, Tier 2, Section 3.9.6.1.5, the North Anna 3 FSAR specifies that check valve testing includes verification that obturator movement is in the direction required for the valve to perform its safety function. The North Anna 3 FSAR also includes additional check valve test provisions for (1) acceptance criteria, (2) a disassembly examination program where test methods are impractical, (3) nonintrusive diagnostic techniques, (4) post-maintenance testing, (5) preoperational testing, and (6) data collection for testing and inspections. In addition to the provisions in ESBWR DCD, Tier 2, Section 3.9.6.5, “Valve Replacement, Repair and Maintenance,” the North Anna 3 FSAR provides additional provisions for determining new reference values.

In addition to the provisions in ESBWR DCD, Tier 2, Section 3.9.6.8, “Non-Code Testing of Power-Operated Valves,” the North Anna 3 FSAR provides additional provisions for performing periodic tests of power-operated valves that are consistent with the guidance in NRC RIS 2000-03.

- STD COL 3.9.9-4-A Snubber Inspection and Test Program

To address COL Item 3.9.9-4-A, the North Anna 3 COL applicant specifies FSAR provisions that will supplement ESBWR DCD, Tier 2, Section 3.9.3.7.1(3)e, “Snubber Preservice and Inservice Examination and Testing.” For example, the North Anna 3 FSAR provides additional provisions to supplement the provisions for preservice examination and testing, and inservice examination and testing, of snubbers in ESBWR DCD, Tier 2, Section 3.9.3.7.1(3)e. In addition, the North Anna 3 FSAR provides additional provisions for listing snubber information to supplement ESBWR DCD, Tier 2, Section 3.9.3.7.1(3)f, “Snubber Support Data.”

In addition, in FSAR Section 3.9.3.7.1(3)3, the applicant states that as part of the system specific post COL ITAAC for piping and component design a plant-specific table will include snubber information as part of a subsequent FSAR update for ASME Class 1, 2 and 3 systems.

Supplemental Information

- STD SUP 3.9-1 10 CFR 50.55a Relief Requests and Code Cases

The North Anna 3 FSAR supplements ESBWR DCD, Tier 2, Section 3.9.6.6, “10 CFR 50.55a Relief Requests and Code Cases,” by specifying that no relief from or alternative to the ASME OM Code is being requested.

- STD SUP 3.9-2 Risk-Informed Inservice Testing

The North Anna 3 FSAR supplements ESBWR DCD, Tier 2, Section 3.9.7, “Risk-Informed Inservice Testing,” by specifying that risk informed IST is not being utilized.

- STD SUP 3.9-3 Risk-Informed Inservice Inspection of Piping

The North Anna 3 FSAR supplements ESBWR DCD, Tier 2, Section 3.9.8, “Risk-Informed Inservice Inspection of Piping,” by specifying that risk informed inservice inspection is not being utilized.

North Anna 3 Departure 3.7-1 related to SSCs

In the North Anna 3 COL, Part 7, "Departures Report," Revision 6, the applicant identifies DCD departure NAPS DEP 3.7-1 for the plant specific FIRS which exceeds the CSDRS, as discussed in Section 3.7 of this SER. The staff has evaluated this departure and its related effect on the North Anna 3 SSCs.

License Conditions

Part 10, Revision 7, of the North Anna 3 COL application specifies proposed license conditions related to Mechanical Systems and Components in the following topic areas: steam dryer, explosively actuated valves, and the operational program implementation schedule.

3.9.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG–1966, the FSER related to the certified ESBWR DCD and NUREG–1966, Supplement 1.

In addition, acceptance criteria associated with the relevant requirements of the Commission regulations are given in SRP Section 3.9.2, which include the following:

- The guidance associated with the reactor internals startup testing is given in RG 1.20, (Revision 3).

- 10 CFR Part 50, Appendix A, GDC 1, which requires (in part) that components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

- GDC 2, which requires (in part) that components important to safety be designed to withstand seismic events without a loss of capability to perform their safety functions.

- GDC 4, which requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operations, maintenance, testing, and postulated pipe ruptures including loss-of-coolant accidents.

- GDC 14, “Reactor Coolant Pressure Boundary,” which requires that the RCPB be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage; rapidly propagating failures; and gross ruptures.

- GDC 15, “Reactor Coolant System Design,” which requires that the reactor coolant system and associated auxiliary, control, and protection systems be designed with sufficient margins to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including anticipated operational occurrences.

- 10 CFR Part 50, Appendix S, as it relates to the suitability of the plant design bases for mechanical components established in consideration of site seismic characteristics.

The regulatory basis for the staff's review of the North Anna 3 FSAR is provided by 10 CFR Parts 50 and 52. Specifically, the NRC regulations in 10 CFR 52.79(a)(11) require that a COL application provide a description of the programs and their implementation necessary to ensure that the systems and components meet the requirements of the ASME BPVC and the ASME OM Code, in accordance with 10 CFR 50.55a. As discussed in the ESBWR DCD FSER, GDC 1, 2, 4, 14, 15, 37, "Testing of Emergency Core Cooling System"; 40, "Testing of Containment Heat Removal System"; 43, "Testing of Containment Atmospheric Cleanup System"; 46, "Testing of Cooling Water System"; and 54, "Systems Penetrating Containment"; in Appendix A to 10 CFR Part 50 establish the necessary design, fabrication, construction, testing, and performance requirements for SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. The QA criteria in 10 CFR Part 50, Appendix B provide assurance that the design, tests, and documentation related to functional design, qualification, and IST programs for pumps, valves, and dynamic restraints will comply with established standards and criteria; thereby ensuring that such equipment will be capable of performing the intended functions.

RG 1.206 provides guidance for a COL applicant in preparing and submitting the COL application in accordance with NRC regulations. For example, Section C.IV.4 in RG 1.206 discusses the requirement in 10 CFR 52.79(a) that descriptions of operational programs need to be included in the FSAR for a COL application to allow reasonable assurance for a finding of acceptability. In particular, a COL applicant should fully describe the IST and other operational programs defined in Commission Paper SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," to avoid the need for ITAAC for operational programs. The term "fully described" for an operational program should be understood to mean that the program is clearly and sufficiently described in terms of scope and level of detail to allow a reasonable assurance finding. Further, operational programs should be described at a functional level with an increasing level of detail, where implementation choices could materially and negatively affect the program's effectiveness and acceptability. In the SRM for SECY-05-0197 dated February 22, 2006, the Commission approved the SECY including the use of a license condition for operational program implementation milestones that are fully described or referenced in the FSAR.

The staff's review of the North Anna 3 COL application followed the applicable guidance in SRP Section 3.9. North Anna 3 FSAR Table 1.9-201, "Conformance with Standard Review Plan," specifies that the COL application conform to the subsections in SRP Section 3.9. The staff also compared the North Anna 3 FSAR information with the guidance in RG 1.206, as listed in North Anna 3 FSAR Table 1.9-203, "Conformance with the FSAR Content Guidance in RG 1.206."

3.9.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.9 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.9 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD that represent the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the "Mechanical Systems and Components."

The staff's review of the information contained in the North Anna 3 COL FSAR is as follows:

COL Items

- CWR COL 3.9.9-1-A Reactor Internals Vibration Analysis, Measurement and Inspection Program

This COL Information Item states the following.

DCD COL Item 3.9.9-1-A in Section 3.9.9 of the ESBWR DCD states that the COL applicant will perform the following:

1. For the reactor internals, other than steam dryer, classify its reactor per the guidance in RG 1.20 and provide a milestone for submitting a description of the inspection and measurement programs to be performed (including measurement locations and analysis predictions) and the results of the vibration analysis, measurement and test program (Section 3.9.2.4).

2. For the steam dryer, which is classified as a prototype per the guidance in RG 1.20, (a) provide a milestone of no later than 90 days before startup to prepare and provide to the NRC a Steam Dryer Monitoring Plan as described in NEDE-33313P, Section 10; (b) submit or reference a steam dryer predicted analysis (for the plant-specific or a sample steam dryer) that concludes the steam dryer will not exceed stress limits with applicable bias and uncertainties and the minimum alternating stress ratio (MASR) of 2.0; (c) describe startup program (with proposed license conditions) that includes appropriate notification points during power ascension, and submittal of the completed analysis of steam dryer data within 90 days following completion of the power ascension testing and monitoring of the steam dryer; and (d) specify periodic steam dryer inspections during refueling outages (Section 3.9.2.4).

To address COL Information Item 3.9.9-1-A, the North Anna 3 COL applicant specified that the vibration assessment program for reactor internals other than the steam dryer, as discussed in RG 1.20, is provided in DCD Appendix 3L and NEDE-33259P-A. In addition, the classification of the North Anna 3 reactor internals in accordance with RG 1.20 is dependent on ESBWR plant start-up testing status, that is, if North Anna 3 is the initial ESBWR to perform testing of the reactor internals, or if testing is performed at another reactor prior to North Anna 3 testing.

Specific to the steam dryer, the CVAP, as specified in RG 1.20 is provided in ESBWR DCD Appendix 3L, NEDE-33312P, NEDE-33313P, and NEDE-33408P.

The steam dryer is classified as a prototype according to RG 1.20, Revision 3, and the applicant presents an approach that is consistent with RG 1.20 and Section 10.2 of NEDE-33313P, including four elements of a steam dryer CVAP that must be addressed.

The staff reviewed the classification of the North Anna 3 reactor internals. The North Anna 3 classification of the reactor internals has two scenarios. In the first scenario, the North Anna 3 reactor internals are classified as the ESBWR prototype for testing the reactor internals. In the second scenario, should a CVAP for an ESBWR unit other than North Anna 3 be completed and approved by the NRC as a valid prototype before the initiation of startup testing at North Anna 3, the North Anna 3 reactor internals will be classified as non-prototype Category I. As described in NUREG–1966, Supplement 1, the Supplemental FSER related to the certified ESBWR DCD, Tier 2, Section 3.9.5, the steam dryer will be classified as a prototype regardless of the presence of another ESBWR unit. The staff finds the classification approach for the North Anna 3 reactor internals to be acceptable because the classification of the reactor internals for North Anna 3 is consistent with RG 1.20, and the classification of the steam dryer as a prototype regardless of the presence of another ESBWR unit is conservative.

For reactor internals (other than the steam dryer) to be installed in North Anna 3, the staff finds the review and acceptance of the CVAP specified in the ESBWR DCD to be acceptable as described in NUREG–1966, Supplement 1, the supplemental FSER related to the certified ESBWR DCD, Tier 2, Section 3.9.5. Therefore, the staff finds the portion of COL Item 3.9.9-1-A related to the reactor internals (other than the steam dryer) for North Anna 3 to be satisfied.

For the steam dryer, a description of the staff's review and acceptance of the ESBWR steam dryer evaluation methodology is in NUREG–1966, Supplement 1, the Supplemental FSER related to the certified ESBWR DCD, Tier 2, Section 3.9.5. The North Anna 3 FSAR specifies the COL applicant's actions that are necessary to satisfy the portion of COL Item 3.9.9-1-A related to the steam dryer. For the North Anna 3 steam dryer Item (a) of COL Item 3.9.9-1-A, the CVAP to be applied is described in ESBWR DCD, Tier 2, Section 3.9 and Appendix 3L and in NEDE-33313P, Section 10.0. The CVAP includes preparing and submitting to the NRC a SDMP no later than 90 days before startup. For Item (b) of COL Item 3.9.9-1-A, the detailed design of the North Anna 3 steam dryer will follow the methodology described in DCD Appendix 3L and in the incorporated engineering reports. As described in NEDE-33313P, Section 10.2(b), an example of a steam dryer predictive analysis that concludes the steam dryer will not exceed stress limits with the applicable bias and uncertainties and the MASR of 2.0 is provided in NEDE-33408P. The example of an as designed steam dryer that was subject to the predictive analysis process and successful startup testing described in NEDE-33408P serves as the design analysis report for the steam dryer and provides sufficient information for licensing. For Item (c) of COL Item 3.9.9-1-A, the North Anna 3 startup program is based on NEDE-33313P, Section 10.2(c), which includes (1) providing appropriate notification points during power ascension; (2) providing data to the NRC at certain hold points and at full power; and (3) providing a full stress analysis report and evaluation to the NRC within 90 days of reaching the full power level. For Item (d) of COL Item 3.9.9-1-A, the periodic steam dryer inspection program for North Anna 3 during refueling outages is described in NEDE-33313P, Section 10.2(d). Part 10 of the North Anna 3 COL application provides a proposed license condition for the steam dryer startup program and the periodic inspection program.

The staff has reviewed the actions specified in the North Anna 3 FSAR for each of the individual portions of COL Item 3.9.9-1-A regarding the steam dryer. The staff determined that the North Anna 3 FSAR actions related to the steam dryer satisfy the provisions in ESBWR DCD, Tier 2 and NEDE-33312P, NEDE-33313P, and NEDE-33408P incorporated in the ESBWR DCD as accepted in NUREG–1966, Supplement 1 on ESBWR DCD, Tier 2, Section 3.9.5. These North Anna 3 actions include application of the CVAP for the steam dryer described in the ESBWR DCD, Tier 2 and NEDE-33313P, reference of the example steam dryer predictive analysis in NEDE-33408P, preparation of a North Anna 3 startup program that incorporates the SDMP in NEDE-33313P, and specification of a periodic steam dryer inspection program consistent with NEDE-33313P. The North Anna 3 steam dryer monitoring and inspection program will be verified by the license condition specified in this SER section. The staff notes that the license condition proposed in this SER, as compared to the model condition proposed in NEDE-33313P, has been reformatted to better conform with standard license condition format and has been rewritten for clarity and to remove redundancy. Some of these changes resulted in minor changes in substance, such as more clearly specifying power levels for steam dryer monitoring and methods for informing the NRC of the results of monitoring. The staff reviewed and accepted the ESBWR DCD and its referenced engineering reports on the steam dryer as part of the NRC review of the ESBWR DC application. Therefore, the staff finds that the actions specified by the North Anna 3 COL applicant satisfy the steam dryer portion of COL Item 3.9.9-1-A.

The staff notes that the ESBWR DCD identifies specific portions of the information on the structural integrity and functional capability of mechanical systems and components to be Tier 2* information. As part of this identification of Tier 2* information, the ESBWR DCD identifies Tier 2, Section 3.9.2.3 as well as the GEH Reports NEDE-33312P, NEDE-33313P, and NEDE-33408P on the ESBWR steam dryer incorporated by reference in the DCD as Tier 2* in their entirety. Therefore, the North Anna 3 steam dryer evaluation methodology will be implemented as Tier 2* information in accordance with the ESBWR DC.

Based on its review described above, the staff finds that the North Anna 3 COL applicant has satisfied the provisions in COL Information Item COL 3.9.9-1-A. The staff discusses the applicable license conditions and FSAR provisions related to reactor internals for North Anna 3 in this SER section under "Post Combined License Activities." The staff finds that the information related to reactor internals classification and testing is adequate in meeting NRC regulatory requirements and RG 1.20 guidance, and is therefore acceptable.

- STD COL 3.9.9-2-A ASME Class 2 or 3 or Quality Group D Components with 60-Year Design Life

DCD COL Item 3.9.9-2-A in Section 3.9.9 of the ESBWR DCD states the following:

> The COL Applicant will provide a milestone for completing the required equipment stress reports, per ASME BPV Code, Subsection NB, for equipment segments that are subject to loadings that could result in thermal or dynamic fatigue and for updating the FSAR, as necessary, to address the results of the analysis (Section 3.9.3.1).

North Anna 3 COL FSAR, Revision 8, Section 3.9.3.1, "Loading Combinations, Design Transients and Stress Limits," states that the required equipment stress reports will be completed within 6 months of the completion of DCD ITAAC Table 3.1-1 for the as-built piping systems and components. In addition, the North Anna 3 FSAR specifies that the FSAR will be revised as necessary in a subsequent update to address the results of this analysis. The staff observes that in order to complete the referenced ITAAC related to the pipe break analyses listed in DCD Tier 1, Table 3.1-1, the applicant will first perform equipment and piping stress analyses that support the determination of pipe break locations based on the as-built conditions. Additional ITAAC related to the completion of component and piping stress analyses in accordance with ASME BPVC requirements are in DCD Tier 1. Dominion clarified in a subsequent letter dated April 17, 2014 (ADAMS Accession No. ML14108A345), that there are currently no non-Class 1 components for North Anna 3 that are subjected to cyclic loadings of a magnitude and/or duration so severe that the 60-year design life cannot be assured. Therefore, the staff finds that no supplemental information that provides an analysis or design per the

Tier 2* provisions of ESBWR DCD, Tier 2, Section 3.9.3.1, is necessary. The staff also observes that the original basis for including these requirements in the ESBWR DCD related to the staff's concerns regarding environmentally assisted fatigue, which have been resolved through the final staff position in RG 1.207, "Guidelines for Evaluating Fatigue Analyses Incorporating the Life Reduction of Metal Components Due To the Effects of the Light-Water Reactor Environment for New Reactors," which is committed to in ESBWR DCD, Tier 2, Section 3.9.1. Therefore, the applicant has provided an acceptable milestone related to the development of the required equipment stress reports, as requested in the COL item. These milestone activities are acceptable to the staff, as they address one detail of the overall stress analysis that will be confirmed through completion of ITAAC related to ASME BPVC requirements, as well as periodic FSAR updates required by the regulations. Post licensing and inspection processes are already in place to provide final verification of these overall activities. Based on the provision of the required evaluation and FSAR updates in response to this COL item and the associated ITAAC, the staff finds the applicant's response to COL Item 3.9.9-2-A acceptable.

- STD COL 3.9.9-3-A Inservice Testing Programs

This COL item is related to the functional design, qualification, and IST Programs for pumps, valves, and dynamic restraints. COL Item 3.9.9-3-A in Section 3.9.9 of the ESBWR DCD states the following:

> The COL Applicant shall provide a full description of the IST Program and a milestone for full program implementation as identified in Section 3.9.6.1.

The staff reviewed the North Anna 3 COL application and the applicable sections in the ESBWR DCD incorporated by reference in the North Anna 3 FSAR for the functional design, qualification, and IST Programs for safety-related pumps, valves, and dynamic restraints to determine whether the North Anna 3 COL application meets the regulatory requirements to provide reasonable assurance that the applicable safety-related components at North Anna 3 will be capable of performing their safety functions. In response to several RAIs, GEH and Dominion revised the ESBWR DCD and North Anna FSAR, respectively, to provide a full description of the IST and MOV Operational Programs in support of the North Anna 3 COL application.

ESBWR DCD Section 3.9.3.5, "Valve Operability Assurance," describes the process for the functional design and qualification of valves to be used in the ESBWR. Section 3.9.3.5 in ESBWR DCD, Tier 2 specifies that valve designs not previously qualified will meet the requirements of ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Facilities." For valve designs that were previously qualified to standards other than ASME QME-1-2007, ESBWR DCD Tier 2, Section 3.9.3.5 specifies an approach for valve qualification that follows the key principals of ASME QME-1-2007. Based on the lessons learned from valve performance experience at operating nuclear power plants, the staff found the provisions in Revision 5 to the ESBWR DCD for the functional design and qualification of safety-related valves to be acceptable.

The staff issued RAI 03.09.06-1, which requested Dominion to discuss the process, such as by component examples, for implementing the provisions specified in ESBWR DCD Tier 2, Section 3.9.3.5 for the functional design and qualification of valves and dynamic restraints. Dominion's response in a letter dated September 11, 2008, stated that GEH is responsible for the design and qualification of mechanical equipment, including valves and dynamic restraints. Dominion noted that GEH is currently developing the procurement specifications and processes that will be made available for NRC review. With respect to solenoid-operated valves, Dominion stated that GEH will supply the power supply parameters to the valve supplier, and that the supplier will be responsible for qualifying the valves to those requirements. As discussed in Section 3.9.6.3.2, “Valves,” in NUREG-1966, the staff conducted an audit of the procurement specifications for the ESBWR design. The staff described its review of the ESBWR procurement specifications in a publicly-available audit report (ADAMS Accession No. ML092390403). As a result, this RAI was closed.

In COL Item 3.9.9.3-A, the applicant provided supplemental information on the North Anna 3 IST Program which provides the overall PST of pumps, valves, and restraints. The North Anna 3 COL FSAR does not identify any additional plant-specific valves to be included in the IST Program beyond those listed in ESBWR DCD, Tier 2, Table 3.9-8. ESBWR DCD, Tier 2, Section 3.9.6.1.4, “Valve Testing,” references NUREG–1482 (Revision 1), “Guidelines for Inservice Testing at Nuclear Power Plants.” Following the issuance of the North Anna 3 COL, the guidance in NUREG–1482 (Revision 2 issued in October 2013) can be used to develop the IST Program for North Anna 3, including the specific information to be included in program documentation and tables utilized for NRC inspection.

ESBWR DCD Tier 2, Section 3.9.6 specifies that IST of the applicable ASME BPV Code, Section III, Class 1, 2, and 3 pumps and valves will be performed in accordance with the ASME OM Code required by 10 CFR 50.55a(f), including limitations and modifications set forth in 10 CFR 50.55a. ESBWR DCD Tier 2, Section 3.9.10, “References,” specifies the 2001 Edition, with the 2003 Addenda of the ASME OM Code for use in the ESBWR design. The North Anna 3 FSAR incorporates by reference these provisions in the ESBWR DCD. As Supplemental Information STD COL 3.9-1, North Anna 3 FSAR Section 3.9.6.6, “10 CFR 50.55a Relief Requests and Code Cases,” states that no relief from or alternative to the ASME OM Code is being requested beyond what is identified in the DCD. The ASME OM Code 2001 through 2003 Addenda is incorporated by reference in 10 CFR 50.55a of the NRC regulations, with certain limitations and modifications. Therefore, the staff considers the application of the ASME OM Code 2001 Edition through 2003 Addenda, as specified in the NRC regulations with applicable limitations and modifications, to be acceptable for the North Anna Unit 3 IST Program description. As specified in 10 CFR 50.55a, a COL licensee is required to incorporate in the IST Program the latest edition and addenda of the ASME OM Code approved in 10 CFR 50.55a(f), on the date 12 months before initial fuel load.

The staff reviewed the description of the ASME OM Code requirements in the North Anna 3 FSAR on the IST Program that supplements the provisions in the ESBWR DCD including the prohibition of preconditioning that undermines the purpose of the IST activities. The staff finds the North Anna 3 FSAR to be consistent with Subsection ISTC, “Inservice Testing of Valves in Light-Water Reactor Nuclear Power Plants,” of the ASME OM Code incorporated by reference in 10 CFR 50.55a, and therefore, the FSAR description of the use of ASME OM Code, Subsection ISTC, is acceptable.

North Anna 3 FSAR Section 3.9.6 describes the incorporation of lessons learned from valve experience at operating nuclear power plants into the air-operated valve (AOV) IST Program for North Anna 3. The staff issued RAI 03.09.06-3, which requested the applicant to discuss (1) the provisions in the FSAR for the periodic verification of AOV capability, (2) the application of lessons learned from valve performance to power-operated valves (POVs) other than AOVs, and (3) the basis for the statement in Section 3.9.6 of the proposed revision to the North Anna 3 FSAR that post-maintenance procedures are applied where high-risk valve performance could be affected. Dominion's response to this RAI, in a letter dated September 11, 2008, discussed the IST Program for AOVs and other POVs (with the exception of MOVs). In Revision 1 (dated December 2008) to the North Anna 3 FSAR, the applicant supplemented the ESBWR DCD with a description of the testing program for POVs to be used at North Anna 3. For example, the AOV program will include the key elements of the Joint Owners Group AOV program discussed in Regulatory Issue Summary (RIS) 2000-03, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design-Basis Conditions," which also references the staff comments on the program. Among the key lessons learned in the AOV program, the North Anna 3 FSAR specifies that periodic dynamic testing of AOVs will be performed to re-verify the capability of the valve to perform its required functions, if necessary, based on valve qualification or operating experience. The North Anna 3 FSAR states that the attributes of the AOV Testing Program are applied to other POVs to the extent that they apply to and can be implemented on those valves. The North Anna 3 FSAR also clarifies that post-maintenance procedures ensure that baseline testing is re-performed as necessary, when maintenance on the valve (valve repair or replacement) has the potential to affect valve functional performance. The provisions included in the North Anna 3 FSAR to supplement the ESBWR DCD are sufficient to apply the lessons learned from valve testing to the POV Testing Program at North Anna 3. Therefore, this RAI is closed.

RAI 03.09.06-5 requested Dominion to discuss the commencement of the Preservice Testing Program. Dominion's response to this RAI in a letter dated September 11, 2008, stated that as described in RG 1.206 Section C.IV.4.3, the COL will contain a license condition that requires Dominion to submit to the NRC a schedule that supports planning for and conducting NRC inspections of Operational Programs (including preservice testing). The schedule will be submitted 12 months after the COL has been issued and will be updated every 6 months until 12 months before the scheduled fuel loading, and every month thereafter, until either the operational programs in FSAR Table 13.4-201 have been fully implemented or the plant has been placed in commercial service, whichever comes first. Dominion stated that commencement of preservice testing will be concurrent with the operational status of the equipment and its readiness to support preservice testing, with completion of the preservice testing before fuel load, as indicated in FSAR Table 13.4-201. Dominion indicated that this provision means, for example, that the installation of the valves in the piping system must be complete, along with most of the piping system itself, when the valve power and controls are in place to support valve stroking. Any post-installation construction testing and valve setup activities (such as setting torque or limit switches, lubricating the valve, packing installation or adjustment) must be complete. Dominion stated that accomplishing these activities will depend on the plant construction and turnover schedules. Because the staff found that Dominion's response clarified, in an acceptable manner, the commencement of the Preservice Testing Program, this RAI is closed.

The ESBWR DCD specifies that the ESBWR reactor design does not require the use of pumps to mitigate the consequences of design-basis accidents or to achieve or maintain a safe-shutdown condition. The post-accident long-term decay heat removal for the ESBWR is performed by nonsafety-related systems as accepted in SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Nonsafety Systems in Passive Plant Designs." The availability of systems relied on after 72 hours that is addressed under the RTNSS Program is discussed in Chapter 19.0, "Probabilistic Risk Assessment and Severe Accidents," of this SER.

The staff finds that the North Anna 3 COL FSAR as discussed above contains an acceptable description of the functional design, qualification, and IST program for North Anna 3 that provides reasonable assurance that meets the NRC regulations and the ASME OM Code requirements.

Adverse Flow Effects

Nuclear power plant operating experience has revealed the potential for adverse flow effects from vibration caused by hydrodynamic loads and acoustic resonance within reactor coolant, steam, and feedwater systems, as well as reactor internal components such as steam dryers. Therefore in RAI 03.09.02-1 dated August 19, 2008 (ADAMS Accession No. ML082320133), the staff requested that Dominion describe the planned implementation of the program to address potential adverse flow effects on safety-related valves and dynamic restraints within the IST Program in the reactor coolant, steam, and feedwater systems at North Anna Unit 3 from hydraulic loading and acoustic resonance during plant operation.

In response to RAI 03.09.02-1 dated October 2, 2008 (ADAMS Accession No. ML082810405), the applicant presented a plan to use the overall Initial Test Program (ITP), which includes preoperational and startup testing, to address potential adverse flow effects on safety-related valves and dynamic restraints. The program will confirm attributes of the component design described in the ESBWR DCD, with implementation described in FSAR Section 14.2 and Table 13.4-201. As part of ESBWR DCD Tier 2, Section 3.9.2, the COL applicant referred to ESBWR DCD Tier 2, Section 3.9.2.1, "Piping Vibration, Thermal Expansion and Dynamic Effects," which states that the overall test program is divided into the preoperational test phase and the initial startup test phase with piping vibration, thermal expansion, and dynamic effects testing performed during both phases and described in ESBWR DCD Tier 2, Chapter 14. The COL applicant also referred to ESBWR DCD Tier 2, Section 3.9.2.1.1, "Vibration and Dynamic Effects Testing," which states that the purpose of these tests is to confirm that the piping, components, restraints, and supports of specified high- and moderate-energy systems have been designed to withstand the dynamic effects of steady-state, flow induced vibration (FIV) and anticipated operational transient conditions.

The North Anna 3 COL applicant referenced ESBWR DCD Tier 2, Section 3.9.3.5, which requires valve specifications to incorporate lessons learned from nuclear power plant operations and research programs, including applicable load combinations. The COL applicant also referred to ESBWR DCD Tier 2, Sections 3.9.3.7 and 3.9.3.8, which require analyses or tests for component supports to assure their structural capability to withstand seismic and other dynamic excitations. With respect to reactor internals, ESBWR DCD Section 3.9.2.3 states that the major reactor internal components within the vessel are subjected to extensive testing, coupled with dynamic system analyses, to properly evaluate the resulting FIV phenomena during normal reactor operation and from anticipated operational transients. The preoperational and startup tests are described in DCD Section 14.2.8.1.42, "Expansion, Vibration and Dynamic Effects Preoperational Test," and in DCD Section 14.2.8.2.10, "System Vibration Test," which describe the applicable preoperational and startup tests. Based on this information, the staff found the COL applicant's description of plans to implement the provisions in the ESBWR DCD to address potential adverse flow effects for safety-related valves and dynamic restraints at North Anna 3 to reflect nuclear power plant operating experience. In particular, the COL applicant plans to address the effects of steady-state FIV and operational transients, including lessons learned from operating experience and research programs as part of equipment qualification. Further, the COL applicant plans to address potential adverse flow effects by monitoring piping vibration during the ITP for North Anna 3. The staff's review of the qualification provisions for potential adverse flow effects as part of the review of design and procurement specifications is documented in SER Section 3.9.6. The implementation of the provisions in ESBWR DCD Tier 2, Chapter 14 will be reviewed as part of future NRC inspections at North Anna 3. The staff finds the North Anna 3 COL applicant's plans acceptable because they recognize the safety significance of potential adverse flow effects with future regulatory activities to monitor the details of those plans. Therefore, RAI 03.09.02-1 is resolved and closed.

The staff issued RAI 03.09.02-2 dated August 19, 2008 (ADAMS Accession No. ML082140136), requesting North Anna 3 COL applicant to indicate when it proposed to submit to the staff an implementation schedule to review the comprehensive FIV assessment program for reactor internals, in accordance with RG 1.20, Revision 3 and SRP Sections 3.9.2 and 3.9.5. In response to RAI 03.09.02-2 dated October 2, 2008 (ADAMS Accession No. ML082810405), the COL applicant stated that the comprehensive FIV assessment program for reactor internals was submitted by GEH to the staff as part of the ESBWR DCD review; this is now reflected in the ESBWR DCD, Revision 10. The reactor internals vibration analysis, measurement and inspection program is addressed under COL Information Item 3.9.9-1-A. The response of the North Anna 3 COL applicant to this COL Information Item has been evaluated by the staff as discussed above in this SER section. Therefore, RAI 03.09.02-02 is resolved and closed.

Special Tests

As part of STD COL 3.9.9-3-A the COL applicant in FSAR Section 3.9.6.1.4 (4), provided the following additional information for development of the IST program for explosively actuated (i.e., squib) valves.

> Industry and regulatory guidance is considered in development of IST program for explosively actuated valves. In addition, the IST program for explosively actuated valves incorporates lessons learned from the design and qualification process for these valves such that surveillance activities provide reasonable assurance of the operational readiness of explosively actuated valves to perform their safety functions.

Subsection ISTC-5260, "Explosively Actuated Valves," in the ASME OM Code specifies that at least 20 percent of the charges in squib valves shall be fired and replaced at least once every 2 years. If a charge fails to fire, the ASME OM Code states that all charges with the same batch number shall be removed, discarded, and replaced with charges from a different batch. In light of the updated design and safety significance of squib valves in new reactors, the need for improved surveillance activities for squib valves is being considered by the ASME.

In RAI 03.09.06-1 for the Fermi 3 RCOL application, the staff requested Detroit Edison to describe its plans for addressing the surveillance of squib valves that will provide reasonable assurance of the operational readiness of those valves to perform their safety functions in support of the Fermi 3 COL application. In a letter dated November 9, 2010 (ADAMS Accession No. ML103140611), Detroit Edison submitted a planned revision to Fermi 3 COL FSAR Section 3.9.6 to specify that industry and regulatory guidance will be considered in the development of the IST Program for squib valves. Detroit Edison indicated that the FSAR would also state that the IST Program for squib valves will incorporate lessons learned from the design and qualification process for these valves, such that surveillance activities provide reasonable assurance of the operational readiness of squib valves to perform their safety functions. The staff found that the planned changes to the Fermi 3 COL FSAR were sufficient to describe the IST Program for squib valves for incorporating the lessons learned from the design and qualification process in developing surveillance activities that will provide reasonable assurance of the operational readiness for squib valves to perform their safety functions.

Dominion, following its COLA revision to the ESBWR on April 25, 2013, adopted the response to this RAI in a letter dated August 30, 2013 (ADAMS Accession No. ML13247A394) and provided the FSAR updated information as part of FSAR Revision 6, July 2013. The staff finds that this supplemental information for development of the squib valve IST program for North Anna 3 is acceptable.

As discussed later in this SER section, North Anna 3 incorporated the FERMI License Condition directing the implementation of a surveillance program for squib valves in the gravity-driven cooling system and the automatic depressurization system for North Anna 3 prior to fuel load to supplement the IST requirements in the ASME OM Code, consistent with the licensing of other passive design new reactors. The staff considers the application of the ASME OM Code as incorporated by reference in 10 CFR 50.55a prior to startup of North Anna 3 to be sufficient for squib valves in the standby liquid control (SLC) system for North Anna 3, without the additional provisions of License Condition 3.9 that are necessary for the gravity driven cooling system and the automatic depressurization system, based on operating experience with SLC squib valves in current boiling-water reactor nuclear power plants.

- STD COL 3.9.9-4-A Snubber Inspection and Test Program

DCD COL Item 3.9.9-4-A in Section 3.9.9 of the ESBWR DCD states the following:

> The COL Applicant shall provide a full description of the snubber preservice and inservice inspection and testing programs, and a milestone for program implementation, including development of a data table identified in Subsection 3.9.3.7.1(3)f (Subsection 3.9.3.7.1(3)e).

The staff reviewed the applicant's information related to the snubber preservice and inservice examination and testing programs included under Section 3.9.3.7.1(3)e of the North Anna 3 COL FSAR, which states the following:

> A preservice thermal movement examination is also performed; during initial system heatup and cooldown, for systems whose design operating temperature exceeds 121°C (250°F), snubber thermal movement is verified.
>
> Additionally, preservice operational readiness testing is performed on all snubbers. The operational readiness test is performed to verify the parameters of ISTD-5120. Snubbers that fail the preservice operational readiness test are evaluated to determine the cause of failure, and are retested following completion of corrective action(s).
>
> Snubbers that are installed incorrectly or otherwise fail preservice testing requirements are re-installed correctly, adjusted, modified, repaired or replaced, as required. Preservice examination and testing is re-performed on installation-corrected, adjusted, modified, repaired or replaced snubbers as required.

The preservice inspection and testing programs for snubbers will be completed in accordance with milestones described in Section 13.4.

Inservice examination and testing of all safety-related snubbers is conducted in accordance with the requirements of the ASME OM Code, Subsection ISTD. Inservice examination is initially performed not less than two months after attaining 5 percent reactor power operation and will be completed within 12 calendar months after attaining 5 percent reactor power. Subsequent examinations are performed at intervals defined by ISTD-4252 and Table ISTD-4252-1. Examination intervals, subsequent to the third interval, are adjusted based on the number of unacceptable snubbers identified in the then current interval.

An inservice visual examination is performed on all snubbers to identify physical damage, leakage, corrosion, degradation, indication of binding, misalignment or deformation and potential defects generic to a particular design. Snubbers that do not meet visual examination requirements are evaluated to determine the root cause of the unacceptability, and appropriate corrective actions (e.g., snubber is adjusted, repaired, modified, or replaced) are taken. Snubbers evaluated as unacceptable during visual examination may be accepted for continued service by successful completion of an operational readiness test.

Snubbers are tested inservice to determine operational readiness during each fuel cycle, beginning no sooner than 60 days before the scheduled start of the applicable refueling outage. Snubber operational readiness tests are conducted with the snubber in the as-found condition, to the extent practical, either in place or on a test bench, to verify the test parameters of ISTD-5210. When an in-place test or bench test cannot be performed, snubber subcomponents that control the parameters to be verified are examined and tested. Preservice examinations are performed on snubbers after reinstallation when bench testing is used (ISTD-5224), or on snubbers where individual subcomponents are reinstalled after examination (ISTD-5225).

Defined test plan groups (DTPG) are established and the snubbers of each DTPG are tested according to an established sampling plan each fuel cycle. Sample plan size and composition are determined as required for the selected sample plan, with additional sampling as may be required for that sample plan based on test failures and failure modes identified. Snubbers that do not meet test requirements are evaluated to determine root cause of the failure, and are assigned to failure mode groups (FMG) based on the evaluation, unless the failure is considered unexplained or isolated. The number of unexplained snubber failures not assigned to an FMG determines the additional testing sample. Isolated failures do not require additional testing. For unacceptable snubbers, additional testing is conducted for the DTPG or FMG until the appropriate sample plan completion criteria are satisfied.

Unacceptable snubbers are adjusted, repaired, modified, or replaced. Replacement snubbers meet the requirements of ISTD-1600. Post-maintenance examination and testing, and examination and testing of repaired snubbers, is done to ensure that test parameters that may have been affected by the repair or maintenance activity are verified acceptable.

> Service life for snubbers is established, monitored and adjusted as required by ISTD-6000 and the guidance of ASME OM Code Nonmandatory Appendix F.
>
> The inservice inspection and testing programs for snubbers will be completed in accordance with milestones described in Section 13.4.

In the North Anna 3 FSAR, Section 3.9.3.7.1(3)e, “Snubber Support Data,” it is stated that for the ASME Class 1, 2, and 3 systems listed in DCD Tier 1, Section 3.1, that contain snubbers, a plant-specific table will be prepared in conjunction with the closure of the system-specific ITAAC for piping and component design and will include specific snubber information. This information will be included in the FSAR as part of a subsequent FSAR update.

The staff finds that the provisions specified in the North Anna 3 FSAR on the snubber inspection and test program together with the ESBWR DCD provisions incorporated by reference in the North Anna 3 FSAR adequately describe the snubber inspection and test program as consistent with the 3-87 ASME OM Code provisions in accordance with Commission policy to review a description of the operational programs (including the snubber IST program) in support of the COL application review. As indicated in a license condition specified later in this SER section, the licensee will submit a schedule that supports planning and conducting NRC inspections of operational programs. During inspections of the North Anna 3 operational programs, the staff will confirm that the PST and IST Operational Programs (including the snubber program) have been established consistent with the North Anna 3 FSAR and this SER section, including completion of the applicable requirements specified in the North Anna 3 FSAR. Therefore, COL Item 3.9.9-4-A is satisfied.

Supplemental Information

The North Anna 3 COL application also provides three instances of standard supplemental information in Section 3.9. In Section 3.9.6.6, STD SUP 3.9-1 states that no relief from or alternative to the ASME OM Code is being requested. In Section 3.9.7, STD SUP 3.9-2 states that risk-informed IST is not being utilized, replacing a statement in the ESBWR DCD that risk-informed IST initiatives, if any, are included in IST Program implementation plans. Similarly, in Section 3.9.8, STD SUP 3.9-3 states that risk-informed inservice inspection is not being utilized, replacing a statement in the ESBWR DCD that initiatives for risk-informed inservice inspection of piping, if any, are included in inservice inspection implementation plans. All three of these supplemental statements confirm that the North Anna 3 applicant intends to follow the processes for ASME OM Code implementation, IST Program implementation, and inservice inspection implementation described in the ESBWR DCD, as supplemented in the North Anna 3 COL application and evaluated as described in this SER section. Therefore, the staff finds this supplemental information acceptable.

North Anna 3 Departure 3.7-1 related to SSCs

In the North Anna 3 COL, Part 7, "Departures Report," Revision 6, the applicant identifies DCD departure NAPS DEP 3.7-1 for the plant-specific FIRS which exceeds the CSDRS, as discussed in Section 3.7 of this SER.

In ESBWR DCD 3.9, “Mechanical Systems and Components,” it states that, in accordance with GDC 2 and 10 CFR Part 50, Appendix S, the RPV assembly and its safety-related internal components are designed to withstand seismic events with site-specific seismic characteristics. In response to RAI 03.09.02-3 dated August 1, 2014 (ADAMS Accession No. ML14217A472), Dominion verified that the North Anna 3, ASME Code Design and Purchase Specification of all components designed and purchased to ASME Code, Section III, Class 1, 2, and 3 and related ASME code subsections requirements; including the RPV assembly and its safety related internal components along with its core support structures, in the requirements for loads and load combinations, will include both the CSDRS and the Unit 3 site specific FIRS in establishing the SSE ground motion response spectra, as defined in FSAR Section 3.7.1 The applicant further stated that according to the Unit 3 COLA, Part 7, departure NAPS DEP 3.7-1, and FSAR Section 3.7.1, the Unit 3 SSE design ground motion in FSAR Section 3.7.1 applies to the seismic design, analysis, and qualification of North Anna 3 plant SSCs, including the ASME Code components. The applicant's response also stated that the RPV evaluation which is described in FSAR Section 3.7.2.4 is performed utilizing both CSDRS and Unit 3 site-specific FIRS. The staff reviewed FSAR, Revision 8, Section 3.7.1, "Seismic Design Parameters," NAPS DEP 3.7-1 and verified that according to this section for each structure and each equipment location within the buildings, the site-specific ISRS that exceed the standard design ISRS, are used in conjunction with the standard design ISRS for seismic design and qualification of equipment and components. In addition the staff reviewed FSAR 3.7.2.4.1.8, "Site-Specific Seismic Design and Analysis of Structures, Systems, and components," which confirms that the seismic capability of the RPV subsystem is verified through the DCD Tier 1, Table 2.1.1-3, "ITAAC For the Reactor Pressure Vessel and Internals," using SSE loads developed from the results of site-specific SSI analysis of the RB/FB model.

Based on its review above, the staff finds the applicant's response acceptable because it demonstrated that the GDC 2 and 10 CFR Part 50, Appendix S requirements have been satisfied that equipment and components including the RPV assembly and its safety-related internal components will be designed to withstand seismic events of the evaluated site-specific seismic characteristics.

Interfaces for Standard Design

ESBWR DCD, Tier 2, Section 1.8, "Interfaces with Standard Design," identifies site-specific interfaces with the standard ESBWR design. DCD Table 1.8-1, "Matrix of NSSS Interfaces," references Section 3.9 for the supporting interface areas of mechanical SSCs. The staff reviewed the North Anna 3 COL application for interface requirements with the ESBWR standard design regarding the functional design, qualification, and IST Programs for safety-related valves and dynamic restraints using the review procedures described in SRP Section 3.9.6. The staff finds that the applicant's consideration of design interface items is acceptable based on compliance with NRC regulations discussed in this SER section.

3.9.5 Post Combined License Activities

With respect to the ESBWR steam dryer, NEDE-33313P specifies Tier 2* provisions for the COL holder to complete the design and construction of the steam dryer for an ESBWR nuclear power plant. For example, Section 9.1, "Instrumentation for Monitoring Steam Dryer Response," in NEDE-33313P describes the process to meet ITAAC 12, 13, and 14 in DCD Tier 1, Table 2.1.1-3, for the installation of pressure sensors, strain gages, and accelerometers on the as-built steam dryer to monitor its performance during power ascension. Section 10.1.1, "Steam Dryer Design Analysis Report," in NEDE-33313P specifies the elements for the as-designed ESBWR steam dryer analysis report. Section 10.1.2, "Steam Dryer As-Built Analysis

Report," in NEDE-33313P specifies the process to satisfy ITAAC 16 in DCD Tier 1, Table 2.1.1-3, in verifying that the as-built steam dryer fatigue analysis provides at least a MASR of 2.0 to the allowable alternating stress intensity of 93.7 MPa (13,600 psi). Appendix A, "ITAAC for Reactor Pressure Vessel Internals," to NEDE-33313P describes the process to meet ITAAC 8.b in DCD Tier 1, Table 2.1.1-3, to provide assurance that the reactor internal structures will meet the provisions of ASME BPVC, Subsection NG-3000, except for the weld quality and fatigue factors for secondary structural non-load bearing welds. Appendix B, "ITAAC for Main Steam Line [MSL] and [Safety Relief Valve] SRV/Safety Valve [SV] Branch Piping Acoustic Resonance," to NEDE-33313P describes the process to meet ITAAC 36 in DCD Tier 1, Table 2.1.2-3, to provide assurance that the MSL and SRV/SV branch piping geometry will preclude first and second shear layer wave acoustic resonance conditions from occurring and avoids excessive pressure loads on the steam dryer at plant normal operating conditions. These post-COL activities for the ESBWR steam dryer will be performed by the COL holder for North Anna 3 as described by the Tier 2* provisions in the ESBWR DCD and its referenced engineering reports unless the COL holder obtains regulatory approval for an alternative process.

Section 3.9.2.4 of the North Anna 3 FSAR provides the following provisions for the submittal of reports regarding reactor internals after receipt of the COL:

- For reactor internals other than the steam dryer, the comprehensive vibration assessment program will be developed and implemented as described in DCD Appendix 3L with no departures. The vibration measurement and inspection programs will comply with the guidance specified in RG 1.20, Revision 3, consistent with the Unit 3 reactor internals classification. A summary of the vibration analysis program and description of the vibration measurement (including measurement locations and analysis predictions) and inspection phases of the comprehensive vibration inspection program will be submitted to the NRC 6 months prior to implementation.

- For reactor internals other than the steam dryer, the preliminary and final reports (as necessary), which together summarize the results of the vibration analysis, measurement and inspection programs will be submitted to the NRC within 60 and 180 days, respectively, following the completion of the programs.

The staff finds these provisions for the submittal of a summary of the vibration analysis program, a description of the vibration measurement and inspection phases of the comprehensive vibration inspection program, and the preliminary and final reports of the vibration analysis, measurement, and inspection programs for reactor internals other than the steam dryer to be acceptable as consistent with the provisions of the ESBWR DCD and R-COLA FSAR. For the steam dryer, these actions are addressed in the license condition specified below.

License Conditions:

FSAR Section 13.4 indicates that FSAR Table 13.4-201 lists each operational program, the regulatory source for the program, the associated implementation milestones, and the FSAR section where the operational program is fully described, as discussed in RG 1.206. RG 1.206, Regulatory Position Section C.IV.4.3 states that the COL will contain a license condition that requires the licensee to submit to the NRC a schedule that supports planning and conducting NRC inspections of operational programs including PST, IST, reactor material surveillance and containment leakage testing. The schedule must be submitted 12 months after the NRC issues the COL. The schedule will be updated every 6 months, until 12 months before scheduled fuel loading, and every month thereafter until either the operational programs in FSAR Table 13.4-201 have been fully implemented or the plant has been placed in commercial service, whichever comes first.

3.6 Operational Program Readiness

The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:

- The implementation of site-specific Severe Accident Management Guidelines
- The spent fuel rack coupon monitoring program implementation

The staff has determined that a license condition is required for safety significant squib valves based on its review of the North Anna 3 COL application and as evaluated by the staff in Section 3.9.4 under the heading “Special Tests,” as follows:

3.9 Explosively Actuated Valves

Before initial fuel load, the licensee shall implement a surveillance program for explosively actuated valves (squib valves) in the Gravity-Driven Cooling System and the Automatic Depressurization System at Unit 3 that includes the following provisions in addition to the requirements specified in the ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code) as incorporated by reference in 10 CFR 50.55a.

a. Preservice Testing (PST)

All explosively actuated valves shall be preservice tested by verifying the operational readiness of the actuation logic and associated electrical circuits for each explosively actuated valve with its pyrotechnic charge removed from the valve. This must include confirmation that sufficient electrical parameters (voltage, current, resistance) are available at the explosively actuated valve from each circuit that is relied upon to actuate the valve. In addition, a sample of at least 20 percent of the pyrotechnic charges in all explosively actuated valves shall be tested in the valve or a qualified test fixture to confirm the capability of each sampled pyrotechnic charge to provide the necessary motive force to operate the valve to perform its intended function without damage to the valve body or connected piping. The sampling must select at least one explosively actuated valve from each redundant safety train. Corrective action shall be taken to resolve any deficiencies identified in the operational readiness of the actuation logic or associated electrical circuits, or the capability of a pyrotechnic charge. If a charge fails to fire or its capability is not confirmed, all charges with the same batch number shall be removed, discarded, and replaced with charges from a different batch number that has demonstrated successful 20 percent sampling of the charges.

b. Operational Surveillance

Explosively actuated valves shall be subject to the following surveillance activities after commencing plant operation:

(1) At least once every 2 years, each explosively actuated valve shall undergo visual external examination and remote internal examination (including evaluation and removal of fluids or contaminants that may interfere with operation of the valve) to verify the operational readiness of the valve and its actuator. This examination shall also verify the appropriate position of the internal actuating mechanism and proper operation of remote position indicators. Corrective action shall be taken to resolve any deficiencies identified during the examination with post-maintenance testing conducted that satisfies the PST requirements.

(2) At least once every 10 years, each explosively actuated valve shall be disassembled for internal examination of the valve and actuator to verify the operational readiness of the valve assembly and the integrity of individual components and to remove any foreign material, fluid, or corrosion. The examination schedule shall provide for each valve design used for explosively actuated valves at the facility to be included among the explosively actuated valves to be disassembled and examined every 2 years. Corrective action shall be taken to resolve any deficiencies identified during the examination with post-maintenance testing conducted that satisfies the PST requirements.

(3) For explosively actuated valves selected for test sampling every 2 years in accordance with the ASME OM Code, the operational readiness of the actuation logic and associated electrical circuits shall be verified for each sampled explosively actuated valve following removal of its charge. This must include confirmation that sufficient electrical parameters (voltage, current, resistance) are available for each valve actuation circuit. Corrective action shall be taken to resolve any deficiencies identified in the actuation logic or associated electrical circuits.

(4) For explosively actuated valves selected for test sampling every 2 years in accordance with the ASME OM Code, the sampling must select at least one explosively actuated valve from each redundant safety train. Each sampled pyrotechnic charge shall be tested in the valve or a qualified test fixture to confirm the capability of the charge to provide the necessary motive force to operate the valve to perform its intended function without damage to the valve body or connected piping. Corrective action shall be taken to resolve any deficiencies identified in the capability of a pyrotechnic charge in accordance with the PST requirements.

This license condition supplements the current requirements in the ASME OM Code for explosively actuated valves, and sets forth requirements for PST and operational surveillance, as well as any necessary condition. The license condition will expire either when (1) the license condition is incorporated into the Unit 3 IST program; or (2) the updated ASME OM Code requirements for squib valves in new reactors (i.e., plants receiving a construction permit, or a

COL for construction and operation, after January 1, 2000), as accepted by the NRC in 10 CFR 50.55a, are incorporated into the Unit 3 IST program. For the purpose of satisfying the license condition, the licensee retains the option of including in its IST program either the requirements stated in this condition, or including updated ASME OM Code requirements.

The staff has determined that a license condition related to the steam dryer for North Anna 3 is needed, based on its review of the North Anna 3 COL application and as evaluated by the staff in Section 3.9.4, CWR COL 3.9.9-1-A item, as follows:

3.10 Steam Dryer License Conditions

1. Dominion Virginia Power shall prepare a Steam Dryer Monitoring Plan (SDMP) and submit the SDMP to the NRC no later than 90 days before the scheduled date for initial fuel loading.

2. Dominion Virginia Power shall provide Power Ascension Test (PAT) procedures for steam dryer monitoring to the NRC resident inspectors at least 10 days before the scheduled date for initial fuel loading. The PAT procedures must include the following:

   - Level 1 and Level 2 acceptance limits, as defined in Report NEDE-33313P (Revision 5, December 2013), for on-dryer strain gage and on-dryer accelerometer measurements to be used up to 100 percent power;

   - The power levels at which the steam dryer will be monitored (subject to Conditions 3 and 4 of this license) during power ascension, and the duration of monitoring at each power level;

   - A description of activities to be accomplished during monitoring at each power level;

   - Plant parameters to be monitored;

   - A description of the actions to be taken if acceptance criteria are not satisfied; and

   - A description of the process for verification of the completion of commitments and planned actions specified in the PAT procedures.

3. Dominion Virginia Power shall complete the actions specified in Item 2 of the model license condition specified in paragraph (c) of Section 10.2, “Comprehensive Vibration Program Elements for a COL Applicant,” in NEDE-33313P (Revision 5) between 65 and 75 percent thermal power.

4. Dominion Virginia Power shall measure, record, and evaluate pressures, strains, and accelerations from the steam dryer instrumentation at power levels approximately 5 percent higher than the previous power level at which Dominion Virginia Power measured, recorded, and evaluated such parameters until 100 percent thermal power is reached. Dominion Virginia Power shall generate data trending and a projection of strain levels for each successive power level, including full power. Dominion Virginia Power shall use data trending analysis to assess whether the Level 1 or Level 2 acceptance limits would be exceeded at the next higher power level for which the PAT specifies monitoring. Dominion Virginia Power shall provide the data trending results and revised limit curves to the NRC project manager by facsimile or electronic transmission.

5. At each power level for which Conditions 3 and 4 of this license require steam dryer monitoring, Dominion Virginia Power shall measure and record pressure, strain, and acceleration responses over a range of plant conditions sufficient to confirm that loading and fatigue effects from normal variations in plant conditions at power levels up to and including 100 percent thermal power will not adversely affect the life of the dryer. Dominion Virginia Power shall include its evaluation of steam dryer performance during such variations in plant conditions, including during Power Maneuvering in the Feedwater Temperature Operating Domain testing, in the dryer structural response as part of the full stress analysis report described in Condition 9 of this license.

6. If a flow-induced resonance is identified at any power level at which Conditions 3 and 4 of this license require steam dryer monitoring, and the strains or vibrations exceed the pre-determined Level 1 or Level 2 limit curve, Dominion Virginia Power shall cease power ascension until completing the actions specified in Item 5 of the model license condition specified in paragraph (c) of Section 10.2 in NEDE-33313P (Revision 5) and the following:

    a. If a Level 1 limit curve is exceeded, Dominion Virginia Power shall reduce power to the last power level at which Dominion Virginia Power performed steam dryer monitoring pursuant to Conditions 3 and 4 of this license and at which the Level 1 limit curve was not exceeded. Dominion Virginia Power shall perform a stress analysis to develop a new Level 1 limit curve before increasing power to the next level at which Condition 4 of this license requires steam dryer monitoring.

    b. If a Level 2 limit curve is exceeded, or if data trending indicates that a Level 1 limit curve may be challenged before the next power level at which Condition 4 of this license requires steam dryer monitoring is reached, Dominion Virginia Power shall evaluate the Level 1 and Level 2 limit curves and perform a stress analysis that demonstrates that the stress acceptance limits are satisfied at the higher power level before power is increased.

7. Dominion Virginia Power shall determine end-to-end bias and uncertainties by comparing the predicted and measured strain or acceleration on the steam dryer at each power level at which Dominion Virginia Power performs steam dryer monitoring pursuant to Conditions 3 and 4 of this license and confirm the conservatism of the predicted dryer stress field. At each such power level, Dominion Virginia Power shall adjust the predicted strain and acceleration responses using the frequency-dependent end-to-end bias errors and uncertainty values. If any of the measured sensor data at that power level exceeds the adjusted predictions, Dominion Virginia Power shall either (a) modify the bias errors and uncertainty values and limit curves and ensure measured sensor responses do not exceed the adjusted predictions, or (b) quantitatively evaluate the effect on fatigue life.

8. At the initial power level at which Condition 3 of this license requires steam dryer monitoring and at approximately 85 and 95 percent power, Dominion Virginia Power shall provide the steam dryer data analysis and results to the NRC project manager by facsimile or electronic transmission; and shall not exceed the power level at which it performed the steam dryer monitoring for at least 72 hours after the NRC project manager has confirmed receipt of the transmission.

9. Dominion Virginia Power shall provide data collected from the steam dryer monitoring required by Condition 4 of this license at 100 percent power to the NRC project manager by facsimile or electronic transmission within 72 hours of completing the collection of that data, with receipt confirmation from the NRC project manager. Dominion Virginia Power shall submit a full stress analysis report and evaluation to the NRC document control desk in accordance with 10 CFR 52.4 within 90 days of first reaching 100 percent thermal power. The report must include the minimum stress ratio and the final dryer load definition using steam dryer data, and associated bias errors and uncertainties, and must demonstrate that the steam dryer will maintain its structural integrity over its design life considering variations in plant parameters, including, but not limited to, reactor pressure and core flow rate. If the structural integrity of the steam dryer for the full plant life is not demonstrated by the stress analysis, Dominion Virginia Power shall describe its compensatory actions, such as future dryer replacement, in the stress analysis report.

10. Dominion Virginia Power shall implement a periodic steam dryer inspection program as follows:

    a. During the first two refueling outages after first reaching 100 percent thermal power, Dominion Virginia Power shall perform a visual inspection of all accessible areas and susceptible locations of the steam dryer in accordance with industry guidance on steam dryer inspections in the latest NRC staff-approved version of BWRVIP-139-A, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines," with any conditions or limitations specified in the NRC staff approval. The results of these baseline inspections shall be submitted to the NRC within 60 days following startup after each outage.

    b. At the end of the second refueling outage after reaching 100 percent thermal power, Dominion Virginia Power shall update the Steam Dryer Monitoring Program to include a long-term inspection plan based on plant-specific and industry operating experience, and shall submit the updated program to the NRC within 180 days following startup from the second refueling outage.

In addition to the above three license conditions, the staff notes that, as discussed earlier in this SER section, Part 10 of the North Anna 3 COL application lists a detailed license condition for the ITP that includes activities to address COL Item STD COL 14.2.3-A, "Preoperational and Startup Test Procedures." This license condition will ensure that the COL licensee implements the ITP, which includes the reactor internals initial start-up FIV testing.

ITAAC

ESBWR DCD, Tier 1 includes numerous ITAAC to verify the acceptability of the as-built mechanical systems and components at North Anna 3. A sample of the ITAAC related to the North Anna 3 steam dryer includes the following:

ESBWR DCD, Tier 1, Table 2.1.1-3, "ITAAC for the Reactor Pressure Vessel and Internals"

ITAAC Item 8b. The RPV internal structures listed in Table 2.1.1-1 (chimney and partitions, chimney head and steam separators assembly, and steam dryer assembly) meet the requirements of ASME BPVC, Subsection NG-3000, except for the weld quality and fatigue factors for secondary structural non-load bearing welds.

ITAAC Item 12. The number and locations of pressure sensors installed on the steam dryer for startup testing ensure accurate pressure predictions at critical locations.

ITAAC Item 13. The number and locations of strain gages and accelerometers installed on the steam dryer for startup testing are capable of monitoring the most highly stressed components, considering accessibility and avoiding discontinuities in the components.

ITAAC Item 14. The number and locations of accelerometers installed on the steam dryer for startup testing are capable of identifying potential rocking and of measuring the accelerations resulting from support and vessel movements.

ITAAC Item 16. The as-built steam dryer predicted peak stress is below the fatigue limitation. ESBWR DCD, Tier 1, Table 2.1.2-3, "ITAAC for the Nuclear Boiler System.

ITAAC Item 36. The main steam line and SRV/SV [safety relief valve/safety valve] branch piping geometry precludes first and second shear layer wave acoustic resonance conditions from occurring and avoids pressure loads on the steam dryer at plant normal operating conditions.

With respect to the ESBWR steam dryer, NEDE-33313P specifies Tier 2* provisions for the COL licensee to complete the design and construction of the steam dryer for an ESBWR nuclear power plant. For example, Section 9.1, "Instrumentation for Monitoring Steam Dryer Response," in NEDE-33313P describes the process to meet ITAAC Items 12, 13, and 14 in DCD Tier 1, Table 2.1.1-3, for the installation of pressure sensors; strain gages; and accelerometers on the as-built steam dryer to monitor its performance during power ascension. Section 10.1.1, "Steam Dryer Design Analysis Report," in NEDE-33313P specifies the elements for the as-designed ESBWR steam dryer analysis report. Section 10.1.2, "Steam Dryer As-Built Analysis Report," in NEDE-33313P specifies the process to satisfy ITAAC Item 16 in DCD Tier 1, Table 2.1.1-3, for verifying that the as-built steam dryer fatigue analysis provides at least a MASR of 2.0 to the allowable alternating stress intensity of 93.7 MPa (13,600 psi). Appendix A, "ITAAC for Reactor Pressure Vessel Internals," to NEDE-33313P describes the process to meet ITAAC Item 8b in DCD Tier 1, Table 2.1.1-3, so as to provide assurance that the reactor internal structures will meet the provisions of ASME BPVC, Subsection NG-3000, except for the weld quality and fatigue factors for secondary structural non-load bearing welds. Appendix B, "ITAAC for Main Steam Line and SRV/Safety Valve Branch Piping Acoustic Resonance," to NEDE-33313P describes the process to meet ITAAC 36 in DCD Tier 1, Table 2.1.2-3, to provide assurance that the main steam line and SRV/SV branch piping geometry will preclude first and second shear layer wave acoustic resonance conditions from occurring and avoids excessive pressure loads on the steam dryer at plant normal operating conditions. These post COL activities for the ESBWR steam dryer will be performed by the COL licensee for North Anna 3, as described by the Tier 2* provisions in the ESBWR DCD and its referenced engineering reports, unless the COL licensee obtains regulatory approval for an alternative process.

3.9.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the relevant information relating to the dynamic testing and analysis of SSCs, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff reviewed North Anna 3 FSAR, Section 3.9 and the provisions specified in ESBWR DCD, Tier 2, Section 3.9 that are incorporated by reference in the North Anna 3 FSAR for structural integrity and functional capability of mechanical systems and components for the North Anna 3 nuclear power plant. The staff review of the information provided in Section 3.9 of the ESBWR DCD, Tier 2 is provided in the FSER on the ESBWR DC applicant as modified by NUREG–1966, Supplement 1 on Section 3.9.5 of the ESBWR DCD, Tier 2. Based on its review, the staff concludes that the North Anna 3 COL applicant has provided reasonable assurance that mechanical systems and components to be installed in North Anna 3 will have the structural integrity and functional capability to perform their design functions for the safe operation of the North Anna 3 nuclear power plant.

North Anna 3 Departure 3.7-1 related to SSCs

The staff, by its above review, finds that the applicant has adequately addressed NAPS DEP 3.7-1 as it relates to *SSCs* and has provided sufficient information to meet GDC 2 and 10 CFR Part 50, Appendix S.

In addition, based on the staff's review discussed in this SER section, the staff concluded that the North Anna 3 COL application, together with incorporation by reference of the ESBWR DCD, provides an acceptable description of the Dynamic and Analysis and Testing Program to be used at North Anna 3 considering the site-specific SSE as defined in FSAR Section 3.7.1. The staff has determined that the North Anna 3 COL applicant has provided sufficient information to satisfy the requirements of 10 CFR Parts 50 and 52 for the dynamic testing and analysis of North Anna 3 SSCs.

3.10 Seismic and Dynamic Qualification of Mechanical and Electrical Equipment

3.10.1 Introduction

Seismic and dynamic qualification of seismic Category I equipment include the following types:

- Safety-related active mechanical equipment that performs a mechanical motion while accomplishing a system safety-related function. Examples include pumps, valves, and valve operators.

- Safety-related, non-active mechanical equipment whose mechanical motion is not required while accomplishing a system safety-related function, but whose structural integrity must be maintained in order to fulfill its design safety-related function.

- Safety-related instrumentation and electrical equipment and certain monitoring equipment.

Mechanical and electrical equipment (including instrumentation and controls and where applicable, their supports) classified as seismic Category I must demonstrate that they are capable of performing their intended safety-related functions under the full range of normal and accident (including seismic loadings). This equipment includes devices associated with systems that are essential to safe shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing a significant release of radioactive material into the environment or in mitigating the consequences of accidents.

3.10.2 Summary of Application

Section 3.10 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.10 of the ESBWR DCD, Revision 10. In addition, in FSAR Section 3.10, the applicant provided the following:

<u>COL Items</u>

- STD COL 3.10.4-1-A Dynamic Qualification Report

In FSAR Section 3.10.1.4, the applicant described its implementation schedule for completing ITAAC to be provided to the NRC no later than 1 year after issuance of the COL or the start of construction as defined in 10 CFR 50.10(a), whichever is later.

Supplemental Information

- STD SUP 3.10-1 Quality Assurance Program for Equipment Qualification

In FSAR Section 3.10.1.4, the applicant states that the North Anna 3 QA Program is in FSAR Section 17.5, including requirements for handling safety-related quality records; control of purchased material, equipment, and services; test control; and other quality related processes.

3.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the seismic and dynamic qualification of mechanical and electrical equipment, and the associated acceptance criteria are in SRP Section 3.10. Specific requirements include the following:

- GDC 1 and GDC 30, “Quality of Reactor Coolant Pressure Boundary,” as they relate to qualifying equipment to appropriate quality standards commensurate with the importance of the safety functions to be performed.
- GDC 2 and Appendix S to 10 CFR Part 50, as they relate to designing equipment to withstand the effects of natural phenomena such as earthquakes.
- GDC 4, as it relates to qualifying equipment as capable of withstanding the dynamic effects associated with external missiles and internally generated missiles, pipe whip, and jet impingement forces.
- GDC 14, as it relates to qualifying equipment associated with the reactor coolant boundary so that there is an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.
- 10 CFR Part 50, Appendix B, as it relates to qualifying equipment using the QA criteria.

- 10 CFR Part 50, Appendix B, Criterion III, as it relates to verifying and checking the adequacy of a design by the performance of a suitable test program (among other options), which specifically requires that a test program used to verify the adequacy of a specific design feature shall include suitable qualification testing of a prototype unit under the most adverse design conditions.

- 10 CFR 52.80(a), which requires that a COL application to contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and NRC's regulations.

3.10.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.10 of the certified ESBWR DCD. The staff reviewed Section 3.10 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

<u>*COL Items*</u>

- STD COL 3.10.4-1-A Dynamic Qualification Report

The staff reviewed the conformance of Section 3.10 of the North Anna COL FSAR to the guidance in RG 1.206, Chapter 3, Sections C.I.3.10 and C.III.1.3.10, "Seismic and Dynamic Qualification of Mechanical and Electrical Equipment." The staff's review of Section 3.10 of the North Anna COL FSAR found that the applicant has appropriately incorporated by reference Section 3.10 of the ESBWR DCD, Revision 10. In addition to meet the guidance in Section C.I.3.10.4 and C.III.3.10.4 of RG 1.206, the applicant should provide the results of tests and analyses to demonstrate adequate seismic qualification of equipment. However, RG 1.206 acknowledges that this level of detail may not be available and provides an alternative provision for an implementation plan that includes milestones and completion dates. The information included with this plan should address those details not addressed in the DCD. Those details include, for example, a listing of the equipment to be qualified, the method of qualification, and who will be performing the qualification. The expectation is that all information for these planning phases would be completed before component procurement and would be available for inspection by the staff as necessary.

Therefore the staff in RAI 3.10-1 requested that the applicant provide an implementation plan that includes the level of detail that will be completed prior to procurement and the plan for completing equipment qualification as called for in RG 1.206. This information is necessary for the staff to make a reasonable assurance safety finding for licensing (i.e., to find that the design is in accordance with the regulations). It is expected that this information would be available to be audited by the staff prior to equipment installation. In its response to RAI 3.10-1, the applicant provided its qualification plan including its ITAAC implementation schedule as well as stating in Section 3.10.1.4 of North Anna 3, FSAR Revision 8 the following:

> The Dynamic Qualification Report and documentation that describe the seismic and dynamic qualification methods will be made available for NRC staff review, inspection, and audit. Information that verifies the seismic and dynamic qualification will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process. FSAR information will be revised, as necessary, as part of a subsequent FSAR update.

As described in the North Anna 3 COL FSAR, Revision 8, Section 3.10, the applicant provided requirements that meet the alternative provision for an implementation plan that includes applicable ITAAC and milestones and completion dates as required in RG 1.206. Therefore, RAI 3.10-1 is resolved and closed and the staff finds the North Anna 3 FSAR Supplemental Information Item STD SUP 3.10-1 acceptable.

Supplemental Information

- STD SUP 3.10-1 Quality Assurance Program for Equipment Qualification

The staff reviewed the additional information provided in STD SUP 3.10-1, which provides a pointer to North Anna 3 COL FSAR, Revision 8, Section 17.5 for the quality requirements related to equipment qualification (including seismic qualification). This pointer provides additional clarification and does not affect the staff's conclusions on either the ESBWR DCD information incorporated by reference or the technical information specific to the North Anna 3 COL FSAR, Revision 8, Section 3.10; therefore, it is acceptable to the staff.

3.10.5 Post Combined License Activities

The applicant identifies the following FSAR requirements related to safety-related seismic and dynamic equipment qualification:

- An implementation schedule for completing ITAAC will be provided to the NRC no later than 1 year after issuance of the combined license or at the start of construction as defined in 10 CFR 50.10(a), whichever is later. Dominion shall submit updates to the ITAAC schedules every 6 months thereafter and, within 1 year of its scheduled date for initial loading of fuel, and shall submit updates to the ITAAC schedules every 30 days until the final notification is provided to the NRC under paragraph 10 CFR 52.99(c)(1).

- The Dynamic Qualification Report and documentation that describe the seismic and dynamic qualification methods will be made available for the NRC staff review, inspection, and audit. Information that verifies the seismic and dynamic qualification will be made available to the NRC to facilitate reviews, inspections, and audits throughout the post COL construction process.

3.10.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the seismic and dynamic qualification of mechanical and electrical equipment that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 3.10, and other NRC RGs. The staff's review concluded that the applicant has adequately addressed COL Item STD COL 3.10.4-1-A and Supplemental Item STD SUP 3.10-1. Therefore, the staff finds that North Anna 3 COL FSAR, Revision 8, Section 3.10, is acceptable and meets the NRC regulatory requirements and acceptance criteria in SRP Section 3.10 and RG 1.206 including GDC 1, GDC 2, GDC 4, GDC 14, and GDC 30; Appendix S to 10 CFR Part 50, 10 CFR Part 50, Appendix B, Criterion III, and 10 CFR 52.80(a).

3.11 <u>Environmental Qualification of Mechanical and Electrical Equipment</u>

3.11.1 Introduction

This FSAR section describes the Environmental Qualification (EQ) Program to be used at North Anna 3 for the electrical and mechanical safety-related equipment. The objective of the EQ Program is to reduce the potential for common failures resulting from specified environmental events and to demonstrate that the equipment within the scope of the EQ Program is capable of performing its intended design function under all conditions, including environmental stresses resulting from design-basis events. During plant operation, the COL licensee implements the EQ Program, which specifies the replacement frequencies of affected safety-related equipment in harsh environments. The EQ Program also addresses nonsafety-related equipment failures under the postulated environmental conditions that could prevent the satisfactory performance of the safety function requirements of the specified safety-related equipment, and certain post-accident monitoring equipment.

The safety-related equipment must perform its safety functions under all normal environmental conditions, abnormal operational occurrences, design-basis events, post-design-basis events, and containment test conditions. This capability is demonstrated through qualification testing and analysis of similar equipment under the temperature, pressure, humidity, chemical effects, radiation, and submergence conditions in which the equipment will be expected to operate. The qualification information shall include identification of the equipment required to be environmentally qualified. Each component shall have onsite and in an auditable form, the designated functional requirements; the definition of the applicable environmental parameters; the periodic maintenance to support the qualified life; the accident that the component is required to mitigate; the required operation time; and the documentation of the qualification process employed to demonstrate the required environmental capability. This information shall be maintained and remain current.

3.11.2 Summary of Application

Section 3.11 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.11 of the ESBWR DCD, Revision 10. In addition, in FSAR Section 3.11 the applicant provides the following:

COL Items

- STD COL 3.11-1-A Environmental Qualification Documentation

In FSAR Section 3.11.4.4 the applicant provides additional information to address COL Item 3.11-1-A. The applicant states that the EQ Program consists of the equipment and certain post-accident monitoring devices that are in scope and that must be environmentally qualified for use in a harsh environment as identified in the ESBWR DCD, Tier 2, Section 3.11, Table 3.11.1. This EQ Master Equipment List (EQMEL) consists of equipment that is essential to emergency reactor shutdown, containment isolation, reactor core cooling, or containment and reactor heat removal or that is otherwise essential in preventing a significant release of radioactive material to the environment. The North Anna 3 FSAR also specifies that the implementation of the EQ Program, including the development of the Environmental Qualification Document (EQD), will be in accordance with the milestone schedule in FSAR Section 13.4, "Operational Program Implementation."

3.11.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is discussed in NUREG–1966.

The relevant requirements of the Commission regulations for the EQ operational program and EQD and the associated acceptance criteria are in SRP Section 3.11.

The applicable regulatory requirements for the EQD are as follows:

- 10 CFR 50.49, "Environmental qualification of electrical equipment important to safety for nuclear plants," requires an applicant for a nuclear power plant license to establish a program that qualifies electrical equipment for environmental effects.

- GDC 1 requires components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

- GDC 2 requires components important to safety be designed to withstand the effects of natural phenomena without loss of capability to perform their safety function.

- GDC 4 requires components important to safety be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss of coolant accidents.

- GDC 23, "Protection system failure modes," requires protection systems to be designed to fail in a safe state, or in a state demonstrated to be acceptable on some other defined basis, if conditions such as postulated adverse environments occur (e.g., extreme heat or cold, pressure, steam, water, or radiation).

- 10 CFR Part 50, Appendix B, Criterion III, “Design Control,” requires measures to be established to ensure that applicable regulatory requirements and the associated design bases are correctly translated into specifications, drawings, procedures, and instructions. These measures should include provisions to ensure that appropriate quality standards are included in design documents and deviations from established standards are controlled. A process should also be established to determine the suitability of equipment that is essential to safety-related functions and to identify, control, and coordinate design interfaces between participating design organizations. Where a testing program is used to verify the adequacy of a specific design feature, the test shall include suitable qualification testing of a prototype unit under the most adverse design conditions.

- 10 CFR Part 50, Appendix B, Criterion XI, “Test Control,” requires a test control plan to be established to ensure that all tests needed to demonstrate a component's performance capability are identified in accordance with required procedures and acceptance limits in the applicable design documents.

- 10 CFR Part 50, Appendix B, Criterion XVII, “Quality Assurance Records,” requires sufficient records to be maintained to furnish evidence of activities affecting quality. The records must include inspections, tests, audits, work performance monitoring, and materials analyses. Records must be identifiable and retrievable.

The related acceptance criteria are as follows:

- In accordance with SECY-05-0197, as accepted in the Commission’s SRM dated February 22, 2006, equipment qualification is an Operational Program that will be reviewed in the COL application. The staff reviews this program to make a reasonable assurance finding on the program. A COL applicant should fully describe the EQ and other Operational Programs as defined in SECY-05-0197 to avoid the need for ITAAC to implement those programs. The term “fully described” for an operational program should be understood to mean that the program is clearly and sufficiently described in terms for scope and level of detail to allow a reasonable assurance finding of acceptability. Further, Operational Programs should be described at a functional level and an increasing level of detail where implementation choices could materially and negatively affect the program effectiveness and acceptability. The Commission approved the use of a license condition for operational program implementation milestones that are fully described or referenced in the FSAR as discussed in the SRM for SECY-05-0197, dated February 22, 2006.

3.11.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.11 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 3.11 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR, appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the North Anna 3 COL application and the applicable sections in the ESBWR DCD incorporated by reference into the North Anna 3 FSAR for the description of the EQ Program for mechanical and electrical equipment to determine whether the North Anna 3 COL application meets the regulatory requirements to provide reasonable assurance that the applicable equipment at North Anna 3 will be capable of performing their intended functions.

The staff reviewed the following information in the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 3.11-1-A Environmental Qualification Documentation

The staff reviewed the additional information related to the environmental qualification documentation under Section 3.11.7 of the North Anna 3 COL FSAR, Revision 8, which states the following:

> This COL item is addressed in Section 3.11.4.4.

In ESBWR DCD, Tier 2, Section 3.11.7, COL Item 3.11-1-A states that the COL applicant will provide a full description and a milestone for implementing the EQ Program that will include completion of the plant-specific EQD per Section 3.11.4.4, "Environmental Qualification Documentation." In FSAR Section 3.11.4.4, the applicant states that a description of the EQ Program is provided in ESBWR DCD, Tier 2, Section 3.11. The applicant also states that the implementation of the EQ Program, including the development of the EQD will be in accordance with the milestone schedule in FSAR Section 13.4. The staff reviewed the applicant's resolution to ESBWR COL Item 3.11-1-A in FSAR Section 3.11.4.4. In addition to reviewing the North Anna 3 COL application, the staff reviewed the information in the ESBWR DCD. Provisions in the ESBWR DCD support the North Anna 3 COL application by fully describing the EQ Operational Program for North Anna 3.

North Anna 3 FSAR, Section 3.11 incorporates by reference ESBWR DCD, Tier 2, Section 3.11 with supplemental information. In RAI 03.11-1 the staff requested Dominion provide or reference certain information related to the EQ Program for safety-related mechanical equipment or indicate the status of and the schedule for its availability. In Dominion's RAI response dated September 11, 2008 (ADAMS Accession No. ML082730754), which noted that the ESBWR DCD, Tier 2, Section 3.11, Revision 5, COL Item 3.11-1-A, had been revised requiring a full description of the EQ program along with a milestone for program implementation by the COL applicant. The North Anna 3 FSAR, Section 3.11, Revision 8, reflects this change. For example, ESBWR DCD, Tier 2, Table 3.11-1, "Electrical and

Mechanical Equipment for Environmental Qualification," identifies the environment in which a component within the scope of the EQ Program will be located. The RAI response stated that no site-specific, safety-related equipment will be used beyond that described in the ESBWR DCD, Section 3.11.4.1, "Harsh Environment Qualification," in ESBWR DCD, Tier 2, indicates that the qualification of mechanical equipment includes materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, and fluids for hydraulic systems). The RAI response stated that the completion of the plant-specific EQD will be accomplished as specified in FSAR Section 3.11.4.4. Furthermore, the RAI response indicated that the completion of the EQ Program for plant equipment will be confirmed by the close-out of the ITAAC, which is specified in ESBWR DCD, Tier 1, Table 3.8-2, "ITAAC for Environmental Qualification of Mechanical and Electrical Equipment." As noted in Section 3.9.4 of this SER, GEH is responsible for the design and qualification of mechanical equipment, and the GEH procurement specifications and processes were made available for NRC to review.

In RAI 03.11-3 the staff requested Dominion to clarify whether the FSAR would be updated to include additional equipment not identified in ESBWR DCD, Tier 2, Table 3.11-1. In Dominion's RAI response dated September 11, 2008, the applicant stated that there is no safety-related equipment or safe shutdown equipment outside the scope of the ESBWR design. As a result, there is no additional equipment covered by the EQ Program that is not identified in DCD Table 3.11-1. Therefore, RAI 03.11-3 is resolved and closed.

In RAI 03.11-5 the staff requested that Dominion describe consideration of FIV in the qualification of safety-related mechanical equipment, including acoustic resonance and hydraulic loading. In Dominion's RAI response dated September 11, 2008, the applicant stated that ESBWR DCD, Tier 2, Section 3.9.3.5 requires the ESBWR general valve requirement specification to include requirements related to the design and functional qualification of safety-related valves that incorporate lessons learned from nuclear power plant operations and research programs. ESBWR DCD, Tier 2, Section 3.10 addresses methods of testing and analysis employed to ensure the capability of mechanical and electrical equipment under the full range of normal and accident loadings. The RAI response indicated that testing, as described in ESBWR DCD, Tier 2, Section 3.9.2 and FSAR Section 14.2, will provide confidence in the capability of safety-related equipment to perform their safety functions. For example, ESBWR DCD, Tier 2, Section 3.9.2.1.1 discusses vibration and dynamic effects testing that will be performed during the ITP, as described in DCD Sections 14.2.8.1.42 and 14.2.8.2.10. The objective of these tests will be to confirm that the piping, components, restraints, and supports of specified high and moderate-energy systems were designed to withstand the dynamic effects of steady-state FIV and anticipated operational transient conditions. The staff considers that the actions specified in the ESBWR DCD will address potential adverse flow effects on safety-related valves and dynamic restraints including the consideration of lessons learned from nuclear power plant operating experience. Therefore, RAI 03.11-5 is resolved and closed.

In the North Anna 3 FSAR, Section 13.4, Table 13.4-201, "Operational Programs Required by NRC Regulations," lists each operational program, the regulatory source for the program, the FSAR section where the operational program is described and the associated implementation milestones. This Table specifies the implementation milestone for the EQ Program as "prior to fuel load." In RAI 03.11-6 the staff requested that Dominion further clarify the commencement of the EQ Program and its transition into an operating reactor program. Dominion's RAI response dated September 11, 2008, stated that the COL application will contain a license condition that will require the COL licensee to submit a schedule to the NRC 12 months after the issuance of the COL, which will support planning and conducting NRC inspections of operational programs including the EQ Program, with periodic updating of the schedule. This schedule will address additional program implementation details, such as commencement of the EQ Program. The transition of the EQ Program into an operating program will occur as part of the plant turnover process. The staff finds that the RAI response clarified plans for the implementation and turnover of the EQ Program during plant construction and startup. Therefore, RAI 03.11-6 is resolved and closed.

ESBWR DCD, Tier 1, Revision 10, Section 3.8, "Environmental Qualification of Mechanical and Electrical Equipment," specifies the EQ ITAAC for safety-related mechanical and electrical equipment in Table 3.8-2. The inspections, tests, and analyses for safety-related or RTNSS mechanical equipment located in a harsh environment state that type tests, or a combination of type tests and analyses will be performed. In RAI 03.11-7 that staff requested the applicant to describe the plan for the implementation of the ITAAC for safety-related mechanical equipment located in a harsh environment, as specified in ESBWR DCD, Tier 1. Dominion's response to the staff RAI 03.11-7, dated September 11, 2008, stated that ESBWR DCD, Tier 1, Section 1.1.2.2 provides the description of ITAAC implementation. Part 10 of the North Anna 3 COL application incorporates the DCD ITAAC by reference. With respect to specific ITAAC implementation, the NRC regulations in 10 CFR 52.99, "Inspection during construction," require the licensee to submit a schedule for completing the inspections, tests, or analyses in the ITAAC, no later than 1 year after COL issuance or the start of construction as defined in 10 CFR 50.10(b) with subsequent updates to the ITAAC schedule. The RAI response stated that plans and schedules for implementing the ITAAC will be provided in accordance with 10 CFR 52.99. The staff finds that these provisions for addressing the EQ ITAAC are consistent with the regulations and are acceptable. Therefore, RAI 03.11-7 is resolved and closed.

ESBWR DCD, Tier 2, Section 3.11 describes the program for the initial EQ of electrical and mechanical equipment within the EQ Program for nuclear power plants applying the ESBWR reactor design. An NRC audit at the GEH office in Wilmington, NC, in July 2009, found that the ESBWR DCD does not address the transition from the initial EQ program to the operational aspects of the EQ Program. As discussed in RG 1.206 and Commission Paper SECY-05-0197, COL applicants must fully describe their operational programs to avoid the need for ITAAC regarding those programs. Therefore, the staff requested in RAI 03.11-8 that Dominion address the operational aspects of the EQ Program in the FSAR. Dominion's RAI response dated February 4, 2010 (ADAMS Accession No. ML100470588), provided a proposed revision to the FSAR to enhance the EQ Program description and to address the operational aspects of the program. The staff found that the planned revision to the COL FSAR which is included in Revision 8 provides an acceptable description of the transition from the initial EQ Program to the operational aspects of the EQ Program. The North Anna 3 FSAR, Revision 8 describes the EQMEL that identifies the electrical and mechanical equipment that must be environmentally qualified for use in a harsh environment. The FSAR describes the control of revisions to the EQ files and the EQMEL. The FSAR specifies that the operational aspect of the EQ Program will include: (1) evaluation of EQ results for design life to establish activities to support continued EQ; (2) determination of surveillance and preventive maintenance activities based on EQ results; (3) consideration of EQ maintenance recommendations from equipment vendors; (4) evaluation of operating experience in developing surveillance and preventive maintenance activities for specific equipment; (5) development of plant procedures that specify individual equipment identification, appropriate references, installation requirements, surveillance and maintenance requirements, post-maintenance testing requirements, condition monitoring requirements, replacement part identification, and applicable design changes and modifications; (6) development of plant procedures for reviewing equipment performance and EQ operational activities, and for trending the results to incorporate lessons learned through appropriate modifications to the EQ operational program; and (7) development of plant procedures for the control and maintenance of EQ records. Therefore, since the applicant meets the intent of the EQ and other Operational Programs as defined in SECY-05-0197, RAI 03.11-8 is resolved and closed. Based on the above evaluation, the staff finds that the applicant has adequately addressed COL Item STD COL 3.11-1-A, and it is therefore acceptable.

Interfaces for Standard Design

ESBWR DCD, Tier 2, Section 1.8, "Interfaces with Standard Design," identifies site-specific interfaces with the standard ESBWR design. DCD Table 1.8-1, "Matrix of NSSS Interfaces," references Section 3.11 for the supporting interface of the design of mechanical and electrical equipment in accordance with its potential operational environmental conditions. The staff reviewed the North Anna 3 COL application for interfacing requirements with the ESBWR standard design regarding the EQ of mechanical and electrical equipment using the review procedures described in SRP Section 3.11. The staff finds the applicant's consideration of design interface items to be acceptable based on compliance with 10 CFR 50.49 as discussed above.

3.11.5 Post Combined License Activities

The following items were identified as the responsibility of the COL licensee:

License Conditions

Dominion has proposed the following license conditions to address the North Anna 3 EQ programs as follows:

> 3.6 Operational Program Readiness
>
> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site-specific Severe Accident Management Guidelines
> - The spent fuel rack coupon monitoring program implementation

License Condition 3.6, "Operational Program Implementation," in Part 10 of the North Anna 3 COL application includes the EQ Program in FSAR table 13.4-201. This license condition will require the EQ Program to be implemented prior to initial fuel load. The schedule for implementation of the EQ program must be available to the staff no later than 12 months after issuance of the COL. The condition will also require that the schedule be updated every 6 months until 12 months before scheduled fuel load, and every month thereafter until the operational programs listed in the North Anna 3 COL FSAR Table 13.4-201 have been fully implemented or the plant has been placed in commercial service, whichever comes first.

3.11.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the EQ of the mechanical and electrical equipment that were incorporated by reference have been resolved.

In addition, the staff compared the supplemental information in the COL application to the relevant NRC regulations, the guidance in SRP Section 3.11, and other NRC RGs. The staff's review concluded that the applicant has provided sufficient information to satisfy the NRC requirements. Therefore, the staff concludes that the North Anna 3 COL FSAR, with the incorporation by reference of the ESBWR DCD, provides an acceptable description of the EQ of electrical and mechanical equipment to be used at North Anna 3, which provides reasonable assurance that the electrical and mechanical equipment within the scope of the North Anna 3 EQ Program will be capable of performing their safety functions in accordance with NRC regulations.

3.12 Piping Design Review

3.12.1 Introduction

This FSAR section covers the design of the metallic piping system and piping support for seismic Category I, Category II, and nonsafety systems. The discussion also includes the adequacy of the structural integrity, and the functional capability of the safety-related piping system, piping components, and their associated supports. The design of the piping systems should ensure that they perform their safety-related functions under all postulated combinations of normal operating conditions, system operating transients, postulated pipe breaks, and seismic events. This includes pressure retaining piping components and their supports, buried piping, instrumentation lines, and the interaction of non-seismic Category I piping and associated supports with seismic Category I piping and associated supports. This section also covers the design transients and resulting loads and load combinations with appropriate specified design and service limits for seismic Category I piping and piping supports - including those designated as ASME Code Class 1, 2, and 3.

3.12.2 Summary of Application

Section 3.12 of the North Anna 3 COL FSAR, Revision 8, references the related sections of Chapter 3 and Chapter 5 of the ESBWR DCD, Revision 10 for the information on seismic Category I and II and NS piping analyses. In addition in FSAR Section 3.12, the applicant provides the following:

Supplemental Information

- CWR SUP 3.12-1 Piping Design Review

In FSAR Section 3.12, the applicant states the following:

> Information on seismic Category I and II, and non-seismic piping analysis and their associated supports is presented in DCD Sections 3.7, 3.9, 3D, 3K, 5.2 and 5.4.

3.12.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966.

In addition, the relevant requirements of the Commission regulations for the piping and support design, and the associated acceptance criteria, are in SRP Section 3.12.

3.12.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Chapters 3 and 5 of the ESBWR DCD. The staff reviewed Section 3.12 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the following information in the North Anna 3 COL FSAR:

Supplemental Information

- CWR SUP 3.12-1 Piping Design Review

The staff reviewed Supplemental Information STD SUP 3.12-1. The ESBWR DCD does not have Section 3.12. Therefore, this supplemental information is being considered as an editorial change to provide a map for the piping design information. The staff finds this change acceptable.

The staff also reviewed COL application FSAR Section 3.7 to verify that the site-specific structural response spectra has been used to evaluate North Anna 3 seismic Category I and II and NS piping. This evaluation is documented in Section 3.7.2 of this SER. On the basis that site-specific response spectra was used for the piping design evaluation as evaluated under North Anna 3 departure NAPS DEP 3.7-1, in this SER, Sections 3.7 and 3.9, the staff finds that the ESBWR standard plant design as modified by NAPS DEP 3.7-1 is acceptable at the North Anna 3 site.

In addition to the piping design acceptance criteria (DAC) ITAAC in ESBWR DCD, Tier 1, the staff also reviewed COL Item NAPS COL 14.3A-1-1 which provides a schedule for completing the piping DAC ITAAC. On the basis that the applicant's proposed DAC are sufficient to provide reasonable assurance in meeting the requirements of 10 CFR 52.80(a), the staff finds this acceptable.

3.12.5 Post Combined License Activities

The following activities will be implemented following issuance of the COL:

Piping DAC

1. The ASME Code piping and support design reports are completed on a system-by-system basis for applicable systems in order to support closure of the DAC ITACC.

2. Reconciliation of the as-built piping to the design analysis requirements.

3.12.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. In addition, the staff compared the additional COL information in the application to the relevant NRC regulations and the guidance in SRP Section 3.12. The staff's review concludes that the applicant is in compliance with NRC regulations. The applicant has adequately addressed the COL information item involving the completion of the piping DAC ASME Design Reports. In conclusion, the applicant has provided sufficient information for satisfying 10 CFR Part 52 requirements by providing reasonable assurance that the piping system will be designed and built in accordance with the certified ESBWR design.

3.13 <u>Threaded Fasteners – ASME BPV Code Class 1, 2 and 3</u>

3.13.1 Introduction

This FSAR section covers the selection of the materials and design, and the inspecting and testing for threaded fasteners before initial service and during service and is limited to threaded fasteners in the ASME BPVC Class 1, 2 or 3 systems.

ESBWR DCD, Revision 10 does not contain Section 3.13 because the DCD application was submitted before the new SRP Section 3.13 was issued in March 2007. However, ESBWR DCD, Tier 2, Section 3.9.3.9, "Threaded Fasteners - ASME BPVC Class 1, 2 and 3," provides sufficient information for the staff to conclude that the selection of the materials and design, and inspecting and testing for threaded fasteners before initial service and during service are acceptable. Therefore, North Anna 3 FSAR, Revision 8, Section 3.13 provides supplemental information that references ESBWR DCD, Tier 2, Section 3.9.3.9.

3.13.2 Summary of Application

Section 3.13 of the North Anna 3 FSAR, Revision 8, references Section 3.9.3.9 of the ESBWR DCD, Revision 10. Section 3.9 of North Anna 3 FSAR incorporates by reference Section 3.9.3.9 of the ESBWR DCD. In addition, in FSAR Section 3.13 the applicant provides the following:

Supplemental Information

- STD SUP 3.13-1 Threaded Fasteners – ASME Code Class 1, 2, and 3

In FSAR Section 3.13, the applicant states the following:

> Criteria applied to the selection of materials, design, inspection and testing of threaded fasteners (i.e., threaded bolts, studs, etc.) are presented in DCD Section 3.9.3.9, with supporting information in DCD Sections 4.5.1, 5.2.3, and 6.1.1.

3.13.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966.

The relevant requirements of the Commission regulations for the piping and support design, and the associated acceptance criteria, are in SRP Section 3.13. Specific requirements include the following:

- 10 CFR Part 50, Appendix A, GDC 1 and 30, as they relate to the requirement that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed.

- GDC 4, as it relates to the compatibility of components with environmental conditions.

- GDC 14, as it relates to the requirement that the RCPB be designed, fabricated, erected, and tested in a manner that provides assurance of an extremely low probability of abnormal leakage, rapidly propagating failure, or gross rupture.

- GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," as it relates to the requirement that the RCPB be designed with a sufficient margin to ensure that when stressed under operating, maintenance, testing, and postulated accident conditions the boundary behaves in a non-brittle manner and the probability of rapidly propagating fracture is minimized.

- 10 CFR Part 50, Appendix B, as it relates to controlling the cleaning of material and equipment to prevent damage or deterioration.

- 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements," as it relates to materials testing and acceptance criteria for fracture toughness of reactor pressure boundary components.

- 10 CFR 50.55a incorporates by reference the design criteria of ASME BPVC, Section III, Class 1, 2, and 3 components. The selection of materials, design, testing, fabrication, installation and inspection of threaded fasteners and mechanical joints are acceptable if they meet the criteria of ASME BPVC, Section III Class 1, 2, and 3 components. However, 10 CFR 50.55a(b)(4) permits the use of code cases that have been adopted by the staff in RG 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," in lieu of applicable criteria in ASME BPVC, Section III, Class 1, 2, and 3 component.

- 10 CFR 52.47(b)(1), which requires a DC application to contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the DC is built and will operate in accordance with the DC, the provisions of the Atomic Energy Act, and NRC's regulations.

- 10 CFR 52.80(a), which requires that a COL application to contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC's regulations.

3.13.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 3.9.3.9 of the certified ESBWR DCD. The staff reviewed Section 3.13 of the North Anna 3 COL FSAR, Revision 8, which references ESBWR Section 3.9.3.9, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR, Revision 8, appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the following information in the North Anna 3 COL FSAR:

Supplemental Information

- STD SUP 3.13-1 Threaded Fasteners – ASME Code Class 1, 2, and 3

The staff reviewed STD SUP 3.13-1 related to the criteria for the selection of materials, design, inspection, and testing of threaded fasteners included under Section 3.13 of the North Anna 3 COL FSAR. STD SUP 3.13-1 which points to ESBWR DCD Tier 2, Sections 4.5.1, 5.2.3, and 6.1.1. Those sections provide additional and specific requirements concerning threaded fasteners used in reactor internals, the reactor coolant system, and other engineered safety features. The staff found that STD SUP 3.13-1 appropriately points out the DCD sections that identify the specific use of threaded fasteners in reactor internals, the reactor coolant system, and other engineered safety features. The staff reviewed the conformance of Section 3.13 of the North Anna 3 COL FSAR to the guidance of RG 1.206, Section C.III.1, Chapter 3, C.I.3.13, "Threaded Fasteners." The staff's review of Section 3.13 of the North Anna 3 COL FSAR found that the applicant has appropriately incorporated by reference Section 3.9.3.9 of ESBWR DCD, Revision 10. The staff considers the applicant's Supplemental Information Item STD SUP 3.13-1 to adequately address threaded fasteners and is therefore acceptable.

3.13.5 Post Combined License Activities

There are no post COL activities related to this section.

3.13.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 3.13, and other NRC RGs. The staff's review concludes that the information in North Anna 3 COL FSAR, Section 3.13 is within the scope of the DC and adequately incorporates by reference Section 3.9.3.9 of the ESBWR DCD, which addresses SRP Section 3.13. The information is thus acceptable and meets the NRC regulations.

References

1. 10 CFR 50.44, "Combustible gas control for nuclear power reactors."

2. 10 CFR 50.49, "Environmental qualification of electrical equipment important to safety for nuclear plants."

3. 10 CFR 52.4, "Deliberate misconduct."

4. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

5. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

6. 10 CFR Part 50, Appendix A, GDC 1, "Quality standard and records."

7. 10 CFR Part 50, Appendix A, GDC 14, "Reactor coolant pressure boundary."

8. 10 CFR Part 50, Appendix A, GDC 15, "Reactor coolant system design."

9. 10 CFR Part 50, Appendix A, GDC 16, "Containment design."

10. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

11. 10 CFR Part 50, Appendix A, GDC 23, "Protection system failure modes."

12. 10 CFR Part 50, Appendix A, GDC 30, "Quality of reactor coolant pressure boundary."

13. 10 CFR Part 50, Appendix A, GDC 31, "Fracture prevention of reactor coolant pressure boundary."

14. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."

15. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

16. 10 CFR Part 50, Appendix A, GDC 50, "Containment design basis."

17. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

18. 10 CFR Part 50, Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants."

19. 10 CFR Part 50.55a, "Codes and standards."

20. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

21. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

22. ACI 349-01, "Code Requirements for Nuclear Safety Related Concrete Structures," 2001.

23. ANSI/AISC N690-1994 and Supplement 2, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities."

24. ASCE 4-98, "Seismic Analysis of Safety-Related Nuclear Structures and Commentary," 1998.

25. ASME Boiler and Pressure Code (BPVC).

26. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

27. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," Subsection N, "Division 1," 2001 Edition, 2003 Addenda.

28. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," Subsection NB, "Class 1 Components," 2001 Edition, 2003 Addenda.

29. ASME BPVC, Section III, Division 2, Subsection CC, "Code for Concrete Reactor Vessels and Containments," 2004.

30. ASME BPVC, Section III, Subsection NG 3000, " Structures within the reactor pressure vessel. "

31. ASME BPVC, Section VIII, "Rules for Construction of Pressure Vessels," 2001 Edition, 2003 Addenda.

32. ASME BPVC, Section VIII, "Rules for Construction of Pressure Vessels," Division 1, 2001 Edition, 2003 Addenda.

33. ASME BPVC, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

34. ASME BPVC, Section XI, Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Plants," 2001 Edition, 2003 Addenda.

35. ASME BPVC, Section XI, Subsection IWC, "Requirements for Class 2 Components of Light-Water Cooled Plants," 2001 Edition, 2003 Addenda.

36. ASME BPVC, Section XI, Subsection IWD, "Requirements for Class 3 Components of Light-Water Cooled Plants," 2001 Edition, 2003 Addenda.

37. ASME OM Code-2001 including Addenda through 2003, "Code for Operation and Maintenance of Nuclear Power Plants."

38. ASME OM Code-ISTD-4252-1, "Visual Examination Table."

39. ASME OM Code-ISTD-5210, "Test Parameters."

40. ASME OM Code-ISTD-5224, "Bench Test."

41. ASME OM Code-ISTD-5225, "Subcomponent Test."

42. ASME OM-S/G-2003, "Standards and Guides for Operation and Maintenance of Nuclear Power Plants."

43. Bechtel Topical Report BC-TOP-1, "Containment Building Liner Plate Design Report," September 1974 (ADAMS Accession No. ML14093A217).

44. BWRVIP-139-A, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines" April 2010 (ADAMS Accession No. ML101270174).

45. Empresarios "Design Report of the New Fuel Storage Racks in the Reactor Building for North Anna 3," Document 092-322-F-M-00002, Revision 2 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047).

46. Empresarios "Design Report of the Spent Fuel Storage Racks in Reactor Building for North Anna 3," Document 092-175-F-M-00003, Revision 1 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047).

47. EPRI /NSAC, NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," April 8, 1999.

48. EPRI NP-4726-A, "Seismic Hazard Methodology for the Central and Eastern United States," Vols. 1 - 10, 1988.

49. EPRI NP-5930, "A Criterion for Determining Exceedance of the Operating Basis Earthquake," July 1982.

50. EPRI NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake," December 1982.

51. EPRI Technical Report TR-100082 "Standardization of the Cumulative Absolute Velocity," December 1991.

52. EPRI, GMM "EPRI (2004, 2006) Ground-Motion Model Review Project: Final Products 3002000717," Chapter 7, "Updated EPRI (2004, 2006)," June 2013 (ADAMS Accession No. ML13155A553).

53. EPRI, NP-6395-D, "Probabilistic Seismic Hazard Evaluations at Nuclear Power Plant Sites in the Central and Eastern United States," 1989.

54. EPRI, NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake," December 1982.

55. EPRI, NP-6695, "Guidelines for Nuclear Plant Response to an Earthquake," December 1982.

56. EPRI, TR-100082, "Standardization of the Cumulative Absolute Velocity," December 1991.

57. EPRI, TR-1009684, "CEUS Ground Motion Project Final Report," 2004.

58. EPRI, TR-1012045, "Assessment of a Performance- Based Approach for Determining the SSE Ground Motion for New Plant Sites," Vol. 2, "Seismic Hazard Results at 28 Sites," May 2005.

59. Equipos Nucleares, S.A. (ENSA) Technical Note "ESBWR Fuel Building Pool Bottom Synthesized SSE Accelerations Time Histories," Document 5926ATN02, Revision 3 (as described in the North Anna 3 Audit 2 Summary Report, ADAMS Accession No. ML16193A047).

60. GEH 002N8467, Revision 4, "North Anna 3 Fuel Rack Seismic Analysis" (ADAMS Accession No. ML16125A364).

61. GEH 002N8530, Revision 4, "North Anna 3 PCCS Condenser Seismic Analysis" (ADAMS Accession No. ML16125A366).

62. GEH 003N0526, Revision 1, "North Anna 3 Seismic Qualification of Spent Fuel in the Spent Fuel Racks" (ADAMS Accession No. ML16153A388, ML16125A367 Non-public).

63. GEH DE-ES-0089, Revision 0, "Stress Analysis Report for Drywell Head" (ADAMS Accession No. ML15362A012).

64. GEH DE-ES-0090, Revision 0, "Local Analysis Model for GDCS Pool," 2015.

65. GEH DE-ES-0096, Revision 0, "Liner Anchorage Evaluation" (ADAMS Accession No. ML16167A447).

66. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

67. GEH-SER-DMN-011, Revision 0, "Benchmarking of SASSI 2010 MSM Results from North Anna 3 Site-Specific SSI Analysis."

68. GEH-SER-DMN-011, Revision 1, "Benchmarking of SASSI2010 MSM Results from NA3 Site-Specific SSI Analysis" (ADAMS Accession No. ML15222A283).

69. GEH-SER-DMN-014, Revision 1, "Additional Oscillators for Fully Cracked Model for RAI 3.7.2-14(f)," (NRC staff Report for Audit Non-public).

70. GEH-SER-DMN-020, Revision 1, "Validation Summary Report for SASSI 2010 and Appendix with Validation Problems for RAI 03.07.02-10/RAI 03.07.02-26 Response" (ADAMS Accession No. ML15222A280).

71. GEH-WG3 U73 ERD-S-0002, Revision 6, "Control Building and Firewater Service Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A270).

72. GEH-WG3-T11-DRD-S-0001, Revision 2, "RCCV Structural Design Report" (ADAMS Accession No. ML16148A049, ML16148A169 Non-public).

73. GEH-WG3-T11-DRD-S-0002, Revision 0, "Structural Design Report for Containment Liner Plate," (ADAMS Accession No. ML15357A308).

74. GEH-WG3-T11-DRD-S-0003, Revision 0, "Structural Design Report for Containment Metal Components" (ADAMS Accession No. ML15362A008, ML15362A013 Non-public).

75. GEH-WG3-T12-ERD-S-0001, Revision 0, "Structural Design Report for Containment Internal Structures" (ADAMS Accession No. ML15342A146).

76. GEH-WG3-U63-ERD-S-0001, Revision 4, "Firewater Service Complex Seismic Analysis Report" (ADAMS Accession No. ML16148A131).

77. GEH-WG3-U63-ERD-S-0002, Revision 1, "Firewater Service Complex Stability Analysis Report" (ADAMS Accession No. ML15362A011).

78. GEH-WG3-U63-ERD-S-0003, Revision 2, "Firewater Service Complex Structural Design Report" (ADAMS Accession Nos. ML16148A050, and ML16148A125 Non-public).

79. GEH-WG3-U71-ERD-S-0001 Revision 4, "Reactor/Fuel Building Complex Seismic Analysis Report" (ADAMS Accession Nos. ML16097A203 and ML16097A204).

80. GEH-WG3-U71-ERD-S-0003, Revision 1, "Reactor/Fuel Building Complex Stability Analysis Report" (ADAMS Accession No. ML15362A009).

81. GEH-WG3-U71-ERD-S-0004, Revision 2, "Reactor Building Structural Design Report" (ADAMS Accession No. ML16148A081, ML16148A146 Non-public).

82. GEH-WG3-U73 ERD-S-0002, Revision 6, "Control Building and Firewater Service Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A270).

83. GEH-WG3-U73-ERD-S-0001 Revision 2, "Control Building Seismic Analysis Report" (ADAMS Accession Nos. ML15357A305, ML15357A312, and ML15357A313).

84. GEH-WG3-U73-ERD-S-0003, Revision 3, "Control Building Stability Analysis Report," (ADAMS Accession No. ML16148A129).

85. GEH-WG3-U73-ERD-S-0004, Revision 3, "Control Building Structural Design Report" (ADAMS Accession No. ML16148A051, ML16148A126 Non-public).

86. GEH-WG3-U73-ERD-S-0005, Revision 3, "Control Building and Reactor/Fuel Building Complex Seismic Structure-Soil-Structure Interaction Analysis Report" (ADAMS Accession No. ML16076A271).

87. GEH-WG3-U97-ERD-S-0001, Revision 2, "Fuel Building Structural Design Report" (ADAMS Accession No. ML16148A128, ML16148A169 Non-public).

88. IEEE Std 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," 1987.

89. NEDE-33259P-A, "Reactor Internals Flow Induced Vibration Program" (ADAMS Accession No. ML091660434).

90. NEDE-33312P, "ESBWR Steam Dryer Acoustic Load Definition" (ADAMS Accession No. ML13344B157; ML13344B163 Non-public).

91. NEDE-33313P, "ESBWR Steam Dryer Structural Evaluation" (ADAMS Accession No. ML13344B158; ML13344B164 Non-Public).

92. NEDE-33408P, "ESBWR Steam Dryer- Plant Based Load Evaluation Methodology, PBLE01 Model Description" (ADAMS Accession No. ML13344B159; (ML13344B175 and ML13344B176 Non-public).

93. NEDO-33373, Revision 5, "Dynamic Load-Drop and Thermal-Hydraulic Analyses for ESBWR Fuel Racks," September 2010 (GEH report for the ESBWR standard design of the racks, ADAMS Accession No. ML102990229).

94. NEDO-33411, Revision 0 "Risk Significance of Structures, Systems and Components for the Design Phase of the ESBWR," March 2008 (ADAMS Accession No. ML080880316).

95. NRC ISG DC/COL ISG-017, "Ensuring Hazard-Consistent Seismic Input for Site Response and Soil Structure Interaction Analyses," March 24, 2010 (ADAMS Accession No. ML100570194).

96. NRC ISG DC/COL-ISG-1, "Interim Staff Guidance on Seismic Issues of High Frequency Ground Motion," May 19, 2008 (ADAMS Accession No. ML081400293).

97. NRC RG 1.115, Revision 1, "Protection Against Low-Trajectory Turbine Missiles," July 1977 (ADAMS Accession No. ML003739456).

98. NRC RG 1.12, Revision 2, "Nuclear Power Plant Instrumentation for Earthquakes," March 1997 (ADAMS Accession No. ML003739944).

99. NRC RG 1.122, Revision 1, "Development of Floor Design Response Spectra for Seismic Design of Floor Supported Equipment and Components," February 1978 (ADAMS Accession No. ML003739367).

100. NRC RG 1.136, Revision 3 "Design Limits, Loading Combinations, Materials, Construction, and Testing of Concrete Containments," March 2007 (ADAMS Accession No. ML070310045).

101. NRC RG 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments), "November 2001 (ADAMS Accession No. ML013100274).

102. NRC RG 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997 (ADAMS Accession No. ML003761662).

103. NRC RG 1.166, "Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Post Earthquake Actions," March 1997 (ADAMS Accession No. ML003740089).

104. NRC RG 1.167, "Restart of a Nuclear Power Plant Shut Down by a Seismic Event," March 1997 (ADAMS Accession No. ML003740093).

105. NRC RG 1.199, "Anchoring Components and Structural Supports in Concrete." November 2003 (ADAMS Accession No. ML033360660).

106. NRC RG 1.20, Revision 3, "Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing," March 2007 (ADAMS Accession No. ML070260376).

107. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

108. NRC RG 1.207, "Guidelines for Evaluating Fatigue Analyses Incorporating the Life Reduction of Metal Components Due to the Effects of the Light-Water Reactor Environment for New Reactors," March 2007 (ADAMS Accession No. ML070380586).

109. NRC RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," March 2007 (ADAMS Accession No. ML070310619).

110. NRC RG 1.216, "Containment Structural Integrity Evaluation for Internal Pressure Loadings Above Design-Basis Pressure," August 2010 (ADAMS Accession No. ML093200703).

111. NRC RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," October 2011 (ADAMS Accession No. ML110940300).

112. NRC RG 1.26, Revision 3, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

113. NRC RG 1.26, Revision 4, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," March 2007 (ADAMS Accession No. ML070290283).

114. NRC RG 1.29, Revision 4, "Seismic Design Classification," March 2007 (ADAMS Accession No. ML070310052).

115. NRC RG 1.57, "Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components," May 2013 (ADAMS Accession No. ML12325A043).

116. NRC RG 1.60, Revision 1, "Design Response Spectra for Seismic Design of Nuclear Power Plants," December 1973 (ADAMS Accession No. ML003740207).

117. NRC RG 1.61, Revision 1, "Damping Values for Seismic Design of Nuclear Power Plants," March 2007 (ADAMS Accession No. ML070260029).

118. NRC RG 1.69, Revision 1, "Concrete Radiation Shields for Nuclear Power Plants," May 2009 (ADAMS Accession No. ML090820425).

119. NRC RG 1.7, Revision 3, "Control of Combustible Gas Concentrations in Containment." March 2007 1978 (ADAMS Accession No. ML070290080).

120. NRC RG 1.91, Revision 1, "Evaluations of Explosions Postulated to Occur at Transportation Routes Near Nuclear Power Plants," February 1978 (ADAMS Accession No. ML003740286).

121. NRC RIS 2000-03, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions," March 15, 2000 (ADAMS Accession No. ML003686003).

122. NRC SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005, (ADAMS Accession Nos. ML052770225, ML052770257), and the related SRM, dated February 22, 2006 (ADAMS Accession No. ML060530316).

123. NRC SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," April 2, 1993, (ADAMS Accession No. ML003708021), and the related SRM, dated July 21, 1993 (ADAMS Accession No. ML003708056).

124. NRC SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs," March 28, 1994, (ADAMS Accession No. ML003708068), and the related SRM, dated June 30, 1994 (ADAMS Accession No. ML003708098).

125. NRC Staff NUREG–0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

126. NRC Staff NUREG/CR-6728, "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines," October 2001 (ADAMS Accession No. ML013100232).

127. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

128. U.S. Code, "Atomic Energy Act of 1954," as amended, NUREG-0980 Vol. 1, No. 10, September 2013 (ADAMS Accession No. ML13274A489).

4.0 REACTOR

4.0 REACTOR

4.1 Introduction

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the staff evaluation of the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR) Chapter 4 which describes the reactor mechanical components of the North Anna 3 Economic Simplified Boiling-Water-Reactor (ESBWR), which includes the reactor internals, control blades and control rod drive, core support structural materials, fuel system design (fuel rods and assemblies), nuclear design, and thermal-hydraulic design. Furthermore, it provides an evaluation of the capability of the reactor to perform its safety functions throughout its design lifetime under all normal operational modes, including transient, steady-state, and accident conditions. This chapter also includes information to support the accident analysis in Chapter 15 of this SER.

4.2 Summary of Application

Chapter 4 of the North Anna 3 COL application (COLA), FSAR, Revision 8, incorporates by reference Chapter 4 of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in FSAR Chapter 4, the applicant provides the following:

Tier 2 Departures Requiring Prior NRC Approval

- NAPS DEP 3.7-1 — Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

This departure increases the fuel assembly and control blade seismic loads beyond the certified design fuel assembly and control blade loads by including the site-specific seismic response as part of the safe shutdown earthquake (SSE) for North Anna 3.

COL items

- STD COL 4.3-1-A — Variances from Certified Design

The applicant shall address changes to the reference design of the fuel, control rod or core design.

- STD COL 4A-1-A — Variances from Certified Design

The applicant shall address changes to the reference design of the fuel, control rod or core design.

For all combined license (COL) items, the applicant states that there are no changes to the fuel, control rod, or core design from the referenced certified design.

4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is described in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-

Water Reactor." In addition, the relevant requirements of the Commission regulations for the reactor, and the associated acceptance criteria, are in Chapter 4 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Revision 3, March 2007.

In accordance with Section VIII, "Processes for Changes and Departures," of Appendix E to Part 52, the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. Tier 2 departures affecting technical specifications require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.C.4. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59, "Changes, tests, and experiments."

The staff review of North Anna 3 Departure NAPS DEP 3.7-1 and whether it is acceptable is based on compliance with 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criteria (GDC) 2, "Design Bases for Protection Against Natural Phenomena," as it relates to the structural protection for fuel assemblies and control blades during accidents involving earthquakes. GDC 2 requires the design bases of structures, systems, and components, which include fuel assemblies and control blades, to reflect appropriate consideration of natural phenomena, which includes consideration of combined loading due to natural phenomena and limiting hydrodynamic loads.

4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Chapter 4 of the ESBWR DCD. The staff reviewed Chapter 4 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this chapter.

Chapter 4 of the North Anna 3 COL FSAR contains the following sections:

4.1 Summary Description
4.2 Fuel System Design
4.3 Nuclear Design
4.4 Thermal and Hydraulic Design
4.5 Reactor Materials
4.6 Functional Design of Reactivity Control System

Appendix 4A Typical Control Rod Patterns and Associated Power Distribution for ESBWR
Appendix 4B Fuel Licensing Acceptance Criteria
Appendix 4C Control Rod Licensing Acceptance Criteria
Appendix 4D Stability Evaluation

[1] See "*Finality of Referenced NRC Approvals*" in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

The staff reviewed the following information in the COL FSAR:

<u>Tier 2 Departures Requiring Prior NRC Approval</u>

- NAPS DEP 3.7-1 Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The staff reviewed NAPS DEP 3.7-1 as it relates to the site-specific seismic ground motion exceedances of the ESBWR Certified Seismic Design Response Spectra (CSDRS) and documented its safety finding in Chapter 3 of this report. In the COLA, Part 7: Departures Report, regarding NAPS DEP 3.7-1, the applicant stated a change to FSAR Chapter 4.2 was made as a result of site-specific seismic exceedances. The staff reviewed the changes to Chapter 4.2 to ensure the site-specific fuel assemblies and control blades were still in compliance with the Commission’s regulations. The staff notes that the ESBWR standard plant seismic analysis, which utilizes the CSDRS, forms the basis of the GE14E fuel assembly and ESBWR Marathon control blade mechanical designs. DCD Tier 2* Reference 4.2-4 (in ESBWR DCD Section 4.2.7) describes the structural capability of the GE14E assembly and assembly components to withstand seismic/dynamic loading. DCD Tier 2* Reference 4.2-8 describes the structural capability of the ESBWR Marathon control rod blade.

As a result of the site-specific seismic exceedances of the CSDRS, the staff was unable to determine from the information provided in the FSAR whether the fuel and control blades to be loaded in the North Anna 3 reactor would be able to withstand loads resulting from natural phenomena, as required by GDC 2. Therefore, on July 24, 2014, the staff asked the applicant in RAI 04.02-1, to provide site-specific supplemental information in Chapter 4.2 of the FSAR that demonstrates that the North Anna 3 fuel assembly and control blade mechanical loads remain bounded by the component design analyses and testing performed for the ESBWR Design Certification (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14283A563). On May 19, 2016, the applicant provided a response to RAI 04.02-1 (ADAMS Accession No. ML16146A277). The staff’s review of the response and supplemental information is described below.

Fuel Assembly

As part of its response to RAI 04.02-1, the applicant provided to the staff a site-specific Technical Report WG3-002N9544, “North Anna Unit 3 Site-Specific GE14E Fuel Assembly Mechanical Design Report,” Revision 2 (ADAMS Accession No. ML16146A278), which documents the analysis performed to show that the North Anna 3 fuel assembly mechanical loads remain bounded by the fuel assembly capacity limits.

In general, the staff notes that the applicant’s methodology for evaluating the site-specific fuel assembly mechanical loads follows the methodology described in the ESBWR DCD, Chapter 4; that is, the applicant provided an evaluation of combined loads (*i.e.*, loss of coolant accident (LOCA), SSE, and safety relief valve (SRV) actuation load) on the fuel assembly to demonstrate that the site-specific loads remain bounded by the capacity limits of the GE14E fuel assembly, as described in DCD Tier 2* (ESBWR DCD, Revision 10, Reference 4.2-4, NEDC-33240P-A, “GE14E Fuel Assembly Mechanical Design Report,” Revision 1) and approved for application to the ESBWR design in 10 CFR Part 52, Appendix E. The applicant also stated in the response to RAI 04.02-1 that the inspections, tests, analyses, and acceptance criteria (ITAAC) associated with the fuel assembly (DCD Tier 1, ITAAC Item 15, Table 2.1.1-3, “ITAAC for the Reactor Pressure Vessel and Internals”) ensures that a full analysis, as described in WG3-002N9544 and NEDC-33240P-A, will be completed prior to fuel load using the as-built characteristics of the fuel assembly and reactor pressure vessel to confirm that the as-built North Anna 3 combined loads on the fuel assembly remain bounded by the fuel assembly capacity limits. Furthermore, the ITAAC Item 15 in Table 2.1.1-3 requires a fuel lift analysis in accordance with NEDC-21175-3-P-A, "BWR [Boiling Water Reactor] Fuel Assembly Evaluation of Combined Safe Shutdown (SSE) and Loss-of-Coolant Accident (LOCA) Loadings (Amendment No. 3)," to ensure fuel bundle lift-out from the fuel support piece does not exceed the acceptance limit given in WG3-002N9544. While the applicant has not performed the fuel lift analysis as part of its current evaluation presented in WG3-002N9544, the staff confirmed that the methodology described in WG3-002N9544 is in accordance with the ESBWR DCD and assures as-built fuel assembly compliance with GDC 2.

During the review of the site-specific fuel assembly analysis, the staff noted that the site-specific exceedances of the seismic response spectra parameters would result in a reduction in margin to the GE14E fuel capacity limits. Therefore, the staff considered several areas to examine more closely, which included the overall methodology for addressing the site-specific seismic exceedances at the fuel assembly level, the site-specific seismic calculation for determining the seismic accelerations of the fuel, the combination of loads for assessing fuel assembly structural adequacy, and the irradiation effects on the fuel assembly seismic response analyses. Between March 2016 and May 2016, the staff conducted a regulatory audit to confirm the information presented in the applicant's response to RAI 04.02-1 and the supplemental information provided in WG3-002N9544 in the areas listed above (ADAMS Accession No. ML16077A343). The regulatory audit included a 3-day onsite meeting (March 23 – March 25, 2016) with the applicant to review supporting calculations. The audit also included the staff's use of the applicant's Electronic Reading Room to review additional calculations and supporting information related to Chapter 4 of the FSAR. The staff issued an audit report to document the results of the audit (ADAMS Accession No. ML16188A142). A summary of the staff's audit activities related to the site-specific fuel analyses is set forth below.

During the on-site audit and during subsequent public meetings,[2] the applicant clarified the specific steps of the methodology followed to address the fuel assembly response due to the site-specific seismic exceedances. Subsequently, the applicant submitted to the NRC, by letter dated May 19, 2016, a revised RAI 04.02-1 response and associated technical reports (ADAMS Accession No. ML16146A277). The revised response included FSAR Chapter 4 markups. The staff confirmed how the applicant obtained the site-specific accelerations at the fuel and confirmed that the methodology used in WG3-002N9544 for determining combined loads follows the methodology described in the ESBWR DCD. Additionally, the staff confirmed that the method for determining the site-specific accelerations, which is described in the FSAR Section 4.2 markups (ADAMS Accession No. ML16146A277), is identical to that used to complete ITAAC Item 15 of Table 2.1.1-3 in the ESBWR DCD. The staff further confirmed that all changes to the FSAR as provided in the revised response to RAI 04.02-1 (ADAMS Accession No. ML16146A277) were incorporated in Revision 9 of Part 2 (FSAR) of the North Anna 3 COLA. Furthermore, the applicant updated Revision 9 of Part 2 of the North Anna 3 COLA to correct Section 4.2.7 regarding the Tier 2* marking of Reference 4.2-201. Therefore

[2] Summaries of these meetings are posted in ADAMS at Accession Nos. ML16050A485, ML16071A370, ML16078A401, ML16103A343, ML16078A429, ML16097A606, ML16095A194, ML16110A022, ML16110A023, ML16111B309, ML16137A064, ML16147A433, and ML16148A091. Portions of the public meetings were closed to discuss proprietary information.

the Confirmatory Item 4.2-1 from the staff advanced SER for North Anna 3 is resolved and closed.

Also during the audit, the staff examined the calculations the applicant had completed to develop the site-specific seismic loading at the fuel assembly. The staff noted that the applicant analyzed the time-history motion of the fuel assemblies for determining the maximum resultant horizontal fuel acceleration. The staff confirmed that the calculations represent the most limiting seismic motions (as reviewed in Chapter 3 of this SER) and that the applicant's method for determining the maximum seismic acceleration in the horizontal and vertical directions, which is described in the FSAR Section 4.2 markups (ADAMS Accession No. ML16146A277), is consistent with NRC Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," Revision 2. The staff also confirmed that the applicant's methodology for calculating the seismic accelerations of the fuel assemblies is identical to the methodology described in the DCD. The staff further confirmed that all changes to the FSAR as provided in the revised response to RAI 04.02-1 (ADAMS Accession No. ML16146A277) were incorporated in Revision 9 of Part 2 (FSAR) of the North Anna 3 COLA. Furthermore, the applicant updated Revision 9 of Part 2 of the North Anna 3 COLA to correct Section 4.2.7 regarding the Tier 2* marking of Reference 4.2-201. Therefore the Confirmatory Item 4.2-1 from the staff advanced SER for North Anna 3 is resolved and closed.

Due to the decrease in margin to the GE14E fuel assembly capacity limits, the staff also audited the applicant's calculation for combining loads (i.e., seismic + accident loads) to confirm that accident loads (i.e., LOCA and SRV) in addition to the increased site-specific seismic loads do not cause the fuel assembly capacity limits to be exceeded. The applicant provided a calculation, as mentioned in the response to RAI 04.02-1 that considered bounding LOCA and SRV loadings in combination with the site-specific seismic loads. The staff confirmed that the calculation of combining loads is conservative for the North Anna 3 reactor and that the site-specific loads at the fuel assembly, as presented in the response to RAI 04.02-1 (ADAMS Accession No. ML16146A277), are less than the fuel assembly's capacity limits. The staff further confirmed that all changes to the FSAR as provided in the revised response to RAI 04.02-1 (ADAMS Accession No. ML16146A277) were incorporated in Revision 9 of Part 2 (FSAR) of the North Anna 3 COLA. Furthermore, the applicant updated Revision 9 of Part 2 of the North Anna 3 COLA to correct Section 4.2.7 regarding the Tier 2* marking of Reference 4.2-201. Therefore the Confirmatory Item 4.2-1 from the staff advanced SER for North Anna 3 is resolved and closed.

During the staff's review of the application, the staff determined that the applicant's primary structure model (FSAR Chapter 3) is the same as the DCD model, and both the applicant's and DCD's models use mass and stiffness as inputs for the fuel. The staff further noted that, identical to the DCD model, the applicant's primary structure model does not account for fuel assembly spacer grids and other fuel assembly components. The staff determined that due to the increased site-specific seismic loadings and decreased margin to the site-specific fuel assembly acceptance limits, the effect of spacer grid spring relaxation due to irradiation, as discussed in NRC Information Notice (IN) 2012-09, "Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength," could cause an additional increase in site-specific seismic loads; however, the staff also noted that boiling water reactor fuel is channeled and that, in general, the fuel channel dominates the fuel bundle's structural response to loads. During the audit, the staff examined a condition report that documented the applicant's assessment of IN 2012-09. The staff confirmed that the applicant's site-specific primary structure model is adequate for determining fuel assembly seismic loads in light of IN 2012-09 because the stiffness of the fuel assembly channel box dominates the fuel assembly mechanical response.

To summarize the staff's review regarding the site-specific fuel assembly, the staff gathered information in the regulatory audit that confirmed the information provided in the docketed RAI response, which is incorporated into Revision 9 of Part 2 of the North Anna 3 COLA. Based on the applicant's response to RAI 04.02-1 and Technical Report WG3-002N9544, Revision 2, as confirmed by the staff's regulatory audit, the staff finds that the GE14E fuel to be loaded into the North Anna 3 reactor meets GDC 2.

Control Blade

As part of its response to RAI 04.02-1 (ADAMS Accession No. ML16146A277), the applicant provided to the staff a site-specific Technical Report 002N8005, "North Anna 3 Control Rod Seismic Analysis," Revision 2 (ADAMS Accession No. ML16146A279), which documents the analysis performed to show that the North Anna 3 control blade mechanical loads and scram insertion times are bounded by the control blade capacity limits and scram insertion time limits in the ESBWR DCD, Chapter 4.2.4.

In general, the staff noted that the applicant's methodology for evaluating the site-specific control blade mechanical loads follows the methodology described in the ESBWR DCD, Chapter 4; that is, the applicant provided an analysis of combined loads (i.e., LOCA, SSE, and SRV actuation load) on the control blades to demonstrate that the site-specific loads remain bounded by the capacity limits of the ESBWR Marathon control blade, as described in DCD Tier 2* Reference 4.2-8 (NEDE-33244P-A, "ESBWR Marathon Control Rod Mechanical Design Report," Revision 2.). The staff noted increases in the site-specific control blade loads from the analysis presented in the DCD; however, margin to the control blade capacity limits still exists. The applicant also evaluated the site-specific seismic motion on the effect of control blade insertion times. The staff noted ample margin in the site-specific calculation of fuel assembly displacement to the acceptance limits defined in the ESBWR DCD, Chapter 4 and NEDE-33244P-A for the Marathon control blade.

As part of the North Anna 3 COLA, the applicant added a site-specific ITAAC for the control blades (COLA Part 10, ITAAC Item 1, Table 2.4.19-1). In accordance with the methodology described in the DCD, the applicant stated in the response to RAI 04.02-1 (ADAMS Accession No. ML16146A277), that the site-specific ITAAC associated with the control blades ensures that a full analysis, as described in Technical Report 002N8005 and NEDE-33244P-A, will be completed prior to fuel load using the as-built characteristics of the control blades and other reactor components to confirm that the North Anna 3 combined loads on the control blade remain bounded by the control blade capacity limits and the scram insertion time limits for the Marathon control blade. The staff determined this site-specific ITAAC to be acceptable and confirmed that the methodology described assures as-built control blade compliance with GDC 2.

During the same regulatory audit, the staff reviewed the calculation that determined the site-specific fuel channel oscillation and confirmed that the results presented in Technical Report 002N8005 accurately represent the site-specific seismic analysis. The staff issued an audit report to document the audit results (ADAMS Accession No. ML16188A142).

Based on the applicant's response to RAI 04.02-1 and Technical Report 002N8005, Revision 2, as confirmed by the staff's regulatory audit, the staff finds that the Marathon control blades to be used in the North Anna 3 reactor meet GDC 2.

In conclusion, despite the seismic exceedances from the ESBWR DCD in ground motion at the North Anna 3 site, the applicant has adequately demonstrated that these exceedances do not cause the GE14E fuel assemblies nor the Marathon control blades to be used in the North Anna 3 reactor to experience accident and seismic loads in excess of the design's acceptance limits. Accordingly, the staff finds that the GE14E fuel assemblies and Marathon control blades to be used in the North Anna 3 reactor are in compliance with the Commission's regulations.

COL Information Items

- STD COL 4.3-1-A Variances from Certified Design
- STD COL 4A-1-A Variances from Certified Design

For COL Items STD COL 4.3-1-A and STD COL 4A-1-A, the applicant states that there are no changes to the fuel, control rod or core design from the referenced certified design. The staff reviewed the information in the COL FSAR and concludes that the application does not depart from the standard design in regards to fuel, control rod, or core design, and no further evaluation of these matters is necessary.

4.5 Post Combined License Activities

The applicant added a site-specific ITAAC in Part 10 of the COLA Table 2.4.19-1, Item 1, to ensure that a full analysis, as described in Technical Report 002N8005 and NEDE-33244P-A, will be completed prior to fuel load using the as-built characteristics of the control blades and other reactor components to confirm that the site-specific combined loads on the control blade remain bounded by the control blade capacity limits and the scram insertion time limits for the Marathon control blade.

4.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information remains to be addressed in the COL FSAR related to this chapter. The results of the staff's technical evaluation of the DCD information are incorporated by reference in NUREG–1966. The staff's review confirmed that the applicant has adequately addressed COL Items STD COL 4.3-1-A and STD COL 4A-1-A.

The staff's review also confirmed that the applicant has adequately addressed NAPS DEP 3.7-1 relating to the North Anna 3 fuel assemblies and control blades. The staff reviewed the applicant's analysis of the fuel assemblies and control blades relating to NAPS DEP 3.7-1 and, for the reasons set forth above, finds that analysis acceptable. The staff further confirmed that all changes to the FSAR as provided in the revised response to RAI 04.02-1 (ADAMS Accession No. ML16146A277) were incorporated in Revision 9 of Part 2 (FSAR) of the North Anna 3 COLA. Furthermore, the applicant updated Revision 9 of Part 2 of the North Anna 3 COLA to correct Section 4.2.7 regarding the Tier 2* marking of Reference 4.2-201. Therefore the Confirmatory Item 4.2-1 from the staff advanced SER for North Anna 3 is resolved and closed.

References

1. 10 CFR 50.59, "Changes, tests and experiments."

2. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

3. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

4. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

5. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

6. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

7. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

8. GEH Technical Report 002N8005, "North Anna 3 Control Rod Seismic Analysis," Revision 2 (ADAMS Accession No. ML16146A279)

9. GEH Technical Report WG3-002N9544, "North Anna Unit 3 Site-Specific GE14E Fuel Assembly Mechanical Design Report," Revision 2 (ADAMS Accession No. ML16146A278).

10. NEDC 21175 3-P-A, "BWR [Boiling Water Reactor] Fuel Assembly Evaluation of Combined Safe Shutdown (SSE) and Loss-of-Coolant Accident (LOCA) Loadings (Amendment No. 3)."

11. NEDC 33240P-A, "GE14E Fuel Assembly Mechanical Design Report," Revision 1.

12. NEDE-33244P-A, "ESBWR Marathon Control Rod Mechanical Design Report," Revision 2.

13. NRC IN 2012-09, "Irradiation Effects on Fuel Assembly Spacer Grid Crush Strength,"

14. NRC RG 1.92, Revision 2, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," September 2012 (ADAMS Accession No. ML12220A043).

15. NRC Staff NUREG–0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

16. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

5.0 REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

5.0 REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) reactor coolant system (RCS) and connected systems of the Economic Simplified Boiling-Water Reactor (ESBWR) design including those systems and components that contain or transport fluids coming from or going to the reactor core. These systems form a major portion of the reactor coolant pressure boundary (RCPB). This chapter also provides information on the North Anna 3 RCS and pressure-containing appendages out to and including isolation valves. This grouping of components is characterized as the RCPB and is defined in Title 10 *Code of Federal Regulations* (10 CFR) 50.2, "Definitions."

5.1 <u>Summary Description</u>

Section 5.1, "Summary Description," of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference with no departures or supplements Section 5.1, "Summary Description," of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the summary description have been resolved.

5.2 <u>Integrity of Reactor Coolant Pressure Boundary</u>

Section 5.2, "Integrity of Reactor Coolant Pressure Boundary," of the North Anna 3 FSAR discusses measures employed to provide and maintain the integrity of the RCPB.

5.2.1 Compliance with Codes and Code Cases

5.2.1.1 Compliance with 10 CFR 50.55a

5.2.1.1.1 Introduction

Section 5.2.1.1 of the North Anna 3 COL FSAR, Revision 8, addresses the American Society of Mechanical Engineers (ASME) code edition and addenda to be used at North Anna 3 in order to demonstrate compliance with the NRC regulations in 10 CFR 50.55a, "Codes and standards."

5.2.1.1.2 Summary of Application

Section 5.2.1.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.1.1 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.2.1.1, the applicant provides the following:

<u>Supplemental Information</u>

- STD SUP 5.2-2

In FSAR Section 5.2.1.1, the applicant provided supplemental information that preservice inspection (PSI) and In-Service Inspection (ISI) of the RCPB are conducted in accordance with the applicable edition and addenda of the ASME Boiler and Pressure Vessel Code (BPV Code)

Section XI, which is required by 10 CFR 50.55a. FSAR Section 5.2.1.1 also states the following:

> As described in DCD Section 3.9.6 for pumps and valves, and in DCD Section 3.9.3.7.1 for dynamic restraints, preservice and in-service testing of RCPB components is in accordance with the edition and addenda of the ASME OM Code required by 10 CFR 50.55a.

5.2.1.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, “Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor.” In addition, the relevant requirements of the Commission regulations for compliance with 10 CFR 50.55a, and the associated acceptance criteria, are in Section 5.2.1.1 of NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” (SRP).

In particular, NRC regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” and Part 52 provide the regulatory basis for the staff’s review of the information in the North Anna 3 COL application (COLA). For example, NRC regulations in 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (GDC) 1, “Quality standards and records,” require that nuclear power plant structures, systems, and components (SSCs) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. Furthermore, NRC regulations in 10 CFR 50.55a, as they relate to the establishment of the minimum quality standards for the design, fabrication, erection, construction, testing, and inspection of nuclear power plant components, require conformance with appropriate editions of published industry codes and standards.

Also, the staff followed the guidance in Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” June 2007, in evaluating North Anna 3 COL FSAR Section 5.2.1.1 for compliance with NRC regulations.

5.2.1.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.2 of the certified ESBWR DCD. The staff reviewed Section 5.2.1.1 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

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[1] See “*Finality of Referenced NRC Approvals*” in SER Section 1.2.2, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- STD SUP 5.2-2

The FSAR incorporates by reference Section 5.2.1.1 of the ESBWR DCD Tier 2, which refers to Table 3.2-1, “Classification Summary,” and Table 3.2-3, “Quality Group Designations – Codes and Industry Standards,” of the ESBWR DCD for the ASME Code applied to components in the ESBWR design with respect to Section III of the ASME BPV Code.

In Request for Additional Information (RAI) 05.02.01.01-1(Agencywide Documents Access and Management System (ADAMS) Accession No. ML082110133), dated July 28, 2008, the staff requested that the applicant address the application of other sections of the ASME BPV Code and the ASME *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) in its implementation of the ESBWR reactor design. In its response to this RAI dated September 11, 2008 (ADAMS Accession No. ML082610417), the applicant stated that the FSAR would be revised to provide references to the appropriate sections that discuss compliance with ASME BPV Code Section XI and the ASME OM Code, “Operation and Maintenance of Nuclear Power Plants.” As a result, FSAR Section 5.2.1.1 states that the PSI and ISI of the RCPB will be conducted in accordance with the applicable edition and addenda of the ASME BPV Code Section XI, required by 10 CFR 50.55a as described in FSAR Section 5.2.4. FSAR Section 5.2.1.1 also states that preservice testing (PST) and in-service testing (IST) of the RCPB components will be in accordance with the edition and addenda of the ASME OM Code required by 10 CFR 50.55a as described in DCD Section 3.9.6, for pumps and valves and DCD Section 3.9.3.7.1, for dynamic restraints. The staff verified these revisions and finds that the reference to the applicable sections of the ESBWR DCD for the application of appropriate ASME Code editions and addenda is consistent with NRC regulations and is therefore acceptable. Therefore, RAI 05.02.01.01-1 is resolved and closed.

5.2.1.1.5 Post Combined License Activities

There are no post COL activities related to this section.

5.2.1.1.6 Conclusion

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to compliance with 10 CFR 50.55a that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in Section 5.2.1.1 the SRP, and other NRC RGs. The staff’s review concludes that the applicant has presented adequate information in the North Anna 3 COL FSAR to meet the requirements in 10 CFR 50.55a.

5.2.1.2 Applicable Code Cases

5.2.1.2.1 Introduction

Section 5.2.1.2, “Applicable Code Cases,” of the North Anna 3 COL FSAR, Revision 8, addresses the applicable Code Cases for the ASME BPV Code and the ASME OM Code. This section also addresses NRC RGs that indicate the acceptance of ASME Code Cases with or without conditions. In general, ASME develops a Code Case based on inquiries from the nuclear industry associated with code clarifications, modifications, or alternatives to the code. All Code Cases will remain valid and available for use until annulled by the ASME. ASME Code Cases acceptable to the staff are published in RG 1.84, Revision 35, “Design and Fabrication Code Case Acceptability, ASME Section III, Division 1”, RG 1.147,Revision 16, “In-Service Inspection Code Case Acceptability, ASME Section XI, Division 1”, and RG 1.192, “Operation and Maintenance Code Case Acceptability, ASME OM Code”, in accordance with requirements of 10 CFR 50.55a(b)(4), 10 CFR 50.55a(b)(5) and 10 CFR 50.55(b)(6), respectively.

5.2.1.2.2 Summary of Application

Section 5.2.1.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.1.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without supplemental information or departures.

5.2.1.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the applicable code cases, and the associated acceptance criteria, are in Section 5.2.1.2 of the SRP. The NRC regulations in 10 CFR Part 50 and 10 CFR Part 52 provide the regulatory basis for the staff’s review of the information in the North Anna 3 COLA. For example, 10 CFR Part 50, Appendix A, GDC 1 requires that nuclear power plant SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed. Furthermore, NRC regulations in 10 CFR 50.55a, that are related to the establishment of the minimum quality standards for the design, fabrication, erection, construction, testing, and inspection of nuclear power plant components, require conformance with appropriate editions of published industry codes and standards.

As one acceptable means of meeting the applicable NRC regulations, RG 1.84 lists the ASME BPV Code Section III Code Cases related to design, fabrication, materials, and testing that are acceptable with applicable conditions for implementation at nuclear power plants. RG 1.147 lists ASME BPV Code Section XI Code Cases that are acceptable, with the applicable conditions for use in the ISI of nuclear power plant components and their supports. RG 1.192 lists Code Cases related to the ASME OM Code for operation and maintenance of nuclear power plant components that are acceptable with applicable conditions for implementation at nuclear power plants.

The staff followed the guidance in SRP Section 5.2.1.2 and RG 1.206 to evaluate North Anna 3 FSAR Section 5.2.1.2 for compliance with NRC regulations.

5.2.1.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.2.1.2 of the certified ESBWR DCD. The staff reviewed Section 5.2.1.2 of the North Anna 3 COL FSAR and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to applicable Code Cases.

The North Anna 3 FSAR incorporates by reference Section 5.2.1.2 of the ESBWR DCD Tier 2, without departures or supplemental information. In ESBWR DCD, Tier 2, Section 5.2.1.2 indicates that the various ASME Code Cases that may be applied to components in the ESBWR design are listed in ESBWR DCD, Tier 2, Table 5.2-1. ESBWR DCD, Tier 2, Section 5.2.1.2 also notes that RG 1.84 and RG 1.147 provide a list of ASME Code design and fabrication Code Cases that the NRC has generically approved.

In RAI 05.02.01.02-1, dated July 28, 2008 (ADAMS Accession No. ML082110133), the staff requested that the applicant discuss the use of any Code Cases related to the ASME BPV Code and the OM Code not listed in ESBWR DCD, Tier 2, Table 5.2-1. In the response to this RAI dated September 11, 2008 (ADAMS Accession No. ML082610417), the applicant stated that no ASME BPV Code Section III or Section XI Code Cases, other than those listed in Table 5.2-1 of the ESBWR DCD, had been identified as necessary. The applicant stated that other Code Cases approved by the NRC in RG 1.147 might be used during the development and implementation of the PSI and ISI Programs. ESBWR DCD, Tier 2, Section 3.9.3.7.1b, "Inspection, Testing, Repair, and/or Replacement of Snubbers," references RG 1.192 for the use of Code Cases (such as Code Case OMN-13) applicable to IST of dynamic restraints. ESBWR DCD, Tier 2, Section 3.9.6.6, "10 CFR 50.55a Relief Requests and Code Cases," indicates that the IST Program for the ESBWR does not use any ASME Code Cases. In addition, the applicant stated that other Code Cases approved by the NRC in RG 1.192 might be used during the development and implementation of the PST and IST Programs for North Anna 3. In the RAI response, the applicant indicated that the FSAR would be revised to reference RG 1.192 in Section 5.2.1.2. Subsequently, the ESBWR DCD was revised to include RG 1.192 in the list of RGs to be used in meeting the requirements of GDC 1 and 10 CFR 50.55a. The staff finds that the description of the planned use of ASME Code Cases in ESBWR DCD, Tier 2, Section 5.2.1.2, is consistent with the applicable NRC regulations and RGs. Therefore, RAI 05.02.01.02-1 is closed without the need to revise Section 5.2.1.2 of the North Anna 3 FSAR.

In RAI 05.02.01.02-2, dated July 28, 2008 (ADAMS Accession No. ML082110133), the staff requested that the applicant discuss its compliance with the requirements regarding the use of annulled Code Cases specified in 10 CFR 50.55a(b)(4), (5), and (6). In the response to this RAI dated September 11, 2008 (ADAMS Accession No. ML082610417), the applicant stated that the design, fabrication, and construction of safety-related components will be conducted in accordance with ASME Code requirements specified in ESBWR DCD, Tier 2, Table 3.2-1, "Classification Summary," and Table 3.2-3, "Quality Group Designations – Codes and Industry Standards." The applicant also noted that Section 5.2.1.1 of the ESBWR DCD specifies that the ESBWR meets the relevant requirements of 10 CFR 50.55a. The applicant added that these requirements include the application of any limitations and modifications to the applicable Code edition and addenda as may be specified in 10 CFR 50.55a, including any limitations regarding the use of annulled Code Cases. With respect to PSI/ISI and PST/IST of safety-related components, the applicant stated that the applicable edition and addenda of the ASME Code as identified in 10 CFR 50.55a is used, subject to the limitations and modifications specified in 10 CFR 50.55a—including those limitations specified in 10 CFR 50.55a(b)(4), (5), and (6) regarding the use of Code Cases. The staff finds that the plans described by the applicant for using ASME Code Cases at North Anna 3 meet the applicable NRC regulations. Therefore, RAI 05.02.01.02-2 is resolved and closed.

5.2.1.2.5 Post Combined License Activities

There are no post COL activities related to this section.

5.2.1.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

5.2.2 Overpressure Protection

This FSAR section addresses the safety and relief valves and the portion of the reactor protection system that ensures overpressure protection for the RCPB during operation at power.

Section 5.2.2, "Overpressure Protection," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.2, "Overpressure Protection," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] The staff's review confirmed that no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the overpressure protection have been resolved.

5.2.3 Reactor Coolant Pressure Boundary Materials

This FSAR section addresses information related to the materials selection, fabrication, and processing of RCPB piping and components, as well as the compatibility of RCPB materials with the reactor coolant.

Section 5.2.3, "Reactor Coolant Pressure Boundary Materials," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.3, "Reactor Coolant Pressure Boundary Materials," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review. The staff's review confirmed that no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the RCPB materials have been resolved.

5.2.4 Preservice and In-Service Inspection and Testing of Reactor Coolant Pressure Boundary

5.2.4.1 Introduction

Section 5.2.4 of the North Anna 3 COL FSAR discusses components that are part of the RCPB, which must be designed to permit periodic inspection and testing of important areas and features to assess their structural and leak-tight integrity. ISI Programs are based on the requirements of 10 CFR 50.55a in that Code Class 1 components, as defined in Section III of the ASME BPV Code, meet the applicable inspection requirements set forth in Section XI of the ASME Code, "Rules for In-Service Inspection of Nuclear Power Plant Components."

5.2.4.2 Summary of Application

Section 5.2.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix, Section VI.B.1. In addition, the applicant provided the following information in FSAR Section 5.2.4:

COL Items

- STD COL 5.2-1-A — Preservice and In-Service Inspection Program Description

The applicant provided additional information in FSAR Section 5.2.4 and Sections 5.2.4.3.4, 5.2.4.6, and 5.2.4.11 in order to fully describe the PSI and ISI Programs; including the applicable ASME Code Edition and Addenda, the certification of nondestructive examination (NDE) personnel as amended by 10 CFR 50.55a, system leakage tests as amended by 10 CFR 50.55a, and the PSI and ISI Program implementation milestones.

- STD COL 5.2-3-A — Preservice and In-Service Inspection NDE Accessibility Plan Description

The applicant provided additional information in FSAR Section 5.2.4 and Section 5.2.4.2 to address Class 1 austenitic or dissimilar metal welds and preservation of accessibility during construction to enable the performance of ISI examinations during the operational phase.

Supplemental Information

- STD SUP 5.2-1

The applicant provided supplemental information in FSAR Section 5.2.4.6 to describe the relevant Technical Specification (TS) sections that address system pressure tests and RCS pressure-temperature (P-T) limits.

License Condition

- Part 10, License Condition 3.6 — Operational Program Readiness

In Section 3.6 of Part 10, "Tier 1/ITAAC/Proposed License Conditions," of the COLA, the applicant proposed an operational program readiness license condition.

5.2.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the RCPB in-service inspections and testing, and the associated acceptance criteria, are in Section 5.2.4 of the SRP.

The regulatory basis for accepting the COL items (STD COL 5.2-1-A, STD COL 5.2-3-A) is in GDC 32, "Inspection of reactor coolant pressure boundary," as it relates to the periodic inspection and testing of the RCPB; and 10 CFR 50.55a, as it relates to the requirements for testing and inspecting the Code Class 1 components as specified in Section XI of the ASME BPV Code. In addition, SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," provides the Commission policy for fully describing an operational program. Moreover, the regulatory basis for accepting STD SUP 5.2-1 is 10 CFR 50.55a.

5.2.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.2.4 of the certified ESBWR DCD. The staff reviewed Section 5.2.4 of the North Anna COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 5.2-1-A — Preservice and In-Service Inspection Program Description

ESBWR DCD COL Item 5.2-1-A states that the COL applicant is responsible "for providing a full description of the preservice and in-service inspection programs and augmented inspection programs by supplementing, as necessary, the information in Section 5.2.4 and to provide the milestones for their implementation." To address this COL item, the applicant provided additional information in FSAR Section 5.2.4 and Sections 5.2.4.3.4, 5.2.4.6, and 5.2.4.11 in order to provide a full description of the North Anna 3 PSI and ISI Programs.

In FSAR Section 5.2.4, the applicant stated that "the initial in-service inspection program incorporates the latest edition and addenda of the ASME BPV Code approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load." 10 CFR 50.55a(g)(4)(i) states that in-service examinations and pressure tests conducted during the initial 120-month inspection interval must comply with the requirements in the latest edition and addenda of the Code (or Code Cases) incorporated by reference in paragraph (b) of this section (10 CFR 50.55a) on the date 12 months before the date scheduled for initial loading of fuel under a COL under 10 CFR Part 52 of this chapter subject to the limitations and modifications listed in paragraph (b) of this section. The staff finds that the information provided by the applicant in FSAR Section 5.2.4 is acceptable because it is in compliance with the requirements of 10 CFR 50.55a(g)(4) and 10 CFR 50.55a(b).

In FSAR Section 5.2.4.3.4, the applicant stated that "certification of NDE personnel shall be in accordance with ASME Section XI, IWA-2300, as modified by 10 CFR 50.55a(b)(2)(xviii)." 10 CFR 50.55a(b)(2)(xviii) imposes a modification on the use of the latest edition and addenda of the Code incorporated by reference into 10 CFR 50.55a by requiring that Level I and Level II NDE personnel be recertified on a 3-year interval in lieu of the 5-year interval specified in Section XI, IWA-2314. Given that the initial ISI program will be in accordance with the latest edition and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a, the information provided in the FSAR Section 5.2.4.3.4 is acceptable because it is in compliance with 10 CFR 50.55a(b).

In FSAR Section 5.2.4.6 the applicant stated that "system leakage and hydrostatic pressure tests will meet all the requirements of ASME Code Section XI, IWA-5000 and IWB-5000 for Class 1 components, including the limitation of 10 CFR 50.55a(b)(2)(xxvi)." 10 CFR 50.55a(b)(2)(xxvi) imposes a limitation on the use of the 2001 Edition through the latest edition and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a by requiring that the provisions of IWA-4540(c) from the 1998 Edition of Section XI for pressure testing Class 1, 2, and 3 mechanical joints be applied. Given that the initial ISI program will be in accordance with the latest edition and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a, the information provided in the FSAR Section 5.2.4.6 is acceptable because it is in compliance with 10 CFR 50.55a(b).

In FSAR Section 5.2.4.11, the applicant stated that DCD Section 5.2.4 "fully describes the Preservice and In-Service Inspection and Testing Programs for the RCPB and that the implementation milestones for the Preservice and In-Service Inspection and Testing Programs are provided in FSAR Section 13.4." Since the PSI Program uses essentially the same elements of the ISI Program and the PSI Program requirements are stated under ASME Section XI, the staff concurs with the statement that the PSI/ISI Programs are fully described. The staff reviewed Table 13.4-201 and found that the implementation milestones for the PSI/ISI operational programs are listed.

In North Anna 3 COL FSAR, Part 10, Section 3.6, the applicant has also provided a proposed license condition related to the PSI/ISI operational program which includes the programs listed in Table 13.4-201.

The staff finds implementation milestones are acceptable because they are in accordance with the requirements of ASME Section XI and 10 CFR 50.55a. The staff also finds that the proposed license condition is acceptable because it is in accordance with SECY-05-0197. As discussed in SECY-05-0197, a COL applicant should provide schedules for the implementation of operational programs in order to support the planning for and conducting of NRC inspections. Therefore, the staff will include such license condition in the North Anna 3 COL.

Based on the evaluation described above, STD COL 5.2-1-A is acceptable.

- STD COL 5.2-3-A Preservice and In-Service Inspection NDE Accessibility Plan Description

ESBWR DCD COL Item 5.2-3-A states that the COL applicant is responsible "for developing a plan and providing a full description of its use during construction, PSI, ISI, and during design activities for components that are not included in the referenced certified design, to preserve accessibility to piping systems to enable NDE of ASME Code Class 1 austenitic and dissimilar metal welds during in-service inspection." To address this COL item, the applicant provided additional information in FSAR Sections 5.2.4 and Section 5.2.4.2.

In FSAR Section 5.2.4, the applicant stated that all Class 1 austenitic or dissimilar metal welds are included in the referenced certified design. The applicant described in FSAR Section 5.2.4.2 how anomalies and construction issues are addressed using change control procedures during the construction phase of the project. Procedures require that changes to approved design documents, including field changes and modifications, are subject to the same review and approval process as the original design. Control of accessibility for inspection and testing during licensee design activities affecting Class 1 components is provided via procedures for design control and plant modifications. The applicant explained that ultrasonic techniques (UT) will be the preferred NDE method for all PSI and ISI volumetric examinations; radiographic techniques (RT) will be used as a last resort only if UT cannot achieve the necessary coverage. The same NDE method used during PSI will be used for ISI to the extent possible to assure a baseline point of reference. If a different NDE method is used for ISI than was used for PSI, equivalent coverage will be achieved as required by the Code.

During normal plant operation, ultrasonic examination is the desired NDE method for austenitic and dissimilar metal welds due to ease in obtaining examination coverage of piping that is filled with water and as low as reasonably achievable considerations. The use of RT is an acceptable replacement for UT and is allowed under ASME Section XI, Table IWB-2500, since the examination technique specified for these welds is volumetric. The information provided by the applicant meets the requirements under 10 CFR 50.55a(g)(3), which requires that plants be designed to enable the performance of in-service examinations. The use of RT as a supplemental examination technique with 100 percent coverage meets the requirements of ASME Section XI, Table IWB-2500. The information provided by the applicant provides reasonable assurance that during construction, controls will exist to maintain the accessibility to enable the performance of in-service examinations for austenitic and dissimilar metal welds. The information provided by the applicant meets the requirements of 10 CFR 50.55a(g)(3) and ASME Section XI. Based on the evaluation described above, STD COL 5.2-3-A is acceptable.

Supplemental Information

- STD SUP 5.2-1

Under Section 5.2.4.6, the applicant stated that system pressure tests and correlated TS requirements are provided in the plant TS 3.4.4, "RCS Pressure and Temperature P/T Limits," and TS 3.10.1, "In-Service Leak and Hydrostatic Testing Operation." The proposed change provides additional information with respect to system pressure testing that is located within the TS.

Since the location of additional information regarding pressure testing is at the discretion of the licensee, and, the proposed change under STD COL 5.2-1-A (discussed above) meets the ASME Code and the limitations under 10 CFR 50.55a(b)(2)(xxvi), the staff concludes that the supplemental information as it pertains to pressure testing is acceptable.

5.2.4.5 Post Combined License Activities

In FSAR Table 13.4-201, the applicant provided the implementation milestones for the PSI and ISI Programs.

The applicant proposed a license condition in Part 10 of the COLA Revision 8 as follows:

3.6 Operational Program Readiness

The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

5.2.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff concludes that the information in North Anna 3 COL FSAR Section 5.2.4 meets the relevant guidelines in SRP Section 5.2.4 and RG 1.206, and is therefore acceptable. The staff further concludes that the North Anna 3 COL FSAR PSI/ISI Programs and implementation milestones are consistent with the policy established in SECY-05-0197. Conformance with these guidelines and the policy provides an acceptable basis for satisfying in part, the requirements of GDC 32 and 10 CFR 50.55a.

5.2.5 Reactor Coolant Pressure Boundary Leakage Detection

5.2.5.1 Introduction

Section 5.2.5 of the North Anna 3 COL FSAR discusses the RCPB leakage detection systems that are designed to detect and, to the extent practical, identify the source of reactor coolant leakage.

5.2.5.2 Summary of Application

Section 5.2.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.2.5 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.2.5, the applicant provides the following:

<u>*COL Item*</u>

- STD COL 5.2-2-A Leak Detection Monitoring

In the ESBWR DCD, Revision 9, STD COL Item 5.2-2-H becomes STD COL 5.2-2-A.

In FSAR Section 5.2.5, the applicant provided additional information to address STD COL 5.2-2-A. The applicant replaced Section 5.2.5.9, "Leak Detection Monitoring," of the ESBWR DCD, Tier 2 with new information stating that operators are provided with procedures for detecting, monitoring, recording, trending, and determining the sources of the RCPB leakage. In addition, FSAR Section 13.5, "Plant Procedures," provides a description of the plant procedures program and implementation milestones.

5.2.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG-1966. In addition, the relevant requirements of the Commission regulations for RCPB leakage detection, and the associated acceptance criteria, are in Section 5.2.5 of the SRP.

The staff's acceptance of the leakage detection design is based on meeting the requirements of the following criteria:

- GDC 2, "Design basis for protection against natural phenomena," as it relates to the capability of the design to maintain and perform its safety function following an earthquake.

- GDC 30, "Quality of reactor coolant pressure boundary," as it relates to the detection, identification, and monitoring of the source of reactor coolant leakage.

Also, the staff followed the guidance in RG 1.206 for evaluating the compliance of North Anna 3 COL FSAR Section 5.2.5 with NRC regulations.

5.2.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.2.5 of the certified ESBWR DCD. The staff reviewed Section 5.2.5 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 5.2-2-A Leak Detection Monitoring

In the ESBWR DCD, Revision 9, STD COL Item 5.2-2-H becomes STD COL 5.2-2-A.

The staff identified that the substitution of Tier 2, Section 5.2.5.9 of the ESBWR DCD with STD COL 5.2-2-H text appears to inappropriately limit the intended scope of the procedures contained in Tier 2, Section 5.2.5.9 of the ESBWR DCD. In addition, inclusion in FSAR, Revision 0 of the STD COL 5.2-2-H text of the examples "sump pump run time, sump level, and condensate transfer rate" without inclusion of "radioactivity," also appears to inappropriately limit the scope of the procedures. In RAI 05.02.05-1 (ADAMS Accession No. ML081750645) dated June 23, 2008, the staff requested the following:

a) Revise the FSAR to clarify the scope of procedures relative to TSs. In addition to establishing the leakage rates for the limits in the TS, the operators should be able to use the procedures to identify and monitor the unidentified leakage at a level much lower than the TS limit so that the operator can monitor leakage, evaluate trends, determine the source of leakage, and evaluate potential corrective actions. This level to provide operators an early alert to initiate actions prior to the TS limit should be established as an alarm. The alarm level being established in an approved revision of the ESBWR DCD Section 5.2.5 is acceptable for the COLA.

b) Confirm the procedure scope addresses the conversion of different parameter indications to include all three detection instrumentation in TS Limiting Condition for Operation 3.3.4.1, and clarify STD COL 5.2-2-H accordingly. The procedures should include indications from 1) the drywell floor drain high conductivity water sump monitoring system, 2) drywell air coolers condensate flow monitoring system, and 3) drywell fission product monitoring system.

In the letter dated August 8, 2008, the applicant revised FSAR Section 5.2.5.9 and STD COL 5.2-2-H to clarify that the procedures will fully address the topics described in Items (a) and (b) of the RAI and will be consistent with Section 5.2.5 of the ESBWR DCD, Revision 5. The revised FSAR Section 5.2.5.9 and STD COL 5.2-2-H states as follows:

> Operators are provided with procedures for detecting, monitoring, recording, trending, and determining the sources of RCPB leakage. Examples of parameters that are monitored are sump pump run time, sump level, condensate transfer rate, and process chemistry/radioactivity.
>
> The procedures are used for converting different parameter indications for identified and unidentified leakage into common leak rate equivalents (volumetric or mass flow) and leak rate rate-of-change values, including indications from: 1) the drywell floor drain high conductivity water sump monitoring system, 2) the drywell air coolers condensate flow monitoring system, and 3) the drywell fission product monitoring system.
>
> The procedures are used to monitor leakage at levels well below Technical Specifications limits and provide guidance for evaluating potential corrective action plans to prevent the plant from exceeding a Technical Specifications limit.
>
> An unidentified leakage rate-of-change alarm provides an early alert to the operators to initiate corrective actions prior to reaching a Technical Specifications limit.

The staff reviewed the applicant's response to the above RAI. The staff found that the response addresses all the concerns identified in the RAI, and that the applicant is committed to be consistent with ESBWR DCD, Tier 2, Section 5.2.5. Tier 2, Section 5.2.5 of the DCD Revision 10, includes an alarm that annunciates if a step increase in the unidentified leak rate occurs ("reference DCD Section 5.2.5.4, Limits for Reactor Coolant Leakage Rates within the Drywell.") The standard design and procedures will enable the operators to monitor leakage at levels well below TS limits, and initiate actions to prevent the plant from exceeding a TS limit. Based on the above, the staff finds RAI 05.02.05-1 resolved, and the staff confirmed the applicant provided the appropriate information in FSAR Revision 9.

FSAR Section 13.5.2.1, “Operating and Emergency Operating Procedures,” states the following:

> Operating procedures are developed at least six months prior to fuel load to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations.

The staff concludes that the above information meets the relevant guidelines in SRP Section 5.2.5 and RG 1.206, Regulatory Positions C.III.1 and C.I.5.2.5, and is thus acceptable. Conformance with these guidelines and with GDC 2 and GDC 30 provides an acceptable basis for satisfying the NRC requirements.

5.2.5.5 Post Combined License Activities

The applicant proposed a license condition in Part 10 of the COLA Revision 8 as follows:

> 3.6 Operational Program Readiness

The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

5.2.5.6 Conclusion

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional supplemental information in the COLA to the relevant NRC regulations, the guidance in Section 5.2.5 of the SRP, and other NRC RGs. The staff’s review concluded that the applicant has presented adequate information in the North Anna 3 COL FSAR to meet the requirements of GDC 2 and GDC 30, and the guidance in RG 1.206 and SRP Section 5.2.5.

5.3 Reactor Vessel

5.3.1 Reactor Vessel Materials

5.3.1.1 Introduction

Section 5.3.1, “Reactor Vessel Materials,” of the North Anna 3 COL FSAR, Revision 8, addresses the reactor vessel (RV) material specifications, including weld materials, special processes used to manufacture and fabricate components, special methods for NDE, special controls and special processes used for ferritic steels and austenitic stainless steels, fracture toughness, reactor vessel materials surveillance program (RVSP), and RV fasteners.

5.3.1.2 Summary of Application

Section 5.3.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.3.1 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.3.1, the applicant provides the following:

COL Items

- STD COL 5.3-2-A Materials and Surveillance Capsule

The applicant provided additional information in FSAR Section 5.3.1.8 in order to fully describe the North Anna 3 RVSP and its implementation.

- STD COL 16.0-1-A 5.6.4-1 Pressure-Temperature Limit Curves

This COL item is discussed in SER Section 5.3.2, “Pressure-Temperature Limits.”

- NAPS COL 5.3-2-A

In FSAR Section 5.3.1.6, the applicant states a need to delete the parenthetical statement in the first sentence of the first paragraph in ESBWR DCD, Tier 2, Section 5.3.1.6. This statement refers to DCD Section 5.3.1.8, the content of which is completely replaced with new information in FSAR Section 5.3.1.8 by the resolution of STD COL 5.3-2-A.

License Conditions

- Part 10, License Condition 3.5.7 Fuel Loading
- Part 10, License Condition 3.6 Operational Program Readiness

5.3.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for RV materials, and the associated acceptance criteria, are in Section 5.3.1 of the SRP.

In particular, the regulatory basis for the acceptance of the RVSP information (COL Items NAPS COL 5.3-2-A and STD COL 5.3-2-A) is established in:

- 10 CFR Part 50, Appendix A, GDC 32, as it relates to the RVSP
- 10 CFR 50.60, “Acceptance criteria for fracture prevention measures for light-water nuclear power reactors for normal operation,” as it relates to compliance with the requirements of 10 CFR Part 50, Appendices G and H
- 10 CFR Part 50, Appendix G, “Fracture Toughness Requirements,” as it relates to materials testing and acceptance criteria for fracture toughness
- 10 CFR Part 50, Appendix H, “Reactor Vessel Material Surveillance Program Requirements,” as it relates to the RVSP
- SECY-05-0197, as it relates to fully describing an operational program

Also, the staff followed the guidance in RG 1.206 for evaluating the compliance of North Anna 3 COL FSAR Section 5.3.1 with NRC regulations.

5.3.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.3.1 of the certified ESBWR DCD. The staff reviewed Section 5.3 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>*COL Items*</u>

- STD COL 5.3-2-A and NAPS COL 5.3-2-A Reactor Vessel Materials Surveillance Program

ESBWR DCD COL Item 5.3.2-A states that the COL applicant will "develop a description of the RV material surveillance program and milestones per Section 5.3.1.8." To address this COL item, the applicant provided STD COL 5.3-2-A and NAPS COL 5.3-2-A in order to fully describe the North Anna 3 RVSP and its implementation.

After reviewing the information provided in North Anna 3 COL FSAR Revision 0, Section 5.3.1, including the information referenced in DCD Tier 2, Section 5.3.1, the staff found that the COL applicant had not met the minimum guidelines in RG 1.206 for a description of the RVSP and its implementation. The staff determined that more information was needed to fully describe the RVSP in accordance with SECY-05-0197 to reach a resolution for this COL item. Thus, the staff requested additional information in RAI 5.03.01-1 (ADAMS Accession No. ML082030183), dated July 21, 2008, in order to complete this review.

In RAI 05.03.01-1, the staff requested that the applicant provide additional information on the preparation of the surveillance capsule specimens, the surveillance capsule locations, and the number and type of specimens in each capsule associated with the RVSP. In the response to RAI 05.03.01-1 dated September 3, 2008 (ADAMS Accession No. ML082520378), the applicant described in detail the preparation of the capsule specimens, the number and type of specimens, and the location of the specimen capsules in the core beltline region; the applicant also agreed to update the FSAR. The staff determined that the applicant's response appropriately addressed the issue in RAI 05.03.01-1. The staff reviewed FSAR Section 5.3.1.8 and confirmed that the information described in the response to RAI 05.03.01-1 has been included in Revision 1 of the FSAR. Therefore, the staff finds that the applicant has adequately addressed this issue and RAI 05.03.01-1 is resolved and closed.

In FSAR Revision 8, Section 5.3.1.8, the applicant describes in detail the preparation of the surveillance capsule specimens; the number and type of specimens; the location of the specimen capsules in the core beltline region; and the reporting of test results. The staff finds that the information in FSAR Section 5.3.1.8 is acceptable because it is in accordance with ASTM International (ASTM) E185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," and 10 CFR Part 50, Appendix H.

The implementation milestone for the RVSP is provided in FSAR Section 13.4. In Table 13.4-201, the applicant has stated that the RVSP is to be implemented prior to fuel load and required by a license condition. In addition, in North Anna 3 COL, Part 10, the applicant has provided the following proposed license conditions related to the RVSP:

> The licensee shall implement the Reactor Vessel Materials Surveillance Program prior to initial fuel load. (North Anna 3 COL, Part 10, Section 3.5.7)
>
> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. (North Anna 3 COL, Part 10, Section 3.6)

Based on the information described above, the staff finds the applicant's proposed license conditions are acceptable because they provide assurance that the operational program will be implemented with specific milestones consistent with policy established in SECY-05-0197. The staff finds that the COL applicant has met the minimum guidelines provided in RG 1.206 regarding the description of the RVSP and its implementation and that the applicant has provided a sufficient level of detail to "fully describe" its RVSP as an operational program. On this basis, the COL information items are acceptable.

- STD COL 16.0-1A 5.6.4-1 Pressure-Temperature Limit Curves

The staff's evaluation of STD COL 16.0-1-A 5.6.4-1 is in Section 5.3.2 of this SER.

5.3.1.5 Post Combined License Activities

In FSAR Table 13.4-201, the applicant described the implementation milestone for the RVSP.

As discussed above, the staff has identified the following license conditions:

In Section 3.5.7 of Part 10 of the COLA, Revision 8, the applicant identifies the following license conditions:

> The licensee shall implement each operational program prior to initial fuel load:
>
> - Reactor Vessel Material Surveillance Program

In Section 3.6 of Part 10 of the COLA, the applicant identifies the following license condition:

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

5.3.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved. In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in Section 5.3.1 of the SRP, and other NRC RGs. The staff's review concludes that the applicant has adequately addressed STD COL 5.3-2-A, in accordance with the acceptance criteria in SRP Section 5.3.1, the guidance in RG 1.206 and is consistent with the policy established in SECY-05-0197. Conformance with these guidelines and the policy provides an acceptable basis for satisfying the requirements of 10 CFR Part 50, Appendices G and H. The applicant's additional information is therefore acceptable.

5.3.2 Pressure-Temperature Limits

5.3.2.1 Introduction

This section of the North Anna 3 COL FSAR discusses P-T limits that are required as a means of protecting the RV during startup and shut down to minimize the possibility of a fast fracture. The methods outlined in Appendix G of Section XI of the ASME Code are employed in the analysis of protection against a non-ductile failure. Beltline material properties degrade with radiation exposure, and this degradation is measured in terms of the adjusted reference temperature, that includes a reference nil ductility temperature (NDT) shift, initial RT_{NDT}, and margin.

5.3.2.2 Summary of Application

Section 5.3.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.3.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.3.1.5, the applicant provided the following:

COL Item

- STD COL 16.0-1-A 5.6.4-1 Pressure-Temperature Limit Curves

In ESBWR DCD, Revision 9, COL Item 16.0-1-H 5.6.4-1 becomes STD COL 16.0-1-A 5.6.4-1.

In FSAR Section 5.3, the applicant provides supplemental information in Section 5.3.1.5, "Fracture Toughness Compliance with 10 CFR Part 50, Appendix G," which states:

> The pressure-temperature limit curves are developed in accordance with the Pressure and Temperature Limits Report, as discussed in the Technical Specifications Section 5.6.4. Prior to fuel load, the pressure-temperature limit curves will be updated to reflect plant-specific material properties, if required.

In addition, the applicant has provided technical report NEDC-33441P, "GE Hitachi Nuclear Energy Methodology for the Development of Economic Simplified Boiling Water Reactor (ESBWR) Reactor Pressure Vessel Pressure-Temperature Curves," Revision 6. This report is referenced in North Anna 3 TS Section 5.6.4 as providing the analytical methods used to determine the RCS pressure and temperature limits.

5.3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the regulatory basis for the acceptance of STD COL 16.0-1-A 5.6.4-1 is in 10 CFR Part 50, Appendix G, which provides the requirements for P-T limits.

5.3.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.3.2 of the certified ESBWR DCD. The staff reviewed Section 5.3.2 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 16.0-1-A 5.6.4-1 Pressure-Temperature Limit Curves

ESBWR DCD, Tier 2, Section 5.3.1.5 states that the COL applicant, in accordance with the ESBWR TS (Chapter 16, Section 5.6.4), will furnish bounding P-T curves either as part of the TS or as part of a pressure and temperature limit report (PTLR) submittal for NRC to review. To address this item, the North Anna 3 COL FSAR, Revision 1, Section 5.3.1.5, states that "the pressure-temperature limit curves are developed in accordance with the PTLR as discussed in North Anna Unit 3 TSs (Part 4 of the COLA) Section 5.6.4." In Section 5.6.4, the applicant states that the PTLR methodology is scheduled for submittal to the NRC in the second quarter of 2009. This was tracked as Open Item 5.3.2-2.

In addition, the staff identified the need for the applicant to address the submittal of plant-specific P-T limits in the FSAR. Therefore, in RAI 05.03.02-1(ADAMS Accession No. ML091480213), dated May 28, 2009, the staff requested that the FSAR be revised to provide a commitment to submit the P-T limits using plant-specific material properties before fuel loading. This RAI was tracked as Open Item 5.3.2-1.

The resolution of the Open Items is described in the sections below.

Resolution of Standard Content Open Items

To address Open Item 5.3.2-2, the applicant submitted Technical Report NEDC-33441P, "GE Hitachi Nuclear Energy Methodology for the Development of Economic Simplified Boiling Water Reactor (ESBWR) Reactor Pressure Vessel Pressure-Temperature Curves," Revision 6, in a letter dated December 6, 2013 (ADAMS Accession No. ML13346A654) (hereafter referred to as the ESBWR PTLR). This report was prepared by GE-Hitachi (GEH) and was submitted in support of the North Anna 3 COLA to address the COL Item described above. As such, the purpose of this report is to provide the bounding P-T limits and the associated methodology for the development of the PTLR using the criteria in Generic Letter (GL) 96-03, "Relocation of

Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits."

The first part of the staff's review was to ensure that the information provided in the proposed PTLR and the revised TS pages are in accordance with the guidance in GL 96-03. The second part of the staff's review was to verify that the proposed P-T limits have been developed appropriately using the methodology provided in ESBWR PTLR.

5.3.2.4.1 Summary of the Regulatory Requirements for the Submittal of a PTLR

The NRC established requirements in 10 CFR Part 50 to protect the integrity of the RCPB in nuclear power plants. The staff evaluates the acceptability of a facility's proposed PTLR based on the following NRC regulations and guidance: Appendix G to 10 CFR Part 50; Appendix H to 10 CFR Part 50; RG 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials"; GL 92-01, Revision 1,"Reactor Vessel Structural Integrity, 10 CFR 50.54(f)"; GL 92-01; Revision 1, Supplement 1,"Reactor Vessel Structural Integrity"; SRP Section 5.3.2; and GL 96-03. Appendix G to 10 CFR Part 50 requires that facility P-T limits for the RPV be at least as conservative as those obtained by applying the linear elastic fracture mechanics methodology of Appendix G to Section XI of the ASME Code. Appendix H to 10 CFR Part 50 establishes requirements related to facility RPV material surveillance programs. RG 1.99, Revision 2 contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy resulting from neutron radiation. GL 92-01, Revision 1 requested that licensees submit the RPV data for their plants to the staff for review. In GL 92-01, Revision 1, Supplement 1, the staff requested that licensees provide and assess data from other licensees that could affect their RPV integrity evaluations. SRP Section 5.3.2 provides an acceptable method for determining the P-T limits for ferritic materials in the beltline of the RPV based on the ASME Code, Section XI, Appendix G methodology.

The most recent version of Appendix G to Section XI of the ASME Code which has been endorsed in 10 CFR 50.55a, and therefore, by reference in 10 CFR Part 50, Appendix G, is the 2007 Edition through the 2008 Addenda of the ASME Code. The P-T limit methodology based on this edition of Appendix G to Section XI of the ASME Code (ASME Code Section XI, Appendix G methodology) incorporates the provisions of ASME Code Cases N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels Section XI, Division 1"; and N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves Section XI, Division 1." Additionally, Appendix G to 10 CFR Part 50 imposes minimum head flange temperatures when the system pressure is at or above 20 percent of the preservice hydrostatic test pressure.

GL 96-03 addresses the technical information necessary for a licensee to implement a PTLR. GL 96-03 establishes the information that must be included in (1) an acceptable PTLR methodology (with the P-T limit methodology as its subset), and (2) the PTLR itself. Technical specification task force (TSTF)-419 provides additional guidance, which includes an alternative format for documenting the implementation of a PTLR in the "Administrative Controls" section of a facility's TS.

5.3.2.4.2 Evaluation of the North Anna 3 COL Technical Specification Requirements for Implementation and Control of a PTLR

The North Anna 3 COL TS contain all of the necessary provisions required for the implementation and control of a PTLR. The North Anna 3 TS are in Part 4 of the COLA. The relevant TS requirements include the TS definition of the PTLR (TS Section 1.1); the TS limiting conditions of operation (LCO) for the reactor coolant system P-T limits (LCO 3.4.4), including LCO Action Statements, SRs, and related applicability criteria; and the necessary administrative controls governing the PTLR content and reporting requirements (TS 5.6.4). All of the TS pages related to the implementation and control of a PTLR are acceptable to the staff.

5.3.2.4.3 Evaluation of the ESBWR Generic PTLR Contents and Methodology against the Seven Criteria for PTLR Contents in Attachment 1 of GL 96-03

As discussed in Section 1.0 of the ESBWR PTLR, this report describes the methodology used to develop the P-T limits and provides specific P-T curves for the RV. Accordingly, the PLTR utilizes generic inputs for the RV beltline material chemistry, the initial nil-ductility reference temperature (RT_{NDT}) values, and the projected neutron fluence to determine the P-T limit curves. These generic inputs are intended to be bounding for the design and represent the maximum allowable limits on the input parameters. Therefore, these generic inputs will be substantiated for use in the North Anna 3 COL PTLR in order to verify that actual plant-specific RV beltline properties remain bounded by the generic inputs contained in the PTLR.

Attachment 1 of GL 96-03 contains seven technical criteria (PTLR Criteria) that the contents of PTLRs should conform to if P-T limits are to be located in a PTLR. The staff's evaluations of the contents of the ESBWR PTLR against the seven criteria in Attachment 1 of GL 96-03 are in the subsections that follow.

5.3.2.4.3.1 PTLR Criterion 1

PTLR Criterion 1 states that the PTLR contents should include the neutron fluence values that are used in the calculations of the adjusted reference temperature (ART) values for the P-T limit calculations. Accurate and reliable neutron fluence values are required in order to satisfy the provisions GDC 14,"Reactor coolant pressure boundary"; GDC 30; and GDC 31,"Fracture prevention of reactor coolant pressure boundary," of 10 CFR Part 50, Appendix A; as well as the specific fracture toughness requirements of 10 CFR Part 50, Appendix G. ESBWR PTLR Section 3.3, "Predicted Fluence," states that the fluence analysis for the ESBWR is based on the NRC-approved methodology provided in GE Licensing Topical Report NEDC-32983P-A, "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluations." In addition, the applicant provides the peak RV neutron fluence values projected to 60 years of facility operation in Section 3.3 of the ESBWR PTLR. The staff determined that these 60-year neutron fluence values were calculated using an NRC-approved methodology that is consistent with the guidelines in RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." The inclusion of valid peak RV neutron fluence values calculated using a neutron fluence methodology that is in conformance with RG 1.190 fulfills the provisions of PTLR Criterion 1. Therefore, the staff determined that PTLR Criterion 1 is satisfied.

5.3.2.4.3.2 PTLR Criterion 2

The requirements for designing and implementing RV material surveillance programs are found in NRC regulation 10 CFR Part 50, Appendix H. The rule requires that RV material surveillance programs for operating reactors comply with the specifications of ASTM E 185. The rule requires that the program design and the surveillance capsule withdrawal schedules for the programs must meet the edition of ASTM E 185 that is current on the issue date of the ASME

Code that the RV was purchased; although the rule permits more recent versions up through the 1982 version of ASTM E 185 to be used.

To ensure conformance with these requirements, PTLR Criterion 2 states that the PTLR should either provide the RV surveillance capsule withdrawal schedule or provide references, by title and number, for the documents containing the RV surveillance capsule withdrawal schedule. The criterion also states that the PTLR should reference, by title and number, any applicable surveillance capsule reports placed on the docket by the licensee requesting approval of the PTLR for its units. This criterion assures that the ART calculations will appropriately follow the RV material surveillance program requirements of 10 CFR Part 50, Appendix H. A discussion of the RV material surveillance program is provided in Section 7.0 of the PTLR. Section 7.0 states that the material surveillance program complies with Appendix H to 10 CFR Part 50 and ASTM E 185-82. The surveillance program description states that four capsules are provided to consider the 60-year design life of the vessel. This amount exceeds the three capsules specified in ASTM E 185-82, because the predicted transition temperature shift is less than 55.6 degrees Celsius (°C) (100 degrees Fahrenheit [°F]) at the inside of the vessel. The capsule withdrawal schedule is also provided in this section, and it is stated that each surveillance capsule will be tested in accordance to 10 CFR Part 50, Appendix H. The applicant also states that the results of the material surveillance program will be used to verify the ΔRT_{NDT} values in accordance with RG 1.99, Revision 2, and the P-T limits will be adjusted, as necessary, based on these results. The staff reviewed the recommended surveillance capsule withdrawal schedule and determined that it is in accordance with the specifications of ASTM E 185-82. On this basis, the staff determined that the provisions of PTLR Criterion 2 are satisfied.

5.3.2.4.3.3 PTLR Criterion 3

PTLR Criterion 3 states that the low temperature overpressure protection system lift- setting limits for the power operated relief valves developed using NRC-approved methodologies may be included in the PTLR. This criterion is not applicable to the ESBWR design and is thus not applicable to the North Anna 3 COL.

5.3.2.4.3.4 PTLR Criterion 4

The P-T limits for operating reactors are generated using a method that accounts for the effects of neutron embrittlement on the fracture toughness of the RV beltline materials in accordance with 10 CFR Part 50, Appendix G. For P-T limits, the effects of neutron embrittlement on the fracture toughness of RV beltline materials is defined in terms of the shift in the RT_{NDT} values resulting from neutron irradiation over a given period of facility operation. The final ART value for a material resulting from neutron embrittlement over a certain period of facility operation is defined as the sum of the initial (unirradiated) reference temperature (initial RT_{NDT}), the mean value of the shift in reference temperature caused by irradiation (ΔRT_{NDT}), and a margin term. RG 1.99, Revision 2, provides the staff's recommended methodologies for calculating the ART values used for P-T limit calculations. ΔRT_{NDT} is a product of a chemistry factor (CF) and a fluence factor. The CF is dependent upon the amount of copper and nickel in the material and may be determined from tables in RG 1.99, Revision 2, or from surveillance data. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depth. The margin term is dependent upon whether the initial RT_{NDT} is a plant-specific or a generic value and whether the CF was determined using the tables in RG 1.99, Revision 2, or surveillance data. The margin term is used to account for uncertainties in the values of the initial RT_{NDT}, the copper and nickel contents, the fluence, and the calculation procedures. Appendix G to

Section XI of the ASME Code requires that licensees determine the ART at the 1/4T and 3/4T locations (T is the vessel beltline thickness).

To ensure compliance with the requirements of 10 CFR Part 50, Appendix G, PTLR Criterion 4 states that the PTLR contents should identify the limiting materials and limiting ART values at the 1/4T and 3/4T locations in the wall of the RV. The ART values and all inputs for the ART calculations including RV beltline material chemistry values, initial RT_{NDT} values (Table 3-1), and peak RV beltline neutron fluence projections at 60 years are in Section 3 of the PTLR. In PTLR Section 3.4, the applicant describes how the procedures outlined in RG 1.99, Revision 2, were applied to determine the ΔRT_{NDT} and ART values. In this section, the applicant states that the nominal irradiation temperature in the beltline region is less than 273.9 °C (525 °F). The staff notes that for the procedures of this RG to be valid for nominal irradiation temperatures less than 273.9 °C (525°F), a correction factor shall be used to compensate for greater embrittlement. To address this issue, the applicant proposed to utilize a correction factor equal to a 0.56 °C (1 °F) increase in the ΔRT_{NDT} for each 0.56 °C (1 °F) decrease in irradiation temperature below 287.8 °C (550 °F). This method will be validated for North Anna 3 using the results of the materials surveillance capsule program. The staff determined that this approach is acceptable because it provides a conservative estimate of the additional effect of irradiation on the beltline region at lower temperatures and that the applicant will verify the applicability of the assumption upon receipt of the surveillance capsule data.

The ART calculations and margin term values for the RV beltline materials are in Section 3.5. These values are determined for a 60-year design life. Based on the ART calculations, the applicant has identified the shell forging as limiting material to be used for the derivation of the P-T limits. To evaluate the proposed P-T limits for the RV, the staff confirmed the applicant's selection of the shell forging as the limiting beltline material and performed an independent calculation of the ART values provided in the report using the RG 1.99, Revision 2, methodology. The staff noted that the applicant had not calculated the ART value at the 3/4T location, which is relevant to the heatup P-T limit calculation, because the ART value at 1/4T is assumed to be bounding for heatup and cooldown. The staff verified that the applicant's assumption is valid.

Based on the evaluation described above, the staff finds that the procedure used to calculate the ART values is consistent with the guidance of RG 1.99, Revision 2. The procedure is therefore acceptable. Also, the PTLR clearly identifies the limiting materials and limiting ART values at the 1/4T location. Therefore, the staff determined that the provisions of PTLR Criterion 4 are satisfied.

5.3.2.4.3.5 PTLR Criterion 5

Section IV.A.2 of 10 CFR Part 50, Appendix G requires that the P-T limits for operating reactors and the minimum temperatures established for the stressed regions of RVs (i.e., for the RV flange and stud assemblies) be met for all conditions. The rule also requires that the P-T limits for operating reactors must be at least as conservative as those that would be generated if the methods of analysis in ASME Code Section XI, Appendix G were used to generate the P-T limit curves. In 10 CFR Part 50, Appendix G, Table 1 summarizes the required criteria for generating the P-T limits for operating reactors.

To ensure that PTLRs are in compliance with the above requirements, PTLR Criterion 5 states that the PTLR contents should provide the P-T limit curves for heatup and cooldown operations, core critical operations, and pressure testing conditions for operating light-water reactors.

Table 4-2 of the PTLR includes P-T limit data for heatup and cooldown operations, core critical operations, and hydrostatic and pressure testing. The P-T limit curves corresponding to these data points are in Figure 4-1 of the PTLR. In Section 5.0, the applicant also provided P-T limit data and the corresponding curves for several non-beltline components—including the closure head flanges and the main steam, feedwater, standby liquid control, and core differential pressure (DP) nozzles. These data meet the provisions of PTLR Criterion 5. This criterion specifies that the PTLR include the P-T limit curves for reactor heatup, cooldown, critical operations, and pressure testing conditions.

The staff also performed independent analyses to verify the P-T limit curves for heatup and cooldown operations, core critical operations, and hydrostatic pressure and leak testing provided in the PTLR. Based on this independent verification, the staff determined that the applicant's proposed P-T limits were developed in accordance with ASME Code Section XI, Appendix G and therefore satisfy the requirements of 10 CFR Part 50, Appendix G. Hence, the applicant's proposed P-T limit curves are acceptable for RV operation.

5.3.2.4.3.6 PTLR Criterion 6

Section IV.A.2 of 10 CFR Part 50, Appendix G requires that the P-T limits for operating reactors and the minimum temperature requirements for the highly stressed regions of the RVs (i.e., for the RV flange and stud assemblies) be met for all conditions. Table 1 of 10 CFR Part 50, Appendix G identifies the required criteria for meeting the minimum temperature requirements for the highly stressed regions of the RV.

PTLR Criterion 6 states that the minimum temperature requirements of 10 CFR Part 50, Appendix G shall be incorporated into the P-T limit curves, and the PTLR shall identify minimum temperatures on the P-T limit curves such as the minimum boltup temperature and the hydrotest temperature. The staff determined that the curves were in compliance with the minimum temperature requirements of 10 CFR Part 50, Appendix G. Furthermore, the PTLR clearly identifies the minimum boltup temperature and hydrotest temperature in Section 6.0. Therefore, the staff determined that the provisions of PTLR Criterion 6 are satisfied.

5.3.2.4.3.7 PTLR Criterion 7

RG 1.99, Revision 2 provides the staff’s recommended methods for calculating the ART values for RV beltline materials. These ART values are calculated for the 1/4T and 3/4T locations in the vessel wall. ASME Code Section XI, Appendix G and 10 CFR Part 50, Appendix G require these values to be used for calculating P-T limit curves for reactors. 10 CFR Part 50, Appendix G also requires that the ART values include the applicable results of the RV material surveillance program of 10 CFR Part 50, Appendix H. ART values for ferritic RV base metal and weld materials increase as a function of accumulated neutron fluence and the quantity of alloying elements in the materials, copper and nickel in particular. The procedures of the RG specify the use of a CF as a means for quantifying the effect of the alloying elements on the ART values. Furthermore, the RG specifies that a CF be calculated and input into the calculation of the final ART value for each beltline material. The RG cites two possible methods for determining the CF values for the RV beltline base metal and weld materials: (1) Regulatory Position 1.1 in the RG allows the licensee to determine the CF values from applicable tables in the RG as a function of copper and nickel content or, (2) Regulatory Position 2.1 allows the use of applicable RV surveillance data to determine the CF values if the base metal or weld materials are represented in a licensee’s RV material surveillance program and if two or more credible surveillance data sets become available for the material in question. The RG defines the criteria for determining the credibility of the RV surveillance data sets. In accordance with the requirements of 10 CFR Part 50, Appendix G, the RG states that if the procedure of Regulatory Position 2.1 results in a higher ART value than that obtained by using the procedure of Regulatory Position 1.1, the surveillance data should be used to determine the CF and the ART. If the procedure of Regulatory Position 2.1 results in a lower value for the ART, either procedure may be used for determining the CF and the ART.

To ensure that PTLRs are in compliance with the above regulatory requirements and guidelines, PTLR Criterion 7 states that if surveillance data are used in the calculations of the ART values, the PTLR contents should include the surveillance data and calculations of the CF values for the RV base metal and weld materials, as well as an evaluation of the credibility of the surveillance data against the credibility criteria of RG 1.99, Revision 2. However, the PTLR is generic for the design and is based on bounding embrittlement correlations for which surveillance data is not yet available. Therefore, the incorporation of surveillance data and related calculations is currently not applicable to the PTLR. As previously discussed, the CF and ART values in the PTLR were determined using the procedures of Regulatory Position 1.1 in RG 1.99, Revision 2. Therefore, the staff determined that the provisions of PTLR Criterion 7 are satisfied.

5.3.2.4.4 Staff Findings on the Acceptability of the PTLR

Based on the evaluation described above, the staff has determined that the contents of the PTLR conform to the staff's technical criteria for PTLRs, as defined in Attachment 1 of GL 96-03. The staff also determined that the PTLR satisfies the requirements of 10 CFR Part 50, Appendix G. Furthermore, the staff determined that the PTLR is compatible with the TS and the PTLR-related TS provisions meet the technical criteria of GL 96-03. The staff notes that the PTLR provides generic, not plant-specific, heatup and cooldown P-T curves based on bounding material properties and projected fluence.

To address the submittal of plant-specific P-T limits (Open Item 5.3.2-1), the COL applicant provided the following statement in FSAR, Revision 9, Section 5.3.1.5:

> Prior to fuel load, the pressure-temperature limit curves will be updated to reflect plant-specific material properties, if required.

The staff finds that this approach is consistent with the guidelines of GL 96-03 and is therefore acceptable. Based on this evaluation, the staff finds that STD COL 16.0-1-A 5.6.4-1 is acceptable. As a result, the Phase 2 North Anna 3 SER with Open Items 5.3.2-1 and 5.3.2-2 are resolved.

5.3.2.5 Post Combined License Activities

The staff has noted the following FSAR requirement for North Anna 3:

- Prior to fuel load, the pressure-temperature limit curves will be updated to reflect plant-specific material properties, if required.

5.3.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR

52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff concludes that the ESBWR PTLR (NEDC-33441P, Revision 6) is acceptable for use by the North Anna 3 COL for establishing limiting P-T limit curves and related input parameters. Pursuant to North Anna 3 TS requirement 5.6.4c, future COL holders and licensees will be required to provide updated, plant-specific PTLRs to the NRC "upon issuance for each RV neutron fluence period and for any PTLR revision or supplement thereto." Finally, per GL 96-03, any subsequent changes in the methodology used to develop the P-T must be approved by the NRC.

The staff also concludes that the information in STD COL 16.0-1-A 5.6.4-1 meets the relevant acceptance criteria of SRP Section 5.3.2 and the guidance in RG 1.206. Conformance with these guidelines provides an acceptable basis for satisfying the requirements of 10 CFR Part 50, Appendix G.

5.3.3 Reactor Vessel Integrity

5.3.3.1 Introduction

This section of the North Anna 3 COL FSAR discusses all factors related to RV integrity.

5.3.3.2 Summary of Application

Section 5.3.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.3.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.3.3, the applicant provided the following:

Supplemental Information

- STD SUP 5.3-1

In FSAR Section 5.3.3.6, the applicant provides supplemental information regarding operating procedures intended to ensure that the P-T limits are not exceeded during normal operating conditions or anticipated plant transients.

5.3.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for RV integrity, and the associated acceptance criteria, are in Section 5.3.3 the SRP and RG 1.206.

5.3.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.3.3 of the certified ESBWR DCD. The staff reviewed Section 5.3.3 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to the review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- STD SUP 5.3-1

In FSAR Section 5.3.3.6, the applicant added supplemental information stating that the development of plant operating procedures is addressed in Section 13.5. These procedures require compliance with the TS, which are intended to ensure that the P-T limits identified in DCD Section 5.3.2 are not exceeded during normal operating conditions and anticipated plant transients. The staff finds that STD SUP 5.3-1 acceptable because it is in accordance with the recommendations of RG 1.206, Regulatory Position C.I.5.3.2.2, which states that the FSAR should include a commitment that plant operating procedures will ensure that the P-T limits will not be exceeded during any foreseeable upset condition.

5.3.3.5 Post Combined License Activities

There are no post COL activities related to this section.

5.3.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG 1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

The staff also concluded that the information in STD SUP 5.3-1 meets the guidance in RG 1.206 and is therefore acceptable. Conformance with this guidance provides an acceptable basis for satisfying the requirements in 10 CFR Part 50, Appendix G. The staff also concluded that the information in STD SUP 5.3-1 meets the guidance of RG 1.206 and is therefore acceptable. Conformance with this guidance provides an acceptable basis for satisfying the requirements of 10 CFR Part 50, Appendix G.

5.4 Reactor Coolant System Component and Subsystem Design

5.4.1 Introduction

Section 5.4, "Reactor Coolant System Component and Subsystem Design," of the North Anna 3 COL FSAR, Revision 8, including the corresponding sections in the referenced ESBWR DCD. Specifically, the staff verified that the following sections of the ESBWR DCD contain information appropriate for incorporation by reference and that any supplemental information to be provided by the COL applicant is addressed in the COLA:

5.4.1 Reactor Recirculation System
5.4.2 Steam Generators (not applicable to the ESBWR)
5.4.3 Reactor Coolant Piping
5.4.4 Main Steamline Flow Restrictors
5.4.5 Nuclear Boiler System Isolation
5.4.6 Isolation Condenser System
5.4.7 Residual Heat Removal System

5.4.8 Reactor Water Cleanup/Shutdown Cooling System
5.4.9 Main Steamlines and Feedwater Piping
5.4.10 Pressurizer (not applicable to the ESBWR)
5.4.11 Pressurizer Relief Discharge System (not applicable to the ESBWR)
5.4.12 Reactor Coolant System High Point Vents
5.4.13 Safety and Relief Valves and Depressurization Valves
5.4.14 Component Supports
5.4.15 COL Information
5.4.16 References

5.4.2 Summary of Application

Section 5.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 5.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 5.4, the applicant provides the following:

Supplemental Information

- STD SUP 5.4-1

In FSAR Section 5.4.8, the applicant states that operating procedures will provide guidance to prevent severe water hammer caused by mechanisms such as voided lines.

- STD SUP 5.4-2

In FSAR Section 5.4.12, the applicant states that the human factors analysis of control room displays and controls for the RCS vents is included as part of the overall human factors analysis of the control room displays and controls described in ESBWR DCD Chapter 18.

- STD SUP 5.4-3

In FSAR Section 5.4.12, the applicant states that operating procedures for the reactor vent system address considerations regarding when venting is and is not needed, including a variety of initial conditions that may require venting. Section 13.5 of the North Anna 3 COL FSAR addresses the development of operating procedures.

5.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the reactor coolant system component and subsystem design, and the associated acceptance criteria, are in Section 5.4 of the SRP.

5.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 5.4 of the certified ESBWR DCD. The staff reviewed Section 5.4 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- STD SUP 5.4-1

In FSAR Section 5.4.8, the applicant stated that operating procedures will provide guidance to prevent severe water hammer caused by mechanisms such as voided lines.

The staff finds that supplement STD SUP 5.4-1 is acceptable because water hammer is to be addressed in the plant operating procedures.

- STD SUP 5.4-2

In FSAR Section 5.4.12, the applicant stated that the human factors analysis of the control room displays and controls for the RCS vents is included as part of the overall human factors analysis of the control room displays and controls described in DCD Chapter 18.

The staff found that this information is entirely incorporated into Chapter 18 of the North Anna 3 COL FSAR. The staff thus concludes that STD SUP 5.4-2 is acceptable.

- STD SUP 5.4-3

In FSAR Section 5.4.12, the applicant stated that operating procedures for the reactor vent system address considerations regarding when venting is needed and when it is not needed.

The staff finds that supplement STD SUP 5.4-3 is acceptable because system venting is to be addressed in the plant's operating procedures.

5.4.5 Post Combined License Activities

There are no post COL activities related to this section.

5.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the supplemental information in the COLA to the relevant NRC regulations and the guidance in Section 5.4 of the SRP. The staff's review finds that the applicant has adequately addressed the supplemental information in accordance with NRC regulations. The supplemental information is therefore acceptable.

References

1. 10 CFR 50.2, "Definitions."

2. 10 CFR 50.55a, "Codes and standards."

3. 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for light-water nuclear power reactors for normal operation."

4. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

5. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

6. 10 CFR Part 50, Appendix A, GDC 1, "Quality standards and records."

7. 10 CFR Part 50, Appendix A, GDC 14, "Reactor coolant pressure boundary."

8. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

9. 10 CFR Part 50, Appendix A, GDC 30, "Quality of reactor coolant pressure boundary."

10. 10 CFR Part 50, Appendix A, GDC 32, "Inspection of reactor coolant pressure boundary."

11. 10 CFR Part 50, Appendix G, "Fracture Toughness Requirements."

12. 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements."

13. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

14. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

15. ASME Boiler and Pressure Code (BPVC).

16. ASME, BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

17. ASME, BPVC, Section III, Subsection N, "Division 1," 2001 Edition, 2003 Addenda.

18. ASME, BPVC, Section III, Subsection N, N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels Section XI, Division 1."

19. ASME, BPVC, Section III, Subsection N, N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves Section XI, Division 1."

20. ASME, BPVC, Section XI, "Rules for In-Service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

21. ASME, BPVC, Section XI, Appendix G, "Fracture Toughness Criteria for Protection Against Failure"

22. ASME, BPVC, Section XI, IWA-2300, "Qualifications of Nondestructive Examination Personnel."

23. ASME, BPVC, Section XI, IWA-2314, "Certification and Recertification."

24. ASME, BPVC, Section XI, IWA-4540, "Pressure Testing of Classes 1, 2, and 3 Items."

25. ASME, BPVC, Section XI, IWA-5000, "System Pressure Tests."

26. ASME, BPVC, Section XI, IWB-2500, "Examination and Pressure Test Requirements."

27. ASME, BPVC, Section XI, IWB-5000, "System Pressure Tests."

28. ASME, BPVC, Section XI, Subsection IWA, "General Requirements."

29. ASME, BPVC, Section XI, Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Plants."

30. ASME, OM Code 2001 including Addenda through 2003, "Code for Operation and Maintenance of Nuclear Power Plants."

31. ASME, OM Code N13, "Requirements for Extending Snubber In-Service Visual Examination Interval at LWR Power Plants."

32. ASTM E 185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," 1982.

33. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

34. NEDC-33441P, "GE Hitachi Nuclear Energy Methodology for the Development of Economic Simplified Boiling Water Reactor (ESBWR) Reactor Pressure Vessel Pressure-Temperature Curves," Revision 6, November 29, 2013 (ADAMS Accession No. ML13346A656 [Public Version NEDO-33441]).

35. NEDE-32983-P-A, Revision 2, "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluations." January 31, 2006 (ADAMS Accession No. ML072480121 [Public Version NEDO-32983-A]).

36. NRC GL 1992-001, Revision 1, "Reactor Vessel Structural Integrity, 10 CFR 50.54(f)," February 28, 1992 (ADAMS Accession No. ML031200626).

37. NRC GL 1992-001, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity," May 19, 1995 (ADAMS Accession No. ML031070449).

38. NRC GL 1996-003, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," January 31, 1996 (ADAMS Accession No. ML031110004).

39. NRC RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," March 2001 (ADAMS Accession No. ML010890301).

40. NRC RG 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," June 2003 (ADAMS Accession No. ML030730430).

41. NRC RG 1.47, Revision 16, "In-Service Inspection Code Case Acceptability, ASME Section XI, Division 1," October 2010 (ADAMS Accession No. ML101800536).

42. NRC RG 1.84, Revision 35, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," October 2010 (ADAMS Accession No. ML101800532).

43. NRC RG 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," May 1988 (ADAMS Accession No. ML003740284).

44. NRC RG 1.99, Revision 2, "Results of Periodic Review of Regulatory Guide 1.99," January 2014 (ADAMS Accession No. ML13346A001).

45. NRC SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005, (ADAMS Accession Nos. ML052770225, ML052770257), and the related SRM, dated February 22, 2006 (ADAMS Accession No. ML060530316).

46. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

47. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

48. NRC TSTF-419, "Analysis of NRC Position Regarding TSTF-363, 408, and 419," September 9, 2001 (ADAMS Accession No. ML012690166).

6.0 ENGINEERED SAFETY FEATURES

6.0 ENGINEERED SAFETY FEATURES

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) discusses the NRC staff evaluation of the North Anna 3 Combined License (COL) engineered safety features (ESFs) of the Economic Simplified Boiling-Water Reactor (ESBWR) plant, which are designed to mitigate the consequences of postulated accidents. The ESFs consist of containment systems, core cooling systems, habitability systems, and fission product removal and control systems. The containment systems include the primary containment system, the passive containment cooling system, the containment isolation system, and the hydrogen control system. The passive core cooling system provides emergency core cooling following postulated design-basis events and is designed to operate without the use of active equipment such as pumps and alternating current power sources. Similarly, the passive containment cooling system removes heat from the containment without the use of active equipment or alternating current power sources. The control room habitability system is designed so that the main control room remains habitable following a postulated design-basis event. Natural removal processes inside containment, the containment boundary, and the containment isolation system provide control of fission products following a postulated design-basis event.

6.1 <u>Design Basis Accident Engineered Safety Feature Materials</u>

Section 6.1, "Design Basis Accident Engineered Safety Feature Materials," of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference with no departures or supplements, Section 6.1, "Design Basis Accident Engineered Safety Feature Materials," which includes Section 6.1.1, "Metallic Materials," and Section 6.1.2, "Organic Materials," of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." Materials used in the ESF components have been evaluated to ensure that material interactions do not occur that can potentially impair operation of the ESFs. Materials have been selected to withstand the environmental conditions encountered during normal operation and during any postulated loss-of-coolant accident (LOCA). Their compatibility with core and containment spray solutions has been considered, and the effects of radiolytic decomposition products have been evaluated.

As documented in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," issued April 2014, the staff reviewed and approved Section 6.1 of the certified ESBWR DCD. Section 6.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.1 of the certified ESBWR DCD, Revision 10, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the design basis accident (DBA) ESF materials that were incorporated by reference have been resolved.

[1] See "*Finality of Referenced NRC Approvals*" in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

6.2 Containment Systems

As documented in NUREG-1966, the staff reviewed and approved Section 6.2, “Containment Systems,” of the certified ESBWR DCD. Section 6.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.2, of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff’s review confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to containment systems that were incorporated by reference have been resolved.

6.3 Emergency Core Cooling System

As documented in NUREG-1966, the staff reviewed and approved Section 6.3, “Emergency Core Cooling Systems,” of the certified ESBWR DCD. Section 6.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed the application and checked the referenced DCD to confirm that the scope of information relating to this review topic is complete.[1] The staff’s review confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the emergency core cooling system that were incorporated by reference have been resolved.

6.4 Control Room Habitability Systems

6.4.1 Introduction

The control room habitability area (CRHA) provides protection for the plant operators and ensures suitable environmental conditions for the equipment necessary to monitor and control the plant during normal operation and to maintain the plant in a safe condition during accident conditions. The control room ventilation system and control building layout and structures ensure that plant operators are adequately protected against the effects of accidental releases of toxic chemicals and radioactive material.

6.4.2 Summary of Application

Section 6.4 “Control Room Habitability Systems” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 6.4, the applicant provides the following:

COL Items

- STD COL 6.4-1-A — Control Room Habitability Area (CRHA) Procedures and Training

The applicant provided additional information in STD COL 6.4-1-A. The applicant stated that the operators are provided with training and procedures for control room habitability that address the applicable aspects of NRC Generic Letter (GL) 2003-01, “Control Room Habitability,” dated June 12, 2003, and are consistent with the intent of Generic Issue (GI) 83, “Control Room Habitability,” Revision 3. FSAR Sections 13.4 and 13.5 contain the implementation milestones for training and procedures, respectively.

- NAPS COL 6.4-2-A Toxic Gas Analysis

The applicant provided additional information in NAPS COL 6.4-2-A. The applicant stated that potential toxic gas sources are evaluated to confirm that an external release of hazardous chemicals does not impact control room habitability.

Supplemental Information

- NAPS SUP 6.4-1 System Safety Evaluation

The applicant described the evaluation of the impact of a postulated design-basis accident in Units 1 or 2 on the Unit 3 control room.

6.4.3 Regulatory Basis

The applicable regulatory requirements for control room habitability are as follows:

- General Design Criterion (GDC) 4, “Environmental and Dynamic Effects Design Bases,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” as it relates to structures, systems, and components (SSCs) important to safety being designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with postulated accidents.

- GDC 5, “Sharing of Structures, Systems and Components,” as it relates to ensuring that sharing among nuclear power units of SSCs important to safety will not significantly impair the ability to perform safety functions, including in the event of an accident in one unit and an orderly shutdown and cooldown of the remaining unit(s).

- GDC 19, “Control Room,” as it relates to maintaining the nuclear power unit in a safe condition under accident conditions and providing adequate radiation protection to permit access and occupancy of the control room under accident conditions.

- 10 CFR 50.34(f)(2)(xxviii), as it relates to evaluation of potential radiation exposure pathways for an accident source term and design provisions to preclude control room habitability problems resulting from exposure through such pathways.

- 10 CFR 52.80(a), “Contents of application; additional technical information,” which requires a COL application (COLA) to address the proposed inspections, tests, and analyses (including those applicable to emergency planning) that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that if the inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act of 1954, as amended, and NRC regulations.

The regulatory basis of the information incorporated by reference is in NUREG–1966, related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for habitability systems and the associated acceptance criteria are , Section 6.4, “Control Room Habitability System,” of NUREG-0800, “Standard Review Plan for the Review of

Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), contains the relevant regulatory requirements for habitability systems and the associated acceptance criteria.

The following regulatory guidance applies to control room habitability:

- Three Mile Island (TMI) Action Plan, Item III.D.3.4.
- Regulatory Guide (RG) 1.78, Revision 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," issued December 2001.
- RG 1.52, Revision 3, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post Accident Engineered Safety Feature Atmosphere Cleanup Systems in Light Water Cooled Nuclear Power Plants," June 2001.
- RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," issued June 2007.
- RG 1.196, "Control Room Habitability at Light Water Nuclear Power Reactors," May 2003.

6.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 6. 4, "Control Room Habitability Systems," of the certified ESBWR DCD, Revision 10. The staff reviewed Section 6.4 of the North Anna 3 COL FSAR Revision 8, and checked the referenced ESBWR DCD to confirm that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference include all the relevant information related to control room habitability systems.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8 as follows:

COL Items

- STD COL 6.4-1-A CRHA Procedures and Training

The staff reviewed NAPS COL 6.4-1-A, which relates to the procedures and training included under Section 6.4 of the FSAR. The applicant provided additional information as follows:

> Operators are provided with training and procedures for control room habitability that address the applicable aspects of NRC Generic Letter 2003-01 and are consistent with the intent of [generic issue] GI 83. Training and procedures are developed and implemented in accordance with [FSAR] Sections 13.2 and 13.5, respectively.

The staff determined that the applicant has provided adequate information regarding the development of operator training and procedures for control room habitability to address the applicable aspects of NRC GL 2003-01 and GI 83. Specifically, in FSAR Section 13.2 and 13.5 the applicant has described the operator training and procedures to be in place 6 months prior to scheduled fuel loading. The staff evaluation of the adequacy of these programs as well as its safety finding is documented in FSAR Sections 13.2 and 13.5 of this this Safety Evaluation Report (SER).

- NAPS COL 6.4-2-A Toxic Gas Analysis

The applicant provided additional information to address DCD COL Item 6.4-2-A, which states:

> The COL applicant will identify potential site-specific toxic or hazardous materials that may affect control room habitability in order to meet the requirements of TMI Action Plan III.D.3.4 and GDC 19.

The potential sources of hazardous chemicals include offsite industrial facilities, transportation routes, and nuclear units on the site. In FSAR Section 2.2, "Nearby Industrial, Transportation, and Military Facilities," the applicant evaluated potentially hazardous offsite chemicals and concluded that there are no significant control room habitability impacts from potential sources within 8 kilometers (km) (5 miles) of the control room. The applicant also performed a toxic gas analysis for potentially hazardous chemicals stored on site, in accordance with the guidance from RG 1.78. The applicant concluded that concentrations of toxic gas in the control room will not exceed the toxicity concentrations in RG 1.78 and National Air Quality Standards.

The applicant also analyzed the onsite hazards of a postulated instantaneous release of toxic gas followed by a vapor cloud explosion or the intake of a flammable vapor concentration into a safety-related intake. The applicant found the locations of the onsite storage facilities as well as the hazards from a tank truck delivery to be acceptable in accordance with the guidance in RG 1.78. Therefore the applicant concluded that seismic Category I safety-related toxic gas monitoring instrumentation is not required.

The applicant identified in FSAR Table 2.2-203 gases that are not toxic but could be an asphyxiant in some circumstances. Nitrogen, for example, is stored onsite as liquid nitrogen in a tank. The applicant's analysis shows that the maximum air concentration for nitrogen as well as the other listed asphyxiants listed in FSAR Table 2.2-203 that have a potential of penetrating inside the CRHA will be significantly less than the maximum concentration recommended in RG 1.78. The staff finds the applicant's analysis acceptable because the applicant's screening methodology follows the guidance of RG 1.78. Accordingly, the staff finds that the information the applicant provided in response to COL Item NAPS COL 6.4-2-A conforms to the requirements of 10 CFR 50.34(f)(2)(xxviii) and GDC 19.

In the evaluation presented in Section 2.2.3 of this SER, the staff performed calculations on seven selected chemical hazards and confirmed that the concentrations at the control room intake and inside the control room are lower than as specified in the applicable guidance, as described in detail below.

The staff conducted an audit (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML15096A147) to review the applicant's calculations supporting the chemical hazards analysis. The staff determined that the applicant's calculation results were consistent with the results of the staff's independent verification calculations for the selected analyses. In all cases, the applicant's results are well below the maximum concentrations listed in RG 1.78. While reviewing the applicant's chemical spill calculations, the staff noted that when meteorological stability class F was selected, only the nighttime temperature of 21.9 degrees Celsius (C) (71.5 degrees Fahrenheit (F)) was used. Therefore, on December, 9, 2014, the staff issued Request for Additional Information (RAI) 06.04-8, (ADAMS Accession No. ML14344A107), requesting the applicant to explain why the daytime temperature of 33.1 degrees C (91.5 degrees F) could not coexist with meteorological stability class F. The applicant's response to this RAI dated February 3, 2015 (ADAMS Accession No. ML15035A523), states that:

> high temperature conditions beyond those considered in the [The Areal Locations of Hazardous Atmospheres (ALOHA) code] ALOHA sensitivity analysis coupled with stable conditions conducive to high [atmospheric dispersion factor] X/Q (i.e., temperatures above 71.5 ^{o}F concurrent with stability class F or G) occur only approximately 1.6 percent of the total hours under consideration, regardless of wind speed and wind direction.
>
> Therefore, a broad range of conditions was simulated using a conservative approach to estimate control room concentrations, and to ensure the values presented are not exceeded more than 5 percent of the time as required by RG 1.78, Section C, 3.3.

As described, the applicant used conservative meteorological conditions in its dispersion analysis, and provided an atmospheric dilution that is exceeded only 5 percent of the time, consistent with RG 1.78. Therefore, the staff finds that the applicant's approach is consistent with RG 1.78, Section C.3.3, and therefore acceptable. Accordingly, RAI 06.04-8 is closed and resolved.

The staff reviewed the information submitted by the applicant in Section 2.2 of the COL FSAR and confirmed that there are no significant control room habitability impacts from hazardous chemicals stored on-site, off-site or transported along offsite routes within 8 km (5 miles) of the plant (see the evaluation in Section 2.2.3 of this SER). Therefore, the staff concludes that the applicant adequately performed the required chemical screening in accordance with guidance of RG 1.78. In addition, based on the independent staff calculations described above and resolution of RAI 06.04-08, the staff confirmed that the applicant correctly estimated control room concentrations of toxic gases, and that those results are acceptable.

Supplemental Information

- NAPS SUP 6.4-1 System Safety Evaluation

The applicant provided additional information that states:

> The impact of a postulated design basis accident (DBA) in Units 1 or 2 on the Unit 3 control room was evaluated. The bounding case is a release from the Unit 2 RB to the Unit 3 Control Building receptor based on a minimum distance criterion. The evaluation was performed as follows:
>
> - Atmospheric dispersion factors, χ/Qs, at the Unit 3 MCR [main control room] intakes were conservatively calculated assuming a point source, a distance of approximately 400 m (1312 ft), and a release height of 10 m (32.8 ft). Meteorological data used for cross-unit impact is consistent with that used for the χ/Q values presented in Section 2.3. A nominal "receptor to source" direction of 60 degrees was assumed (clockwise with respect to "true north"). The χ/Q values are presented in Table 2.3-207.

- The Unit 2 LOCA as described in Section 15.4.1.8 of the Units 1 and 2 UFSAR [updated final safety analysis report] was reviewed. The resultant dose at the Unit 3 MCR intake was determined by adjusting the [low population zone] LPZ dose consequences by the ratio of the χ/Q values, and the ratio of the breathing rates (BR) for the LPZ versus the control room values. Detailed modeling of the Unit 3 control room was not performed because the doses are bounded by a postulated Unit 3 LOCA. No credit was taken for the reduced control room occupancy factor, the Unit 3 control room emergency filtration units, or the “finite cloud” model allowed per RG 1.194.

Based on this conservative analysis, the resultant dose is bounded by the control room operator dose from a postulated Unit 3 DBA, and is less than the GDC 19 limits. The staff reviewed this supplemental information added to Section 6.4 of the COLA. The staff has determined that the applicant correctly identified the relative locations of the accident release points on the unit at which an accident is postulated and the release and control room receptor locations for proposed North Anna 3. Since the latter form the basis for the DBA radiological consequences analysis for the control room at the North Anna 3, the staff has determined that the applicant calculations described above are conservative. Accordingly, the staff finds that the supplemental information, NAPS SUP 6.4-1, provided by the applicant adequately addresses the impact on Unit 3 control room habitability from a DBA at a nearby unit on the North Anna site by showing it is bounded by the dose in the Unit 3 control room from a DBA at Unit 3.

In view of the foregoing, the staff concludes that detailed modeling of the Unit 3 control room in the event of a Unit 1 or 2 DBA is not necessary because the doses are bounded by a postulated Unit 3 LOCA, as documented in Chapter 15 of the North Anna 3 FSAR and reviewed by the staff in Section 15.4 of this SER. Furthermore, simultaneous accidents at multiple units on a common site are considered to be outside the design basis, unless there is a reliance on shared systems between the units. This is not the case for the ESBWR design, which is referenced in the North Anna 3 COLA.

The staff’s evaluation of the applicant’s compliance with the control room habitability dose requirements of GDC 19 in the Unit 3 control room from a postulated Unit 3 DBA is documented in Section 15.4 of this SER.

In view of the above, the staff finds that the applicant’s Supplemental Information NAPS SUP 6.4-1 is adequately addressed and therefore acceptable.

6.4.5 Post Combined License Activities

There are no post COL activities related to this section.

6.4.6 Conclusion

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. As described above, the staff confirmed that the applicant has addressed the additional outstanding information relating to control room habitability identified in the COL items in Section 6.4 of the DCD. In regard to the rest of Section 6.4 of the DCD, the staff confirmed that no outstanding information related to this section remains to be addressed in the North Anna 3 FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to control room habitability that were incorporated by reference have been resolved.

In addition, for the reasons set forth above, the staff concludes that the information presented in the COL FSAR is acceptable and meets the requirements of GDC 4 and 19 of Appendix A to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"; 10 CFR 50.34(f)(2)(xxviii); and 10 CFR 52.80(a). This conclusion is also based on the following:

- STD COL 6.4-1-A is acceptable because the applicant has provided adequate information regarding the development and implementation of operator training and procedures for control room habitability to address the applicable aspects of GL 2003-01 and GI 83. In conclusion, the applicant has provided sufficient information for satisfying 10 CFR 50.34(a)(6) and (10) and 10 CFR 50.34(b)(6)(iv) and (v).

- NAPS COL 6.4-2-A is acceptable because the staff verified that an external release of hazardous chemicals will not impact control room habitability, in accordance with the requirements of 10 CFR 50.34(f)(2)(xxviii) and GDC 19.

- NAPS SUP 6.4-1 is acceptable because the staff finds that the impact of a postulated DBA in Units 1 or 2 on the Unit 3 control room is bounded by a postulated Unit 3 LOCA.

6.5 Atmospheric Cleanup Systems

As documented in NUREG-1966, the staff reviewed and approved Section 6.5, "Atmosphere Cleanup Systems," of the certified ESBWR DCD. Section 6.5 of the COL FSAR incorporated Section 6.5 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E with no departures or supplements. The staff reviewed Section 6.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to confirm that the combination of the information in the ESBWR DCD and information in the COL FSAR represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the applicant has addressed the required information, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the atmospheric cleanup systems have been resolved.

6.6 Preservice and In-service Inspection and Testing of Class 2 and 3 Components and Piping

6.6.1 Introduction

In-service inspection (ISI) programs are based on the requirements of 10 CFR 50.55a, "Codes and Standards," in that for Code Class 1, 2 and 3 components, as defined in Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), an applicant is required to meet the applicable inspection requirements set forth in ASME BPVC Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components." ISI includes preservice examinations before initial plant startup, as required by IWB-2200 (for Class 1 components), IWC-2200 (for Class 2 components) and IWD-2200 (for Class 3 components) of ASME BPVC Section XI.

6.6.2 Summary of Application

Section 6.6, “Preservice and In-service Inspection and Testing of Class 2 and 3 Components and Piping,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 6.6 of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 6.6, the applicant provides the following:

COL Items

- STD COL 5.2-1-A Preservice and In-service Inspection Program Description

In FSAR Section 6.6, the applicant provided additional information in STD COL 5.2-1-A to address pressure testing information for Class 2 and 3 components. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME BPVC Section XI, IWA-5000, IWC-5000, and IWD-5000 for Class 2 and 3 components; including the limitations of 10 CFR 50.55a(b)(2)(xx) and 10 CFR 50.55a(b)(2)(xxvi).

- STD COL 6.6-1-A Preservice Inspection and In-service Inspection Program for Class 2 and 3 components

The applicant provided additional information in STD COL 6.6-1-A to address COL Item 6.6-1-A. The applicant states that (a) the preservice inspection (PSI)/ISI program descriptions for Class 2 and 3 components and piping is in DCD Section 6.6, (b) no relief requests for PSI/ISI programs have been identified, (c) the initial ISI program will be based on the latest edition and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) on the date 12 months before fuel load, and (d) the milestones for the PSI/ISI program implementation are in FSAR, Section 13.4.

The applicant also provided additional information in STD COL 6.6-1-A to address the flow acceleration corrosion (FAC) program. The applicant states that before startup, a comprehensive FAC susceptibility screening will be performed to identify any plant systems that may be susceptible to FAC degradation. Should any plant systems remain susceptible, a FAC program will be implemented with PSI baseline nondestructive examinations (NDEs) and material constituency identified for each as-fabricated piping component in the susceptible systems.

- STD COL 6.6-2-A PSI/ISI NDE Accessibility Plan Description

The applicant provided additional information in STD COL 6.6-2-A to address the accessibility and NDE of Class 1, 2, and 3 austenitic or dissimilar metal welds. The applicant stated that during the construction phase of the project, anomalies and construction issues will be addressed using the change control procedures. These procedures provide that changes to approved design documents, including field changes and modifications, be subject to the same review and approval process as the original design. Accessibility and inspectability are key components of the design process. The control of component accessibility for inspection and testing affecting Class 2 and 3 components during licensee design activities and during plant construction is provided via the procedures for design control and plant modifications. Ultrasonic techniques (UTs) will be the preferred NDE method for all PSI and ISI volumetric examinations; radiographic techniques (RTs) will be used only if UTs cannot achieve the necessary coverage. The same NDE method used during PSI will be used for ISI to the extent practical to assure a baseline point of reference. If a different NDE method is used for the ISI than was used for the PSI, equivalent coverage will be achieved as required by the ASME Code.

6.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the staff FSER related to the certified ESBWR DCD. In addition, the relevant requirements of Commission regulations for the PSI/ISI for Class 2 and 3 components, and the associated acceptance criteria, are stated in SRP Section 6.6.

The applicable regulatory requirement for the PSI/ISI programs for Class 2 and 3 components is as follows:

- 10 CFR 50.55a

The related acceptance criteria are as follows:

- ASME BPVC Section XI

The basis for review of the supplementary information submitted in response to COL information items on the ISI of Class 2 and 3 Components is established in 10 CFR 50.55a, as it pertains to the specification of the PSI, ISI, and testing requirements of the ASME Code for Class 2 and 3 components. Review of the description of the FAC program is based on addressing the concerns described in GL 1989-008, "Erosion/Corrosion-Induced Pipe Wall Thinning," dated May 2, 1989, as they pertain to establishing an erosion-corrosion monitoring program. SRP Section 10.3.6, "Steam and Feedwater System Materials," discusses the need for a FAC program and identifies acceptance criteria.

6.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 6.6 of the certified ESBWR DCD. The staff reviewed Section 6.6 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to confirm that the combination of the information in the DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference include all the information related to the PSI, ISI, and testing of Class 2 and 3 components required in an application.

The staff reviewed the conformance of FSAR Section 6.6 to the guidance in RG 1.206, Section C.III.1, Chapter 6, C.I.6.6, "In-service Inspection of Class 2 and 3 Components." The staff determined that FSAR Section 6.6 incorporates by reference Section 6.6 of the ESBWR DCD. The specific version of ASME BPVC Section XI that is used as the baseline Code in the ESBWR certified design is the 2001 edition, up to and including the 2003 addenda. The staff did not identify any portions of the ESBWR ISI program for Class 1, 2, and 3 components that were excluded from the scope of the staff's review of the ESBWR design. North Anna COL FSAR Section 6.6 states that the PSI/ISI program descriptions for Class 2 and 3 components and piping are in ESBWR DCD Tier 2, Section 6.6. Therefore, the staff's conclusions remain unchanged with regard to the acceptability of the ESBWR ISI program based on the 2001 edition, up to and including the 2003 addenda of ASME BPVC Section XI with regard to the preservice and in-service inspectability of Class 2 and 3 components.

The staff's evaluation of the operational program aspects of the ASME Code Class 2 and 3 ISI program and Augmented Inspection programs is addressed with the Class 1 ISI in Section 5.2.4 of this SER. The adequacy of the ISI program for metal containment (Class MC) components is discussed in Section 3.8.2 of this SER. Accordingly, the staff's evaluation of this section focuses on the acceptability of the COLA supplemental information and responses to the ESBWR COL items as they relate to the ISI of ASME Code Class 2 and 3 components.

The staff also considered whether Section 6.6 of the FSAR conforms to the guidance in RG 1.206, Section C.III.1, Chapter 10, C.I.10.3.6, "Steam and Feedwater System Materials," as it relates to developing an FAC monitoring program to address GL 1989-008, which is discussed in ESBWR DCD Section 6.6 and documented in NUREG-1966, Section 6.6. SRP Section 10.3.6 contains the acceptance criteria used by the staff to evaluate FSAR Section 6.6 as it relates to the FAC program. The SRP indicates that conformance with Electric Power Research Institute (EPRI) NSAC 202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," dated April 8, 1999, is adequate for this purpose and that the implementation of a FAC program consistent with EPRI NSAC 202L-R2 addresses staff concerns identified in GL 1989-008. The applicant has included a license condition to implement a FAC program before commercial service as outlined in Operational Programs Table 13.4-201, "Operational Programs Required by NRC Regulations," in FSAR Part 10, Section 3.6, "Operational Programs Readiness."

The staff reviewed the following information in the North Anna 3 COL FSAR:

- STD COL 5.2-1-A — Preservice and In-service Inspection Program Description

In FSAR Section 6.6, the applicant provided additional information in STD COL 5.2-1-A to address pressure testing for Class 2 and 3 components. The staff addresses this information in Section 5.2.4 of this SER including the limitations under 10 CFR 50.55a. The applicant states that system leakage and hydrostatic tests will meet all applicable requirements of ASME BPVC Section XI, IWA-5000, IWC-5000, and IWD-5000 for Class 2 and 3 components, including the limitations of 10 CFR 50.55a(b)(2)(xx) and 10 CFR 50.55a (b)(2)(xxvi).

The staff finds that Revision 1 to the North Anna 3 COL FSAR agrees with the limitations for pressure testing Class 1, 2, and 3 components in 10 CFR 50.55a and is therefore acceptable.

- STD COL 6.6-1-A — Preservice Inspection and In-service Inspection Program Information

The COL applicant provided a full description of the PSI/ISI programs and the augmented inspection programs for Class 2 and 3 components by supplementing the information in DCD Section 6.6. The COL applicant also provided milestones for program implementation in FSAR Section 13.4.

This COL item is addressed in the FSAR, in part, by replacing the last sentence and the parenthetical statement in the third paragraph of DCD Section 6.6 with the following:

> The PSI/ISI program description for Class 2 and 3 components and piping is provided in DCD Section 6.6.

A PSI/ISI program encompasses Class 1, 2, and 3 components and is evaluated in Section 5.2.4 of the staff's SER on the ESBWR DCD (NUREG–1966). Though Section 6.6

applies to Class 2 and 3 components, the augmented ISI programs that protect against postulated piping failures and the erosion/corrosion of piping include portions of the PSI/ISI programs and include Class 1 components. This topic is discussed in Section 5.2.4 of this SER. Since the staff evaluated the PSI/ISI program for Class 1, 2, and 3 components and the implementation milestones and finds them acceptable as discussed under Section 5.2.4 of this SER, the staff concludes that this portion of STD COL 6.6-1-A is acceptable for Section 6.6 of this SER. The augmented inspection program to address the applicant's FAC program is discussed below.

The staff previously documented its review of the applicant's FAC program in Section 10.3 of the Phase 2 North Anna SER (ADAMS Accession No. ML091520434) because its placement in SER Section 10.3.6 is consistent with the SRP, which provides the FAC acceptance criteria in SRP Section 10.3.6 as noted above. However, the staff has determined that the evaluation of the FAC program is more appropriately addressed in this Section of the SER because the FAC program is addressed in North Anna FSAR Section 6.6, ESBWR DCD Section 6.6, and NUREG-1966, Section 6.6.

STD COL 6.6-1-A also provides supplemental information related to the applicant's FAC program. The staff reviewed the information provided by the applicant in Section 6.6.7.1 of the North Anna 3 COL FSAR, which describes the FAC program. FSAR Section 6.6.7.1 also refers to FSAR Section 13.4 for program implementation milestones. Therefore, the staff also reviewed the information provided in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations."

On June 5, 2008, in RAI 10.03.06-1 and 10.03.06-2 (ADAMS Accession No. ML081580132) the staff requested detailed FAC program information (e.g., FAC program activities that will be conducted during the plant construction phase and the schedule for those activities) and requested that the applicant confirm (1) that the FAC program will include pre-service thickness measurements of the as-built components considered susceptible to FAC, and (2) that these measurements will use the grid locations and measurement methods most likely to be used for ISI according to industry guidelines. In its response dated July 14, 2008 (ADAMS Accession No. ML082050559), the applicant stated that the FAC program is considered an Operational Program under the ISI program listed in Table 13.4-201, "Operational Programs Required by NRC Regulations." The letter included a revised Table 13.4-201 that explicitly lists the FAC program under the ISI program in the FSAR with an implementation milestone of "prior to commercial service." The response also stated that during the construction phase, a comprehensive FAC susceptibility screening and preservice inspection of susceptible systems will be performed.

The applicant's response provided portions of a FAC program description the applicant had developed to address ESBWR DCD Revision 5, COL Item 6.6-1-A. The proposed description of the FAC program includes a statement that the North Anna 3 FAC program will be based on EPRI NSAC 202L-R2. The response also states that preservice, baseline, and NDE will be performed on as-fabricated components in susceptible systems and that these PSIs will use grid locations and measurement methods most likely to be used for ISIs.

The changes proposed in the applicant's response addressed the staff's concerns about the implementation activities and schedule by making the FAC program an explicit part of the operational programs. The proposed revision also addressed the staff concerns about PSI by adding a description of the PSI plan to the FSAR, including the affirmation that locations and measurement methods used for PSI will be those most likely to be used in subsequent inspections.

The staff reviewed the FAC program information provided in FSAR, Revision 1, Section 6.6.7.1 and Table 13.4-201 and confirmed that the proposed modifications in the applicant's July 14, 2008 RAI response were incorporated into the FSAR. The inclusion of the FAC program in Chapter 13 as an operational program addresses the concerns discussed above regarding PSI requirements. Therefore, the staff finds the information on the FAC program acceptable.

Based on the information described above, the staff finds that the FAC program is acceptable because it is consistent with the guidance provided in EPRI NSAC 202-L-R2 and addresses the concerns described in GL 1989-008 as they pertain to establishing an erosion-corrosion monitoring program. Therefore STD COL 6.6-1-A is acceptable.

- STD COL 6.6-2-A PSI/ISI NDE Accessibility Plan Description

The applicant replaced the last sentence in the second paragraph of the ESBWR DCD, Revision 5, with the following:

> During the construction phase of the project, anomalies and construction issues are addressed using change control procedures. Procedures require that changes to approved design documents, including field changes and modifications, are subject to the same review and approval process as the original design. Accessibility and inspectability are key components of the design process. Control of accessibility for inspectability and testing during licensee design activities affecting Class 2 and 3 components is provided via procedures for design control and plant modifications. Ultrasonic techniques (UT) will be the preferred NDE method for all PSI and ISI volumetric examinations; radiographic techniques (RT) will be used as a last resort only if UT cannot achieve the necessary coverage. The same NDE method used during PSI will be used for ISI to the extent possible to assure a baseline point of reference. If a different NDE method is used for ISI than was used for PSI, equivalent coverage will be achieved as required by the Code.

Accessibility of Class 1, 2, and 3 components, and the use of alternative NDE methods are discussed under Section 5.2.4 of this SER and, for the reasons stated in that section, are acceptable to the staff. Accordingly, STD COL 6.6-2-A is acceptable.

6.6.5 Post Combined Operating License Activities

In FSAR Table 13.4-201, the applicant provided the implementation milestones for the PSI/ISI programs. The staff's evaluation of the operational program aspects of the PSI and ISI programs for ASME Class 1, 2, and 3 components is described in Section 5.2.4 of this SER. As discussed in SER Section 5.2.4, the staff has identified the following license condition related to the PSI/ISI programs:

> <u>License Condition 5.2.4-1</u>
>
> The licensee shall submit to the Director of Office of New Reactors, NRC, or the Director's designee, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months

before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

As stated in this SER, Section 5.2.4, the staff will inspect the North Anna 3 PSI and ISI programs during construction to ensure that the implementation of these operational programs will be consistent with the COL FSAR and the requirements of 10 CFR 50.55a.

6.6.6 Conclusion

The staff's findings related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to PSI/ISI of Class 2 and 3 components and piping, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to "Preservice and in-service inspections and testing of Class 2 and 3 Components and Piping: that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in Section 6.6 of the SRP, and other NRC RGs. For the reasons set forth above, the staff concludes that the information to address COL Items 5.2.1-A, 6.6-1-A, and 6.6-2-A, as provided in Section 6.6 of the North Anna COL FSAR, meet the relevant guidelines in Sections 6.6 and 10.3.6 of the SRP and are therefore acceptable. Conformance with these guidelines provides an acceptable basis for satisfying, in part, the requirements of 10 CFR 50.55a and the guidance in GL 1989-008 in regard to PSI/ISI programs.

References

1. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

2. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

3. 10 CFR 50.34b, "Final safety analysis report."

4. 10 CFR 50.34f, "Additional TMI-related requirements."

5. 10 CFR 50.55a, "Codes and Standards,"

6. 10 CFR 52.63, "Finality of standard design certification."

7. 10 CFR 52.80, "Contents of applications; additional technical information."

8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

10. 10 CFR Part 50, Appendix A, GDC 19, "Control room."

11. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."

12. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

13. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

14. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

15. ASME Boiler and Pressure Code (BPVC).

16. ASME, BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

17. ASME, BPVC, Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

18. ASME, BPVC, Section XI, Subsection IWA, "General Requirements," 2001 Edition, 2003 Addenda.

19. ASME, BPVC, Section XI, Subsection IWA, IWA-5000, "System Pressure Tests"

20. ASME, BPVC, Section XI, Subsection IWA-2300, "Qualifications of Nondestructive Examination Personnel"

21. ASME, BPVC, Section XI, Subsection IWA-5000, "System Pressure Tests."

22. ASME, BPVC, Section XI, Subsection IWB, "Requirements for Class 1 Components of Light-Water Cooled Plants," 2001 Edition, 2003 Addenda.

23. ASME, BPVC, Section XI, Subsection IWB-2200, "Preservice Examination."

24. ASME, BPVC, Section XI, Subsection IWB-2500, "Examination and Pressure Test Requirements."

25. ASME, BPVC, Section XI, Subsection IWC, "Requirements for Class 2 Components of Light-Water Cooled Plants" 2001 Edition, 2003 Addenda.

26. ASME, BPVC, Section XI, Subsection IWC-2200, "Preservice Examination."

27. ASME, BPVC, Section XI, Subsection IWC-5000, "System Pressure Tests."

28. ASME, BPVC, Section XI, Subsection IWD, "Requirements for Class 3 Components of Light-Water Cooled Plants" 2001 Edition, 2003 Addenda.

29. ASME, BPVC, Section XI, Subsection IWD-2200, "Preservice Examination."

30. ASME, BPVC, Section XI, Subsection IWD-5000, "System Pressure Tests."

31. EPRI NSAC-202L-R2, "Recommendations for an Effective Flow-Accelerated Corrosion Program," April 8, 1999.

32. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

33. NRC Generic Safety Issues: Issue GI 83, Control Room Habitability (Rev. 3) (NUREG 0933, Main Report with Supplements 1-34).

34. NRC GL 1989-008, "Erosion/Corrosion-Induced Pipe Wall Thinning," May 2, 1989. (ADAMS Accession No. ML031200731).

35. NRC GL 2003-01, "Control Room Habitability," June 12, 2003. (ADAMS Accession No. ML031620248).

36. NRC RG 1.196, Revision 1, "Control Room Habitability at Light-Water Nuclear Power Reactors," January 2007. (ADAMS Accession No. ML063560144).

37. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007. (ADAMS Accession No. ML070720184).

38. NRC RG 1.52, Revision 1, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," July 1976. (ADAMS Accession No. ML13350A197).

39. NRC RG 1.78, Revision1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," December 2001 (ADAMS Accession No. ML013100014).

40. NRC RG 1.94, Revision 1, "Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants," April 1976 (ADAMS Accession No. ML003740305).

41. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

42. NRC Staff NUREG-0933, "Resolution of Generic Safety Issues (Formerly Entitled 'A Prioritization of Generic Safety Issues')," August 2008. (ADAMS Accession No. ML082410719).

43. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

7.0 INSTRUMENTATION AND CONTROL SYSTEMS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) specific detailed design and performance information for the instrumentation and control (I&C) systems for the Economic Simplified Boiling-Water Reactor (ESBWR). These systems help ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, and the capability to prevent or mitigate the consequences of anticipated operational occurrences and postulated accidents. They are significant for plant operation and are used throughout the plant. This chapter provides information on the systems and components that sense various reactor parameters and transmit signals to the control systems during normal operations and to the reactor trip and engineered safety features systems during abnormal and accident conditions. The I&C system for the ESBWR design is a distributed control and information system (DCIS). DCIS is designated as either safety-related DCIS (Q-DCIS) or nonsafety-related DCIS (N-DCIS). The Q-DCIS and N-DCIS functions include diverse power and sensors and diverse hardware and software architectures to significantly reduce the consequence of a potential software common cause failure in the primary I&C protection system.

The Q-DCIS includes the reactor protection system, the neutron monitoring system, the independent control platform, and the safety system logic and control for the emergency safety feature actuation system. The N-DCIS includes the diverse protection system, the balance of plant systems, the plant investment protection systems, the plant computer functions and workstations, and the severe accident mitigation system (deluge system).

Chapter 7 of the North Anna 3, COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference, with no departures or supplements, Chapter 7, "Instrumentation and Control Systems," of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review. The staff's review confirmed that the COL application addressed the required information relating to the I&C systems, and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this chapter. The NRC staff documented the results of its technical evaluation of the information incorporated by reference in the North Anna COLA in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," issued April 2014.

8.0 ELECTRIC POWER

8.0 ELECTRIC POWER

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides information on the functional adequacy of the offsite power systems and safety related onsite electric power systems as applicable to the Economic Simplified Boiling-Water Reactor (ESBWR) design proposed for North Anna 3 Combined License (COL). The electric power system is the source of power for station auxiliaries during normal operation and for the reactor protection system and engineered safety features during abnormal and accident conditions. The NRC staff's review of the electric power systems ensures that these systems have adequate redundancy, independence, and testability in conformance with the current criteria established by the NRC.

8.1 <u>Introduction</u>

8.1.1 Introduction

This section of the COL final safety analysis report (FSAR) describes the transmission grid and its interconnection to the nuclear unit and other grid interconnections. It describes those onsite alternating and direct current (ac and dc) loads that are added to the certified ESBWR design and the function provided by these loads.

The section also includes a regulatory requirements applicability matrix that lists design bases, criteria, regulatory guides (RGs), standards, and other documents to be implemented in the design of the electrical systems that are site specific to the North Anna 3 station. The review of this section is coordinated closely with the reviews described in Sections 8.2, 8.3.1, and 8.3.2, and 8.4 of this SER.

8.1.2 Summary of Application

Section 8.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 8.1 of Revision 10 of the Design Control Document (DCD) for the ESBWR, referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in Part 7, "Departures Report," of the North Anna 3 COL application (COLA) and in FSAR Section 8.1, the applicant provided the following information:

<u>Exemption and Tier 1 and Tier 2 Departures</u>

- Exemption 2 — Electric Power Distribution System Functional Arrangement (Associated with NAPS DEP 8.1-1).

The applicant proposed the site-specific Tier 1 DCD departure from Figure 2.13.1-1, Sheet 1, *Electric Power Distribution System Functional Arrangement*.

In addition, the applicant has identified the following departure in FSAR Section 8.1.5.2.4 Regulatory Requirements – NRC Regulatory Guides:

- NAPS DEP 8.1-2 — Switchyard Surge Protection

The departure lists the subsections for which departures are taken from the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) C62.23, “Application Guide for Surge Protection of Electric Generating Plants” (as endorsed by RG 1.204, “Guidelines for Lightning protection of Nuclear Power Plants” issued November 2005), which is described in ESBWR DCD, Tier 2.

Supplemental Information

- NAPS SUP 8.1-1 Utility Power Grid Description

This supplemental information describes the connection of North Anna 3 to the 500/230-kilo Volt (kV) switchyard.

8.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, “Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” issued April 2014, and it’s Supplement 1, issued September 2014. In addition, Section 8.1, “Electric Power—Introduction,” of NUREG 0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” (SRP), includes the relevant regulatory requirements for the electric power systems (the transmission system and its connections to the nuclear power unit) and the associated acceptance criteria.

The NRC requirements governing the COLA supplemental information are in General Design Criterion (GDC) 17, “Electric power systems,” of Appendix A, “General Design Criteria for Nuclear Power Plants,” to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities.”

An applicant who seeks to depart from information in Tier 1 of a DCD for a certified standard design must request an exemption, as does an applicant who believes its proposed design need not comply with one or more NRC regulations. Exemptions are submitted pursuant to 10 CFR 52.7 and 52.93 and special circumstances as defined in 10 CFR 50.12(a) must be present.

8.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 8.1 of the certified ESBWR DCD. The staff reviewed Section 8.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to confirm that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to the review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference includes all the information necessary for the review of this section, related to the North Anna 3 offsite power systems and safety-related onsite electric power systems.

[1] See *“Finality of Referenced NRC Approvals”* in SER Section 1.2.2 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

The staff reviewed the following information in the COLA Part 7, "Departures Report" and FSAR:

Exemption and Tier 1 and Tier 2 Departures

The applicant proposed the following site-specific Tier 1 exemption and departure in Part 7 of its license application.

- Exemption 2: Electric Power Distribution System Functional Arrangement (Associated with NAPS DEP 8.1-1).

In the on-site power supply system specified in DCD Tier 1, Figure 2.13.1-1, Sheet 1, "Electric Power Distribution System Functional Arrangement," the applicant made a departure from the DCD to accommodate, due to special constraints on the North Anna 3 site, an intermediate switchyard that does not change the functions performed by these components as part of the on-site power supply system for the ESBWR standard plant design.

The applicant provided the following in its description of this Tier 1 Exemption to the DCD:

> The addition of the intermediate switchyard to DCD Tier 1, Figure 2.13.1-1, Sheet 1, adds details regarding the site-specific design of the switchyard for Unit 3 and is consistent with this DCD figure in that it specifies the off-site normal and alternate preferred power supplies are in the switchyard area of the plant. This change more specifically identifies that some of the off-site normal preferred power supply is located in the site-specific intermediate switchyard. Adding the intermediate switchyard to the figure does not change the functions performed by the components shown on this figure and has no effect on how the functions are performed by the components.

In the North Anna 3 COLA, Revision 8, Part 7, "Departures Report," the applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix E, Section III.B, "Design Certification Rule for the ESBWR Design, Scope and Contents," which requires an applicant referencing a certified design to incorporate by reference Tier 1 information. Specifically, in North Anna Part 7, Exemption 2, the applicant proposed to revise the ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1 to accommodate site space constraints by adding an intermediate switchyard to revise the location information for the main generator circuit breaker and the two motor-operated disconnects (MOD).[2]

Regulations

- 10 CFR Part 52, Appendix E, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). 10 CFR Part 52, Appendix E, Section VIII.A.4 also states that the Commission will deny such a request if it finds that the design change will result in a significant reduction in the level of safety otherwise provided by the design.

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[2] *While the applicant describes the requested exemption as being from Section III.B of 10 CFR Part 52, Appendix E, the entirety of the exemption pertains to proposed departures from Tier 1 information in the generic DCD. In the remainder of this evaluation, the NRC will refer to the exemption as an exemption from Tier 1 information to match the language of Section VIII.A.4 of 10 CFR Part 52, Appendix E, which specifically governs the granting of exemptions from Tier 1 information.*

- 10 CFR Part 52.63(b)(1) allows an applicant to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it determines that the request complies with the requirements of 10 CFR 52.7, which, in turn, points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by 10 CFR Part 52, Appendix E must meet the requirements of 10 CFR 50.12, 10 CFR 52.7, and 10 CFR 52.63(b)(1).

Evaluation of Exemption

As stated in 10 CFR Part 52, Appendix E, Section VIII.A.4, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, as long as the criteria given in 10 CFR 50.12 are met and the special circumstances as defined by 10 CFR 50.12 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). 10 CFR 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below. Although the applicant requested an exemption from 10 CFR Part 52, Appendix E, Section III.B, the NRC is treating the requested exemption as one from ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, since the applicant is seeking to depart from the information reflected on that figure.

Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 information. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, Tier 1. The staff determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The underlying purpose of ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, is to identify the standard ESBWR switchyard layout and configuration that will function in a manner the NRC has determined satisfied NRC requirements. The addition of an intermediate switchyard supports the system's intended design functions and does not affect the offsite power system compliance with GDC 17, since the intermediate switchyard is simply an additional space used to hold the plant's output breakers from the plant generator and introduces no new failure modes. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the performance of the associated inspection, test, analysis, and acceptance criterion (ITAAC). Therefore, the staff finds the exemption presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to particular Tier 1 information. Subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the specific ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, is to identify the standard ESBWR switchyard layout and configuration that will function in a manner the NRC has determined satisfies NRC requirements. This site-specific change modifies the standard design to accommodate physical space constraints on the North Anna 3 site for the switchyard. The intermediate switchyard configuration in the requested exemption will continue to perform its intended function and will, therefore, meet the underlying purpose of the rule. Accordingly, special circumstances are present because the certified design information in ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, is not necessary to achieve the underlying purpose of the rule in view of the space constraints on the North Anna 3 switchyard. Therefore, the staff finds that special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from Tier 1 exist.

Special Circumstances Outweigh Reduced Standardization

This exemption would allow the applicant to change certain ESBWR DCD, Tier 1 information proposed in the North Anna 3 COLA in view of site-specific space constraints. The key design functions of the switchyard will nonetheless be maintained, based on the nature of the proposed changes to the generic ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, and the understanding that these changes support the design function of the switchyard. However, this exemption request and the associated changes to North Anna 3 COLA Tier 1 information demonstrate that there is a minimal change from the standard information provided in the ESBWR DCD. Consequently, the decrease in safety due to reduced standardization would also be minimal. For this reason, the staff determined that even if other ESBWR licensees and applicants do not request similar departures, the special circumstances outweigh the potential decrease in safety due to reduced standardization of the ESBWR design, as required by 10 CFR 52.63(b)(1).

No Significant Reduction in Safety

The proposed exemption would not modify the function of the North Anna 3 switchyard from that described in the ESBWR DCD. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4.

Conclusion

For the reasons set forth above, the staff has concluded that pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law; (2) presents no undue risk to the public health and safety; (3) is consistent with the common defense and security; (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization; and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff finds that the applicant's request to depart from the information in ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, is acceptable, and the applicant's request for an exemption from these Tier 1 requirements is granted.

Tier 2 Departure

- NAPS DEP 8.1-2 Switchyard Surge Protection

The applicant identified specific sections of IEEE Standard. C62.23 concerning switchyard surge protection with which the switchyard design is not in conformance. Use of this standard is one of the recommendations of RG 1.204. On August 4, 2008, in a Request for Additional Information (RAI) 08.02-61, (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML11195A365), the staff requested the specific bases for the non-conformance. In its response to RAI 08.02-61 on September, 16, 2011 (ADAMS Accession No. ML11264A130), the applicant addressed each subsection of the standard for which an exception was taken.

The staff reviewed each exception and concurred with the applicant that either the subsection did not apply or that the measures taken provided equivalent protection, as described in the following table.

IEEE Standard.C62.23 Section	Title	Staff Finding
4.3.5	Shielding	This section recommends shielding of distribution lines. The proposed design has one line (342) that fits this description. Instead of shielding the line, the proposed design provides equivalent protection by using multiple metal oxide surge arrestors at the 34.5 kV switchyard interconnection.
5.3.2	Incoming Surges	This section references a paper that discusses alternate wiring practices when redesigning a chemical plant. This provision is not applicable.
5.3.2.1	Control Systems	This section recommends circuit separation based upon voltage level in order to prevent coupling between power cables and low voltage, low energy digital and analog instrument and control (I&C) circuits. The proposed design provides equivalent protection by shielding the cables as power cable voltages in the switchyard are limited to either 120 Vac or 125 Vdc.
5.3.3.1	Control Systems	This section recommends creating a separate radial ground system for control and instrumentation circuits to minimize electrical noise. The proposed design provides equivalent protection by using grounded messenger cables in parallel with cable runs and using grounded, shielded cable in control circuits.
5.3.3.2	Communications Systems	This section recommends gathering communication circuit grounds on a communication backboard and then connecting the grouping to ground with a single insulated ground wire. The proposed design provides equivalent protection by using a non-insulated ground wire that does not touch any other circuit.
5.3.3.3	Electrostatic Discharge	This section recommends using anti-static flooring material or some other equivalent to prevent static discharge between humans and equipment. The proposed design provides equivalent protection by using concrete floors with grounded racks and equipment cabinets grounded to the racks.
5.3.4.1	Communication and Power Circuit Coupling	This section recommends methods for reducing field coupling between parallel cables. The proposed design provides equivalent protection by using shielded control cable with messenger cables from switchyard components to the control house. Within the control house, shielded cable is used and fiber optics is used from the data collectors to point’s offsite.

IEEE Standard.C62.23 Section	Title	Staff Finding
5.3.4.2	Lightning-induced Voltages in Control Cables	This section recommends use of telecommunication cables with grounded sheaths and grounding of both ends of unused conductors. The proposed design provides equivalent protection by using shielded control cables with messenger cables from switchyard components and grounds both ends of the cable shields when run with the messenger cables.
5.3.5.2	Sources of Interference	This section identifies sources of noise that can radiate or be induced into switchyard cables and equipment. However, no specific recommendations are provided. The proposed design addresses this problem by the techniques discussed above by employing a combination messenger cable/shielded cable and continuously grounded open racks to minimize signals induced into the system.
5.3.5.6.2. a)	Single Point Guidelines for a Multipoint Grounding System	This subsection recommends wiring for computer equipment, communications and control systems within a control house to be connected to a multipoint ground system in only one place. The proposed design provides equivalent protection by using shielded cable run in a grounded tray with continuous grounding along the floor and ceiling and around the racks.

Therefore, the applicant has adequately addressed the provisions of IEEE Std. C62.23, and the staff finds that this issue is acceptably resolved.

Supplemental Information

- NAPS SUP 8.1-1 Utility Power Grid Description

The staff reviewed the supplemental information provided by the applicant to modify Section 8.1.2.1, “Utility Power Grid Description.” The applicant provided the following supplement to Section 8.1.2.1:

> The output of Unit 3 is delivered to a main 500/230 kV switchyard through the unit main step-up transformers, and an intermediate switchyard. The main switchyard serves four 500 kV lines and one 230 kV line. The plant is connected to the main switchyard by a 500 kV normal preferred transmission line, and a 230 kV alternate preferred transmission line that supplies power to the two reserve auxiliary transformers.

The staff finds that the applicant has adequately described the North Anna 3 connection to the utility grid. In addition, the staff has determined the switchyard is connected to the grid by at least two separate circuits. Therefore, the staff finds that the connection conforms to the requirements of GDC 17.

8.1.5 Post Combined License Activities

There are no post COLA activities related to this section.

8.1.6 Conclusion

As described in detail above, the Tier 1 departure requiring an exemption as described in North Anna 3 Part 7, Exemption 2, “Electric Power Distribution System Functional Arrangement,” is acceptable because pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law; (2) presents no undue risk to the public health and safety; (3) is consistent with the common defense and security; (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization; and (5) does not significantly reduce the level of safety at the licensee’s facility. Therefore, the staff finds that the applicant’s request to depart from the information in ESBWR DCD, Tier 1, Figure 2.13.1-1, Sheet 1, is acceptable, and the applicant’s request for an exemption from these Tier 1 requirements is granted.

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all the information relevant to the North Anna 3 offsite power systems and safety-related onsite electric power systems, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, “Design Certification Rule for the Economic Simplified Boiling-Water Reactor,” Section VI.B.1, all nuclear safety issues relating to the transmission system and its connections to the nuclear power unit that were incorporated by reference are resolved.

In addition, as set forth above, the staff compared the additional COLA supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 8.1, and other NRC RGs. For the reasons set forth above, the staff concludes that the applicant has provided sufficient information to satisfy the requirements of GDC 17 for this section.

8.2 <u>Offsite Power System</u>

8.2.1 Introduction

This section of the North Anna 3 FSAR describes analyses and referenced documents that include electrical single-line diagrams, electrical schematics, logic diagrams, tables, and physical arrangement drawings for the offsite power system. Industry standards and RGs refer to the offsite power system as the “preferred power system.” The offsite power system should include two or more physically independent circuits capable of operating independently of the onsite standby power sources. The system encompasses the grid, transmission lines (overhead or underground), transmission line towers, transformers, switchyard components and control systems, switchyard battery systems, the main generator, generator circuit breakers, disconnect switches, and other switchyard equipment, such as capacitor banks and volt amperes reactive compensators. The system supplies electric power to safety-related and other equipment.

- The ESBWR passive reactor design used at North Anna 3 minimizes the potential risk contribution of a station blackout (SBO) (loss of all ac power) by not crediting ac power sources for design-basis events for 72 hours. The plant's safety-related passive systems automatically establish and maintain safe-shutdown conditions for the plant following design-basis events, including the extended loss of ac power sources. The passive systems can maintain these safe-shutdown conditions after design-basis events for 72 hours without operator action, following loss of both onsite and offsite ac power sources. As described in the ESBWR DCD, for the standard design for off-site power systems that are not safety related, GDC 5, "Sharing of Structures, Systems, and Components" and GDC 18, "Inspection and Testing of Electric Power and Protective Systems" are not applicable; however, the nonsafety-related offsite and onsite ac systems that supply ac power to the isolation power centers are testable and meet GDC 18 requirements. In addition, the ESBWR Preferred Power Supply (PPS) complies with GDC 17 requirements for two physically independent and separate offsite power circuits, each with the capacity and capability to power equipment during design basis operating modes (plant start-up, normal operation, safe shutdown, accident, and post-accident operation).

8.2.2 Summary of Application

Section 8.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 8.2 of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 8.2, the applicant provided site-specific supplemental information to resolve COL Items 8.2.4-1-A through 8.2.4-10-A. The applicant adds the following site-specific supplemental information:

COL Items

- NAPS COL 8.2.4-1-A Transmission System Description

In FSAR Section 8.2.1.1, the applicant provided detailed information on the designs of the plant site 500 kV switchyard, the four 500 kV and one 230 kV transmission lines connecting the plant switchyard to Dominion's transmission system, and the interface of the switchyard with the transmission grid. The applicant provided Figures 8.2-201 through 8.2-203, which show a one-line diagram of the electrical system from the switchyard to the onsite electrical system, physical arrangement of the offsite power source, and a map of offsite transmission lines, respectively.

- NAPS COL 8.2.4-3-A Normal Preferred Power
- NAPS COL 8.2.4-4-A Alternate Preferred Power

The applicant provided additional information in FSAR Section 8.2.1.2, "Offsite Power System," describing details of normal preferred power and alternate preferred power including an arrangement drawing (Figure 8.2-202).

- NAPS COL 8.2.4-2-A Switchyard Description
- NAPS COL 8.2.4-6-A Switchyard DC Power
- NAPS COL 8.2.4-7-A Switchyard AC Power
- NAPS COL 8.2.4-8-A Switchyard Transformer Protection
- NAPS DEP 8.1-2 Switchyard Surge Protection

The applicant provided additional information in FSAR Section 8.2.1.2.1, “Switchyard,” that described details of the switchyard, switchyard dc and ac power, switchyard transformer protection, and switchyard surge protection and included tables on capacities of switchyard components.

- NAPS COL 8.2.4-5-A Protective Relaying

The applicant provided new information in Section 8.2.1.2.2 that specifically addresses the monitoring of the unit auxiliary transformers (UAT) and reserve auxiliary transformers (RAT) for open circuit conditions as discussed in NRC Bulletin 2012-01, “Design Vulnerability in Electric Power System,” (ADAMS Accession No. ML12074A115). Section 8.2.1.2.3 describes the existing relay schemes that protect the 500 kV transmission lines, switchyard buses, generating unit tie-line, and auxiliary transformers.

[NOTE: The applicant added information concerning the subject of Bulletin 2012-01 in Section 8.2.1.2.2 and renumbered Sections 8.2.1.2.2 and 8.2.1.2.3 as 8.2.1.2.3 and 8.2.1.2.4, respectively.]

- NAPS COL 8.2.4-9-A Stability and Reliability of the Offsite Transmission Power System

- NAPS COL 8.2.4-10-A Interface Requirements

The applicant provided additional information in FSAR Section 8.2.2.1, “Reliability and Stability Analysis,” describing details of a transmission system study performed regularly to verify grid stability, switchyard voltage, and frequency. The purpose of the study was to confirm the transmission system capability and demonstrate formal agreement between the control room and the transmission operator.

Supplemental Information

- NAPS SUP 8.2-1 Bulletin 2012-01

In FSAR Section 8.2.1.2.2, the applicant provided commitments for developing procedures and training for the operations and maintenance staff in support of the transformer open circuit monitoring system.

- NAPS SUP 8.2-2 Testing and Inspection

The applicant provided FSAR Section 8.2.1.2.4, “Testing and Inspection,” which gives details of testing and inspection of the switchyard components.

- NAPS SUP 8.2-3 Failure Mode and Effects Analysis

The applicant provided FSAR Section 8.2.2.3, “Failure Modes and Effects Analysis,” which describes details of the failure modes and effect analysis of transmission system, switchyard, and intermediate switchyard components.

8.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the final safety evaluation report (FSER) related to the ESBWR DCD and NUREG–1966, Supplement 1, FSER related to the Certification of the ESBWR Standard Design, Supplement 1. In addition, the relevant requirements of the Commission regulations for the offsite power system and the associated acceptance criteria are in SRP Section 8.2.

The NRC requirements governing the COL supplemental information are in GDC 17 of Appendix A to 10 CFR Part 50, and specifically, as follows:

- for NAPS COL 8.2.4-1-A, the requirements of GDC 17
- for NAPS COL 8.2.4-3-A and 8.2.4-4-A, the requirements of GDC 17
- For NAPS COL 8.2.4-2-A, 8.2.4-6-A, and 8.2.4-7-A, the requirements of GDC 17 and GDC 5
- for NAPS COL 8.2.4-5-A and 8.2.4-8-A, the requirements of GDC 17
- for NAPS COL 8.2.4-9-A and 8.2.4-10-A, the requirements of GDC 17
- For NAPS SUP 8.2-1, the requirements of GDC 17
- for NAPS SUP 8.2-2, the requirements of GDC 18

The guidance and specific acceptance criteria that apply to the supplemental information are as follows:

- For NAPS COL 8.2.4-9-A and 8.2.4-10-A, the guidelines of RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)"; Branch Technical Position (BTP) 8-3, "Stability of Offsite Power Systems"; BTP 8-6, "Adequacy of Station Electric Distribution System Voltages"; RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"
- For NAPS SUP 8.2-2, the guidelines of RG 1.118, "Periodic Testing of Electric Power and Protection Systems"
- For NAPS SUP 8.2-3, the guidelines of RG 1.206

8.2.4 Technical Evaluation

As documented in NUREG–1966 and NUREG–1966, Supplement 1, the staff reviewed and approved Section 8.2 of the ESBWR DCD. The staff reviewed Section 8.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.[1]

The staff's review confirmed that the information in the application and the information incorporated by reference include all the information relevant to the offsite power system.

The staff reviewed the following information in the COL FSAR:

<u>*COL Items*</u>

- NAPS COL 8.2.4-1-A Transmission System Description

The applicant provided additional information in NAPS COL 8.2.4-1-A to address COL Item 8.2.4-1-A. The applicant stated that the following replaces DCD Section 8.2.1.1:

> NAPS, that is, Units 1, 2, and 3, is connected to the Dominion transmission system by four 500 kV lines and one 230 kV line. The lines are designed and located to minimize the likelihood of simultaneous failure. The Unit 3 main generator feeds electric power through a 27 kV isolated phase bus to a bank of three single phase transformers, stepping the generator voltage up to the transmission voltage of 500 kV. Figure 8.2-201 provides a one-line diagram of the electric system from the switchyard to the onsite system. The transmission lines and towers connecting the switchyard to the transmission system are as follows:
>
> - Two 500 kV overhead lines to the Ladysmith substation (approximately 15 miles)
> - A 500 kV overhead line to the Midlothian substation (approximately 41 miles)
> - A 500 kV overhead line to the Morrisville substation (approximately 33 miles)
> - A 230 kV overhead line to the Gordonsville substation (approximately 31 miles)
>
> Two Ladysmith lines utilize a common right-of-way. Each of the other lines utilizes separate right-of-way. The 230 kV Gordonsville line crosses under the 500 kV Ladysmith and Morrisville lines near the switchyard.

The applicant stated that transmission tower separation, line installation, and clearances are consistent with the National Electric Safety Code (NESC) and Dominion transmission line standards. Adequate clearance exists between wire galloping ellipses to minimize conductor or structural damage.

The staff's review of FSAR Chapter 8, Figure 8.2-201, indicated a discrepancy with the corresponding DCD Revision 4, Figure 8.1-1. Figure 8.1-1 showed the main generator circuit breaker as part of the onsite power system, while Figure 8.2-201 showed the same breaker as being in the intermediate switchyard. Also, in Figure 8.1-1, the main transformer and UATs are connected at the high-voltage side of the main transformer; however, in Figure 8.2-201, UATs high-side voltage is 230 kV, and the main transformer's high-side voltage is 500 kV. It was not clear how the connection can be made with different voltages. On June 13, 2008, the staff issued RAI 08.02-1 (ADAMS Accession No. ML081650433), the staff asked the applicant to clarify the apparent discrepancies. In the response letter dated July 28, 2008, to RAI 08.2-1 (ADAMS Accession No. ML082170400), the applicant stated that the main generator circuit breaker is physically located in the NAPS intermediate switchyard. The applicant stated that it will revise FSAR Figure 8.2-201 to remove the main generator circuit breaker symbol from the figure and will add a note to clarify the interface between DCD Figure 8.1-1 and FSAR Figure 8.2-201. The applicant stated that at North Anna 3, the high-voltage side of the UATs and RATs will be at 230 kV and generator step-up transformers will be at 500 kV on the high side. Because of this, a 500/230 kV transformer bank will be located in the intermediate switchyard to step down 500 kV to 230 kV for use by the UATs, as depicted in FSAR Figure 8.2-201. The applicant added a note to FSAR Figure 8.2-201 to clarify that equipment on the offsite power portion of FSAR Figure 8.2-201 replaces equipment on the offsite power portion of DCD Figure 8.1-1. This Tier 1 departure was evaluated as an exemption above and was determined to be acceptable to the staff. Therefore as described in Section 8.1.6 of this SER, the staff finds that the applicant has adequately addressed the staff's question. The staff confirmed that these changes are incorporated in FSAR Revision 8, and the note to the figure was removed and the issue is resolved.

The staff finds that the information the applicant provided in response to COL Item 8.2-4-1-A conforms to the requirements of GDC 17.

- NAPS COL 8.2.4-3-A Normal Preferred Power
- NAPS COL 8.2.4-4-A Alternate Preferred Power

The applicant provided additional information in North Anna 3 COL 8.2.4-3-A and 8.2.4-4-A to address COL Items 8.2.4-3-A and 8.2.4-4-A. The applicant stated that it has replaced the first and second paragraph of DCD Section 8.2.1.2 with the following:

> The offsite power system is a non-safety-related system. Power is supplied to the plant from multiple independent and physically separate offsite power sources.
>
> The normal preferred power source is any one of the four 500 kV lines, and the alternate preferred power source is any one of the other three 500 kV lines.
>
> The normal preferred power source is supplied to the UATs through the intermediate transformer, MODs [motor operated disconnect] and isolation circuit breakers. The normal preferred power interface with offsite power system occurs at the high voltage terminals of the main generator circuit breaker MOD and UAT MODs. The MOD feeding a faulted UAT will be opened after the UAT high voltage breaker opens.

On June 13, 2008, the staff issued RAI 08.02-2 (ADAMS Accession No. ML081650433), requesting the applicant provide a discussion of the routing of control and instrumentation cables, and miscellaneous power cables associated with normal and alternate preferred circuits, between the switchyard and the power block. In the response letter dated July 28, 2008, to RAI 08.02-2 (ADAMS Accession No. ML082170400), the applicant stated that adequate separation is ensured either by routing cables associated with the normal preferred circuit in a duct bank separate from cables associated with the alternate preferred circuit, or by routing these cables in separate conduits within the same duct bank. The applicant revised FSAR Section 8.2.1.2 to add a description of the routing of control, instrumentation, and miscellaneous power cables. Because normal I&C cables and power cables associated with those I&C circuits will be in duct banks separate from those for the alternate circuits, or will be in separate conduits in the same duct bank, the staff finds that the applicant has adequately addressed the issue of cable separation. The staff confirmed that these changes are incorporated in FSAR Revision 8, and the issue is resolved.

Since underground cables are susceptible to moisture, on June 13, 2008, the staff issued RAI 08.02-4 (ADAMS Accession No. ML081650433), requesting the applicant identify the design features and/or in situ monitoring programs that it will use to monitor the degradation of the cable from the effects of moisture. In the response letter dated July 28, 2008, to RAI 08.02-4 (ADAMS Accession No. ML082170400), the applicant stated that the normal preferred power supply and alternate preferred power supply both use 230 kV underground cable. The applicant stated further that it would periodically monitor cable insulation for underground medium-voltage and high-voltage cable to detect potential cable degradation from moisture intrusion using one of the following methods or an equivalent: partial discharge testing, time domain reflectometry, dissipation factor testing, or very-low-frequency ac testing. On the basis of its review, the staff determined that the applicant did not address the testing frequency. Additionally, the staff determined that testing alone is not sufficient.

The manholes should be inspected every 6 months for water accumulation, and adequate corrective actions (increased inspection frequency) should be taken if water accumulation is found, as required by the maintenance rule 10 CFR 50.65 and as recommended by RG 1.160. Furthermore, the staff needed technical justification for using one of the testing methods indicated above to detect potential high-voltage (230 kV) cable degradation.

On October 16, 2008, the staff issued RAI 08.02-29 (ADAMS Accession No. ML082900201), requesting the applicant to address these issues. In the response letter dated December 1, 2008, to RAI 08.02-29 (ADAMS Accession No. ML083390401), the applicant stated that these 230 kV underground cables in duct banks have a metallic sheath to prevent moisture ingress into the cable insulation. The applicant indicated that it would inspect manholes associated with these duct banks every 6 months for excessive accumulation of water, and would take corrective actions (such as increased inspection frequency), as required by the maintenance rule, 10 CFR 50.65, if excessive water accumulation is found. Duct bank inspection on a 6-month frequency allows for the evaluation of performance and condition monitoring activities every refueling outage, as required by 10 CFR 50.65(a)(3). Accordingly, the applicant has adequately addressed this issue. The staff confirmed that the applicant has revised COL FSAR Section 8.2.1.2 to add manhole inspections for water accumulation in Revision 8 of the FSAR.

Since these 230 kV underground cables are part of the design that satisfies the GDC 17 requirement for having two circuits from the transmission network to the onsite power distribution system, these circuits fall under the requirements of 10 CFR 50.65(a)(1) of the maintenance rule. The staff confirmed that COL FSAR Section 17.6.4 provides the following statement:

> Condition monitoring of underground or inaccessible cables is incorporated into the maintenance rule program. The cable condition monitoring program incorporates lessons learned from industry operating experience, addresses regulatory guidance, and utilizes information from detailed design procurement documents to determine the appropriate inspections, tests and monitoring criteria for underground and inaccessible cables within the scope of the maintenance rule (10 CFR 50.65).

Given that 10 CFR 50.65, "Maintenance Rule," applies for these cables, and the applicant's Maintenance Rule Program is adequate as described in Section 17.6.4 of this SER, further response is not needed for this review. On this basis, the staff finds that the 230 kV underground cables will be included as required by the maintenance rule in a cable condition monitoring program, the cables are monitored for degradation and subsequent action can be taken, if necessary. Accordingly, the issue is resolved.

The FSAR Section 8.2.1.2.1 notes that the 500 kV transmission line rated current is 3,954 amps and the 500 kV bus is rated as 3,891 amps. On June 13, 2008, the staff issued RAI 08.02-5 (ADAMS Accession No. ML081650433), requesting the applicant to explain why the bus rating is less than the transmission line rating and clarify the actual loading of the line and bus. In the response letter dated July 28, 2008, to RAI 08.02-5 (ADAMS Accession No. ML082170400), the applicant stated that transmission line loading (normal loading and emergency loading) is well below the bus rating. Additionally, both Dominion and the Pennsylvania, New Jersey, and Maryland Interconnection (PJM) perform periodic studies to verify that bus work and transmission lines can be operated within their rating. Since transmission line loading (normal loading and emergency loading) is below the bus rating in the switchyard, the staff finds the applicant's response adequate, and this issue is resolved.

Since all North Anna units share the same switchyard, the offsite power system provided for the site should have sufficient capacity and capability to safely shut down all units. As documented in NRC generic communications (e.g., NRC Generic Letter (GL) 07-01, "Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients," dated February 7, 2007; NRC Information Notice (IN) 98-07, "Offsite Power Reliability Challenges from Industry Deregulation," dated February 27, 1998; and NRC IN 95-37, "Inadequate Offsite Power Voltages During Design-Basis Events," dated September 7, 1995), operational experience has shown the need to demonstrate that the offsite power system operation supports equipment important to safety and avoids plant transients. In addition, NRC GL 06-02, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power," dated February 1, 2006, states that, "For nuclear plants licensed in accordance with the GDC in Appendix A to 10 CFR Part 50, the design criteria for onsite and offsite electrical power systems are provided in GDC 17…which requires, among other things, that an offsite electric power system be provided to permit the functioning of certain structures systems and components (SSCs) important to safety in the event of anticipated operational occurrences."

On July 9, 2008, the staff issued RAI 08.02-28 (ADAMS Accession No. ML081910316), requesting that the applicant discuss the capacity and capability of the offsite system (i.e., the 500 kV lines and associated switchyard equipment) to mitigate the consequences of anticipated abnormal operational occurrences associated with unit operation. In the response letter dated August 21, 2008 (ADAMS Accession No. ML083470290), the applicant deferred its technical response to within 45 days following the General Electric Hitachi Nuclear America, LLC (GEH) response to DCD RAI 14.3-394, to ensure that the response was consistent and complete.

GEH submitted their responses to DCD RAI 14.3-394 on August 27, 2008 (ADAMS Accession No. ML082420291), and DCD RAI 14.3-394 S01 on December 9, 2008 (ADAMS Accession No. ML083470290). The applicant provided its subsequent response to RAI 08.02-28 on November 19, 2008 (ADAMS Accession No. ML083260325). The applicant stated in its response as follows: The switchyard for North Anna Power Station was evaluated under a system impact study (SIS) for interconnection of Unit 3 by PJM, the regional transmission operator (RTO). The SIS was performed to verify load flow capability, short-circuit capability, and system stability of the local transmission system in the vicinity of the North Anna 3 switchyard. The study was performed in accordance with North American Electric Reliability Corporation (NERC) criteria. The applicant stated that this level of detail meets the specific requirements of the RTO and ensures that the local transmission system, including the North Anna 3 switchyard, will be a reliable power source. The applicant also stated that the SIS recommended specific upgrades to the transmission system to ensure that PJM interconnection criteria are met with the interconnection of North Anna 3. In the SIS, PJM concludes that the transmission system is capable of accepting the interconnection of North Anna 3 and of operating with the transmission system contingencies evaluated. The evaluation covers NERC contingency classes A, B, and C, where class A assumes all facilities in service function normally, class B considers the loss of any single element of the grid, and class C considers events resulting in the loss of two or more grid elements. The applicant includes in Part 10, “ITAAC” Table 2.4.8-1 of the COLA specific analysis to confirm these offsite interfaces would remain current for North Anna 3 prior to plant operation. The staff reviewed the ITAAC, and finds that it specifies analyses adequate to verify that the as-built offsite interfaces continue to function properly under the NERC contingency classes.

Furthermore, the applicant notes that the DCD does not state the limits for voltage and frequency variation that need to be met by site-specific offsite power systems, as stated in the DCD, “the COL Applicant is responsible for the interface protocol requirements (COL 8.2.4-10-A).” The staff observes that this interface requirement does not set specific electrical characteristics for offsite power systems. The applicant indicated further that it would analyze the as-built onsite power system to determine the maximum load during all operating modes. The applicant stated that these analyses will, in part, specify maximum power, voltage, frequency, and interrupting capability necessary for the offsite power system to support safety-related load operation during all operating modes. These analyses will be re-evaluated as part of a site-specific ITAAC (see Section 14.3 of this SER) and will ensure that each as-built offsite circuit has sufficient capacity and capability. Because the applicants SIS evaluation and the required re-evaluation as part of the North Anna 3 ITAAC requirements in Part 10, Table 2.4.8-1 of the COLA are together sufficient to establish the electrical performance of the offsite power system described above, the staff finds that the applicant has addressed the issue adequately, and the issue is resolved.

For the reasons stated above, and since the offsite circuit interface with the onsite portions of the preferred power supply is adequately rated to supply the load credited during design basis operating modes (as described in DCD ITAAC Table 2.13.1-2, Item 9), the staff finds that the information the applicant provided in response to COL Items 8.2.4-3-A and 8.2.4-4-A conforms to the requirements of GDC 17 and is therefore acceptable.

- NAPS COL 8.2.4-2-A — Switchyard Description
- NAPS COL 8.2.4-6-A — Switchyard DC Power
- NAPS COL 8.2.4-7-A — Switchyard AC Power

The applicant provided additional information in North Anna 3 COL 8.2.4-2-A, 8.2.4-6-A, and 8.2.4-7-A to address COL Items 8.2.4-2-A, 8.2.4-6-A, and 8.2.4-7-A. The applicant replaced the last paragraph of DCD Section 8.2.1.2.1, in part, with the following:

> The NAPS switchyard, prior to the point of interconnection with Unit 3, is a 500/230 kV, air-insulated, breaker-and-a-half bus arrangement Unit 3 is connected to this switchyard by an overhead conductor circuit.
>
> The physical location and electrical interconnection of the switchyard is shown on Figures 8.2-201 and 8.2-202.
>
> The North Anna switchyard uses surge suppressors on the high and low sides of Transformers 1, 2, 3, 5, and 6 to protect equipment from voltage surges, including lightning events. The insulation coordination and surge protective devices are applied in compliance with IEEE 1313.2 (Reference 8.2-205) and IEEE C62.22 (Reference 8.2-206). The surge protective devices are maintained according to NEMA requirements and manufacturer's recommendations.

The FSAR Revision 1, Chapter 1, Table 1.9-201, "Conformance with Standard Review Plan," for SRP Section 8.2, indicated that GDC 5 is not applicable. DCD Revision 4, Section 8.2.2.2 stated that the ESBWR reference plant is designed as a single-unit plant, and therefore, GDC 5 is not applicable. However, the staff noted that the North Anna 3 switchyard is shared with Units 1 and 2 and, therefore, on June 13, 2008, the staff issued RAI 08.02-16 (ADAMS Accession No. ML081650433), requesting the applicant to clarify the applicability of and conformance with GDC 5. In the response letter dated July 28, 2008, to RAI 08.02-16 (ADAMS Accession No. ML082170400), the applicant stated that the North Anna switchyard is not important to safety for North Anna 3, and thus, GDC 5 is not applicable. The staff agrees that GDC 5 related to sharing SSCs important to safety is not applicable and that the switchyard as well as the grid connections are not safety-related class 1E components that provide safety-related offsite electric power systems for functioning of SSCs important to safety. In addition, since the North Anna 3 switchyard and offsite power is not safety related, RG 1.32 does not apply to either the switchyard or the off-site power distribution systems. This is the conclusion in DCD Section 8.1.5.2.4, "Regulatory Requirements," and North Anna 3 did not depart from this aspect of Section 8.1.5.2.4 of the DCD.

The staff has determined that the North Anna 3 UATs and RATs are not shared with North Anna 1 and 2. Although the Unit 3 UATs and RATs are connected to the same grid as the Unit 1 and 2 transformers, the capacity of the offsite power system is large compared to the safety-related loads (battery chargers and uninterruptible power supply (UPS)) fed by these transformers, and those loads will not affect the functioning of any offsite power systems.

The ESBWR DCD, Section 8.2.3 states that a station ground grid is provided that consists of a ground mat below grade at the switchyard that is connected to the foundation embedded loop grounding system provided for the entire power block and associated buildings. On June 13, 2008, the staff issued RAI 08.02-24 (ADAMS Accession No. ML081650433), requesting the applicant to describe the station ground grid. In the response letter dated July 28, 2008, to RAI 08.02-24 (ADAMS Accession No. ML082170400), the applicant stated that a description of the station ground grid appears in Appendix 8a to DCD Section 8. However, the staff noted that the North Anna Station ground grid consists of the switchyard ground grid, the existing Unit 1 and 2 ground grid, and the new Unit 3 ground grid. On October 16, 2008 the staff issued

RAI 08.02-37 (ADAMS Accession No. ML082900201), requesting that the applicant discuss the interface and impact of station grounding resulting from the addition of the Unit 3 ground grid to the existing station ground consisting of the switchyard and the Unit 1 and 2 grounding. In addition, the staff asked the applicant to provide a summary description of the existing grounding system at North Anna and the proposed grounding of Unit 3 to achieve a single point ground at the site.

In the response letter dated December 1, 2008, to RAI 08.02-37 (ADAMS Accession No. ML083390401), the applicant provided additional information. The applicant stated as follows: The ground grids for Unit 3, the intermediate switchyard, and the existing North Anna switchyard will be interconnected. Since each of these ground grids either will provide, or is currently designed to provide, adequate grounding for the associated structures and equipment, the interconnection of all of these ground grids will serve to improve the quality of each of the ground grids. Because each structure provides adequate grounding alone in accordance with IEEE standards as provided in ESBWR DCD, Section 8A.1.2, and the capacity is increased by tying together the ground grids into a single grid for the North Anna site, the staff finds that the applicant has adequately addressed switchyard grounding, and therefore the issue is resolved.

The SRP Section 8.2 (III.1.I) identifies the need to address provisions for surge protection and lightning protection. The staff determined that Chapter 8 of the application did not address these issues. On June 13, 2008, the staff issued RAI 08.02-25 (ADAMS Accession No. ML081650433), requesting that the applicant discuss the adequacy of the surge protection and lightning protection of the offsite power system. In the response letter dated July 28, 2008, to RAI 08.02-25 (ADAMS Accession No. ML082170400), the applicant stated as follows: The North Anna switchyard uses surge suppressors on the high and low sides of transformers 1, 2, 3, 5, and 6. The insulation coordination and surge protective devices are applied in conformance with IEEE 1313.2 (2004), “IEEE Guide for the Application of Insulation Coordination,” and IEEE C62.22 (2003), “IEEE Guide for Application of Metal Oxide Surge Arresters for Alternating Current Systems.” The surge protective devices are maintained according to National Electrical Manufacturers Association requirements and manufacturer’s recommendations. A shield wire arrangement is designed for lightning abatement in the switchyard in accordance with IEEE Standard 62.22-2003; IEEE Standard 988-2000, “Guide to Direct Lightning Shielding of Substations;” and “Insulation Coordination for Power Systems,” by Andrew R. Hileman. The staff finds that the applicant has provided the appropriate surge and lightning protection in accordance with industry approved standards and such protection is acceptable, therefore this issue is resolved.

Based on the above discussion, the staff finds that the information the applicant provided in response to COL Items 8.2.4-2-A, 8.2.4-6-A, and 8.2.4-7-A conforms to the requirements of GDC 17 and GDC 5.

- NAPS COL 8.2.4-5-A Protective Relaying
- NAPS COL 8.2.4-8-A Switchyard Transformer Protection

The applicant provided additional information in NAPS COL 8.2.4-5-A and 8.2.4-8-A to address COL Items 8.2.4-5-A and 8.2.4-8-A. The applicant added the following, in part, to Section 8.2.1.2.3, “Protective Relaying:”

The 500 kV transmission lines are protected with redundant high-speed relay schemes with re-closing and communication equipment to minimize line outages. The 500 kV switchyard buses have redundant bus differential protection using separate and independent current and control circuits. Generating unit tie-lines and auxiliary transformer underground cable circuits are protected with redundant high-speed relay schemes. Transformers 1, 2, 3, 5, and 6 are protected with sudden pressure relays and differential relays.

Dominion is responsible for engineering, constructing, operating, and maintaining its electric transmission system, and for interfacing with PJM, the Regional Transmission Organization (RTO). Dominion's responsibility includes designing, maintaining, and operating all switchyard protective relaying associated with connecting Unit 3 to the North Anna switchyard. PJM studied the interconnection of Unit 3 to the North Anna switchyard and recommended no additional design requirements above those typically used by Dominion in the design of the protective relaying scheme at the switchyard.

The 500 kV circuit breakers are equipped with dual trip coils. Each redundant protection circuit that supplies a trip signal is powered from its redundant DC power load group and connected to a separate trip coil. Equipment and cabling associated with each redundant system is physically separated from its redundant counterpart. Breakers are provided with a breaker failure scheme that isolates a breaker that fails to trip due to a malfunction.

The IEEE Standard 141, "Electrical Power Distribution for Industrial Plants," and Standard 242, "Protection and Coordination of Industrial and Commercial Power System," address the provision of sudden pressure relay and ground fault protection for transformers. On June 13, 2008, the staff issued RAI 08.02-6 (ADAMS Accession No. ML081650433), requesting that the applicant discuss the provision for such transformer protection. In addition, the staff asked the applicant to discuss the monitoring schemes it implements for detection of ground faults in the system if the transformer neutrals are high-resistance grounded.

In the response letter dated July 28, 2008, to RAI 08.02-6 (ADAMS Accession No. ML082170400), the applicant stated as follows: Transformers 1, 2, 3, 5, and 6 in the North Anna switchyard are protected by sudden pressure relays. Transformers 1 and 2 have solid grounds on their 500 kV, wye connected windings. The 34.5 kV, delta connected windings have zigzag transformers connected on the bus, which creates a ground source. This ground source is monitored by relays for ground fault detection. Differential relays applied across these transformers also provide ground fault protection. Since transformers 3, 5, and 6 have no tertiary winding, differential relays provide ground fault protection. The staff finds that the applicant had provided adequate fault protection to the switchyard transformers in accordance with industry IEEE standards and Dominion Engineering controls and practices and the proposed fault protection is therefore acceptable.

In addition the staff determined that the applicant did not identify transformers 1, 2, 3, 5, and 6 in the North Anna 3 site-specific Figure 8.2-201. Therefore, on October 16, 2008, the staff issued RAI 08.02-30 (ADAMS Accession No. ML082900201), requesting the applicant to revise or supplement Figure 8.2-201 accordingly. In the response letter dated December 1, 2008 to RAI 08.02-30 (ADAMS Accession No. ML083390401), the applicant stated that it will revise FSAR Figure 8.2-201 to identify transformers 1, 2, 3, 5, and 6. The staff finds the applicant's response acceptable, and the issue is resolved. The staff confirmed that these changes have been incorporated into the North Anna 3 FSAR Revision 8.

The DCD Revision 4, Section 8.2.4, item 8.2.4-5-A, notes that the COL applicant is responsible for switchyard protective relaying and will ensure that such relaying is coordinated, reviewed, and accepted by the applicable grid reliability organization. On June 13, 2008, the staff issued RAI 08.02-7 (ADAMS Accession No. ML081650433), requesting that the applicant discuss how it will accomplish such coordination, review, and acceptance. In the response letter dated July 28, 2008 to RAI 08.02-7 (ADAMS Accession No. ML082170400), the applicant stated as follows: Dominion is responsible for engineering, constructing, operating, and maintaining the electric transmission system and interfacing with the RTO, PJM. This responsibility includes the design, maintenance, and operation of the switchyard protective relaying associated with the interconnection of Unit 3 to the North Anna switchyard. PJM studied the interconnection of Unit 3 to the North Anna switchyard and recommended no additional design features or functions above those typically used by Dominion in the design of the protective relaying scheme at the switchyard. The staff in its review determined that the applicant has applied industry practice as well as its standard Dominion industrial maintenance program for the North Anna site switchyard therefore this issue is resolved.

For the reasons set forth above, the staff finds that the information the applicant provided in response to COL Items 8.2.4-5-A and 8.2.4-8-A conforms to the requirements of GDC 17.

- NAPS COL 8.2.4-9-A — Stability and Reliability of the Offsite Transmission Power System
- NAPS COL 8.2.4-10-A — Interface Requirements

The applicant provided additional information in NAPS COL 8.2.4-9-A and 8.2.4-10-A to address COL Items 8.2.4-9-A and 8.2.4-10-A. The applicant replaced DCD Section 8.2.2.1, "Reliability and Stability Analysis," with the following:

> A system impact study was performed to assess the effects of interconnection of the 1933 MVA ESBWR on the transmission system in the areas of load flow, import/export capability, short circuit analysis, system stability, and voltage sensitivity. (Reference 8.2-201) The study was prepared using the 2013 summer light load base case and the 2013 summer peak load case projections. The analysis was performed using Power Technology International Software PSS/E for load flow, import/export capability and stability evaluation, and ASPEN One-liner for short circuit evaluation.

The applicant stated that grid availability in the region over the past 20 years was examined and it was confirmed that the system has been highly reliable with minimal outages due to equipment failures.

On June 13, 2008 the staff issued RAI 08.02-10, (ADAMS Accession No. ML081650433), requesting the applicant to clarify whether the analysis addressed multiple facility contingencies (e.g., did the analysis included tripping of all three nuclear units). In the response letter dated July 28, 2008, to RAI 08.02-10 (ADAMS Accession No. ML082170400), the applicant stated that it performed the grid stability analysis in accordance with NERC criteria and subsequently included a case for loss of all generating units at a single station in the latest SIS for PJM

Generator Interconnection (North Anna 3) dated September 2013 that does include an evaluation for all three generating units tripping at North Anna. On October 16, 2008, the staff issued RAI 08.02-31 (ADAMS Accession No. ML082900201), requesting the applicant provide a discussion (including failure mode and effect analysis) of why it believes that an event similar to that at Palo Verde that occurred on June 14, 2004, will not cause the loss of three units at North Anna Station, or if such an event occurs, why it will not impact grid stability.

In the response letter dated December 1, 2008 to RAI 08.02-31 (ADAMS Accession No. ML083390401), the applicant stated as follows: The applicant had reviewed the description of the Palo Verde event in NRC IN 2005-15, "Three-Unit Trip and Loss of Offsite Power at Palo Verde Nuclear Generating Station," dated June 1, 2005. As a result of its review of IN 2005-15, Dominion implemented certain modifications to the protective scheme within the 230 kV portion of the North Anna switchyard. The 500 kV portion of the North Anna switchyard and its connecting substations has circuit breakers with dual trip coils and dual control circuits. The 230 kV portion of the North Anna switchyard and its connecting substation has circuit breakers with single trip coils and single control circuits. The circuit protection scheme at the 230 kV transmission level uses overlapping zones of protection and relies on communications that span the transmission lines from substation to switchyard. If a fault occurs on the 230 kV line at the first remote substation from the North Anna switchyard and the remote substation breaker fails to open, a transfer trip signal will be sent to open the North Anna breaker. This same logic is true for a fault on the 230 kV line near the North Anna switchyard. Also, if a fault occurs on the 230 kV line at North Anna that is not immediately cleared because of breaker failure to operate, trip signals will be generated to open breakers in expanding zones of protection until the fault is cleared. If necessary, the 500 kV breakers will open to isolate the 230 kV portion of the switchyard. At this level, the breakers have dual trip coils and dual control circuits. Since North Anna 1 and 2 interconnect at the 500 kV level, and since Unit 3 is proposed to interconnect at the 500 kV level, the generating units are ultimately protected by equipment that uses dual trip coils and dual control circuits, thus limiting the possibility of an event similar to the Palo Verde event. The staff finds the applicant's response includes a protective breaker and a half scheme that would appropriately isolate a transmission system fault preventing a multi-unit trip like the Palo Verde event and therefore the staff finds the North Anna protective scheme acceptable.

The FSAR Revision 1, Section 8.2.2.1, stated that the stability analysis did not consider the 34.5 kV portion of the North Anna switchyard. The staff review identified the station auxiliary loads for all three units to be substantial. Accordingly, on June 13, 2008, the staff issued RAI 08.02-11 (ADAMS Accession No. ML081650433), requesting the applicant to provide the basis, and identify the connected total station auxiliary loads (of all three units), for excluding analysis of the 34.5 kV portion of the switchyard. In the response letter dated July 28, 2008, to RAI 08.02-11 (ADAMS Accession No. ML082170400), the applicant stated as follows: The stability analysis discussed in the FSAR is an angular stability analysis that verifies stability of the transmission system when exposed to loss of selected transmission and generation assets. This study is performed at the transmission voltage level and would therefore exclude loads operating at distribution voltage levels of 34.5 kV as they have limited ability to cause angular stability difficulties at the transmission level. This is the standard method for performing angular stability by Dominion and PJM.

On October 16, 2008 the staff issued RAI 08.02-32 (ADAMS Accession No. ML082900201), requesting the applicant to quantify the 34.5 kV distribution loads (MW/MVA) in terms of the total load modeled for the 500 kV transmission system. In addition, the staff asked the applicant to explain the reason for its belief that the distribution loads have limited ability to affect the grid stability. In the response letter dated December 1, 2008 to RAI 08.02-32 (ADAMS Accession No. ML083390401), the applicant stated as follows: In the North Anna switchyard, the 34.5 kV buses are fed from either the 500 kV switchyard or the 230 kV switchyard. Each of the 34.5 kV buses serves plant auxiliary loads associated with Units 1 and 2 only. There is no generation source connected to the 34.5 kV buses. The study did not explicitly model the 34.5 kV buses in the North Anna switchyard, but it did include the plant auxiliary loads on each of these buses at the 500 kV level. The applicant stated that it will revise FSAR Section 8.2.2.1 to indicate that the 34.5 kV loads are considered at the 500 kV level. Because the total load represented by plant auxiliaries was included in the analysis of the 500 kV system, and the staff verified that FSAR Revision 8 reflects this fact, therefore, the staff finds the applicant's response acceptable. The staff confirmed that these changes are incorporated in FSAR Revision 8, and the issue is resolved.

FSAR Section 8.2.2.1 states that an examination of grid availability in the region over the past 20 years confirmed that the system has been highly reliable with minimal outages resulting from equipment failure. On June 13, 2008 the staff issued RAI 08.02-12 (ADAMS Accession No. ML081650433), requesting the applicant to provide supporting information for this statement to include the frequency, duration, and causes of outages over the past 20 years for both the transmission system accepting the unit's output and the transmission system providing the preferred power for the unit's load. In the response letter dated July 28, 2008 to RAI 08.02-12 (ADAMS Accession No. ML082170400), the applicant stated that Dominion has reviewed equipment failure history for the period from 1988 to 2008. The applicant indicated further that major types of equipment that can affect the reliability of the North Anna switchyard are transmission lines, transformers, and specific circuit breakers within the switchyard. The applicant concluded that the switchyard has experienced relatively few equipment lockouts because of equipment failure and the equipment lockouts have been limited to individual pieces of equipment. In view of this the information, the staff determined that the North Anna switchyard and local transmission system has been reliable and has not experienced a complete loss of power in the past 20 years. Accordingly, the applicant has shown that the grid as well as the switchyard has been reliable with few cases of equipment failures, therefore, this issue is resolved.

FSAR Revision 1, Section 8.2.2.1 states:

> Upon approaching or exceeding a [maximum, minimum, or degraded switchyard voltage] limit, these procedures verify availability of required and contingency equipment and materials, direct notifications to outside agencies and address unit technical specifications (TS) actions until the normal voltage schedule can be maintained."

On June 13, 2008, the staff issued RAI 08.02-13 (ADAMS Accession No. ML081650433), requesting the applicant to clarify the reference to North Anna 3 TS in this statement. In the response letter dated July 28, 2008, to RAI 08.02-13 (ADAMS Accession No. ML082170400), the applicant stated as follows: The operating procedures for controlling the normal voltage schedule for existing Units 1 and 2 reference the associated Unit 1 and 2 TS for the offsite power system. Unit 3 will implement similar operating procedures to maintain the switchyard voltage schedule and address challenges to the maximum and minimum limits. However, the Unit 3 procedures will not reference any TS for offsite power, because they are not required. Therefore, Dominion will revise the FSAR Section 8.2.2.1 discussion of the operating procedures to delete the reference to the TS. The ESBWR passive reactor design used at

North Anna 3 does not require an offsite or diesel-generated ac source of power for 72 hours after an abnormal event, and the switchyard as well as any off-site power system is not safety related. However the ESBWR DCD prescribes periodic inspection and testing of the nonsafety-related offsite and onsite ac systems that supply ac power to the isolation power centers. Therefore, by implementing procedures to maintain the switchyard voltage schedule as done for the existing Units 1 and 2, the staff finds that the applicant has adequately addressed the issue of maintaining the switchyard limits. The staff confirmed that these changes are incorporated in FSAR Revision 8, and the issue is resolved.

On June 13, 2008, the staff issued RAI 08.02-14 (ADAMS Accession No. ML081650433), requesting the applicant to provide the basis for using 2011 summer light-load and 2014 summer base-case projections rather than the summer heavy-load projections. The staff also asked the applicant to clarify whether the summer loads bound winter peak loads. In the response letter dated July 28, 2008 to RAI 08.02-14 (ADAMS Accession No. ML082170400), the applicant indicated as follows: Load flow analysis and the import/export study portion of the SIS was based on data projected for the timeframe corresponding to Dominion's requested interconnection date of April 2014. The 2014 summer base case was used because it is considered to be the peak load for the transmission system affected and envelops the peak winter load. The stability study portion of the SIS uses a lighter load to identify any problems with angular stability of the system. Dominion submitted the stability study request to the RTO in 2006. The RTO uses a 5-year horizon for its studies; therefore, the 2011 summer case was selected for the stability study. After 2011, the RTO will perform annual baseline analyses to update the Regional Transmission Expansion Plan and identify potential reliability problems. The applicant includes in Part 10, "ITAAC" Table 2.4.8-1 of the COLA specific analyses to confirm these offsite interfaces would remain current for North Anna 3 prior to plant operation. As described above, the staff accepted the applicant's response, and this issue is resolved.

On June 13, 2008 the staff issued RAI 08.02-15 (ADAMS Accession No. ML081650433), requesting the applicant to identify the maximum and minimum grid frequency. Additionally, the staff asked the applicant to discuss how the auxiliary power system studies consider the combined effect of frequency and voltage variation on the operation of safety-related loads (safety-related battery chargers and safety-related UPS) and other running motor loads. In the response letter dated July 28, 2008 to RAI 08.02-15 (ADAMS Accession No. ML082170400), the applicant stated that the potential maximum and minimum grid frequency can be 62 hertz (Hz) to 57.5 Hz with the time restrictions for PJM generators. Generators and their protective systems must be capable of operating at a frequency of 57.5 Hz for 5 seconds or longer, or 58.0 Hz for 30 seconds or longer, to coordinate with system preservation under-frequency load shedding. Additionally, generators and their protective systems must be capable of operation at over frequency up to 62 Hz for a limited duration. These limits are included to increase system reliability as well as set protections for individual generators. The applicant stated further that the auxiliary power system studies conducted by GEH consider the combined effect of frequency and voltage variations on the safety-related loads and other motor loads. The isolation power centers supply power to safety-related loads of their respective division. These loads consist of the safety-related battery chargers or rectifiers as discussed in Section 8.3.1.1.2 and 8.3.1.1.3 of the ESBWR DCD. Isolation power centers are protected against degraded voltage and frequency conditions by way of voltage and frequency relays installed in each isolation power center to provide alarms and facilitate isolation power center bus isolation and transfer functions as described in ESBWR DCD Section 8.3.1.1.2. The staff accepted the applicant's response, and this issue is resolved.

The FSAR Revision 1, Chapter 1, Table 1.9-201, “Conformance with Standard Review Plan,” for SRP Section 8.2 indicated that North Anna 3 satisfies the requirements of 10 CFR 50.65, “Maintenance Rule”. However, the staff review of North Anna 3 FSAR Chapter 8 found no discussion of 10 CFR 50.65. On June 13, 2008, the staff issued RAI 08.02-19 (ADAMS Accession No. ML081650433), requesting the applicant to clarify compliance with the requirements of 10 CFR 50.65(a)(4). In the response letter dated July 28, 2008, to RAI 08.02-19 (ADAMS Accession No. ML082170400), the applicant stated as follows: North Anna 3 complies with the requirements of 10 CFR 50.65(a)(4). In particular, the subject regulation is one aspect of the “Maintenance Rule” (10 CFR 50.65), an operational program. Item 17 in FSAR Table 13.4-201 addresses the implementation of the program, and FSAR Section 17.6 discusses its content.

However, the staff requested that the applicant address the applicability of the Maintenance Rule to switchyard equipment. Accordingly, on October 16, 2008, the staff issued RAI 08.02-36 (ADAMS Accession No. ML082900201), requesting the applicant to address the applicability of the Maintenance Rule to switchyard components, discuss actions to limit the risk associated with transmission system degradation, and discuss actions planned before performing “grid-risk-sensitive” maintenance activities for switchyard components. In the response letter dated December 1, 2008 to RAI 08.02-36 (ADAMS Accession No. ML083390401), the applicant stated as follows: Maintenance Rule Program implementation incorporates by reference Nuclear Energy Institute (NEI) Technical Report 07-02A, “Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52.” The scope of SSCs covered by the Maintenance Rule Program is determined using the scoping procedure defined in the program description in NEI 07-02A. The offsite power system and its components will be evaluated for inclusion in the Maintenance Rule Program in accordance with these scoping procedures during program implementation. NEI 07-02A, Section 17.X.1.5, addresses risk assessment and risk management pursuant to 10 CFR 50.65(a)(4) and considers the issues associated with grid and offsite power system reliability as identified in NRC GL 06-02, items 5 and 6. Therefore, although detailed Maintenance Rule Program development is not anticipated in advance of the schedule defined in Table 13.4-201, performance of grid reliability evaluation as part of the maintenance risk assessment before performing grid-risk-sensitive maintenance activities (such as surveillances, post maintenance testing, and preventive and corrective maintenance) is considered a necessary part of the program in accordance with NEI 07-02A guidance. Since North Anna 3 will implement the Maintenance Rule in accordance with NRC endorsed NEI 07-02A guidance, the staff finds the applicant has provided in its COLA an acceptable plan to implement the Maintenance Rule, and the issue is resolved.

The DCD Revision 10, Section 8.2.3, states that a transmission system reliability and stability review of the site-specific configuration to which the plant is connected will be performed to determine the reliability of the offsite power system and verify that it is consistent with the analysis of Chapter 19. On June 13, 2008, the staff issued RAI 08.02-23 (ADAMS Accession No. ML081650433), requesting the applicant to clarify the manner in which the reliability of the offsite power system is verified to be consistent with the analysis of Chapter 19. In the response letter dated July 28, 2008, to RAI 08.02-23 (ADAMS Accession No. ML082170400), the applicant stated as follows: The ESBWR probabilistic risk assessment (PRA) used site-specific PRA information from the North Anna site to develop PRA parameters for loss of preferred power (LOPP) frequency. The LOPP frequency is divided into plant-centered, switchyard, grid-related, and weather-related initiating events. ESBWR LOPP frequencies are based on NUREG/CR-6890, “Reevaluation of Station Blackout Risk at Nuclear Power Plants, Analysis of Loss of Offsite Power Events: 1986–2004,” issued November 2005. The North

Anna LOPP frequencies were compared to the ESBWR frequencies to identify any outliers. The data show that grid-related losses of power are significantly more frequent than plant-centered, switchyard, or weather-related losses of power. There is a variance in the values for the LOPP frequencies, but their range is acceptable because the change in core damage frequency by using the highest frequency is less than $1x10^{-10}$ per year. Furthermore, the conclusions in DCD Tier 2, Section 19.2.3.1, "Risk from Internal Events," remain valid for the minor variances in LOPP frequencies. Therefore, the ESBWR PRA provides a reasonable representation of the parameters and conditions that are specific to the North Anna site. Additionally, the SIS has identified the transmission facility upgrades necessary to ensure that reliability is not reduced below the set standards. Finally, when the upgrades are made, the reliability of the offsite power system will be consistent with the analysis of Chapter 19, because the applicant is required to be in conformance with the change in core damage frequency as specified in Chapter 19 of the ESBWR DCD related to the switchyard risk, therefore the staff accepted the applicant's response, and this issue is resolved.

FSAR Section 8.2.2.1, "Reliability and Stability Analysis," NAPS COL 8.2.4-9-A, identified maximum and minimum switchyard voltage limits of 534 kV and 505 kV. On July 9, 2008 the staff issued RAI 08.02-27 (ADAMS Accession No. ML081910316), requesting the applicant to explain how these limits were established and confirm that these voltage limits are acceptable for auxiliary power system equipment operation, including safety-related battery chargers and safety-related UPS during different operating conditions. The staff requested that the confirmation include assumptions, acceptance criteria, and summary of results for the following: load flow analysis (bus and load terminal voltages of the station auxiliary system), short-circuit analysis, equipment sizing studies, protective relay setting and coordination, and motor starting with minimum and maximum grid voltage conditions. The staff also requested a separate set of calculations for each available connection to offsite power supply. In addition, the applicant was requested to discuss how the results of the calculations will be verified.

On August 21, 2008 (ADAMS Accession No. ML083470290), the applicant stated that Dominion would submit its response at a later date. On November 19, 2008 (ADAMS Accession No. ML083260325), the applicant indicated as follows: The North Anna 500 kV switchyard voltage limits of 540 kV and 505 kV were established for the operation of Units 1 and 2. Furthermore, the DCD does not then include limits for voltage and frequency variation that need to be met by site-specific offsite power systems. Analyses of the as-built onsite power system will be performed to determine the maximum load during design-basis operating modes. These analyses will, in part, specify credited power, voltage, frequency, and interrupting capability necessary for the offsite power system to support safety-related load operation during design-basis operating modes. These analyses will be accomplished as part of a site-specific ITAAC (see Section 14.3 of this SER) and will ensure that each as-built offsite circuit has sufficient capacity and capability.

On March 18, 2009 (ADAMS Accession No. ML090790310), the applicant stated that the effect of a North Anna 3 trip on the switchyard voltage and frequency limits is addressed as a part of the ITAAC process (see Section 14.3 of this SER). The North Anna 3 COL ITAAC require verification that the offsite portion of the preferred power system has the capability to provide voltage and frequency sufficient to meet the voltage and frequency determined as part of completing DCD ITAAC Table 2.13.1-2, Item 9. The staff finds that the applicant will adequately address the issue of North Anna 3 generator trip on the North Anna site switchyard in its analysis as part of ITAAC prior to plant operation. Therefore the issue is resolved.

For the reasons set forth above, the staff finds that the information the applicant provided in response to COL Items 8.2.4-9-A and 8.2.4-10-A, and as discussed above, conforms to the guidance of RG 1.206; BTP 8-3; BTP 8-6; RG 1.160, and therefore the design complies with the requirements of 10 CFR 50.65 and GDC 17 in this regard.

- NAPS SUP 8.2-1 Monitoring of Transformers for Open Circuit (Bulletin 2012-01)

The applicant has incorporated by reference the ESBWR design for open phase protection described in in ESBWR DCD, Revision 10, Section 8.2.1.2.2 (see Bulletin 2012-01 for discussion of open phase conditions). Operator actions and training are addressed in procedures, as described in North Anna 3 FSAR Section 13.2 and 13.5. Analysis and testing of the monitoring system are performed to determine set points and to verify proper monitoring system functionality. The applicant as well will develop training and procedures for the operations and maintenance staff to support this protection system throughout the plant lifetime. The applicant has also incorporated the following into North Anna COL FSAR Section 8.2.1.2.2 of the FSAR:

> Plant operating procedures associated with the monitoring system, including off-normal operating procedures, will be developed in accordance with Section 13.5.2.1 at least six months prior to fuel load.
>
> Maintenance and testing procedures associated with the monitoring system, including calibration and setpoint determination procedures will be developed in accordance with Section 13.5.2.2.6.1 prior to fuel load.
>
> Control Room operator and maintenance technician training associated with the operation and maintenance of the monitoring system will be developed in accordance with Section 13.2.1 for reactor operators and Section 13.2.2 for non-licensed plant staff. Training will be completed prior to fuel load.

The staff has reviewed the above Dominion FSAR training and procedures associated with the monitoring system for single phase faults, and, for the reasons set forth in Sections 13.2 and 13.5 of this SER, finds them to be acceptable for implementing the monitoring system for open phase faults described in the ESBWR DCD. Therefore the staff finds that the North Anna 3 training and procedures associated with the design for addressing the concerns presented in Bulletin 2012-01 are acceptable.

- NAPS SUP 8.2-2 Testing and Inspection

The applicant provided a new Section 8.2.1.2.4, "Testing and Inspection," as NAPS SUP 8.2-2 with the following addition:

> Transmission lines are inspected via an aerial inspection program approximately twice per year. The inspection focuses on such items as right-of-way encroachment, vegetation management, conductor and line hardware condition, and the condition of supporting structures. Routine switchyard inspection activities include, but are not necessarily limited to, the following:
>
> - Daily transformer inspections

- Periodic inspections of circuit breakers and batteries
- Quarterly infrared scans
- Semi-annual infrared scans (relay panels)
- Semi-annual inspection of substation equipment
- Annual infrared scans
- Annual corona camera scan

Routine switchyard testing activities include, but are not necessarily limited to, the following:

- Transformers – dissolved gas analysis every 5 months
- Electromechanical Relay testing (500 kV) –every 2 years
- Electromechanical Relay testing (230 kV) – every 3 years
- Microprocessor Relay testing (500 kV and 230 kV) – every 4 years
- Transformer Load Tap Changers – dissolved gas analysis every
- Battery Discharge testing – every 5 years
- Circuit Breakers – maintenance and inspection every 6 years
- [Current Transformer] CT maintenance – every 6 years
- Disconnect Switches (line zone) – maintenance and inspection every 6 years
- Ground Grid testing – every 8 years
- Disconnect Switches (bus zone) – maintenance and inspection every 10 years
- [Potential Transformer] PT testing – every 10 years
- [Capacitive Voltage Transformer] CCVT testing – every 10 years
- Arrester testing (bus zone) – every 10 years
- Wave Trap testing – every 12 years

On June 13, 2008, the staff issued RAI 08.02-8 (ADAMS Accession No. ML081650433), requesting the applicant to address the industry (Federal Energy Regulatory Commission, NERC, and IEEE) standards that will be followed for switchyard protection system, monitoring, maintenance, and testing. The staff also asked the applicant to confirm that generator circuit breakers will meet IEEE Standard C37.013, "Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current." In the response letter dated July 28, 2008 to RAI 08.02-8 (ADAMS Accession No. ML082170400), the applicant stated as follows: Monitoring, maintenance, and testing of the switchyard protection system are performed under NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing"; Standard PRC-008-0, "Underfrequency Load Shedding Equipment Maintenance Program"; and Standard PRC-017-0, "Special Protection System Maintenance and Testing." IEEE C37.013 was written specifically for high-current circuit breakers installed between generators and transformer terminals. The proposed Unit 3 at North Anna places the circuit breaker on the high side terminals of the generator step-up transformers. Thus, IEEE C37.013 does not directly apply to the ESBWR standard design, however IEEE C37.010 does apply to the ESBWR generator breaker configuration and is referenced in ESBWR DCD, Section 8.3.1.1 for breaker sizing and design.

The applicant stated that it will revise FSAR Section 8.2.1.2.3 to include the above NERC standards for monitoring, maintenance, and testing of the switchyard protection system. The staff finds that the applicant's commitment to these industry standards acceptable such that switchyard components (but not transformers) will be adequately tested and maintained. The staff confirmed that these changes are incorporated in FSAR Revision 8, and the issue is resolved.

On June 13, 2008, the staff issued RAI 08.02-9 (ADAMS Accession No. ML081650433), requesting the applicant to include transformer testing as part of the overall routine switchyard component testing. In the response letter dated July 28, 2008 to RAI 08.02-9 (ADAMS Accession No. ML082170400), the applicant stated as follows: North Anna switchyard transformers have dissolved gas analysis performed every 6 months. Additionally, if the transformer has a load tap changer (LTC), the dissolved gas analysis is performed on the LTC every 4 years. Infrared scans are performed quarterly on transformers. FSAR Section 8.2.1.2.3 will be revised to indicate that semiannual dissolved gas analysis on transformers and 4-year dissolved gas analysis on LTC will be conducted. The staff confirmed that these changes are incorporated in FSAR Revision 8, in FSAR Section 8.2.1.2.4 and that the testing provided provides increased reliability to these electrical systems. Accordingly, the staff finds that the applicant addressed the issue of testing the non-Class 1E electrical system adequately.

Based on the foregoing, the staff concludes that the information in NAPS SUP 8.2-2, which provides for testing and inspection of off-site electrical components and conforms with the guidance of RG 1.118 and therefore meets the requirements of GDC 18 as described in the ESBWR DCD.

- NAPS SUP 8.2-3 Failure Mode and Effects Analysis

The applicant provided Section 8.2.2.3, "Failure Modes and Effects Analysis," as NAPS SUP 8.2-3 with the following, in part, addition:

> Unit 3 is connected to the Dominion transmission system via four 500 kV and one 230 kV overhead transmission lines. Each transmission line occupies a separate right-of-way, except the two parallel Ladysmith lines, which share the same right- of-way. Failure of any one tower due to structural failure can at most disrupt and cause a loss of power distribution to itself and the adjacent line. Failure of a line conductor would cause the loss of one of the four 500 kV lines, with the other three lines remaining available as normal and alternate preferred power sources.
>
> A breaker-and-a-half scheme is incorporated in the design of the switchyard. This arrangement offers the following flexibility to control a failed condition within the switchyard.
>
> - Any faulted transmission line into the switchyard can be isolated without affecting any other transmission line.
> - Either bus can be isolated without interruption of any transmission line or other bus.
> - Relay schemes used for protection of the offsite power circuits and switchyard equipment include primary and backup protection features. All breakers are equipped with dual trip coils. Each protection circuit that supplies a trip signal is connected to a separate trip coil.

According to the applicant, the failure of any component within the intermediate switchyard may disrupt the normal preferred power supply. However, the alternate preferred power supply will remain available to supply the load.

On the basis of its review, the staff determined that Dominion, in its failure mode and effects analysis, showed that is unlikely that any individual switchyard component failure would prevent the North Anna 3 offsite power system from performing its function to provide normal or alternate power to Unit 3, and therefore the switchyard design meets the guidance of RG 1.206. Therefore, as described above, the North Anna 3 switchyard design meets the requirements of GDC 17 for providing two separate and redundant off-site sources of power, which provides additional reliability to its safety system functions.

8.2.5 Post Combined License Activities

There are no post COLA activities related to this section.

8.2.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all the information relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966, and NUREG–1966, Supplement 1.

In addition, the staff has compared the additional COLA and supplemental information within the application for this section to the relevant NRC regulations, guidance in SRP Section 8.2 and other NRC RGs. For the reasons set forth above, the applicant has adequately addressed COL Information Items NAPS COL 8.2.4-1-A through 8.2.4-10-A involving the design details of the plant site switchyard and its interface with the local transmission grid and NAPS SUP 8.2-1, 8.2-2 and 8.2-3 involving monitoring of transformers for open phase(s), testing and inspection of switchyard components and failure modes and effects analysis. Accordingly, the staff concludes that the application meets the requirements of GDC 17 and 18 and 10 CFR 50.65 in regard to offsite power.

8.3 Onsite Power Systems

8.3.1 AC Power System

8.3.1.1 Introduction

This section of the COL FSAR provides descriptive information, analyses, and referenced documents that include the applicant's information on electrical single-line diagrams, electrical schematics, logic diagrams, tables, and physical arrangement drawings for the onsite ac power system. The onsite ac power system includes those standby power sources, distribution systems, and auxiliary support systems that supply power to safety-related equipment or equipment important to safety, for all normal operating, anticipated operational occurrences (AOO), and accident conditions.

In the North Anna 3 ESBWR passive reactor design, the onsite ac power system consists of power supplied to the plant from two independent offsite power sources, the "Normal Preferred" power source and the "Alternate Preferred" power source. The on-site ac system consists of safety-related and nonsafety-related power systems. Two nonsafety-related ancillary diesel generators are capable of supplying power to the ancillary buses when no other sources of ac power are available. There are four independent safety-related dc divisions to provide power for the safety-related loads discussed in more detail in the next section of this SER.

The onsite power system is divided into two medium voltage power levels of 13.8 kV and 6.9 kV for operational flexibility of the plant nonsafety-related non-Class 1E systems that provide reliable ac power to the various electrical loads. These non-Class 1E nonsafety systems do not perform any safety-related functions or provide a risk-important, nonsafety-related active systems function. These redundant non safety capabilities enhance plant system reliability in normal or abnormal plant operational conditions. Plant loads for investment protection can be manually loaded on the standby power supplies. Diesel generator sets are used as the standby power source for the onsite ac power systems. Those portions of the onsite ac power systems that are not related to safety are described only in sufficient detail to permit an understanding of their interactions with the safety-related portions.

The plant's UPS system (120 V of ac vital power) comprises independent Class 1E and non-Class 1E UPS systems. Each system consists of rectifiers, inverters, ungrounded batteries, and distribution panels. The Class 1E UPS system provides reliable power for the safety-related equipment, including the plant instrumentation, control, monitoring, and other systems that perform vital functions needed to shut down the plant. In addition, the Class 1E UPS system provides power to the emergency lighting in the main control room and the remote shutdown area.

8.3.1.2 Summary of Application

Section 8.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 8.3 of the ESBWR DCD, Revision 10. Section 8.3 of the ESBWR DCD includes Section 8.3.1, "AC Power Systems," which addresses SRP Section 8.3.1, "AC Power Systems (Onsite)."

In addition, in FSAR Section 8A,"Miscellaneous Electrical Systems," the applicant provided the following information:

COL Items

- NAPS COL 8A.2.3-1-A Cathodic Protection System

The applicant provided additional information regarding a cathodic protection system to address NAPS COL 8A.2.3-1-A.

Supplemental Information

- NAPS SUP 8.3-1 Onsite Power Description

In FSAR Section 8.3.1.1, "Description," the applicant provided information describing an intermediate switchyard to transition offsite power from the NAPS switchyard.

8.3.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the ESBWR DCD and NUREG–1966, Supplement 1, FSER related to the Certification of the ESBWR Standard Design, Supplement 1. In addition, the relevant requirements of the Commission regulations for the offsite power system and the associated acceptance criteria are in SRP Section 8.3.1," AC Power Systems (Onsite)."

In addition, the NRC requirements governing the COL supplemental information are in GDC 17.

8.3.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 8.3.1 and Appendix 8A of the certified ESBWR DCD. The staff reviewed Section 8.3.1 and Appendix 8A of the North Anna 3 COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COLA represent the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference includes all the information necessary for the review of ac power systems (onsite).

The staff reviewed the following information contained in the COL FSAR:

COL Item

- NAPS COL 8A.2.3-1-A Cathodic Protection System

The applicant provided additional information in NAPS COL 8A.2.3-1-A. The applicant stated that a cathodic protection system is provided, as required, and that the system is designed in accordance with the standards of the National Association of Corrosion Engineers.

The staff finds that the applicant has adequately addressed the COL item.

Supplemental Information

- NAPS SUP 8.3-1 Onsite Power Description

The applicant provided the following supplemental information to modify Section 8.3.1.1, "Description":

> An intermediate switchyard is utilized to transition off-site power from the NAPS switchyard to the Unit 3 main power transformers, and unit auxiliary transformers (UATs). This intermediate switchyard contains the main generator circuit breaker, and a supply circuit breaker, which provides power to 500/230 kV intermediate transformers used to supply power to the UATs. These intermediate transformers consist of three single phase transformers and include an installed spare transformer. Also included in the intermediate switchyard is a transmission tower which supports a 500 kV disconnect switch that is identified as the point of interconnection between the onsite power sources and offsite power sources.

The staff finds that the applicant has adequately described the North Anna 3 connection to the utility grid and the connection conforms to the requirements of GDC 17 because the North Anna 3 normal and alternate power supplies would provide sufficient capacity and capability to assure that safety system vital functions are maintained in the event of an AOO or postulated accidents.

8.3.1.5 Post Combined License Activities

There are no post COLA activities related to this chapter.

8.3.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all the information relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the onsite ac power system that were incorporated by reference have been resolved.

In addition, the staff has compared the additional COL item and supplemental information within the application to the relevant NRC regulations, guidance in SRP Section 8.3.1, and other NRC RGs and, for the reasons discussed above, concludes that the applicant is in compliance with the NRC regulations.

As discussed above, the staff concludes that the applicant has adequately addressed the North Anna 3 COL item involving cathodic protection systems and supplemental information involving the transmission system and its electrical connection to the plant. In conclusion, the staff finds that the applicant has provided sufficient information to satisfy the requirements of GDC 17 for this section.

8.3.2 DC Power Systems

8.3.2.1 Introduction

This section of the COL FSAR provides descriptive information, analyses, and referenced documents that include the applicant's information on electrical single-line diagrams, electrical schematics, logic diagrams, tables, and physical arrangement drawings for the onsite dc power systems. Onsite dc power systems include those power sources and their distribution systems that supply motive or control power to safety-related equipment. The non-safety-related portions are described only in sufficient detail to permit an understanding of their interactions with the safety-related portions. This section clearly identifies the safety loads and states the length of time they would be operable in the event of a loss of ac power.

The plant's dc power system is comprised of independent Class 1E and non-Class 1E dc power systems. Each system consists of ungrounded stationary batteries, dc distribution equipment, and the UPS.

The Class 1E dc and UPS system in the ESBWR passive reactor design plant is capable of providing reliable power for the safe shutdown of the plant without the support of battery chargers, during a loss of all ac power sources coincident with a design-basis accident for 72 hours. The system is designed so that no single failure will result in a condition that will prevent the safe shut down of the plant.

The non-Class 1E dc and UPS system in the ESBWR passive reactor design plant provides continuous and reliable electric power to the plant's non-Class 1E control and instrumentation loads and equipment, which are used for plant operation and investment protection and for the hydrogen igniters located inside containment. Operation of the non-Class 1E dc and UPS system is not required for nuclear safety-related systems.

8.3.2.2 Summary of Application

Section 8.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 8.3 of the certified ESBWR DCD, Revision 10. Section 8.3 of the ESBWR DCD includes Section 8.3.2, "DC Power Systems," which addresses SRP Section 8.3.2, "DC Power Systems (Onsite)."

In addition, in FSAR Section 8.3.2, the applicant provided the following:

COL Items

- NAPS COL 8.3.4-1-A — Safety-Related Battery Float and Equalizing Voltage Values

In FSAR Section 8.3.2.1.1, "Safety-Related Station Batteries and Battery Chargers," the applicant provides information on safety-related battery float and equalizing voltage values. Additionally, the applicant modifies DCD Table 8.3-4 item b.

- NAPS COL 8.3.4-2-A — Underground or inaccessible power and control cable

In FSAR Section 8.3.3.2, "Cables and Raceways" the applicant provides information on accident mitigating functions that are supplied by DC power that is susceptible to protracted exposure to wetted environments.

Supplemental Information

- NAPS SUP 8.3-2 — Safety-Related Station Batteries and Battery Chargers Station Blackout

In FSAR Section 8.3.2.1.1, "Safety-Related Station Batteries and Battery Chargers Station Blackout," the applicant provided information on the training and procedures to mitigate SBO, with references to Sections 13.2 and 13.5 of the FSAR and DCD Section 15.5.5.

8.3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the ESBWR DCD and NUREG–1966, Supplement 1, FSER related to the Certification of the ESBWR Standard Design, Supplement 1. In addition, the relevant requirements of the

Commission regulations for the DC power system and the associated acceptance criteria are in SRP Section 8.3.2," DC Power Systems (Onsite)."

In addition, the NRC requirements governing the COL supplemental information are in 10 CFR 50.63, "Loss of All Alternating Current Power." The guidance and acceptance criteria for meeting Section 50.63 are in the guidelines of RG 1.155, "Station Blackout"; and Nuclear Management and Resource Council (NUMARC) 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," issued November 1987, and endorsed by RG 1.155.

8.3.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 8.3.2 of the certified ESBWR DCD. The staff reviewed Section 8.3.2 of the North Anna 3 COL FSAR and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference includes all the information necessary for review of the DC power system.

The staff reviewed the following additional information in the COL FSAR:

COL Items

- NAPS COL 8.3.4-1-A Safety-Related Battery Float and Equalizing Voltage Values

The applicant provides additional information to address COL Item 8.3.4-1-A. The applicant replaces the fourth paragraph of DCD Section 8.3.2.1.1 with the following:

> In Divisions 1, 2, 3, and 4, the two 250 volt safety-related batteries per division are sized together so that their total rated capacity will exceed the required battery capacity per division for 72-hour station blackout conditions. The DC system minimum battery terminal voltage at the end of the discharge period is 210 VDC (1.75 volts per cell). The maximum equalizing charge voltage for safety-related batteries is specified by the battery vendor and is as allowed by the voltage rating of the connected loads (UPS inverters). The UPS inverters are designed to supply 120 VAC power with DC input less than the minimum discharge voltage (210 VDC) and greater than the maximum equalizing charge voltage. The safety-related battery float voltage and maximum equalizing charge voltage values are included in Table 8.3-4R.

Additionally, the applicant modifies DCD Table 8.3-4 item b to include float and maximum equalizing charge voltage as follows:

- float voltage at 77°F- 267.6 VDC at the battery terminals
- maximum equalizing charge voltage at 77°F-288 VDC at the battery terminals.

The staff finds that optimum long-term battery performance is obtained by maintaining a float voltage within established design values of 2.22 volts per cell to 2.24 volts per cell provided by the battery manufacturer, which corresponds to nominally 2.23 volts per cell or 267.6 Vdc at 77°F. This provides adequate over-potential, which limits the formation of lead sulfate and self discharge. Therefore, float voltage of 267.6 Vdc at 77°F is acceptable. Additionally, the maximum equalizing charge voltage of 288 Vdc at the battery terminals is acceptable because the UPS inverters (only connected load on dc bus) are designed to function properly with dc input less than the minimum discharge voltage (210 VDC) and greater than the maximum equalizing charge voltage (288 Vdc).

In view of the forging, the staff finds that the applicant adequately resolved COL Item 8.3.4-1-A and float and maximum equalizing charge voltage values were consistent with battery vendor's recommendation and in conformance with the requirements of GDC 17.

- NAPS COL 8.3.4-2-A Underground or inaccessible power and control cable

The applicant stated in FSAR Section 8.3.3.2, "Cables and Raceways" that:

> Underground or inaccessible power and control cable runs to the [Plant Service Water System] PSWS and DG Fuel Oil Transfer System that have accident mitigating functions and are susceptible to protracted exposure to wetted environments or submergence as a result of seasonal or weather event water intrusion are adequately identified and monitored for appropriate corrective actions under the Maintenance Rule (MR) program described in Section 17.6.4.

Given that 10 CFR 50.65, "Maintenance Rule," requirements will be applied to these control cables, and the applicant's Maintenance Rule Program is adequate as described in Section 17.6.4 of this SER, these underground power and control cables will be adequately monitored to ensure reliability of these accident mitigating functions and is therefore acceptable.

Supplemental Information

- NAPS SUP 8.3-2 Safety-Related Station Batteries and Battery Chargers Station Blackout

The applicant provided supplemental information in Section 8.3.2.1.1 of the FSAR for addressing training and procedures to mitigate an SBO event by adding the following at the end of FSAR Section 8.3.2.1.1:

> Training and procedures to mitigate an SBO event are implemented in accordance with Sections 13.2 and 13.5, respectively. As recommended by NUMARC 87-00 (Reference 8.3-201), SBO event mitigation procedures address SBO response (e.g., restoration of on-site standby power sources), AC power restoration (e.g., coordination with transmission system load dispatcher), and severe weather guidance (e.g., identification of site-specific actions to prepare for the onset of severe weather such as an impending tornado), as applicable. The ESBWR is a passive design and does not rely on offsite or onsite AC sources of power for at least 72 hours after an SBO event, as described in DCD Section 15.5.5, Station Blackout. In addition, there are no nearby large power sources, such as a gas turbine or black start fossil fuel plant, that can directly connect to the station to mitigate the SBO event. Restoration from an SBO

event will be contingent upon power being made available from any one of the following sources:

- Any of the standby or ancillary diesel generators.
- Restoration of any one of the four 500 kV transmission lines described in Section 8.2.
- Restoration of the 230 kV transmission line described in Section 8.2.

According to NUMARC 87-00, which is endorsed by RG 1.155, the SBO response procedures include (1) SBO response guidelines, (2) ac power restoration, and (3) severe weather guidelines. On June 19, 2008, the staff issued RAI 08.03.02-1 (ADAMS Accession No. ML081710161), in which the staff asked the applicant to confirm that training and procedures cover all three SBO response procedures. In the response letter dated August 4, 2008 to RAI 08.03.02-1 (ADAMS Accession No. ML082200626), the applicant stated that it will revise the FSAR to indicate that procedures will include these three areas. The applicant further stated that licensed and non-licensed plant personnel receive adequate training for responding to all plant events, both normal and abnormal, and such training encompasses an SBO event. The staff finds that the applicant conforms to the guidance of RG 1.155 and therefore meets the requirements of 10 CFR 50.63, contingent on maintaining these procedures and personnel training. Because the detailed training and procedures will not be fully developed until required by license condition, they will be subject to inspection after implementation. Accordingly, the subject RAI is adequately addressed. The staff confirmed that these changes are incorporated in Revision 8 of the FSAR, and the issue is resolved.

In view of the above, the staff finds that NAPS SUP 8.3-2 conforms to the guidance of RG 1.155 and therefore complies with the requirements of 10 CFR 50.63.

8.3.2.5 Post Combined License Activities

There are no post COL activities related to this section.

8.3.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all the information relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the onsite DC power system that were incorporated by reference have been resolved.

In addition, the staff has compared the supplemental information within the application to the relevant NRC regulations, guidance in SRP Section 8.3.2, and other NRC RGs and, for the reasons discussed above, concludes that the applicant is in compliance with the NRC regulations.

As discussed above, the applicant has adequately addressed North Anna 3 COL supplemental information pertaining to training and procedures to mitigate an SBO event. Accordingly, the staff finds that the applicant has provided sufficient information to satisfy the requirements of 10 CFR 50.63 for this section.

8.4 Station Blackout

The North Anna 3 COL FSAR does not include Section 8.4. Instead, the COL FSAR analyzes SBO in FSAR Section 15.5.5, “Station Blackout.” ESBWR DCD, Section 15.5.5 presents the SBO safety analysis. In the North Anna 3 COL FSAR, Revision 8, Section 15.5.5, “Station Blackout,” the applicant incorporated by reference Section 15.5.5, “Station Blackout,” of the ESBWR DCD, Revision 10, with no departures or supplements. The staff evaluation is set forth in Section 15.5.5 of the staff SER for findings related to information incorporated by reference in NUREG–1966.

References

1. 10 CFR 50.12, "Specific exemptions."

2. 10 CFR 50.63, "Loss of all alternating current power."

3. 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants."

4. 10 CFR 52.63, "Finality of standard design certification."

5. 10 CFR 52.7, "Specific exemptions."

6. 10 CFR 52.97, "Issuance of combined licenses."

7. 10 CFR 52.98, "Finality of combined licenses; information requests."

8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

10. 10 CFR Part 50, Appendix A, GDC 17, "Electric power systems."

11. 10 CFR Part 50, Appendix A, GDC 18, "Inspection and testing of electric power and protective systems."

12. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

13. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

14. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

15. Dominion Transmission Line Standards, North Anna 3 FSAR Revision-9, June 2016.

16. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

17. Hileman, Andrew R., "Insulation Coordination for Power Systems," published by Marcel Dekker, Inc. of New York and Basel, ISBN 0-8247-9957-7, Jun 15, 1999.

18. IEEE Standard 1313.2-1999, "IEEE Guide for the Application of Insulation Coordination."

19. IEEE Standard 141-1986, "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants."

20. IEEE Standard 242-2001, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems."

21. IEEE Standard 988-2000, "Guide to Direct Lightning Shielding of Substations."

22. IEEE Standard C37.013, "Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current."

23. IEEE Standard C62.22-2003, "IEEE Guide for the Application of Metal-Oxide Surge Arresters for Alternating-Current Systems."

24. IEEE Standard C62.23-1995, "IEEE Application Guide for Surge Protection of Electric Generating Plants."

25. IEEE Std C37.010-1999, "IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis".

26. IEEE Std C37.013, "Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current."

27. IEEE Std C57.19.100-1995, "IEEE Guide for Application of Power Apparatus Bushings."

28. NEI 07-02A, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed under 10 CFR Part 52," March 2008. (ADAMS Accession No. ML080910149.)

29. NERC Standard PRC-005-1, "Transmission and Generation Protection System Maintenance and Testing," May 1, 2006.

30. NERC Standard PRC-008-0, "Underfrequency Load Shedding Equipment Maintenance Program," 2005.

31. NERC Standard PRC-017-0, "Special Protection System Maintenance and Testing."

32. North American Electric Reliability Corporation (NERC) Criteria.

33. NRC BL 2012-01, "Design Vulnerability in Electric Power System," (ADAMS Accession No. ML12074A115). NRC BTP 8-3, "Stability of Offsite Power Systems," March 2007. (ADAMS Accession No. ML070710446).

34. NRC BTP 8-6, "Adequacy of Station Electric Distribution System Voltages," March 2007. (ADAMS Accession No. ML070710478).

35. NRC GL 07-01, "Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients," dated February 7, 2007.

36. NRC GL 2006-02, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power," March 30, 2006. (ADAMS Accession No. ML060940432).

37. NRC GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," February 7, 2007. (ADAMS Accession No. ML070360665).

38. NRC IN 2005-15, "Three-Unit Trip and Loss of Offsite Power at Palo Verde Nuclear Generating Station," dated June 1, 2005.

39. NRC IN 95-37, "Inadequate Offsite Power Voltages During Design-Basis Events," dated September 7, 1995.

40. NRC IN 98-07, "Offsite Power Reliability Challenges from Industry Deregulation," dated February 27, 1998.

41. NRC RG 1.118, Revision 3, "Periodic Testing of Electric Power and Protection Systems," April 1995. (ADAMS Accession No. ML003739468).

42. NRC RG 1.155, "Station Blackout," August 1988. (ADAMS Accession No. ML003716792)

43. NRC RG 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997. (ADAMS Accession No. ML003761662).

44. NRC RG 1.204 "Guidelines for Lightning Protection of Nuclear Power Plants," November 2005. (ADAMS Accession No. ML052290422).

45. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007. (ADAMS Accession No. ML070720184).

46. NRC RG 1.32, Revision 3, "Criteria for Power Systems for Nuclear Power Plants," March 2004. (ADAMS Accession No. ML040680488).

47. NRC Staff NUREG/CR-6890, "Reevaluation of Station Blackout Risk at Nuclear Power Plants, Analysis of Loss of Offsite Power Events: 1986-2004," issued November 2005.

48. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

49. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

50. NUMARC 87 00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," issued November 1987, and endorsed by RG 1.155.

9.0 Auxiliary Systems

9.0 AUXILIARY SYSTEMS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) auxiliary systems for the Economic Simplified Boiling-Water Reactor Standard (ESBWR) design including fuel handling and storage, process water and cooling systems, process auxiliaries, alternate shutdown, fire protection, plant communication systems, lighting and diesel generator systems.

9.1 Fuel Storage and Handling

9.1.1 New Fuel Storage

Section 9.1.1, "New Fuel Storage," of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference Section 9.1.1, "New Fuel Storage," of the ESBWR Design Control Document (DCD), Revision 10, referenced in Title10 *Code of Federal Regulations* (CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the ESBWR Design." As documented in NUREG–1966, "Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," the U.S. Nuclear Regulatory Commission (NRC) staff reviewed and approved Section 9.1.1 of the certified ESBWR DCD. The staff reviewed the COL application (COLA) and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

Section 9.1.1.7 of the ESBWR DCD indicates that the applicant is to address DCD COL Item 9.1-4-A related to programs that address fuel handling operations, including criticality safety. The COL applicant removed the two references that DCD Section 9.1.1.7 made to COL 9.1-4-A and addressed them as STD COL 9.1-4-A in Section 9.1.4 of the COL FSAR. The staff's review of STD COL 9.1-4-A is discussed in Section 9.1.4 of this safety evaluation report (SER).

The seismic evaluations for new fuel storage performed in the ESBWR DCD are based on ESBWR standard plant seismic inputs. The North Anna 3 site-specific seismic demands exceed the certified seismic design response spectra (CSDRS). Therefore, the applicant introduced the departure NAPS DEP 3.7-1, "Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra," and referenced it in Section 9.1.1.5 of the North Anna 3 COL FSAR, Revision 9 submitted June, 2016. The applicant performed a site-specific assessment of the new fuel storage rack structural design using the DCD methodology, as approved by the staff in NUREG–1966, the ESBWR DCD Final Safety Evaluation Report (FSER). The North Anna 3 site-specific seismic demands, evaluated in Section 3.7 of this SER, result in changes to the size of anchor bolts for new fuel storage racks in the buffer pool and higher embedment loads than in the ESBWR DCD, Revision 10. The staff evaluated NAPS DEP 3.7-1 with respect to the new fuel storage seismic structure loads in Section 3.8 of this SER.

The inclusion of NAPS DEP 3.7-1 in Section 9.1.1 was verified by the staff in the North Anna 3 FSAR, Revision 9, which incorporated the appropriate changes described in the applicant's

[1] See "*Finality of Referenced NRC Approvals*" in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

revised seismic request for additional information (RAI) responses on May 18, 2016 (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML16146A789). Therefore, Confirmatory Item 09.01-1 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff's review confirms that the applicant has addressed the required information, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to new fuel storage that were incorporated by reference have been resolved.

9.1.2 Spent Fuel Storage

Section 9.1.2, "Spent Fuel Storage," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.2, "Spent Fuel Storage," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.1.2 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The seismic evaluations for spent fuel storage performed in the ESBWR DCD are based on ESBWR standard plant seismic inputs. The North Anna 3 site-specific seismic demands exceed the CSDRS, so the applicant introduced the departure NAPS DEP 3.7-1, "Seismic Design," and referenced it in Section 9.1.2.4 of the North Anna 3 COL FSAR, Draft Revision 9 submitted on May 20, 2016 (ADAMS Accession No. ML16146A789). The applicant performed a site-specific assessment of the spent fuel storage rack structural design using the DCD methodology, as approved by the staff in NUREG–1966. The North Anna 3 site-specific seismic demands, evaluated in Section 3.7 of the SER, result in changes to the size of anchor bolts and the welds from the enveloping plate to the base plates for spent fuel storage racks in the buffer pool deep pit and higher embedment loads than in the ESBWR DCD, Revision 10. The staff evaluated NAPS DEP 3.7-1 with respect to the spent fuel pool (SFP) seismic structure loads in Section 3.8 of this SER.

The inclusion of NAPS DEP 3.7-1 was verified by the staff in the North Anna 3 FSAR, Revision 9, which incorporated the appropriate changes described in the applicant's revised seismic RAI responses on May 18, 2016. Therefore, Confirmatory Item 09.01-2 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff's review confirms that the applicant has addressed the required information, and no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to spent fuel storage that were incorporated by reference are resolved.

9.1.3 Spent Fuel Cooling and Cleanup System

Section 9.1.3, "Spent Fuel Cooling and Cleanup System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.1.3, "Spent Fuel Cooling and Cleanup System," of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.1.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Spent Fuel Cooling and Cleanup System" that were incorporated by reference have been resolved.

9.1.4 Light Load Handling System (Related to Refueling)

9.1.4.1 Introduction

The light load handling system is used to handle the spent fuel assemblies underwater from the time they leave the reactor vessel until they are placed in a container for shipment from the site. Characteristics of the system are aimed at avoiding criticality accidents, radioactivity releases resulting from damage to irradiated fuel, and unacceptable personnel radiation exposure.

9.1.4.2 Summary of Application

Section 9.1.4, "Light Load Handling System (Related to Refueling)," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.4 of the certified ESBWR DCD, Revision 10. In addition, in North Anna 3 COL FSAR, Section 9.1.4, the applicant provided the following:

COL Item

- STD COL 9.1-4-A Fuel Handling Operations

The applicant provided additional information in STD COL 9.1-4-A to address DCD COL Item 9.1.4-A. The applicant described the scope of the fuel handling procedures and procedures for equipment used to move fuel. The applicant states that these procedures will be developed 6 months before fuel receipt. The applicant states that the fuel handling equipment is inspected for operating conditions before each refueling and that a quality assurance (QA) program is applied to monitoring, implementing and assuring compliance with fuel handling procedures. The QA program is described in Section 17.5 of the COL FSAR.

9.1.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, FSER related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the "Light Load Handling System (Related To Refueling)" and the associated acceptance criteria are in Section 9.1.4 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," the Standard Review Plan (SRP).

The applicable regulatory requirements and associated guidance for fuel handling operations are as follows:

- General Design Criterion (GDC) 61, "Fuel Storage and Handling and Radioactivity Control," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR

Part 50, “Domestic Licensing of Production and Utilization Facilities,” as it relates to radioactive releases resulting from fuel damage and the avoidance of excessive personnel radiation exposure.

- GDC 62, “Prevention of Criticality in Fuel Storage and Handling,” as it relates to prevention of criticality accidents.

- Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” June 2007.

9.1.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.1.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.1.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD that represent the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the “Light Load Handling System (Related to Refueling).”

The staff’s review of the information contained in the North Anna 3 COL FSAR is as follows:

<u>*COL Items*</u>

- STD COL 9.1-4-A Fuel Handling Operations

The staff reviewed STD COL 9.1-4-A, Fuel Handling Operations, related to the fuel handling operations included under Section 9.1.4 of the North Anna 3 COL FSAR. DCD COL Item 9.1.4-A in Section 9.1.6, “COL Information,” of the ESBWR DCD, Revision 10, states that the applicant will provide a description of programs that address the following:

- Criticality safety of fuel handling operations
- Fuel handling procedures
- Maintenance manuals and procedures for equipment used to move fuel
- Equipment inspection and test plans for equipment used to move fuel
- Personnel qualifications, training, and control programs for fuel handling personnel
- [Quality Assurance] QA programs to monitor, implement, and assure compliance to fuel handling operations

In FSAR Section 9.1.4.13, “Refueling Operations,” and FSAR Section 9.1.4.19, “Inspection and Testing Requirements,” the applicant addressed DCD COL Item 9.1.4-A in STD COL 9.1-4-A. The applicant added a paragraph in FSAR Section 9.1.4.13 identifying the general subject matter of fuel handling procedures that will be developed. The program described by the applicant in FSAR Section 9.1.4.13 provides procedures for fuel handling, inspection and testing of fuel handling equipment in adequate time to support training and qualification of fuel handling personnel. These procedures will be completed 6 months prior to fuel receipt. In further response to DCD COL Item 9.1.4-A (STD COL 9.1-4-A), the applicant states that qualifications, training and the control programs for fuel handling personnel are addressed in FSAR Section 13.2, "Training." In RAI 09.01.04-1 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to clarify how FSAR Section 13.2 addresses personnel qualification and training for fuel handlers. In their response to RAI 09.01.04-1 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that FSAR Section 13.2 refers to Appendix 13BB, "Training Program," which incorporates by reference Nuclear Energy Institute (NEI) 06-13A, "Template for an Industry Training Program Description." On December 5, 2008, the NRC endorsed NEI 06-13A, Revision 1, as an acceptable template for describing reactor operator (RO) and non-licensed plant staff training programs for COLAs. The staff finds that the applicant has adequately addressed training and qualification of fuel handlers. Therefore, RAI 09.01.04-1 is resolved and closed.

Also in response to DCD COL Item 9.1.4-A, the applicant revised Section 9.1.4.19 of the FSAR to identify that the QA program described in FSAR Section 17.5, "Quality Assurance Program Description-Design Certification, Early Site Permits, and New License Applicants," will monitor, implement and assure compliance with fuel handling procedures. The applicant also states that fuel handling equipment is inspected prior to each refueling. In RAI 09.01.04-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to clarify how testing and inspection before each refueling operation ensures that safety features and interlocks perform satisfactorily and prevent excessive personnel radiation exposure and fuel damage, in keeping with the requirements of GDC 61. In their response to RAI 09.01.04-2 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that the fuel handling procedures required by FSAR Section 9.1.4.13 include checking the status of interlocks. The interlocks for the refueling machine and the fuel handling machine are specified in ESBWR DCD, Section 9.1.4.5, "Refueling Equipment." Additionally, the applicant stated that the ESBWR DCD Technical Specifications (TS) includes TS 3.9.1, "Refueling Equipment Interlocks," which prevent operation of the refueling equipment with fuel loaded over the core whenever any control rod is withdrawn, and prevent control rod withdrawal whenever fuel-loaded refueling equipment is over the core. The staff finds that the applicant's response to RAI 09.01.04-2 is satisfactory and it clarifies the applicant's response in STD COL 9.1-4-A to DCD COL Item 9.1.4-A. Therefore, RAI 09.01.04-2 is resolved and closed.

The staff evaluated COL Item STD COL 9.1-4-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.1.4, along with GDC 61 and 62 and the guidance in RG 1.206. The staff finds that the applicant has satisfactorily addressed this COL Item.

9.1.4.5 Post Combined License Activities

There are no post COL activities related to this section.

9.1.4.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the "Light Load Handling System (Related to Refueling)," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the light load handling system (Related To Refueling), that were incorporated by reference are resolved.

In addition, the staff compared the additional information in the application to the relevant NRC regulations, the guidance in SRP Section 9.1.4, and other NRC regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 61 and 62 and the guidance in RG 1.206. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.1-4-A.

9.1.5 Overhead Heavy Load Handling System

9.1.5.1 Introduction

The overhead heavy load handling systems for North Anna 3 are used to lift loads whose weight is greater than the combined weight of a single spent fuel assembly and its handling device. The principal equipment is the fuel building (FB) crane and reactor building (RB) crane. The overhead heavy load handling system is designed to ensure that inadvertent operations or equipment malfunctions, separately or in combination, will not cause a release of radioactivity, a criticality accident, inability to cool fuel within the reactor vessel or SFP, or prevent safe shutdown of the reactor.

9.1.5.2 Summary of Application

Section 9.1.5, "Overhead Heavy Load Handling System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.1.5 of the certified ESBWR DCD, Revision 10. In addition, in North Anna 3 COL FSAR, Section 9.1.5, the applicant provides the following:

COL Items

- STD COL 9.1-5-A Handling of Heavy Loads

The applicant provided additional information in STD COL 9.1-5-A to address DCD COL Item 9.1-5-A. The applicant described the scope of the heavy load handling procedures. The applicant stated that they will be developed prior to fuel load. The applicant stated that the fuel handling equipment is inspected for operating conditions before each refueling. The applicant described the criteria for inspection of special lifting devices and the inspection and testing of cranes. The applicant described the training and qualification standard for crane operators and the application of specific quality program controls for heavy load handling. The QA program is described in Section 17.5 of the COL FSAR.

9.1.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the certified ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the overhead heavy load handling system and the associated acceptance criteria are in SRP Section 9.1.5.

The regulatory basis for acceptance of the COL information items is established in:

- GDC 1, “Quality Standards and Records,” of 10 CFR Part 50, as it relates to design, fabrication, and testing of structures, systems, and components (SSCs) important to maintain quality standards.

- GDC 4, “Environmental and Dynamic Effects Design Bases” of 10 CFR Part 50, as it relates to the protection of fuel and safety-related equipment from the effects of internally generated missiles (i.e., dropped loads).

9.1.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.1.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.1.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[1]

The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

COL Items

- STD COL 9.1-5-A Handling of Heavy Loads

The staff reviewed STD COL 9.1-5-A related to the handling of heavy loads included under Section 9.1.5 of the North Anna 3 COL FSAR. DCD COL Item 9.1-5-A in Section 9.1.6, “COL Information,” of the ESBWR DCD Tier 2, Revision 10 states that the applicant will provide a description of the program governing heavy loads handling, and the schedule for implementation, that addresses the following:

- Heavy loads and heavy load handling equipment outside the scope of loads described in the referenced certified design and the associated heavy load attributes (load weight and typical load path);

- Requirements for heavy load handling safe load paths and routing plans including descriptions of automatic and manual interlocks not described in the referenced certified design and safety devices and procedures to assure safe load path compliance;

- Summary description of requirements to develop heavy load handling equipment maintenance manuals and procedures;

- Requirements for heavy load handling equipment inspection and test plans;

- Requirements for heavy load personnel qualifications, training, and control programs;

- QA program requirements to monitor, implement, and ensure compliance with the heavy load handling program; and

- Issues described in Regulatory Issue Summary (RIS) 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," related to the use of non-metallic slings with single failure proof lifting devices.

In FSAR Section 9.1.5, "Overhead Heavy Load Handling Systems," the applicant states that no heavy loads are identified that are outside the scope of the certified design.

In accordance with the ESBWR DCD COL Item 9.1-5-A, the COL applicant is to provide a description of automatic and manual interlocks not described in the reference certified design. The applicant's response in STD COL 9.1-5-A in North Anna 3, Revision 1 of the FSAR did not provide this information. In RAI 09.01.05-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff requested that the applicant provide this additional information. In their response to RAI 09.01.05-2 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that there are neither heavy load handling equipment nor interlocks associated with heavy load handling equipment that are outside the scope of the certified design. Therefore, RAI 09.01.05-02 is resolved and closed. Based on the information provided by the applicant in the North Anna 3 FSAR, Revision 8, Section 9.1.5.9, the staff finds that the applicant has satisfied this element of the COL information item requirement.

In FSAR Sections 9.1.5.6, "Other Overhead Load Handling Systems," 9.1.5.8, "Operational Responsibilities", and 9.1.5.9, "Safety Evaluations," the applicant addressed ESBWR DCD COL Item 9.1-5-A in STD COL 9.1-5-A.

The second item listed in COL Item STD COL 9.1-5-A pertains to requirements for heavy load handling safe load paths and routing plans. In FSAR Section 9.1.5.8, the applicant discusses the development of administrative procedures. In that section, the applicant specifies that North Anna 3 FSAR, Section 13.5, "Plant Procedures," requires the development of administrative procedures to control heavy loads prior to fuel load. The section also specifies that heavy load handling procedures address approved safe load paths and exclusion areas. The applicant states that paths are defined in procedures and equipment layout drawings, and that safe load path procedures address specific requirements. There are procedures to limit the height and the times that heavy loads are carried over the SFP, reactor vessel, or the safe shutdown equipment. In addition, when heavy loads could be carried but are not required to be carried directly over the SFP, reactor vessel, or the safe shutdown equipment, procedures will define an area over which loads shall not be carried so that if the load is dropped, it will not result in damage to spent fuel or operable safe shutdown equipment or compromise reactor vessel integrity. A requirement for supervision to be present during heavy load lifts to enforce procedural requirements is also discussed in FSAR Section 9.1.5.8. Based on the information that was provided by the applicant in FSAR Section 13.5 and Section 9.1.5.8, the staff finds that the applicant has satisfied this element of the COL information item requirement since it specifies that the heavy load handling program will include program elements for safe paths, routing plans, and administrative controls.

The third and fourth item listed above in COL Item STD COL 9.1-5-A pertains to the applicant providing a description of requirements to develop heavy load handling equipment maintenance manuals and procedures, and with the requirements for heavy load handling equipment inspection and test plans.

In FSAR Section 9.1.5.8, a list of items to be addressed by the heavy loads handling procedures is provided. Among those are procedures to address equipment identification, required equipment inspections and acceptance criteria prior to performing lift and movement operations, safety precautions and limitations, rigging arrangement for loads and special tools, rigging hardware, and equipment required for the heavy load lifts.

Inspection and test plans for heavy load handling equipment is addressed in the North Anna 3 FSAR, Revision 8, by the addition of two paragraphs in Section 9.1.5.6 titled “Special Lifting Devices” and “Other Lifting Devices,” and a paragraph in Section 9.1.5.8 titled “Inspection and Testing.” The “Special Lifting Devices” paragraph describes the inspection and test plans for special lifting devices. Special lifting devices are specifically designed lifting equipment for loads of greater than 4,500 kg (10,000 lbs) and are designed and constructed in accordance with American National Standards Institute (ANSI) N14.6, “Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or more.” The “Other Lifting Devices” paragraph states that “slings used for heavy load lifts meet the requirements specified for slings in ASME/ANSI B30.9 and the guidance specified in NUREG–0612, Section 5.1.1(5).”

Additionally, to address COL Item STD COL Item 9.1-5-A, the applicant replaced the information in ESBWR DCD, Section 9.1.5.8 with a revised FSAR Section 9.1.5.8, “Operational Responsibilities,” that includes a new “Inspection and Testing” paragraph. In this paragraph, the applicant references ASME/ANSI B30.2, “Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist),” B30.11, “Monorails and Underhung Cranes,” and B30.16, “Overhead Hoists (Underhung),” as the applicable standards for crane testing and inspection.

In North Anna 3 FSAR, Revision 1, the applicant took exception to the acceptance criteria in the standard and proposed visual criteria of no cracks in place of the nondestructive examination (NDE) requirements specified. Additionally, for the Dryer/Separator Strongback, the applicant took exception to the NDE of load bearing welds every five refueling outages. Instead the applicant proposed visual and dimensional examinations prior to the initial lift each outage. In the “Other Lifting Devices” paragraph, the applicant identifies ASME/ANSI B30.9, “Slings,” as the industry standard for testing and inspection requirements for slings used for heavy loads. In addition, the applicant also identified a change to the load rating criteria for slings used for heavy lifts, which are addressed by ASME/ANSI B30.9, and NUREG–0612, “Control of Heavy Loads at Nuclear Power Plants.” Section 5.1.1(5) of NUREG–0612 discusses the use of both the static and maximum dynamic load to determine the proper size and rating of slings. The applicant proposes to exclude dynamic loads for sizing of slings.

The applicant did not provide adequate justification for these exceptions. Therefore, in RAI 09.01.05-1 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to provide their justification for these exceptions. In their response to RAI 09.01.05-1 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant changed “STD COL 9.1-6-5” to “STD COL 9.1-5-A.” In STD 9.1-5-A, the applicant removed all exceptions to the guidelines specified in ANSI N14.6 for special lifting devices and revised their FSAR to state that “testing and inspection of special lifting devices follow the guidelines of ANSI N14.6.” The applicant also removed their proposal to exclude dynamic loads for sizing of slings and revised their FSAR to state that “slings used for heavy load lifts meet the requirements specified for slings in ASME/ANSI B30.9 and the guidance specified in NUREG–0612, Section 5.1.1(5).” The staff finds these changes consistent with the guidelines of SRP Section 9.1.5; thus these changes are acceptable and RAI 09.01.05-1 is resolved and closed.

Based on the information that the applicant has added to FSAR Sections 9.1.5.6 and 9.1.5.8, the staff finds that the applicant has satisfied these elements of the COL information item requirements.

The fifth item listed in STD COL 9.1-5-A pertains to the requirement for heavy load personnel qualifications, training, and control programs. The applicant stated in Section 9.1.5.8 that the operators will be trained and qualified to meet the requirements of ASME/ANSI B30.2. Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The sixth item listed in COL Item STD COL 9.1-5-A pertains to QA program requirements to monitor, implement, and ensure compliance with the heavy load handling program. In Section 9.1.5.8 of the FSAR, the applicant states that the QA program described in Section 17.5, "Quality Assurances Program Description-Design Certification, Early Site Permits, and New License Applicants," is applicable to the heavy loads handling program. Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The seventh, and last issue, listed in COL Item STD COL 9.1-5-A pertains to issues described in RIS 2005-25, Supplement 1. In FSAR Sections 9.1.5.8, the applicant addresses how the procedures address issues described in RIS 2005-25, related to the use of non-metallic slings with single failure proof cranes. This section states that heavy load handling procedures will address "the use of slings constructed from metallic material where single-failure-proof features of the handling system are credited in achieving a very low probability of a load drop as described in RIS 2005-25, Supplement 1, and Clarification of NRC Guidelines for Control of Heavy Loads." Based on this information, the staff finds that the applicant has satisfied these elements of the COL information item requirement.

The staff evaluated COL Item STD COL 9.1-5-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.1.5. Based on the above evaluation, the staff finds that the applicant has satisfactorily addressed DCD COL Item 9.1-5-A. The staff also finds that since there will be a QA program with requirements to monitor, implement, and ensure compliance with the heavy load handling program including the program requirements for inspection and testing of equipment, and the program requirements regarding the qualification, and training of personnel, that GDC 1 requirements related to design, fabrication, and testing of SSCs important to maintain quality standards are satisfied. Furthermore, the staff finds that since the heavy load handling program will implement procedures that will provide for the protection of fuel and safety-related equipment from the effects of internally generated missiles that could be generated in the event of a heavy load drop, the requirements of GDC 4 are also satisfied.

9.1.5.5 Post Combined License Activities

There are no post COL activities related to this section.

9.1.5.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the "Overhead Heavy Load Handling System" and no outstanding information is expected to be addressed in the COL FSAR related to this Section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the overhead heavy load handling system, that were incorporated by reference are resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 9.1.5, and other NRC regulatory guides. The staff's review concludes that the information in this FSAR is acceptable because it meets the requirements of GDC 1 and GDC 4 and satisfactorily addresses DCD COL Item 9.1-5-A.

9.2 Water Systems

9.2.1 Plant Service Water System

9.2.1.1 Introduction

This section of the North Anna 3 COL FSAR describes the plant service water system (PSWS). The system is designed primarily to transfer heat from nonsafety-related heat load components in the Reactor and Turbine Buildings to the environment. The PSWS consists of two independent and fully redundant systems that continuously recirculate raw water through the reactor component cooling water system (RCCWS) and turbine component cooling water system heat exchangers. The source of cooling water for the PSWS is the Auxiliary Heat Sink (AHS), and the heat removed is rejected back to the AHS. The AHS for North Anna 3 consists of mechanical draft plume abated cooling towers. The PSWS is a nonsafety-related system that provides defense-in-depth decay heat removal during normal plant operating and transient conditions. Also, as discussed in the ESBWR DCD Section 19A, "Regulatory Treatment of Non-Safety Systems," the PSWS is subject to regulatory treatment of non-safety systems (RTNSS) based on RTNSS Criterion C considerations.

9.2.1.2 Summary of Application

Section 9.2.1, "Plant Service Water System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.2.1, "Plant Service Water System," of the certified ESBWR DCD, Revision 10.

In addition, in North Anna 3 FSAR, Section 9.2.1 the applicant provided the following:

COL Item

- NAPS COL 9.2.1-1-A Material Selection

In FSAR Section 9.2.1.2, the applicant provided additional information in NAPS COL 9.2.1-1-A to address DCD COL Item 9.2.1-1-A. The applicant selected fiberglass reinforced polyester pipe (FRPP) for the buried portion of the PSWS to preclude long term corrosion. The applicant also stated that appropriate chemical treatment is added to the PSWS basin to mitigate the long-term effects of fouling and corrosion within the PSWS.

Supplemental Information

- NAPS SUP 9.2.1-1 Basin Reserve Storage Capacity

In FSAR Table 9.2-2R, the applicant provided the following supplemental information. The PSWS cooling tower basin reserve water storage capacity is 2.6 million gallons, which is needed to provide heat removal capability for 7 days without active makeup.

- NAPS SUP 9.2.1-2 FRP Piping Testing and Inspections

In FSAR Section 9.2.1.4, the applicant provided additional information to address the PSWS FRPP material initial testing and periodic inspection.

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The applicant provided additional information to replace conceptual design information (CDI) contained in the ESBWR DCD. The portions of PSWS that are not a part of the ESBWR Standard Plant consist of the heat rejection facilities (Normal Plant Heat Sink and AHS), which are dependent on actual site conditions. The North Anna PSWS rejects heat only through the AHS mechanical draft cooling towers. The applicant provided Figure 9.2-1R, "Plant Service Water System Simplified Diagram," depicting the PSWS.

- NAPS CDI Table 9.2-2R, "PSWS Component Design Characteristics"

The applicant provided additional information in Table 9.2-2R to replace CDI in the ESBWR DCD. The applicant provided site-specific temperature parameters and the heat load for the cooling tower design.

- Interface Requirement

Section 4.1, "Plant Service Water System," of the ESBWR DCD Tier 1 information specifies as an interface requirement that the PSWS plant-specific heat rejection facilities must be capable of supporting the post-72-hour cooling function of the PSWS and must ensure that PSWS pumps have sufficient available net positive suction head (NPSH) at the pump suction. Part 10 of the COLA, Section 2.4.3, Table 2.4.3-1, "ITAAC for Plant Service Water Reserve Storage Capacity," provides the required plant-specific Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for this interface requirement.

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9.2.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the PSWS and the associated acceptance criteria are in SRP Section 9.2.1.

The applicable regulatory requirements for the PSWS are as follows:

- GDC 2, "Design Bases for Protection Against Natural Phenomena"
- GDC 4
- GDC 44, "Cooling Water"
- GDC 45, "Inspection of Cooling Water System"
- GDC 46, "Testing of Cooling Water System"

- Item (a) of 10 CFR 52.80, “Contents of applications; additional technical information,” which requires the applicant to address ITAAC

9.2.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the information in the COLA represent the complete scope of information relating to this review topic.[1]

The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the PSWS.

The PSWS is a nonsafety-related system that provides defense-in-depth decay heat removal capability and is subject to RTNSS based upon risk considerations (i.e., RTNSS Criterion C). RTNSS Criterion C is described in SECY-94-084, “Policy, Technical, and Licensing Issues Pertaining to Evolutional and Advanced Light-Water Reactor Designs,” dated March 28, 1994 (ADAMS Accession No. ML003708068) and in SECY-95-132, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs (SECY-94-084),” dated May 22, 1995 (ADAMS Accession No. ML003708005). The staff’s evaluation of plant-specific PSWS considerations for the ESBWR design focuses primarily on confirming the capability of the PSWS to perform its defense-in-depth and RTNSS functions; confirming that the PSWS will not adversely impact safety-related SSCs; and confirming that ITAAC, test program specifications, and RTNSS availability controls for PSWS are appropriate.

The staff reviewed the relevant information in the COL FSAR as follows:

<u>*COL Item*</u>

- NAPS COL 9.2.1-1-A Material Selection

The staff reviewed NAPS COL 9.2.1-1-A related to the underground piping material selection under Section 9.2.1 of the North Anna 3 COL FSAR. In accordance with DCD Tier 2, Section 9.2.1.6, “COL Information,” the COL applicant needs to determine PSWS material selections and provide provisions to preclude long-term corrosion and fouling based on site water quality analysis based on the ESBWR DCD Tier 2, Section 9.2.1.2, “System Description.” The applicant addressed this COL information item by including the following plant-specific information in Section 9.2.1.2 of the North Anna 3 FSAR, Revision 8:

> Fiberglass pressure pipe that meets the requirements of [American Society of Mechanical Engineers] ASME B31.1, Power Piping Code, Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lined with Nonmetals, including applicable ASTM and AWWA standards, is used for below-grade piping. Fiberglass pressure pipe is not susceptible to internal corrosion from the chemically treated water or to external corrosion from ground contact.

The PSWS provides defense-in-depth decay heat removal capability and is subject to RTNSS criterion which does not require the same level of treatment as safety-related SSCs. However, specifications and limitations for using FRPP should be properly described in the FSAR to assure that FRPP is capable of performing in accordance with the Commission’s policy on

RTNSS for the PSWS. The impact of using FRPP on reliability and availability assumptions needs to be addressed especially with respect to common cause failure considerations. Finally, the effects of using FRPP on the consequences of pipe failure during seismic events (such as flood effects) need to be addressed in accordance with GDC 2 requirements. The staff, therefore, requested the applicant in RAI 09.02.01-2 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide additional information to address these considerations and to update the FSAR accordingly. The staff reviewed the applicant's response to RAI 09.02.01-2 dated August 28, 2008 (ADAMS Accession No. ML082460847), and determined the following:

- With respect to criteria and limitations for using FRPP, the applicant indicated that this is addressed by incorporating DCD Chapter 3, Sections 9.2.1.1 and 19A.8.3, and Table 19A-4, "Capability of RTNSS Related Structures." The staff found that aside from general design considerations that apply to the PSWS and RTNSS Criterion C systems and components, the referenced information indicates that the ASME Power Piping Code B31.1, "Power Piping," applies for piping and valves, International Building Code-2003 applies for seismic capability, and Institute of Electrical and Electronics Engineers, Inc., (IEEE) 344, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," (1987) applies for demonstrating structural integrity. However, the referenced information does not describe FRPP specifications that apply and limitations on use that are necessary to accommodate PSWS operating and transient conditions (such as temperature extremes and water hammer) commensurate with defense-in-depth and RTNSS considerations. Variations in manufacturing techniques and product formulations can lead to inferior components and if FRPP support requirements are not properly specified, water intrusion problems could lead to common cause and common mode PSWS failures.

- With respect to reliability and availability assumptions, the applicant indicated that the PSWS design information that is incorporated by reference (discussed in the above bullet) assures that the use of FRPP will not adversely affect reliability and availability assumptions for the PSWS. However, it is not clear that PSWS availability and reliability assumptions will be satisfied without establishing design specifications and limitations for using FRPP. Variations in manufacturing techniques and product formulations can lead to inferior components and if FRPP support requirements are not properly specified, water intrusion problems could lead to common cause and common mode PSWS failures. Furthermore, without establishing FRPP design specifications, it is not clear how the Commission's design reliability assurance program (D-RAP) as described in SRP Section 17.4, "Reliability Assurance Program," can be properly implemented.

As a follow-up to the fiberglass issues, the staff issued RAI 09.02.01-13 dated May 6, 2009 (ADAMS Accession No. ML091260337), requesting the following information:

Describe the special treatment QA provisions applicable to supplemental quality class S/N (Special Quality Assurance/Non-Safety Related) for the FRPP used in PSWS for RTNSS systems. This special treatment should include the following considerations:

    - Describe how operating experiences (OE), whereas buried fiberglass materials have been utilized in a similar application such as water service with similar piping size, pressure and temperatures, will be addressed in the selection of the buried fiberglass materials.

- Describe if the ASME B31.1, “Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals,” will be utilized for the fiberglass design and installation. In addition, describe any material classification, for example American Society for Testing and Materials or American Water Works Association that better defines the piping and fittings standards to be utilized.

- Provide details of the buried fiberglass application related to the special QA requirement associated with RTNSS.

In its response to RAI 09.02.01-13 dated September 2, 2014 (ADAMS Accession No. ML14247A264), the applicant provided additional information related to acceptable application of FRPP for North Anna 3 and that the North Anna 3 PSWS FRPP will meet the requirements of ASME B31.1, “Nonmandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals,” including the applicable American Society for Testing and Materials (ASTM) and American Water Works Association (AWWA) standards for FRPP that have been incorporated into the Code. North Anna 3 FSAR, Section 9.2.1 includes the requirement to meet these industry standards. Therefore, the staff determined this issue and the RAI are closed.

With respect to the consequences of PSWS pipe failures during seismic events, the applicant referred to Tier 2 of the DCD, Section 9.2.1.3, “Safety Evaluation,” which stipulates that a failure of all or any portion of the PSWS will not impact any plant safety function. Because the plant design-bases include flooding effects due to failure of all of the PSWS, failures that may occur due to the use of FRPP are encompassed by the plant design bases. Therefore, the staff finds that the use of FRPP relative to flooding considerations is acceptable.

In addressing COL 9.2.1-1-A , the staff noted that the applicant only addressed buried PSWS piping but did not address material selections for any other parts of the PSWS, including cooling towers and related components. Consequently, the staff asked the applicant in RAI 09.02.01-3 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide additional information to specify and explain the material selections that pertain to the rest of the PSWS. The applicant’s response to RAI 09.02.01-3 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that material selections for the PSWS (which include the AHS) will take into consideration PSWS water quality, water treatment options that are compatible with Lake Anna discharge limits, economic considerations, and DCD-related RTNSS criteria. However, no mention was made of using only materials (including materials in the AHS) that are both suitable and compatible for their assigned applications and for the conditions that exist. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-9 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address the specific composition or properties of those materials to be used in the PSWS. The applicant responded to RAI 09.02.01-9 dated July 8, 2009 (ADAMS Accession No. ML091910257), stating that Carbon steel that meets ASTM standards is used as the pipe material for above grade portions of the PSWS and the water treatment regime mitigates the long-term effects of fouling and corrosion within the PSWS. The applicant revised the COL Item 9.2.1-1-A in FSAR Section 9.2.1 and therefore this RAI and issue is resolved and closed.

SRP Section 9.2.1 and Generic Letter (GL) 89-13, “Service Water System Problems Affecting Safety-Related Equipment” (as referred to by SRP Section 9.2.1), provide guidance for evaluating long-term corrosion and fouling considerations associated with service water systems. In particular, these considerations include:

a. Establishing a program of surveillance and control techniques to prevent flow blockage problems due to biofouling;

b. Establishing a routine inspection and maintenance program to assure that corrosion, erosion, protective coating failure, silting, biofouling and others that are applicable cannot degrade the PSWS defense-in-depth and RTNSS cooling functions; and

c. Establishing a test program to verify (initially and periodically) the heat transfer capability of heat exchangers that are important to safety.

In order to prevent long-term corrosion and fouling of the PSWS, the applicant proposes to chemically treat the water in the PSWS cooling tower basin based on site water quality analysis. The FSAR does not explain what specific vulnerabilities are considered to be pertinent based upon siting considerations and industry OE that applies, and why chemical treatment alone is sufficient for addressing these vulnerabilities. While chemical treatment is a common practice and suitable for minimizing PSWS corrosion and fouling problems to some extent, it does not adequately address all of the potential PSWS vulnerabilities that have been identified over time as a result of industry OE as reflected in GL 89-13. The staff asked the applicant in RAI 09.02.01-4 dated July 15, 2008 (ADAMS Accession No. ML081970390), to address the considerations referred to above and to fully address this COL information item.

The applicant responded to RAI 09.02.01-4 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicating that PSWS is a closed system with makeup water treated to preclude long-term corrosion and fouling based on the site water quality analysis. However, the applicant did not address the question that was asked in that anticipated site and system-specific vulnerabilities and degradation mechanisms, and programmatic controls to address these considerations, were not described. Because the PSWS for North Anna 3 is relied upon for defense-in-depth and RTNSS considerations, reliability is an important factor. Consequently, programmatic controls are necessary to periodically monitor the condition and performance of the PSWS components over time to maintain the availability and reliability of the system. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-10 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the PSWS will be treated in accordance with 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Plant Plants," and Nuclear Management and Resources Council (NUMARC) (now NEI) 93-01, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plant." In addition, the staff asked the applicant to describe or provide drawings which indicate the design of the chemical control system, chemical addition system, or water treatment system for the PSWS.

In response to RAI 09.02.01-10 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant responded by stating that the North Anna 3 PSWS is subject to reliability and availability controls in accordance with the Maintenance Rule Program requirements and as stated in DCD Section 19A.8.2, all RTNSS systems are in scope of D-RAP, as described in FSAR Section 17.4. Since SSCs that are in the scope of the D-RAP are initially classified as high safety-significant (HSS) for the Maintenance Rule Program, the PSWS is initially classified as HSS. The staff finds that including the PSWS system in the scope of the Maintenance Rule

D-RAP and revising its system drawing Figure 9.2-1R showing the chemical treatment connection is acceptable, and therefore this RAI and issue is resolved and closed.

The staff evaluated COL Item NAPS COL 9.2.1-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

Supplemental Information and Conceptual Design Information

- NAPS SUP 9.2.1-1 — Basin Reserve Storage Capacity
- NAPS SUP 9.2.1-2 — FRP Piping Testing and Inspections
- NAPS CDI — System Description
- NAPS CDI — PSWS Component Design Characteristics

Tier 2 of the DCD, Section 9.2.1.2, states that the heat rejection facilities are dependent upon actual site conditions and are not part of the ESBWR standard plant. The conceptual design, for the standard plant, uses a normal power heat sink (NPHS) and an AHS as the heat rejection facilities. The NPHS is a dry cooling array and hybrid cooling tower and the AHS consists of mechanical draft cooling towers. A cross-tie for the standard plant permits aligning PSWS to either of these heat sinks.

The applicant provided supplemental (NAPS CDI) information in Section 9.2.1.2 of the North Anna 3 COL FSAR to address this item. The NAPS CDI indicates that the AHS is the heat rejection facility for North Anna 3, which consists of mechanical draft plume abated cooling towers. The FSAR provides Table 9.2-2R, “PSWS Component Design Characteristics,” and a revised Figure 9.2-1R, “Plant Service Water System Simplified Diagram,” that incorporate the AHS. Table 9.2-2R provides supplemental plant-specific information (NAPS SUP 9.2.1-1) that specifies the basin reserve storage capacity as 1.18×10^4 m^3 (2.6 million gal). In addition to this, the staff noted that the FSAR also repeats the information that was included in Tier 2 of the DCD and there is no distinction between the plant-specific (NAPS CDI) and the standard plant design information. In order to avoid confusion in the future the staff asked the applicant in RAI 09.02.01-5 dated July 15, 2008 (ADAMS Accession No. ML081970390), to provide appropriate clarification. The applicant’s response to RAI 09.02.01-5 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the information in its entirety is supplemental to address the CDI provided in the DCD. However, only the heat rejection facility that is used for the PSWS is identified as CDI in the DCD. Consequently, most of the information that the applicant provided as supplemental is in fact part of the certified design and cannot be characterized as NAPS CDI. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-11 dated May 6, 2009 (ADAMS Accession No. ML091260337), to clearly identify the plant-specific information in the FSAR that addressed the CDI identified in the ESBWR DCD. The applicant responded to RAI 09.02.01-11 dated July 8, 2009 (ADAMS Accession No. ML091910257), and stated that North Anna 3 FSAR, Section 9.2.1.2, Table 9.2-2R, and Figure 9.2-1R will be revised to clearly identify the plant-specific information that addresses CDI identified in the ESBWR DCD. The staff confirmed the information was revised in North Anna 3 FSAR, Revision 8 and therefore this RAI and issue is resolved and closed.

SRP Section 9.2.5, RG 1.27, and GL 89-13 provide guidance that is pertinent for evaluating heat rejection facilities. Important considerations include those discussed above under interface requirements, other plant-specific vulnerabilities and degradation mechanisms that are anticipated based on OE, and the potential impacts of postulated failures or other interactions on safety-related SSCs. The FSAR does not address these considerations. In addition, the FSAR does not address bounding conditions and limiting assumptions that pertain to the functional capability of the cooling towers and programmatic controls that assure functional capability of the cooling towers will be maintained over the life of the plant. Consequently, the staff asked the applicant in RAI 09.02.01-6 dated July 15, 2008 (ADAMS Accession No. ML081970390), to revise the NAPS CDI accordingly to include this information. The applicant's response to RAI 09.02.01-6 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the information requested by the staff is the type of information that is normally provided for a safety-related system. Because the PSWS is nonsafety-related system, the applicant felt that the information in the FSAR was adequate. Although the PSWS is a nonsafety-related system, it is relied upon for providing defense-in-depth cooling for the reactor and SFP, and it is subject to RTNSS considerations. As such, PSWS reliability and availability are important factors. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-10 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the PSWS (including AHS cooling towers) will be treated in accordance with 10 CFR 50.65, RG 1.160, and NUMARC 93-01. In its response to RAI 09.02.01-10 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant stated that the PSWS is subject to reliability and availability controls in accordance with the Maintenance Rule Program requirements. In addition, as stated in DCD Section 19A.8.2, all RTNSS systems are in the scope of the D-RAP, as described in FSAR Section 17.4. Further, as described in FSAR Section 17.4.1, SSCs that are in the scope of the D-RAP are initially classified as HSS for the Maintenance Rule-Program, with any exceptions requiring expert panel review. The PSWS is initially classified as HSS. Since this system will be classified appropriately as described and the staff confirmed the information was revised in North Anna 3 FSAR, Revision 8 this RAI and issue is resolved and closed.

In a follow-up question to RAI 09.02.01-13, the staff issued RAI 09.02.01-15 dated April 29, 2014 (ADAMS Accession No. ML14119A462), and requested additional information on the piping materials initial testing and periodic inspections related to the quality standards that ensure the RTNSS performance requirements described in Chapter 19A for the PSWS system are met. Specifically the staff requested that the quality standards for the FRPP be represented for the PSWS fiberglass material in the North Anna 3 FSAR including additional ITAAC that should be applied to address pressure testing, cyclic testing, or installation of sleeves. The applicant provided its amended response in a letter dated September 2, 2014 (ADAMS Accession No. ML14247A264), and stated that the FSAR will be revised to incorporate the appropriate quality requirements for FRPP material including design loads, applicable codes and standards, and pre-service testing and in-service inspection requirements. In addition the applicant stated that the PSWS design is part of the standard plant and the PSWS piping is within the scope of the standard plant, as is shown in DCD Figure 9.2-1, therefore the standard plant ITAAC applies and there is no site-specific PSWS system ITAAC required. The applicant revised FSAR Section 9.2.1.4 with an additional North Anna 3 supplement item NAPS SUP 9.2.1-2 describing the inspections and tests that would be site-specific for the North Anna 3 PSWS FRPP material as well as including the PSWS system piping in the NEI sponsored, "Underground Piping and Tank Integrity Program," which is developed in accordance with NEI 09-14, "Guideline for the Management of Underground Piping and Tank Integrity." With these COLA changes including the addition of NAPS SUP 9.2.1-2 the staff finds that the RAI 09.02.01-15 and issue is resolved and closed. The staff verified that the North Anna 3 FSAR, Revision 9 incorporated the appropriate changes described in the applicant's response to RAI 09.02.01-15. Therefore, Confirmatory Item 09.02-1 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff evaluated the four items listed above using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

Interface Requirement

Tier 1 of the ESBWR DCD, Section 4.1, specifies as an interface requirement that the PSWS plant-specific heat rejection facilities must be capable of supporting the post-72-hour RTNSS cooling function of the PSWS. In particular, the PSWS must be capable of removing at least 2.02×10^7 mega-joule (MJ) or (1.92×10^{10} British thermal unit (BTU)) over a period of 7 days without active makeup. The COL applicant is required to develop plant-specific ITAAC that demonstrate that each train of the plant-specific cooling tower and basin satisfies this interface requirement.

The applicant provided plant-specific ITAAC item, “ITAAC for Plant Service Water Reserve Storage Capacity,” for the PSWS in Section 2.4.3, “ITAAC for Plant Service Water System (Portion Outside the Scope of the Certified Design),” Table 2.4.3-1, “ITAAC for Plant Service Water Reserve Storage Capacity,” of Part 10 of the COLA. The proposed design is for the PSWS to contain an inventory of cooling water sufficient for removing heat from the RCCWS from time 0 (at shutdown) through day 7 without active makeup. The acceptance criteria proposed by the applicant was that the minimum usable water volume in the cooling tower basins (Trains A and B) and associated pump forebay would be 1.18×10^4 m^3 (2.6 million gal), a volume sufficient to remove at least $2.02x10^7$ MJ ($1.92x10^{10}$ BTU) over a period of 7 days without active makeup.

SRP Section 9.2.5 and RG 1.27, “Ultimate Heat Sink for Nuclear Power Plants” (as referred to by SRP Section 9.2.5), provides guidance for evaluating the adequacy of cooling towers. Important factors that need to be considered when demonstrating that cooling towers are capable of dissipating the required heat load include (among other things) the capability to satisfy the PSWS pump minimum NPSH requirements for the most limiting cooling tower basin water level, temperature, and flow conditions; the maximum allowed PSWS water supply temperature; and the most limiting meteorological assumptions that pertain to the site for determining: (a) heat dissipation capability, and (b) water inventory requirements. Transient analyses that take these factors into consideration (including margin for expected degradation and operating flexibility) and confirmatory testing are usually necessary in order to demonstrate that cooling tower performance satisfies the specified heat removal capability.

The ITAAC proposed by the applicant, which specifies a cooling tower basin water inventory requirement, is as a way of demonstrating that the heat removal capability specified by the DCD is capable of performing its defense-in-depth and RTNSS functions. However, the proposed ITAAC did not adequately demonstrate that the cooling towers are capable of dissipating the heat load as specified in the DCD. The staff asked the applicant in RAI 09.02.01-1 dated July 15, 2008 (ADAMS Accession No. ML081970390), to address the considerations referred to above and revise the ITAAC accordingly. The staff reviewed the applicant’s response to RAI 09.02.01-1 dated August 28, 2008 (ADAMS Accession No. ML082460847), and found it only addressed the required volume of water in the cooling tower basin to support up to 7 days. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-8 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address additional acceptance criteria that confirms the PSWS can remove the required heat capacity over a period of 7 days without active makeup. In its response to RAI 09.02.01-8 dated July 8, 2009 (ADAMS Accession No. ML091910257), the applicant revised the ITAAC to clarify the required water volume in the

PSWS basin is sufficient to ensure the DCD required heat removal capability over the 7 day period including confirmation that there is sufficient available NPSH at the PSWS pump suction location for the lowest probable water level of the heat sink.

The staff evaluated the interface requirement using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

ITAAC Considerations

As specified in the COLA, Part 10, Section 1, "Tier 1/ITAAC," the ITAAC from Tier 1 of the DCD is incorporated by reference. However, Part 10, Section 2.4.3, "ITAAC for Plant Service Water System (Portion Outside the Scope of the Certified Design)," proposes ITAAC for the interface requirement that is specified in Section 4.1 of the DCD Tier 1. The adequacy of the plant-specific ITAAC that are proposed is evaluated above under "Interface Requirements." The applicant's responses to RAI Questions 09.02.01-1 and 09.02.01-8 were reviewed and determined to be acceptable in the above staff's evaluation.

Initial Plant Test Program

As indicated in the FSAR, Chapter 14.2, "Initial Plant Test Program for Final Safety Analysis Reports," the initial plant test program specified by Tier 2 of the DCD for the PSWS is incorporated by reference. The PSWS initial test program is discussed in the DCD Tier 2, Sections 14.2.8.1.51, "Plant Service Water System Preoperational Test," and 14.2.8.2.18, "Plant Service Water System Performance Test." However, these tests do not verify that performance of the CDI portions of the PSWS (including AHS) satisfies design specifications for the various modes of operation. The staff asked the applicant in RAI 09.02.01-7 dated July 15, 2008 (ADAMS Accession No. ML081970390), to establish and describe initial plant test program requirements for the PSWS accordingly. The applicant's response to RAI 09.02.01-7 dated August 28, 2008 (ADAMS Accession No. ML082460847), indicated that the preoperational and startup test programs that are incorporated by reference include testing for the CDI portions of the PSWS. The staff noted that the referenced test programs do not fully address CDI in that cooling tower performance, including fan functions and heat dissipation capability, are not evaluated. Also, the capability of the PSWS to properly function without initiating a water hammer following a loss of power is not addressed by the test program. As a follow-up, the staff asked the applicant in supplemental RAI 09.02.01-12 dated May 6, 2009 (ADAMS Accession No. ML091260337), to address how the design capability of the AHS will be verified by the initial plant test program and how design features which minimize an AHS/PSWS water hammer event are tested or verified that a water hammer event does not occur. The applicant's response to RAI 09.02.01-12 dated August 3, 2009 (ADAMS Accession No. ML092180975), provided revisions to FSAR Section 14.2.8.1.51 and Section 14.2.8.2.18 by adding supplemental information NAPS SUP 14.2-4 and NAPS SUP 14.2-5 in order to clarify the purpose and criteria of the PSWS preoperational test, along with the purpose and description of the PSWS performance test. Based on the staff's review of this RAI response, the staff finds the applicant has addressed the initial test program related to the AHS in the CDI. In addition, the staff finds that the water hammer design features had been added and had been adequately addressed to ensure the CDI had been properly tested. Therefore, this RAI 09.02.01-12 is resolved and closed. Furthermore, the staff has confirmed that the above was incorporated in North Anna 3 FSAR, Revision 8.

The staff evaluated the initial plant test program for the PSWS using the relevant NRC regulations and acceptance criteria in SRP Section 9.2., along with GDC 2, 4, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL item.

9.2.1.5 Post Combined License Activities

There are no post COL activities related to this section.

9.2.1.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the PSWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PSWS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 9.2.1, and other NRC regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 2, 4, 44, 45, 46, and 10 CFR 52.80(a). The staff has evaluated COL Items NAPS COL 9.2.1-A, NAPS SUP 9.2.1-1, NAPS SUP 9.2.1-2, NAPS CDI, along with the DCD ITAAC and Interface Requirement for this Section to the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1 and SRP Section 9.2.5. The staff's evaluation finds that the applicant has satisfactorily addressed these items and therefore the North Anna 3 PSWS as described is acceptable.

9.2.2 Reactor Component Cooling Water System

Section 9.2.2, "Reactor Component Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements, Section 9.2.2, "Reactor Component Cooling Water System," of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.2.2 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the RCCWS that were incorporated by reference have been resolved.

9.2.3 Makeup Water System

9.2.3.1 Introduction

The makeup water system (MWS) provides high purity demineralized water to various plant systems. The MWS consists of two subsystems: a demineralization subsystem and a storage and transfer subsystem. The demineralization subsystem takes station water and treats it to the required water quality standards by removing dissolved solids, organics and other impurities. Treated water is stored in a demineralized water storage tank and distributed throughout the plant using transfer pumps. Except for the piping penetrating containment and the associated containment isolation valves, the MWS is not safety related. However, if available, the MWS can provide makeup to the isolation condenser/passive containment cooling (IC/PCCS) pools following an anticipated operational occurrence (AOO) or any abnormal event.

9.2.3.2 Summary of Application

Section 9.2.3, "Makeup Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.3, "Makeup Water System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.3, the applicant provided the following:

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The applicant provided site-specific information to replace the CDI contained in the ESBWR DCD. The applicant added activated carbon filters upstream of the reverse osmosis unit based on site-specific considerations. The demineralized makeup water is stored in an outdoor demineralized water storage tank and distributed throughout the plant using transfer pumps. Freeze protection is provided for the demineralized water storage tank and piping exposed to freezing conditions. Table 9.2-9R, "Major Makeup Water System Components," in the North Anna 3 COLA lists the major MWS components.

9.2.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the MWS are in SRP Section 9.2.3.

In addition, the relevant requirements of the Commission regulations for the MWS and the associated acceptance criteria:

- GDC 2, in that failure of the nonsafety-related system or component due to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods should not adversely affect SSCs important to safety

- RG 1.29, Revision 4 "Seismic Design Classification," March 2007

9.2.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.3 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD, to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the MWS.

The staff's review of FSAR Section 9.2.3 is limited to the following North Anna 3 COL FSAR site-specific design replacing the CDI in the ESBWR DCD, Revision 10.

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

In FSAR Section 9.2.3.2, the applicant replaced the introductory text and demineralization subsystem portions of the ESBWR DCD, Section 9.2.3.2. In FSAR Section 9.2.3.2, the applicant provided site-specific system descriptions of the MWS.

The MWS consists of two subsystems: (1) the demineralization subsystem, and (2) the storage and transfer subsystem. The makeup water transfer pumps and the demineralization subsystem are sized to meet the demineralized water needs of all operational conditions except for shutdown/refueling/startup. During the shutdown/refueling/startup mode, the increases in plant water consumption require use of a temporary demineralization subsystem and temporary makeup water transfer pumps to be used as a supplemental water source.

The MWS major components are housed entirely in the water treatment building except for the demineralized water storage tank (which is outdoors and adjacent to this building) and the distribution piping to the interface systems. The site-specific design includes freeze protection for the demineralized water storage tank and piping exposed to freezing conditions.

The staff reviewed the site-specific MWS and its components and finds that the applicant's proposed system design is similar to the MWS described in Section 9.2.3.2 of the ESBWR DCD, Revision 10. The NAPS MWS components and associated piping in contact with demineralized water are fabricated from corrosion resistant materials such as stainless steel to prevent contamination of the makeup water.

Water for the demineralization subsystem is provided by the station water system (SWS). Production of demineralized water by the demineralization subsystem can be initiated and shut down either automatically (based on the demineralized water storage tank level) or manually. The applicant described the process and sequence of chemical treatment of the station water to produce demineralized water. The applicant's water treatment process is similar to that described in the DCD Section 9.2.3.2. After the chemical treatment process, the treated water is then transferred to the MWS demineralized storage tank.

The staff reviewed the design information provided in the FSAR Section 9.2.3 for NAPS MWS and finds that the applicant did not identify any further supplements and/or departures, except the above discussed site-specific information. The site-specific portion of the MWS is nonsafety-related and its failure does not compromise any safety-related system or component nor does it prevent a safe-shutdown. Also, the site-specific design will not change the conclusion of ESBWR DCD for MWS, as it relates to GDC 2. Accordingly, the staff finds the site-specific design information meets the requirements of GDC 2 and therefore is acceptable.

Also, the site-specific portion of the MWS does not interface with any potentially radioactive system. Therefore, no interface requirements needed to be satisfied.

9.2.3.5 Post Combined License Activities

There are no post COL activities related to this section.

9.2.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the MWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the MWS that were incorporated by reference are resolved.

In addition, the staff compared the additional North Anna 3 CDI information in the application to the relevant NRC regulations and regulatory guides. The staff's review concludes that the applicant has provided sufficient information on the site-specific CDI for the MWS. The staff also finds that the CDI for the MWS meets the guidance of Regulatory Position C.2 of RG 1.29 regarding nonsafety-related systems because the failure of the nonsafety-related portions of the systems does not impact any safety-related SSCs. With respect to MWS failures and GDC 2, SSCs important to safety are able to withstand the effects of failure of the MWS as well as natural phenomena without loss of capability to perform their safety function. The staff finds that these requirements have been met. Accordingly, the staff finds the site-specific design information meets the regulatory requirements, as discussed in each section above, and therefore is acceptable.

9.2.4 Potable and Sanitary Water Systems

9.2.4.1 Introduction

The potable water system (PWS) supplies clean water for domestic use and human consumption. The sanitary waste discharge system (SWDS) collects and treats sanitary wastes from plant restrooms and locker room facilities. The system design ensures that there is no possibility for radioactive contamination of the potable water or the sanitary waste drainage system. Neither the PWS nor the SWDS has a safety design basis.

9.2.4.2 Summary of Application

Section 9.2.4, "Potable and Sanitary Water Systems," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.4, "Potable and Sanitary Water Systems," of the ESBWR DCD, Revision 10. In addition, in FSAR Section 9.2.4, the applicant provided the following:

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Potable and Sanitary Water Systems

The applicant provided additional information to replace CDI contained in the ESBWR DCD. The applicant described the site-specific potable and sanitary water system. The PWS consists of ground wells at various locations on site. For each well house there is a submersible well pump, compressor, hydro-pneumatic tank and interconnecting piping and valves. The North Anna 3 potable water header is connected to the North Anna 1 and 2 domestic water system with a normally closed valve. The sanitary wastes are collected in underground tanks located throughout the yard and pumped to an on-site sewage treatment plant. Neither the PWS nor the SWDS interconnects with any system that contains radioactive fluids. The SWDS is monitored for radioactivity. The applicant provided Figure 9.2-202, "Potable Water System Simplified Diagram," depicting the PWS and Figure 9.2-203, "Sanitary Waste Discharge System Simplified Diagram," depicting the SWDS.

9.2.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the PWS and the SWDS and the associated acceptance criteria are in SRP Section 9.2.4.

The applicable regulatory requirements for the potable and sanitary water system are as follows:

- GDC 60, "Control of Releases of Radioactive Materials to the Environment," of 10 CFR Part 50, Appendix A which relates to design provisions provided to control the release of liquid effluents containing radioactive material from contaminating the PSWS.

Since the PWS/SWDS may affect SSCs due to nonsafety-related equipment failures, additional regulatory requirements are as follows:

- GDC 2 as it relates to structures housing the system and the system itself having the capability of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes and floods without loss of safety-related functions.

- GDC 4 as it relates to effects of missiles inside and outside of the containment, pipe whip, jets, and environmental conditions from high and moderate energy line breaks and dynamic effects of flow instabilities and loads (e.g., water hammer) during normal plant operation, as well as during accident conditions.

9.2.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD, to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that information in the application and the information incorporated by reference address the required information related to the PWS/SWDS.

The staff reviewed the relevant information in the COL FSAR:

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI Potable and Sanitary Water Systems

The staff reviewed NAPS CDI related to the site-specific design of the potable and sanitary water system included under Section 9.2.4 of the North Anna 3 COL FSAR, Revision 8. Meeting the requirements of GDC 60 for this system ensures that design provisions are in place to prevent liquid effluents containing radioactive materials from contaminating the PWS and SWDS and potentially being released to the environment.

The PWS and SWDS do not perform any safety-related function and are not connected to any safety-related systems. Failure of these systems does not affect any safety-related components or prevent a safe shutdown of the plant.

The proposed source of potable water for the PWS is water from ground wells, at a supply capacity of 12.6 liters per second (200 gallons per minute). It is stated in the application that the water quality will meet the standards of the authorities having jurisdiction. The PWS does not handle radioactive fluids, and it is not connected to and does not interface with any system potentially containing radioactive fluids. However, potable water is supplied to areas where potential backflow could cause radiological contamination. In the unlikely event of radiological intrusion into the PWS in these areas, the applicant has proposed use of backflow preventers to prevent the spread of contamination into the PWS. The staff concludes that because the PWS is not connected to or does not interface with systems that contain radioactivity, and backflow preventers are installed in areas of potential contamination, acceptable design provisions have been made to prevent the inadvertent contamination of the PWS with radioactive material.

The proposed SWDS consists of an onsite sewage treatment plant with a normal capacity of 94,500 liters per day (25,000 gallons per day) or a maximum capacity of 189,000 liters per day (50,000 gallons per day) of sanitary sewage. The effluent is discharged to the waste heat treatment facility. The effluent meets standards established by Federal, state, and local regulations and permits. The SWDS does not handle radioactive fluids. It is not connected to and does not interface with any system potentially containing radioactive fluids.

The staff requested information related to process and effluent monitoring and sampling provisions for the SWDS in RAI 11.05-2 dated May 19, 2008 (ADAMS Accession No. ML081410065). In their response to RAI 11.05-2 dated June 30, 2008 (ADAMS Accession No. ML081900515), the applicant removed composite samplers from the SWDS design and proposed a per batch sewage treatment plant sludge tank grab sampling program. The North Anna 3 FSAR was updated to reflect these changes. The staff concludes that the grab sampling program is adequate in detecting potential radiological contamination and preventing uncontrolled radioactive releases to the environment from this system for the following reasons: the SWDS is not connected to or does not interface with systems that contain radioactivity; sewage treatment plant sludge tank sampling will be performed; and acceptable design provisions have been made to prevent the inadvertent contamination of the SWDS with radioactive material and inadvertent radioactive releases to the environment.

Based on the staff's review of the applicant's design criteria and design bases for the potable and sanitary water systems, the staff finds that acceptable design provisions have been made to prevent the inadvertent contamination of the systems with radioactive material, and therefore find the proposed design of the potable and sanitary water system meets the requirements of GDC 60 and is acceptable.

The staff finds that the site-specific CDI presented within this section of the North Anna 3 COL FSAR is acceptable and meets the requirements of GDC 2, 4, and 60. The staff bases its conclusion on the fact that the potable and sanitary water systems have no safety-related functions and failure of the system would not compromise any safety-related system or component, nor would it prevent a safe shutdown of the plant. The North Anna 3 CDI for the PWS and SWDS have no interface with any safety-related equipment, and no interconnections exist between the PWS and SWDS and any potentially radioactive system. In addition, flooding consequences from the PWS storage tank was evaluated and determined to be acceptable since safety-related or RTNSS SSCs would not be negatively affected from performing their intended functions.

9.2.4.5 Post Combined License Activities

There are no post COL activities related to this section.

9.2.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the potable and sanitary water systems, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the potable and sanitary water systems that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.2.4, and NRC regulatory guides. The staff concludes that the applicant's information on CDI in this section of the North Anna 3 COL FSAR is acceptable and meets the requirements of GDC 2, 4, and 60.

The staff bases its conclusion on the fact that the potable and sanitary water systems have no safety-related function and failure of the system would not compromise any safety-related system or component, nor would it prevent a safe shutdown of the plant. The North Anna 3 CDI for the PWS/SWDS have no interface with any safety-related equipment, and no interconnections exist between the PWS/SWDS and any potentially radioactive system. In addition, flooding consequences from the PWS storage tank was evaluated and determined to be acceptable since safety-related or RTNSS SSCs would not be negatively affected from performing their intended functions.

9.2.5 Ultimate Heat Sink

9.2.5.1 Introduction

The Ultimate Heat Sink (UHS) consists of the IC/PCCS pools, which provide the heat transfer mechanism for the reactor and containment to the atmosphere. The Fire Protection System

(FPS) provides makeup water for the IC/PCCS pools, and SFP from the primary (seismic Category I) firewater storage tanks via the safety-related Fuel and Auxiliary Pools Cooling System (FAPCS) piping, and other water sources that are credited for providing makeup water for the IC/PCCS pools, and SFP after water from the firewater storage tanks has been depleted. The Dryer/Separator pool and Reactor Well provide sufficient makeup water for the IC/PCCS expansion pools to support operation of the IC System and PCCS System during the initial 72 hours following an accident. A source of makeup water for the SFP is not credited during this period. After the initial 72 hours, the FPS is relied upon for supplying the necessary makeup water for the IC/PCCS pools or the SFP for up to 7 days. The parts of the UHS that are relied upon for the first 72 hours following an accident are safety-related and are evaluated in Section 5.4.6, "Isolation Condenser System (ICS)," and Section 6.2.2, "Passive Containment Cooling System." The parts of the UHS that are relied upon for providing makeup water during the period from 72 hours through 7 days post-accident are not required to be safety-related, but must be readily available on-site and are subject to RTNSS as discussed in Chapter 19A of the ESBWR DCD, Revision 10. This section evaluates the adequacy of the capability that is credited for providing makeup water to the IC/PCCS pools, or SFP after the initial 7 days have elapsed following an accident.

9.2.5.2 Summary of Application

Section 9.2.5, "Ultimate Heat Sink," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.5, "Ultimate Heat Sink," of the ESBWR DCD, Revision 10. In addition, in FSAR Section 9.2.5, the applicant provided the following:

COL Item

- STD COL 9.2.5-1-A Post Seven Day Makeup to UHS

The applicant provided additional information in STD COL 9.2.5-1-A to address DCD COL Item 9.2.5-1-A. The applicant stated that procedures will be provided to identify and prioritize available makeup water seven days after an accident and provide instructions for establishing the necessary connections. The procedures will be developed in accordance with the procedure development milestone in Section 13.5.

9.2.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the UHS and the associated acceptance criteria are in SRP Section 9.2.5.

The applicable regulatory guidance for the evaluation of COL 9.2.5-1-A is as follows:

- GDC 2, 4, 44, 45, and 46
- GDC 5, "Sharing of Structures, Systems, and Components"

9.2.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.5 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and information incorporated by reference address the required information related to the UHS.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>*COL Item*</u>

- STD COL 9.2.5-1-A Post Seven Day Makeup to UHS

The staff reviewed STD COL 9.2.5-1-A related to the makeup water to the UHS included under Section 9.2.5 of the North Anna 3 COL FSAR, Revision 8. As discussed above in the Introduction Section, the UHS consists of both safety-related and nonsafety-related SSCs. The staff's evaluation of the UHS for the ESBWR design focuses primarily on assuring that sufficient makeup water is available and can be supplied to the IC/PCCS pools, or SFP for long-term cooling after the initial 7 days have elapsed following an accident. Acceptability is judged based upon conformance with the regulatory basis referred to above, as applied to the standard plant design and reflected in Tier 2 of the ESBWR DCD, Revision 10, Section 9.2.5.

This COL information item is listed in Tier 2 of the ESBWR DCD, Section 9.2.5.1, "COL Information," and specifies that COL applicants need to develop procedures for supplying makeup water to the IC/PCCS pools or SFP 7 days after an accident. During the period from 72 hours up to 7 days following an accident, the FPS is credited for providing post-accident makeup water to the UHS through safety-related FAPCS piping. After 7 days, the applicant can either use offsite makeup sources to replenish the UHS water supply via safety-related FAPCS connections that are located outside the RB and FB, or the applicant can use on-site water sources if they are available. The minimum required flow rate that is specified for post-72 hour makeup is 46 meter (m) ^{3}/hr or (200 gallon per minute (gpm)), and makeup water quality is normally required to meet demineralized water chemistry specifications. However, during accident conditions, makeup water quality that satisfies FPS or SWS chemistry specifications can be used. The post 7-day makeup water source is not required to be safety-related or subject to RTNSS, but should be from sources that are diverse or highly reliable. These considerations are discussed in Tier 2 of the ESBWR DCD, Section 9.2.5, which specifically states: "The COL applicant will develop procedures to supply makeup water 7 days after an accident (9.2.5-1-A)."

The applicant provided the following response for this COL Item:

> Procedures that identify and prioritize available makeup sources seven days after an accident, and provide instructions for establishing necessary connections, will be developed in accordance with the procedure development milestone in Section 13.5.

Except for the development milestones that are referred to by the proposed response, it is not clear to what extent the other provisions of Section 13.5, "Plant Procedures," will be implemented, what makeup considerations will be addressed, what criteria will be satisfied, and how soon after an accident the makeup capability will be assessed. Therefore, the staff asked the applicant in RAI 09.02.05-1 dated June 19, 2008 (ADAMS Accession No. ML081710161) to provide additional information to address these considerations. In a response to RAI 09.02.05-1 dated August 4, 2008 (ADAMS Accession No. ML082200626), the applicant described details associated with UHS makeup procedure development. For “STD COL 9.2.5-1-A,” the applicant has stated that procedures will be provided to identify and prioritize available makeup sources for 7 days after an accident. In addition, the applicant made reference to Section 13.5.2.1.4, “Emergency Operating Procedures,” and stated that this UHS makeup procedure under, "STD COL 9.2.5-1-A", will be developed through the implementation of the operating procedure development process. The staff determined that this approach is acceptable since the applicant will develop this procedure and develop the details to address available means of makeup delivery which includes permanent plant systems, portable equipment and temporary delivery/processing systems in North Anna 3 FSAR, Section 9.2.5. Based on the RAI response, the statement in FSAR Section 9.2.5, and the schedule defined in FSAR Section 13.5, the staff determined this issue and RAI 09.02.05-1 are closed.

The staff evaluated STD COL 9.2.5-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.2.1, along with GDC 2, 4, 5, 44, 45, and 46. The staff finds that the applicant has satisfactorily addressed this COL Item.

9.2.5.5 Post Combined License Activities

Procedures that identify and prioritize available makeup sources 7 days after an accident, and provide instructions for establishing necessary connections, will be developed in accordance with the procedure development milestone in FSAR Section 13.5.

9.2.5.6 Conclusions

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirms that the applicant has addressed the required information relating to the UHS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the UHS that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, regulatory guides and the guidance in SRP Section 9.2.5. The staff’s review concludes that the applicant’s information is acceptable and meets the requirements of GDC 2, 4, 5, 44, 45, and 46. Therefore, the staff finds that the applicant has satisfactorily addressed DCD COL Item 9.2.5-1-A.

9.2.6 Condensate Storage and Transfer System

9.2.6.1 Introduction

The condensate storage and transfer system (CS&TS) supplies condensate-quality water for makeup to selected plant systems. It consists of two independent and 100 percent redundant transfer pumps, that takes suction from a single condensate storage tank (CST), and provides water to interface systems as required. The CST serves as a reservoir for the CS&TS water inventory and is the normal source of water for makeup to selected plant systems. It also provides storage capacity for condensate rejected from the condensate and feedwater system, for condensate quality liquid waste management system effluent during normal operation, and for condensate and feedwater system and hotwell inventory during system maintenance outages. The CS&TS is not a safety-related system, and does not perform any safety-related function.

9.2.6.2 Summary of Application

Section 9.2.6, “Condensate Storage and Transfer System,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.6,” Condensate Storage and Transfer System,” of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.6, the applicant provided the following:

Supplemental Information

- STD SUP 9.2.6-1 System Description

The applicant provided the following supplemental information. The applicant stated that freeze protection is provided for the North Anna 3 CS&TS.

9.2.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the CS&TS and the associated acceptance criteria are in SRP Section 9.2.6.

SRP Section 9.2.6 states that “The safety-related portions of the condensate storage facility are protected from the effects of natural phenomena including cold weather, tornadoes, and flooding such that the event will not adversely affect the safety function of the system.”

Since the CS&TS is not a safety-related system, and does not perform any safety-related functions, there is no applicable regulatory requirement for the freeze protection for the CS&TS.

9.2.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.6 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.6 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the CS&TS.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- STD SUP 9.2.6-1 System Description

The staff reviewed STD SUP 9.2.6-1 related to the freeze protection for the CS&TS included under Section 9.2.6 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.2.6 of the North Anna COL FSAR to the relevant NRC regulations and acceptance criteria defined in SRP Section 9.2.6, “Condensate Storage Facilities.” The staff’s review finds that the applicant appropriately incorporated by reference Section 9.2.6 of the ESBWR DCD, Revision 10, with the following Tier 2 supplemental information added:

> The applicant provided supplemental information as part of the FSAR with regards to CS&TS freeze protection. In FSAR Section 9.2.6, the applicant added the following text to the end of the first paragraph of Section 9.2.6.2 of the ESBWR DCD, Revision 10: "Freeze protection is provided for the CS&TS."

The staff reviewed the standard supplemental information provided in STD SUP 9.2.6-1. Freeze protection for the CS&TS is addressed in Tier 2, Section 1.2.2.12.2, "Condensate Storage and Transfer System," of the ESBWR DCD, Revision 10. Although the CS&TS does not perform or ensure any safety-related function, and is not required to achieve or maintain safe shutdown, DCD Tier 2, Section 1.2.2.12.2 specifies that if required, the CS&TS will be provided with freeze protection. A general discussion on freeze protection is provided in FSAR Section 1.2.2.12.16, "Freeze Protection." The incorporation of freeze protection in the CS&TS design is a system enhancement that has no impact on the system's regulatory compliance, but could result in increased system reliability and availability; therefore the staff finds the proposed standard supplement acceptable.

9.2.6.5 Post Combined License Activities

There are no post COL activities related to this section.

9.2.6.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the CS&TS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the CS&TS that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, regulatory guides, and the guidance in SRP Section 9.2.6. The staff's review concludes that the applicant's information provided in STD SUP 9.2.6-1 is acceptable. The staff bases its conclusion on the fact that freeze protection in the CS&TS design is a system enhancement that has no impact on the system's regulatory compliance.

9.2.7 Chilled Water System

Section 9.2.7, "Chilled Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.7, "Chilled Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.2.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Chilled Water System" that were incorporated by reference have been resolved.

9.2.8 Turbine Component Cooling Water System

Section 9.2.8, "Turbine Component Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.8, "Turbine Component Cooling Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.2.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Turbine Component Cooling Water System" that were incorporated by reference have been resolved.

9.2.9 Hot Water System

Section 9.2.9, "Hot Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.2.9, "Hot Water System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.2.9 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Hot Water System" that were incorporated by reference have been resolved.

9.2.10 Station Water System

9.2.10.1 Introduction

The SWS provides filtered and treated water as makeup to the circulating water system (CWS) cooling tower basin, the PSWS cooling tower basin, the MWS and to fill the primary firewater tanks.

9.2.10.2 Summary of Application

Section 9.2.10, "Station Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.2.10, "Station Water System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.2.10, the applicant provided the following:

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Detailed System Description

The applicant provided additional site-specific information to replace CDI contained in the ESBWR DCD and described the SWS. The SWS is comprised of two subsystems: (1) the plant cooling tower makeup subsystem (PCTMS) which provides makeup to the plant service water cooling towers and the main CWS cooling tower and (2) the pretreated water supply system (PWSS) which is used for filling the primary firewater tanks. The applicant provided Tables 9.2-203, "Station Water System – Plant Cooling Tower Makeup System Component Design Parameters," and 9.2-204, "Station Water System – Pretreated Water Supply System Component Design Parameters," which list the design parameters of the SWS equipment. The applicant provided Figures 9.2-204, "Station Water System – Plant Cooling Tower Makeup System (PCTMS)," and 9.2-205, "Station Water System – Pretreated Water Supply System (PWSS)," which depict the SWS.

9.2.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, there is no associated SRP section for the SWS.

The applicable regulatory guidance for the evaluation of NAPS CDI is as follows:

- GDC 2, in that failure of the nonsafety-related system or component due to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods should not adversely affect the safety-related SSCs.

9.2.10.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.2.10 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.2.10 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the SWS.

The staff reviewed the information in the COL FSAR as follows:

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI Detailed System Description

The staff reviewed NAPS CDI related to the ESBWR conceptual design of the SWS and the design parameters for the SWS components included under Section 9.2.10 of the North Anna 3 COL FSAR.

In FSAR Section 9.2.10.2, “System Description,” the applicant replaced the “Detailed System Description” portion of this section in the reference ESBWR DCD, Revision 10. In FSAR Section 9.2.10.2, the applicant provided the site-specific detailed description of SWS design proposed for North Anna 3. The SWS consists of two subsystems as previously stated: (1) PCTMS, and (2) PWSS.

The PCTMS provides makeup water to the cooling tower basins for both PSWS and CWS. The supply of water makes up for losses resulting from evaporation, drift, and blowdown from the cooling towers. In addition, the PCTMS provides makeup water to replace water used for strainer backwashes. The PCTMS consists of a water source, pumps, strainers, connecting piping, valves, and instrumentation. The applicant provided a simplified system diagram in FSAR Figure 9.2-204, “Station Water System – Plant Cooling Tower Makeup System (PCTMS),” and component design parameters for the PCTMS in FSAR Table 9.2-203, “Station Water System – Plant Cooling Tower Makeup System Component Design Parameters.”

The PWSS chemically conditions and filters the water supplied to the MWS for further treatment for use as demineralized water. The PWSS also supplies water to the FPS for filling the primary firewater tanks. In addition, the PWSS provides cooling tower makeup to the PSWS as an alternate to the PCTMS. The PWSS also provides water for the strainers and filter backwashes. The PWSS consists of a water source, pumps, strainers, filters, chemical injection equipment, and station water storage tank, connecting piping, valves, and instrumentation. Further, the applicant provided a simplified system diagram in FSAR Figure 9.2-205, “Station Water System – Pretreated Water Supply System (PWSS),” and component design parameters for the PCTMS in Table 9.2-204, “Station Water System – Pretreated Water Supply System Component Design Parameters.”

The staff reviewed the site-specific design information provided in NAPS FSAR Section 9.2.10.2, and finds that the applicant replaced the detailed system description from the reference ESBWR DCD, Section 9.2.10.2, “System Description,” as the site-specific NAPS CDI.

The SWS design in the application is identical to that in the DCD. Also, the staff finds that the applicant did not identify any departures and/or supplements, except that the applicant included additional information by providing the SWS-PWSS flow diagram in FSAR Figure 9.2-205 and component design parameters in FSAR Table 9.2-204. Additionally, the staff referred to Section 9.2.10.3, “Safety Evaluation,” in the ESBWR DCD and finds that the SWS has no safety-related function. The DCD further states that failure of the SWS does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant. Further, the NAPS SWS has no interface with any safety-related equipment, and no interconnections exist between the SWS and any potentially radioactive system. The design information provided in the North Anna 3 COLA does not impact the conclusions in the ESBWR staff SER, and therefore the staff finds the North Anna 3 SWS design acceptable.

Based on the above discussion, the staff finds that the North Anna 3 SWS meets the requirements of GDC 2, since, it is a nonsafety-related system, and failure of the system or its components due to natural phenomena will have no adverse effects on safety-related SSCs.

Site Specific Pre-Operational Tests

In NAPS SUP 14.2-3 the applicant provided information in Section 14.2.9.1.1, “Station Water System Pre-Operation Test,” to address SWS pre-operational testing. The preoperational testing review is performed under Section 14.2 of this SER.

9.2.10.5 Post Combined License Activities

There are no post COL activities related to this section.

9.2.10.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the SWS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SWS that were incorporated by reference are resolved.

In addition, the staff concludes that the site-specific design portion of the North Anna 3 SWS is acceptable and meets the relevant NRC regulations and regulatory guides. The staff's review concludes that the applicant's information is acceptable and meets the requirements of GDC 2.

9.3 Process Auxiliaries

9.3.1 Compressed Air Systems

Section 9.3.1, "Compressed Air Systems," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.1, "Compressed Air Systems," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.1 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Compressed Air Systems" that were incorporated by reference have been resolved.

9.3.2 Process Sampling System

9.3.2.1 Introduction

The process sampling system is designed to collect representative water and gaseous samples for analysis contained in the reactor coolant system (RCS) and associated auxiliary system process streams during all normal modes of operation and following an accident. The proposed design includes permanently installed sample lines, sampling panels with analyzers and associated sampling equipment, provisions for local grab sampling, and permanent shielding. Provisions are made to ensure that representative samples are obtained from turbulent flow zones to ensure adequate mixing. Continuous sample flows are routed from selected locations to the sampling stations where pressure, temperature, and flow adjustments are made as necessary. Effluents from sample stations are returned to an appropriate process stream or to the radwaste drain headers through a common return line.

9.3.2.2 Summary of Application

Section 9.3.2,"Process Sampling System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.3.2,"Process Sampling System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.2, the applicant provided the following:

COL Item

- STD COL 9.3.2-1-A Post Accident Sampling Program

The applicant provided additional information in STD COL 9.3.2-1-A to address DCD COL Item 9.3.2-1-A. The applicant described the post-accident sampling (PAS) program. The PAS program consists of emergency operating procedures that rely on installed post-accident radiation monitoring instrumentation, plant procedures for obtaining highly radioactive grab samples, a containment monitoring system capable of operation in post loss-of-coolant accident (LOCA) mode, and effluent radiation monitoring. The PAS program functions in lieu of a dedicated post-accident sampling system (PASS).

9.3.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the PAS program and the associated acceptance criteria are in SRP Section 9.3.2.

The applicable regulatory requirements for the PAS program are as follows:

- GDC 64, "Monitoring Radioactivity Releases"
- Item (b) of 10 CFR 20.1101(b), "Radiation Protection Programs"
- Section IV.B of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50

9.3.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the PAS program.

COL Item

- STD COL 9.3.2-1-A Post Accident Sampling Program

The staff reviewed STD COL 9.3.2-1-A related to the PAS program included under Section 9.3.2 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.3.2 of the North Anna 3 COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.3.2, “Process and Post-Accident Sampling Systems.” The staff’s review of the North Anna 3 COL FSAR, Section 9.3.2 finds that it appropriately incorporates by reference Section 9.3.2 of the ESBWR DCD, Revision 10. In addition the applicant provided information on the North Anna 3 PAS program as required by STD COL 9.3.2-1-A of the ESBWR DCD. The PAS program meets the guidance provided in SRP Section 9.3.2.I.6 for actions required in lieu of a PASS as follows:

> Emergency Operating Procedures that rely on Emergency Action Levels, defined in the Emergency Plan (EP), are used to classify fuel damage events. These procedures rely on installed post-accident radiation monitoring instrumentation described in DCD Section 7.5 and do not require the capability to obtain and analyze highly radioactive coolant samples although sample analyses may be used for classification as well.
>
> Plant procedures contain instructions for obtaining highly radioactive grab samples from the following:
>
> - Reactor Coolant – from the reactor water cleanup/shutdown cooling sample line using the RB Sample Station. These samples can be analyzed for the parameters indicated in DCD Table 9.3-1. If coolant activity is greater than 1.0 Ci/ml, handling of the samples is delayed to avoid overexposure of personnel.
>
> - Suppression Pool – from FAPCS sample line at the RB Sample Station. These samples can be analyzed for the parameters indicated in DCD Table 9.3-1. If coolant activity is greater than 1.0 Ci/ml, handling of the samples is delayed to avoid overexposure of personnel.
>
> - Containment Atmosphere - may be taken as described in DCD Section 11.5.3.2.11 and analyzed for fission products.
>
> - DCD Section 7.5.2.2 describes Containment Monitoring System operation in post-LOCA mode for gaseous sampling for O2 and H2.
>
> - Effluent radiation monitoring is described in DCD Section 7.5. Field sampling and monitoring capability is maintained in accordance with the EP.
>
> - Post-accident monitoring is adequate to implement the EP without reliance on post-accident sampling capability; therefore, the absence of a dedicated Post-Accident Sampling System does not reduce the effectiveness of the EP.

As part of the review of FSAR, Revision 0, Section 11.5, the staff noted that FSAR Section 9.3.2.2 (System Description) refers incorrectly to Section 11.5.3.2.12 of the ESBWR DCD (Tier 2) regarding available provisions for sampling the containment atmosphere. This section of the ESBWR DCD addresses the radiation monitoring system for the technical support center (TSC) air intake and not the containment.

Accordingly, the applicant was requested in RAI 9.03.02-1 dated June 11, 2008 (ADAMS Accession No. ML081640399), to update the reference citation in FSAR Section 9.3.2.2 with the proper DCD Tier 2, Chapter 11.5 section addressing provisions for the sampling of containment atmosphere. In response to RAI 09.03.02-1 dated July 23, 2008 (ADAMS Accession No. ML082140231), the applicant proposed a revision to the section of the FSAR by correcting the improper reference. The staff finds that the applicant has revised their FSAR accordingly and RAI 09.03.02-1 is resolved and closed. The staff finds that the North Anna 3 COL FSAR, Revision 8, has adequately addressed STD COL 9.3.2-1-A by providing information that adequately describes the North Anna 3 PAS program capability.

The staff evaluated COL Item STD COL 9.3.2-1-A using the relevant NRC regulations and acceptance criteria in SRP Section 9.3.2. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.3.2-1-A with respect to the requirements of GDC 64, 10 CFR 20.1101(b) and Section IV.B of Appendix E to 10 CFR Part 50.

9.3.2.5 Post Combined License Activities

There are no post COL activities related to this section.

9.3.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the PAS program, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PAS, that were incorporated by reference are resolved.

In addition, the staff compared the additional supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.3.2, and other NRC regulatory guides. The staff's review concludes that the applicant's information presented in this section of the FSAR is acceptable and meets the requirements of GDC 64, 10 CFR 20.1101(b), and Section IV.B of Appendix E to 10 CFR Part 50. Therefore, staff finds that the applicant has satisfactorily addressed DCD COL Item 9.3.2-1-A.

9.3.3 Equipment and Floor Drain System

Section 9.3.3, "Equipment and Floor Drain System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.3, "Equipment and Floor Drain System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Equipment and Floor Drain System" that were incorporated by reference have been resolved.

9.3.4 Chemical and Volume Control System

Section 9.3.4, "Chemical and Volume Control System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.4, "Chemical and Volume Control System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.4 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Chemical and Volume Control System" that were incorporated by reference have been resolved.

9.3.5 Standby Liquid Control System

9.3.5.1 Introduction

The Standby Liquid Control System (SLCS) is an independent reactivity control system designed to provide both manual and automatically initiated capability for bringing the reactor from full power and minimum control rod inventory to a subcritical condition with the reactor in the most reactive state without taking credit for control rod movement. The SLCS performs safety-related functions; therefore, it is classified as safety-related and is designed as a seismic Category I system. The SLCS meets the following safety design bases by providing: (1) a diverse backup capability, independent of normal reactor shutdown methods, to shut down the reactor when the control rods fail to insert during AOOs and anticipated transients without scram (ATWS), and (2) makeup water to the reactor pressure vessel (RPV) to mitigate the consequences of a LOCA.

The SLCS is a passive system that consists of two identical and separate trains. Each SLCS train includes a nitrogen-pressurized accumulator containing sodium pentaborate solution and is connected by piping through two parallel injection explosive-actuated (squib) valves to the RPV. Each train provides 50 percent of the required SLCS injection capacity required for an ATWS.

9.3.5.2 Summary of Application

Section 9.3.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.3.5 of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.5, the applicant provided the following:

<u>Supplemental Information</u>

- STD SUP 9.3.5-1 System Description

The applicant provided the following supplemental information:

STD SUP 9.3.5-1 added the following to the end of the fifth paragraph under "Detailed System Description" of DCD Section 9.3.5.2, "System Description":

The above provisions adequately prevent loss of solubility of borated solutions (sodium pentaborate).

9.3.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the SLCS and the associated acceptance criteria are in SRP Section 9.3.5.

The applicable regulatory requirements for the SLCS thermal environmental conditions are as follows:

- GDC 2, 4, and 5
- GDC 26, “Reactivity control system redundancy and capability”
- GDC 27, “Combined reactivity control systems capability”
- Item (c)(4) of 10 CFR 50.62, “Requirements for reduction or risk from ATWS events for light-water-cooled nuclear power plants”
- 10 CFR 52.80(a)

9.3.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the SLCS.

The staff reviewed the information in the COL FSAR as follows:

Supplemental Information

- STD SUP 9.3.5-1 System Description

The staff reviewed STD SUP 9.3.5-1-A related to the SLCS included under Section 9.3.5 of the North Anna 3 COL FSAR. The staff reviewed conformance of Section 9.3.5 of the COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.3.5, “Standby Liquid Control System (BWRs).” The staff’s review of Section 9.3.5 of the COL FSAR finds that it appropriately incorporates by reference Section 9.3.5 of the ESBWR DCD, Revision 10.

The staff review of this application is limited to STD SUP 9.3.5-1, in which the applicant summarized that the provisions adequately prevent loss of solubility of borated solutions (sodium pentaborate).

The staff reviewed the resolution to the supplementary item related to the provisions to prevent loss of solubility of borated solutions (sodium pentaborate) included under Section 9.3.5.2 of the North Anna 3 COL FSAR. STD SUP 9.3.5-1, a supplemental information item, is an editorial change that enlightens and summarizes the technical information of the previous paragraphs in the DCD with respect to preventing the loss of solubility of borated solutions of the SLCS. The statement does not alter the technical information related to preventing loss of solubility of borated solutions or affect compliance with the relevant regulatory requirements and hence is acceptable. Because it is just an editorial change, the staff expects no additional information in the COL FSAR related to STD SUP 9.3.5-1.

9.3.5.5 Post Combined License Activities

There are no post COL activities related to this section.

9.3.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant addressed the required information relating to the SLCS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SLCS that were incorporated by reference are resolved.

In addition, the staff compared the supplemental information in the COLA to the relevant NRC regulations, the guidance in SRP Section 9.3.5, and other NRC regulatory guides. The staff's review concludes that applicant's information in this section of the COL FSAR is acceptable and meets the requirements of GDC 2, 4, 5, 26, and 27; 10 CFR 50.62(c)(4); and 10 CFR 52.80(a).

9.3.6 Instrument Air System

Section 9.3.6, "Instrument Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.6, "Instrument Air System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.6 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Instrument Air System" that were incorporated by reference have been resolved.

9.3.7 Service Air System

Section 9.3.7, "Service Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.7, "Service Air System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Service Air System" that were incorporated by reference have been resolved.

9.3.8 High Pressure Nitrogen Supply System

Section 9.3.8, "High Pressure Nitrogen Supply System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.8, "High Pressure Nitrogen Supply System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "High Pressure Nitrogen Supply System" that were incorporated by reference have been resolved.

9.3.9 Hydrogen Water Chemistry System

9.3.9.1 Introduction

The hydrogen water chemistry system (HWCS) is designed to inject hydrogen into the feedwater system at the suction of the feedwater pumps to reduce oxidizing species in the RCS. The addition of hydrogen reduces the likelihood of corrosion failures that would adversely affect plant availability. Oxygen is injected into the off-gas system to ensure a proper mixture of hydrogen and oxygen.

ESBWR DCD Section 9.3.9 addresses information related to the ESBWR HWCS. The HWCS is not within the certified scope of the ESBWR. The ESBWR Standard Plant Design includes the capability to incorporate a HWCS, but the system itself is not part of the ESBWR Standard Plant Design.

9.3.9.2 Summary of Application

Section 9.3.9, "Hydrogen Water Chemistry," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 3.9, "Hydrogen Water Chemistry," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.9, the applicant provided the following:

COL Items

- STD COL 9.3.9-1-A		Implementation of Hydrogen Water Chemistry

The applicant provided additional information in STD COL 9.3.9-1-A to address DCD COL Item 9.3.9-1-A. The applicant stated that the hydrogen water chemistry (HWC) option is included in the plant's design.

- NAPS COL 9.3.9-2-A		Hydrogen and Oxygen Storage and Supply

The applicant provided additional information in NAPS COL 9.3.9-2-A to address DCD COL Item 9.3.9-2-A. The applicant stated that the hydrogen supply system for the HWCS is integrated with the generator hydrogen supply system and is described in DCD Section 10.2.2.2.8.

Site Specific Information Replacing Conceptual Design Information

- NAPS CDI		System Description

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant described the HWC injection points and states that a monitoring system is provided to track the effectiveness of the HWCS.

- NAPS CDI		Hydrogen Storage Facility

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant provided a description of the hydrogen storage facility.

The hydrogen is stored in two independent 6,000 gallon ASME Section VIII, Division 1 cryogenic tanks located outside the plant protected area.

Separate skid mounted gaseous bulk hydrogen storage bottles ensure hydrogen supply for generator cooling as a backup for the liquid hydrogen supply for North Anna 3.

- STD CDI		Power Generation Design Basis

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that hydrogen is injected into the feedwater at the suction of the feedwater pumps and oxygen is injected into the off-gas system.

- STD CDI		Inspection and Testing Requirements

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that the connections for the HWCS are tested and inspected with the feedwater and off-gas piping. Major components of the HWCS are inspected and tested as separate components prior to installation.

- STD CDI Instrumentation and Controls

The applicant provided additional information to replace CDI in the ESBWR DCD. The applicant stated that instrumentation is provided to control the injection of hydrogen and augment the injection of oxygen.

9.3.9.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

There is no associated SRP section for the HWCS.

The applicable industry requirements for the HWCS, which have been endorsed by the NRC, are as follows:

- Electric Power Research Institute (EPRI) Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,”

- EPRI Report NP-5283-SR-A, “Guidelines for Permanent BWR Hydrogen Water Chemistry Installations,”

9.3.9.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.9 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.9 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the HWCS.

The staff reviewed the information in the COL FSAR as follows:

COL Items

- STD COL 9.3.9-1-A Implementation of Hydrogen Water Chemistry

The HWCS is composed of hydrogen and oxygen supply systems to inject hydrogen in the feedwater and oxygen in the off-gas while several monitoring systems track the effectiveness of the HWCS. Provisions are made in the design to allow for installation of a system adding hydrogen to the feedwater at the suction of the feedwater pumps. The ESBWR DCD requires that the HWCS utilizes the guidance included in the EPRI Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,” 1987 Revision. The report provides guidelines on how to operate the HWCS. The staff has endorsed the report in its SER of the EPRI Utility Requirements Document and on that basis the staff finds EPRI Report NP-4947-SR, 1987 Revision acceptable. In addition, the staff finds that the North Anna COL FSAR has adequately addressed STD COL 9.3.2-1-A by providing information that adequately describes the North Anna 3 HWCS and incorporates the EPRI guidance.

- NAPS COL 9.3.9-2-A Hydrogen and Oxygen Storage and Supply

The HWCS is nonsafety-related; however, given the potential for hydrogen combustion or detonation, the handling of hydrogen at nuclear power plant facilities needs to be safe, reliable, and consistent with the requirements for using hydrogen gas. The ESBWR DCD requires that any HWCS installations including the means for storing and handling hydrogen meet the EPRI Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations." The report provides guidance to store and handle hydrogen at nuclear power facilities. The staff has endorsed EPRI Report NP-5283-SR-A in its letter J.E. Richardson to G.H. Niels dated July 13, 1987. Because it follows the NRC-endorsed report, the staff finds that the North Anna COL FSAR specifies an acceptable method to handle and store hydrogen for the HWCS and incorporates the EPRI guidance. The staff evaluated the potential accidents from hydrogen storage in Section 2.2.3 of this SER.

Site-Specific Information Replacing Conceptual Design Information

The staff finds that all the NAPS and STD CDIs listed below are acceptable because they do not affect the staff's safety evaluation of the HWCS in the ESBWR DCD. These site-specific CDIs also do not affect the COL applicant's incorporation of the EPRI guidelines as the main guidance for the proper operation and installation of the HWCS.

- NAPS CDI System Description

The staff finds the site-specific additional information acceptable because it provides the design details for the North Anna 3 monitoring system to track the effectiveness of the HWCS that meet the NRC-endorsed EPRI guidelines.

- NAPS CDI Hydrogen Storage Facility

The staff finds that the North Anna COL FSAR provides the additional site-specific information that specifies an acceptable method to store hydrogen that meet the NRC-endorsed EPRI guidelines.

- STD CDI Power Generation Design Basis

The staff finds the CDI acceptable because it provides the site-specific additional information as to the designed location where the gas is injected to meet the NRC-endorsed EPRI guidelines.

- STD CDI Inspection and Testing Requirements

The staff finds the CDI acceptable because the site-specific additional information will ensure that the HWCS will work as designed and will meet the NRC-endorsed EPRI guidelines.

- STD CDI Instrumentation and Controls

The staff finds the CDI acceptable because the site-specific additional information provides the design detailed information on the proper functionality of the HWCS to meet the NRC-endorsed EPRI guidelines.

9.3.9.5 Post Combined License Activities

There are no post COL activities related to this section.

9.3.9.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the HWCS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the HWCS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in applicable industry standards, and other NRC regulatory guides. The staff's review concludes that the applicant's information on STD CDI and NAP3 CDI in this FSAR section is acceptable and meets the NRC-endorsed EPRI guidelines.

The staff also finds that the applicant has satisfactorily addressed DCD COL Items 9.3.9-1-A and 9.3.9-2-A with respect to the NRC-endorsed EPRI guidelines.

9.3.10 Oxygen Injection System

9.3.10.1 Introduction

The oxygen injection system (OIS) is designed to add oxygen to the Condensate and Feedwater System in order to reduce corrosion and suppress corrosion product release. The OIS does not perform any safety-related function. This section of the North Anna 3 COL FSAR addresses information related to the ESBWR OIS. Industry experience has shown that the most beneficial oxygen concentration is between 30 to 200 ppb. The OIS is also designed to inject oxygen into the off-gas system when the HWC is implemented, to ensure that excess hydrogen in the off-gas stream is recombined.

9.3.10.2 Summary of Application

Section 9.3.10, "Oxygen Injection System," of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.3.10 of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.10, the applicant provided the following;

COL Item

- NAPS COL 9.3.10-1-A Oxygen Storage Facility

The applicant provided additional information in NAPS COL 9.3.10-1-A to address DCD COL Item 9.3.10-1-A. The applicant described the bulk oxygen storage facility which consists of a 9,000 gallon ASME Section VIII, Division 1 cryogenic tank located outside the plant fenced area. The tank is equipped with an atmospheric vaporizer, a pressure regulating valve, an excess flow check valve and relief valves.

9.3.10.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, there is no associated SRP section, for the oxygen storage facility. However, the staff uses the following applicable industry standards and requirements for the HWCS:

- EPRI Report NP-4947-SR, 1987 Revision
- EPRI Report NP-5283-SR-A, 1987 Revision

9.3.10.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.10 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.10 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the OIS.

The staff reviewed the information in the COL FSAR as follows:

COL Item

- NAPS COL 9.3.10-1-A Oxygen Storage Facility

The staff reviewed NAPS COL 9.3.10-1-A related to the oxygen storage facility included under Section 9.3.10 of the North Anna 3 COL FSAR, Revision 8. The OIS is designed to add sufficient oxygen (30 to 200 ppb) to reduce corrosion, general corrosion, and the release of corrosion products in the condensate and feedwater systems. The requirements for design, operation, maintenance, surveillance, and testing of the oxygen storage facility are specified in EPRI Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations." The ESBWR DCD specifies that any HWCS installations meet the EPRI Report NP-5283-SR-A. In addition, the oxygen storage facility is located in an area where the amount of combustible material is limited through design and administrative controls. North Anna 3 COL FSAR uses the guidance of EPRI Report NP-5283-SR-A to store and handle oxygen. The staff has endorsed EPRI Report NP-5283-SR-A in its letter J.E. Richardson to G.H. Niels dated July 13, 1987. Therefore, the staff finds that the North Anna COL FSAR specifies an acceptable method to handle and store oxygen.

In addition, the staff finds that the North Anna 3 COL FSAR has adequately addressed NAPS COL 9.3.10-1-A by providing information that adequately describes the North Anna 3 oxygen injection module of the HWCS and by providing an acceptable description of the oxygen storage facility.

9.3.10.5 Post Combined License Activities

There are no post COL activities related to this section.

9.3.10.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the OIS, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the OIS, that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in applicable industry standards, and other NRC regulatory guides. The staff's review concludes that the applicant's information in this FSAR section is acceptable and meets the NRC endorsed EPRI guidelines. The staff also finds that the applicant has satisfactorily addressed DCD COL Item 9.3.10-1-A with respect to the NRC endorsed EPRI guidelines.

9.3.11 Zinc Injection System

9.3.11.1 Introduction

Minimizing the plateout of radioactive cobalt on reactor coolant piping can lead to potentially lower dose rates in the vicinity of this piping and result in correspondingly lower doses to personnel in the portions of the plant containing this piping. In order to minimize the plateout of radioactive cobalt on reactor coolant piping and other components, the North Anna 3 design will incorporate a Zinc Injection System (ZNIS). The ESBWR standard plant design includes the capability to connect a ZNIS and space, but the system itself is not part of the ESBWR standard plant design and is not a safety-related system. Each applicant first would determine based on material properties if a ZNIS system is needed. If it is needed then the applicant provides a system description.

9.3.11.2 Summary of Application

Section 9.3.11, "Zinc Injection System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.3.11, "Zinc Injection System," of the certified ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.3.11, the applicant provided the following;

- NAPS COL 9.3.11-1-A — Applicant Determination if a Zinc Injection System is needed

The site-specific design includes the ZNIS for control of reactor coolant cobalt.

- NAPS COL 9.3.11-2-A — System Description

A passive ZNIS system is provided which consists of a simple recirculation loop around the feedwater pumps that continuously injects small amounts of depleted zinc oxide into the reactor feedwater through the dissolution of depleted zinc oxide pellets contained in the ZNIS vessel.

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI System Description

The referenced DCD includes CDI for certain systems, or portions of systems, that are outside the scope of the standard plant design. The ESBWR standard plant design includes provisions for connecting an optional ZNIS which includes the following design considerations: (1) piping connections for a bypass loop around the feedwater pumps, and (2) space for ZNIS equipment that is considered site-specific CDI.

9.3.11.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

There is no associated SRP section for the ZNIS.

The industry guidelines applicable to HWCS and related to the effects of water impurities on reactor internals, which have been endorsed by the NRC, are as follows:

- EPRI Report NP-4947-SR, “BWR Hydrogen Water Chemistry Guidelines,”
- EPRI Report NP-5283-SR-A, “Guidelines for Permanent BWR Hydrogen Water Chemistry Installations”

9.3.11.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.3.11 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.3.11 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the ZNIS.

The staff reviewed the information in the COL FSAR as follows:

COL Item

- NAPS COL 9.3.11-1-A Applicant Determination if a Zinc Injection System is needed
- NAPS COL 9.3.11-2-A System Description

In the North Anna 3 FSAR, the applicant stated that these COL Items (STD COL 9.3.11-1-A and STD COL 9.3.11-2-A) address the provisions for a ZNIS for North Anna 3. The staff’s review confirms that the applicant has addressed the relevant information and no outstanding information is expected to be addressed in the COL FSAR related to this section. From a dose reduction perspective of the ZNIS, the staff in Section 12.3 of this SER, provides an evaluation of the applicant’s use of a ZNIS for North Anna 3.

- NAPS CDI System Description

The staff finds the CDI item acceptable because it provides for the optional provision for a ZNIS for North Anna 3 which would provide a reduction of on-site dose to plant personnel addressed in this SER in Section 12.3.

9.3.11.5 Post Combined License Activities

There are no post COL activities related to this section.

9.3.11.6 Conclusion

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Zinc Injection System" that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant guidance in applicable industry standards. The staff's review concludes that the applicant's information in this FSAR section is acceptable and meets the NRC-endorsed EPRI guidelines.

9.3.12 Auxiliary Boiler System

Section 9.3.12, "Auxiliary Boiler System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.3.12, "Auxiliary Boiler System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.3.12 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Auxiliary Boiler System" that were incorporated by reference have been resolved.

9.4 Heating, Ventilation, and Air Conditioning

Section 9.4, "Heating, Ventilation, and Air Conditioning," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.4, "Heating, Ventilation, and Air Conditioning," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.4 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR

Part 52, all nuclear safety issues relating to the heating, ventilation, and air conditioning, that were incorporated by reference have been resolved.

9.5 Other Auxiliary Systems

9.5.1 Fire Protection System

9.5.1.1 Introduction

This section of the North Anna 3 COL FSAR describes the FPS which provides assurance, through a defense-in-depth philosophy, that the Commission's fire protection objectives are satisfied. These objectives are: (1) to prevent fires from starting; (2) to detect rapidly, control, and extinguish promptly those fires that do occur; and (3) to provide protection for SSCs important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant. In addition, FPS must be designed such that their failure or inadvertent operation does not adversely impact the ability of the SSCs important to safety to perform their safety functions. The FPS has a RTNSS function to provide post 72-hour makeup to the IC/PCCS pools or the SFP depending on the makeup needs.

9.5.1.2 Summary of Application

Section 9.5.1, Appendix 9A, and Appendix 9B of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 9.5.1, Appendix 9A, and Appendix 9B of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.1, the applicant provided the following:

COL Items:

- NAPS COL 9.5.1-1-A Secondary Firewater Storage Source

The applicant provided additional information in NAPS COL 9.5.1-1-A to address DCD COL Item 9.5.1-1-A. The applicant identified Lake Anna as the secondary source of water. The lake has a capacity well in excess of 550,000 gallons as specified in ESBWR DCD, Revision 10, and as per guidance given in RG 1.189, Revision 2, "Fire Protection for Nuclear Power Plants**,"** Regulatory Position 3.2.1.

- NAPS COL 9.5.1-2-A Secondary Firewater Capacity

The applicant provided additional information in NAPS COL 9.5.1-2-A to address DCD COL Item 9.5.1-2-A. The applicant stated that tests will be performed to demonstrate that the secondary fire protection pump circuit supplies the required flow and pressure at the Turbine Building/Yard interface boundary. DCD Section 14.2.8.1.39 which is incorporated by reference states that FPS tests are in accordance with the criteria in codes and standards listed in Table 9.5-1. FSAR Table 1.9-201 and Table 1.9-204 supplements DCD Table 9.5-1 for those systems outside the scope of the DCD and operational aspects of the fire detection and suppression systems. Table 1.9-204 adds additional codes and standards applicable to the site-specific Yard criteria. Therefore, secondary pump curve tests and flow tests will be in accordance with National Fire Protection Association (NFPA) 20, "Standard for the Installation of Stationary Pumps for Fire Protection."

- NAPS COL 9.5.1-4-A Piping and Instrumentation Diagrams

The applicant provided additional information in NAPS COL 9.5.1-4-A to address DCD COL Item 9.5.1-4-A. The applicant provided Figures 9.5-201, 9.5-202 and 9.5-203 depicting the site-specific firewater supply piping.

- STD COL 9.5.1-5-A Fire Barriers

The applicant provided additional information in STD COL 9.5.1-5-A to address DCD COL Item 9.5.1-5-A. The applicant stated that the mechanical and electrical penetration seals are qualified to RG 1.189 through testing by an independent laboratory. Certification test results will be available for review at least 6 months before receipt of fuel.

- STD COL 9.5.1-6-A Smoke Control

The applicant provided additional information in STD COL 9.5.1-6-A to address DCD COL Item 9.5.1-6-A. The applicant stated that the procedures for manual smoke control will be developed as part of the Fire Protection Program implementation. The program will be operational for areas storing new fuel prior to receipt of the fuel. Other elements of the Fire Protection Program will be operational before initial fuel load.

- STD COL 9.5.1-7-A Fire Hazards Analysis (FHA) Compliance Review

The applicant provided additional information in STD COL 9.5.1-7-A to address DCD COL Item 9.5.1-7-A. The applicant stated that the compliance review of the as-built design against the assumptions and requirements stated in the FHA will be completed in accordance with the milestone schedule in FSAR Section 13.4. ESBWR DCD, Revision 10 includes the specific items to be reviewed.

- STD COL 9.5.1-8-A Fire Protection Program Description

The applicant provided additional information in STD COL 9.5.1-8-A to address DCD COL Item 9.5.1-8-A. The applicant stated that the Fire Protection Program elements necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area are fully operational prior to receipt for new fuel. The remaining required elements of the Fire Protection Program will be fully operational prior to initial fuel load per FSAR Section 13.4.

- NAPS COL 9.5.1-10-A Fire Brigade

The applicant provided additional information in NAPS COL 9.5.1-10-A to address DCD COL Item 9.5.1-10-A. The applicant stated that the fire brigade will be implemented in accordance with the milestones in FSAR Section 13.4 for the Fire Protection Program.

- STD COL 9.5.1-11-A Quality Assurance

The applicant provided additional information in STD COL 9.5.1-11-A to address DCD COL Item 9.5.1-11-A. The applicant stated the following:

“Quality assurance controls are applied to the activities involved in the design, procurement, installation, and testing and the administrative controls of FPS, in accordance with the measures outlined in Chapter 17.

For the operational fire protection program, the Quality Assurance Program implements the requirements of RG 1.189 through site-specific administrative controls procedures. The procedures will be developed six months before fuel receipt and will be fully implemented prior to fuel receipt.”

- NAPS COL 9A.7-1-A Yard Fire Zone Drawings

The applicant provided additional information in STD COL 9A.7-1-A to address DCD COL Item 9A.7-1-A. STD COL 9A.7-1-A provides Yard fire zone drawings for the site-specific portions of the Yard.

- NAPS COL 9A.7-2-A Detailed Fire Hazards Analysis of the Yard

The applicant provided additional information in STD COL 9A.7-2-A to address DCD COL Item 9A.7-2-A. NAPS COL 9A.7-2-A commits to performing a detailed FHA of the Yard area that is outside the scope of the certified design.

Supplemental Information

- NAPS SUP 9.5.1-1 and NAPS SUP 9A-01 Codes, Standards and Regulatory Guidance

The applicant provided Table 9.5-201 to supplement DCD Table 9.5-1 for those portions of the Fire Protection Program that are not addressed in the ESBWR DCD and for operational aspects of the fire detection and suppression systems.

- STD SUP 9.5.1-3 Combustible and Ignition Source Controls

The applicant revised FSAR Section 9.5.1.15.6 to add combustible and ignition source controls for areas adjacent to the main control room (MCR) and in computer rooms that are not part of the MCR complex and prohibit storage of transient combustibles below the raised floor in the MCR complex and prohibit the storage of hazardous chemicals in areas that contain or expose equipment important to safety.

9.5.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the Fire Protection Program and the associated acceptance criteria are given in SRP Section 9.5.1.

The applicable regulatory requirements for the Fire Protection Program are as follows:

- 10 CFR 50.48(a), “Fire protection,”
- 10 CFR Part 50 Appendix A, GDC 3, “Fire protection,”
- 10 CFR Part 50 Appendix A, GDC 5
- 10 CFR Part 50 Appendix A, GDC 19, ”Control Room,”

- 10 CFR Part 50 Appendix A, GDC 23, “Protection system failure modes,”
- RG 1.189, Revision 2

In addition to the regulatory requirements and guidance provided above, SRP Section 9.5.1 provides enhanced fire protection criteria for new reactor designs, as documented in SECY-90-016, “Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements,” dated January 12, 1990; SECY-93-087, “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,” dated April 2, 1993; and SECY-94-084. SECY-90-016 provides enhanced fire protection criteria for evolutionary LWRs. SECY-93-087 recommends that the enhanced criteria be extended to include passive reactor designs. The Commission approved SECY-90-016 and SECY-93-087 in staff requirements memoranda. SECY-94-084, in part, provides criteria defining safe-shutdown conditions for passive LWR designs.

9.5.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.5.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the FPS.

The staff reviewed the information in the COL FSAR as follows:

The staff reviewed the relevant information in the COL FSAR and the applicant’s responses to RAI letters accordingly and concludes that the relevant information in the COL and Supplemental Information Items, and responses to RAIs is acceptable and meets the requirements of GDC 3, 5, 19 and 23 of Appendix A to 10 CFR Part 50, 10 CFR 50.48 and is in conformance with SECY-90-016, SECY-93-087 and SECY-94-084 as shown below:

North Anna 3 conforms to the SRP Section 9.5.1 acceptance criteria with the following exceptions:

- SRP Acceptance Criterion 1 (RG 1.174, Revision 1 – PRA Insights) does not apply to North Anna 3. PRA has not been applied to the design of the plant-specific Fire Protection Program.

- SRP Acceptance Criterion 2 (RG 1.188, Revision 1 – License Renewal) and 4 (RG 1.191 – Decommissioning) are not applicable to the North Anna 3 COLA.

- SRP Acceptance Criterion 3 (RG 1.189, Revision 1 – Fire Protection): North Anna 3 conforms except that the site executive in charge of construction (Vice President – Nuclear Development) is in charge of fire protection during construction as described in North Anna 3 COL FSAR, Revision 7, Table 1.9-202 and Section 13.1.

- SRP Acceptance Criterion 5 (RG 1.206, Regulatory Position C.III.1, Section C.I.9.5.1 – Fire Protection Program): North Anna 3 conforms to the nine requirements listed in Section C.I.9.5.1 as per North Anna 3 COL FSAR, FSAR, Revision 8, Section 9.5.1, Appendix 9A, Appendix 9B, Section 13.1.1.2.1, Section 13.1.1.2.10, Section 13.1.1.3.2.2.4, and Section 13.1.2.1.1. See also the RAI technical evaluations shown below.

- SRP Acceptance Criterion 6 (SECY-90-016, SECY-93-087, and SECY-94-084): North Anna 3 conforms as per North Anna 3 COL FSAR, Revision 8, Table 1.9-201 and the technical evaluation below for RAI 09.05.01-16 and STD COL Item 9.5.1-6-A.

- SRP Acceptance Criterion 7 implementation milestones: North Anna 3 does not conform to the requirement for the Fire Protection Program to be fully implemented prior to fuel receipt at the plant site. North Anna 3 will use a two tier approach such that the elements of the Fire Protection Program necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area are fully operational prior to receipt for new fuel. Other required elements of the Fire Protection Program described in this FSAR section are fully operational prior to initial fuel loading per FSAR Section 13.4.

The staff reviewed the relevant information in the COL FSAR:

COL Item

- NAPS COL 9.5.1-1-A Secondary Firewater Storage Source

The staff reviewed NAPS COL 9.5.1-1-A related to secondary firewater sources included under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that the volume of the secondary firewater source, identified to be Lake Anna, is well in excess of the 550,000 gallons minimum specified in ESBWR DCD, Revision 10. The staff therefore finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- NAPS COL 9.5.1-2-A Secondary Firewater Capacity

The staff reviewed NAPS COL 9.5.1-2-A related to secondary firewater capacity included under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that each secondary fire pump will be tested to show that each pump can supply a minimum of 2,130 gpm with sufficient discharge pressure to develop a minimum of 107 psig line pressure at the Turbine Building/Yard interface boundary which is the same as the DCD requirement. This test cannot be performed until the system is built. This activity will be completed prior to fuel receipt. DCD Section 14.2.8.1.39, which is incorporated by reference, states that FPS tests are in accordance with the criteria in codes and standards listed in Table 9.5-1 and by FSAR Table 9.5-201. Therefore, secondary pump curve tests and flow test will be in accordance with NFPA 20. Accordingly, the staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- NAPS COL 9.5.1-4-A Piping and Instrumentation Diagrams

The staff reviewed NAPS COL 9.5.1-4-A related to the site-specific simplified piping and instrumentation diagrams included under Section 9.5.1 of the North Anna 3 COL FSAR, Revision 8. The staff reviewed Figures 9.5.201, 9.5.202, and 9.5.203 of the North Anna 3 COLA and DCD Figure 9.5.1, and determined that these figures do provide simplified diagrams of the site-specific firewater piping as requested by the DCD. The staff requested in RAI 09.05.01-17 dated July 27, 2008 (ADAMS Accession No. ML082100346), the applicant to include all the appropriate fire water loads of the plant in these figures. The applicant responded to RAI 09.05.01-17 dated September 4, 2008 (ADAMS Accession No. ML082530448), clarifying a few inconsistencies between these figures in the ESBWR DCD and the North Anna 3 FSAR COL. Included in the response was a clarification that North Anna 3 does not have a dedicated warehouse but will utilize the existing warehouse buildings that support North Anna 1 and 2. The North Anna 3 sharing of the Units 1 and 2 existing warehouse buildings does not adversely affect the Fire Protection Program at North Anna 3 because there is no equipment important to safety and in use located in these structures. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item.

- STD COL 9.5.1-5-A Fire Barriers

The staff reviewed NAPS COL 9.5.1-5-A related to the qualification of fire barriers included under Section 9.5.1.10 of the North Anna 3 COL FSAR, Revision 8. The staff determined that mechanical and electrical penetration seals and electrical raceway fire barrier systems will be qualified to the requirements delineated in RG 1.189 by a recognized testing laboratory in accordance with the applicable guidance of NFPA 251, “Standard Methods of Tests of Fire Resistance of Building Construction and Materials,” and/or American Society for Testing and Materials (ASTM) E-119, “Standard Test Methods for Fire Tests of Building Construction and Materials.” Detailed design in this area is not complete. Specific design and certification test results for penetration seal designs and electrical raceway fire barrier systems will be available for inspection at least 6 months prior to fuel receipt. The staff therefore finds that North Anna 3 COL FSAR, Revision 8, fully addresses this COL information item.

- STD COL 9.5.1-6-A Smoke Control

The staff reviewed STD COL 9.5.1-6-A related to manual smoke control included under Section 9.5.1.11 of the North Anna 3 COL FSAR, Revision 8. The staff determined that procedures for manual smoke control will be developed as part of the Fire Protection Program implementation in accordance with milestones in FSAR Section 13.4. Smoke removal provisions are in accordance with NFPA 804, “Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants,” except Sections 8.4.3 (3) and 8.4.3.2 as per the DCD. NFPA 804 has not been endorsed by the NRC but is considered acceptable where it does not conflict with regulatory requirements and guidance. The staff in RAI 09.05.01-3 dated June 11, 2008 (ADAMS Accession No. ML081630351) requested that the applicant should specify the appropriate NRC regulatory requirements and guidance when conflicts exist with NFPA 804. The applicant’s response to RAI 09.05.01-3 dated July 23, 2008 (ADAMS Accession No. ML082140230) stated that should a conflict exist between RG 1.189 and NFPA 804, the North Anna 3 COLA conforms to RG 1.189. Automatic sprinkler protection is provided where applicable to limit heat and smoke generation as per the DCD. The staff noted that the North Anna 3 COL FSAR did not provide enough information regarding the enhanced fire protection requirements for new reactors found in SECY 90-016 and SECY 93-087. Specifically, the requirement related to the mitigation of the spread of smoke, hot gases, and fire suppressants from the fire-affected safety division to any non-fire-affected safety division. The staff requested additional information describing how the FHA will evaluate the potential for the migration of smoke, hot gases, or fire suppressant to prevent safe shutdown and will verify that fire dampers that do not close on smoke detection are not to be relied upon to prevent the migration of smoke from one redundant train to another. The applicant's response to RAI 09.05.01-16 dated September 4, 2008 (ADAMS Accession No. ML082530448), stated that FSAR Section 9.5.1 incorporated by reference ESBWR DCD, Section 9.5.1, which describes the ESBWR plant design features that address building ventilation, fire barriers, and smoke control necessary for safe shutdown. As stated in the ESBWR DCD, the design satisfies the guidance SRP Section 9.5.1 and BTP SPLB 9.5-1, which state that smoke, hot gases, or fire suppressant does not migrate into other fire areas to the extent that safe shutdown capabilities, including operator actions, could be adversely affected. The ESBWR fire protection design satisfies this guidance with a combination of fire dampers and other barriers, smoke evacuation capabilities, and minimal required operator actions. Additionally, manual smoke control procedures will be developed as part of the Fire Protection Program implementation. Smoke–rated dampers that close on smoke detection are provided in areas where smoke migration into other areas can adversely affect safe shutdown. Details are provided in the FHA in Appendix 9A. There are no fire protection-related site-specific design features that are required to ensure safe-shutdown of the plant.

For the reasons discussed above, the staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- STD COL 9.5.1-7-A FHA Compliance Review

The staff reviewed STD COL 9.5.1-7-A related to review for FHA compliance included under Section 9.5.1.12 of the North Anna 3 COL FSAR, Revision 8. The staff determined that a compliance inspection of the as-built design against the assumptions and requirements stated in the FHA will be completed in accordance with the milestones in FSAR Section 13.4. This is acceptable to the staff. ESBWR DCD, Revision 10 includes all the specific items to be inspected in STD 9.5.1-7-A and deleted STD SUP 9.5.1-2. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item.

- STD COL 9.5.1-8-A Fire Protection Program Description

The staff reviewed STD COL 9.5.1-8-A related to the operational status of the Fire Protection Program included under Section 9.5.1.15 of the North Anna 3 COL FSAR, Revision 8. The staff determined that the elements of the Fire Protection Program necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area will be fully operational prior to receipt for new fuel. Remaining required elements of the Fire Protection Program described in this section will be fully operational prior to initial fuel loading per Section 13.4 of this SER. SRP Section 9.5.1.1, Revision 0 states that Fire Protection Program should be fully implemented prior to fuel receipt at the plant site. Additionally, the Fire Protection Program requirements are incorporated by reference to the DCD. The staff accepts North Anna 3's fire protection implementation milestones as given in Section 13.4 since they will provide appropriate protection consistent with the plant's completion schedule. The staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- NAPS COL 9.5.1-10-A Fire Brigade

The staff reviewed NAPS COL 9.5.10-1-A related to implementation of the fire brigade included under Sections 9.5.1.15.4 and 13.1.2.1.5 of the North Anna 3 COL FSAR, Revision 8. The staff determined that implementation of the fire brigade will be in accordance with the milestones in

Section 13.4 for the Fire Protection Program. The staff accepts North Anna 3's fire brigade implementation milestones as given in Section 13.4 since they will provide appropriate protection consistent with the plant's completion schedule. Additionally, the fire brigade requirements are incorporated by reference to the DCD. The staff finds that North Anna 3 COL FSAR, Revision 8 fully addresses this COL information item.

- STD COL 9.5.1-11-A Quality Assurance

The staff reviewed STD COL 9.5.1-11-A related to implementation of the QA program included under Section 9.5.1 of the North Anna 3 COL FSAR, Revision 8. The staff determined that the QA controls for activities involved in the design, procurement, installation, and testing and administrative controls of FPS for safety-related areas is in accordance with the measures outlined in Chapter 17. The applicant's response to RAI 09.05.01-11 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to safety-related areas, QA controls will be applied to fire protection for nonsafety-related areas, consistent with FSAR Appendix 17BB. This includes areas with nonsafety-related SSCs that are significant contributors to plant safety. For the operational Fire Protection Program, the QA Program implements the requirements of RG 1.189 through site-specific administrative controls procedures. These operational QA procedures will be developed 6 months prior to fuel receipt and will be fully implemented prior to fuel receipt. The staff accepts North Anna 3's fire protection QA program milestones since they will provide appropriate protection consistent with the plant's completion schedule. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item.

- NAPS COL 9A.7-1-A Yard Fire Zone Drawings

The staff reviewed STD COL 9A.7-1-A related to site Yard fire zone drawings included under Appendix 9A of the North Anna 3 COL FSAR, Revision 7. The staff reviewed the revised Yard fire zone drawings, Figures 9A.2-201 through 9A.2-206, and the information in Section 9A.4.7, and determined that the site-specific Yard fire zones have been included as needed and reflect design evolution changes unrelated to fire protection, and added missing information. The staff finds that North Anna 3 COL FSAR, Revision 7 fully addresses this COL information item (see also NAPS COL 9.5.1-4-A evaluation above).

- NAPS COL 9A.7-2-A Detailed Fire Hazards Analysis of the Yard

The staff reviewed STD COL 9A.7-2-A related to site detailed FHA included under Appendix 9A of the North Anna 3 COL FSAR, Revision 7. The staff reviewed the information in Sections 9A.4.7, 9A.5.7, 9A.5.8, 9A.5.9, and 9A.5.12 and determined that the detailed FHA of the plant areas that are outside the scope of the certified design will be completed 6 months prior to fuel load. The staff accepts North Anna 3's site-specific FHA milestones since they will provide appropriate protection consistent with the plant's completion schedule. The staff finds that North Anna 3 COL FSAR, Revision 8, fully addresses this COL information item.

Supplemental Information

- NAPS SUP 9.5.1-1 and 9A-01 Codes, Standards and Regulatory Guidance

The staff reviewed NAPS SUP 9.5.1-1 and NAPS SUP 9A-01 related to the codes and standards included under Section 9.5.1 and Appendix 9A of the North Anna 3 COL FSAR, Revision 7. The staff determined that revised Table 9.5-201 added the codes and standards that are applicable for those portions of the Fire Protection Program outside the scope of the DCD and for the operational aspects of the Fire Protection Program. Section 9.5.1.15.1, Fire Protection Program Criteria, of the North Anna 3 COL FSAR also utilized Table 9.5-201 to supplement DCD Table 9.5-1. These added codes and standards are acceptable for North Anna 3 since the NFPA standards listed are referenced in RG 1.189; the Virginia Statewide Building Code is a local code that is required to be met by North Anna 3; Environmental Protection Agency standards are Federal standards that apply to North Anna 3; and the ASME Code, Section IX is approved for use by the NRC; where applicable. Additionally, two footnotes were removed from DCD Table 9.5-2 that do not apply to the North Anna 3 COLA.

- NAPS SUP 9.5.1-1 Primary and Secondary Firewater Source

The staff reviewed NAPS SUP 9.5.1-1 related to the water treatment of the primary and secondary firewater sources under Section 9.5.1.4 of the North Anna 3 COL FSAR, Revision 8. The staff determined that revised Section 9.5.1.4 under FSAR, Revision 7, changed the firewater treatment chemical for the primary fire source to Hydrogen Peroxide. The Hydrogen Peroxide is injected into the discharge side of the PWSS pumps which draws water from Lake Anna and then supplies the treated water to various areas of the plant including filling of the primary firewater storage tanks. The secondary firewater source is treated using Hypochlorite. The Hypochlorite is injected into the discharge side of the secondary fire pumps located in the Station Water Intake Building. The staff was concerned about the non-filtering of the secondary water source; however, the applicant stated that although strainers are used, filtering is not required because of the small amount of total suspended solids in the lake water. Based on the water quality requirements with NFPA 13, "Standard for Installation of Sprinkler Systems," and the applicant's maintenance program for maintaining the fire water at an acceptable level, the staff finds the use of strainers and chemical cleaning agents sufficient to maintain the water quality. The staff determined that Hydrogen Peroxide and Hypochlorite are acceptable water treatment agents for fire suppression systems for their ability to combat biofouling and microbiologically induced corrosion. These agents used in conjunction with strainers, and applicable filtering media form an acceptable level of water quality expected in fire suppression systems as per RG 1.189 and applicable NFPA codes.

- STD SUP 9.5.1-3 Combustible and Ignition Source Controls

The staff reviewed revised FSAR Section 9.5.1.15.6 and the applicant's responses to RAIs 09.05.01-5, 6, and 7 to add combustible and ignition source controls for areas adjacent to the MCR and in computer rooms that are not part of the MCR complex and prohibit storage of transient combustibles below the raised floor in the MCR complex and prohibit the storage of hazardous chemicals in areas that contain or expose equipment important to safety. The development of these procedures will be as per North Anna 3 COL FSAR, Section 13.5.

The staff noted that the ESBWR DCD took exception to the RG 1.189 guidance to provide automatic suppression in the rooms adjacent to the MCR. In RAI 09.05.01-5 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the program to control the fire hazard presented by paper or other combustible materials, as well as potential ignition sources (e.g., coffee makers) in the MCR complex. The applicant's response to RAI 09.05.01-5 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 FSAR will be revised to include administrative requirements to specifically control combustible materials and potential ignition sources in rooms adjacent to the MCR. The staff finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 8 as required.

The staff also noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing automatic fire suppression below the raised floor in the MCR complex. In RAI 09.05.01-6 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the approach restricting transient combustibles in this area and describe the extent to which cabling below the raised floor will be contained in conduit. The applicant's response to RAI 09.05.01-6 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 COL FSAR will be revised to prohibit the storage of transient combustibles below the raised floor in the MCR complex. Regarding cables in conduit under the raised floor, the applicant stated that North Anna 3 does not specify any site-specific design criteria outside the scope of the DCD. The staff finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 7 as required.

The staff also noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing fixed automatic suppression for computer rooms for computers performing functions important to safety that are not part of the MCR complex. In RAI 09.05.01-7 dated June 11, 2008 (ADAMS Accession No. ML081630351), the staff requested the applicant to describe the program controlling the fire hazard presented by paper or other combustible materials, as well as potential ignition sources in these rooms. The applicant's response to RAI 09.05.01-7 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that in addition to the administrative controls described in ESBWR DCD Section 9.5.1.15.6, the North Anna 3 COL FSAR will be revised to include administrative requirements to specifically control combustible materials and potential sources in computer rooms that are not part of the MCR complex. The staff finds that the response to this RAI is acceptable and that the proposed FSAR revision has been incorporated into the North Anna 3 COL FSAR, Revision 7 as required.

The staff finds that the combustible and ignition controls are acceptable and meet the guidance of RG 1.189. The staff also finds that the proposed FSAR revisions have been incorporated into the North Anna 3 COL FSAR, Revision 8 as required.

Multiple Spurious Actuations

The staff noted that the application lacked information regarding the assumptions and methodologies that will be used by the applicant to identify, assess, and resolve the potential for multiple spurious actuations that may prevent post-fire safe-shutdown. This is a subject area of great interest, and the NRC published and/or endorsed guidance in this matter. In a staff RAI 09.05.01-2 dated June 11, 2008 (ADAMS Accession No. ML081630351) a question in regards to this issue was submitted to the applicant. The applicant's response to RAI 09.05.01-2 dated July 23, 2008 (ADAMS Accession No. ML082140230), stated that GE Hitachi (GEH) will address this issue in a related DCD RAI and that the NRC stated during a July 9, 2008, conference call that the applicant did not need to provide a response to this RAI since GEH was to address this issue. This issue was subsequently addressed in the ESBWR DCD, Revision 10, which includes revised language in Section 9A.2.4 regarding acceptance criteria guidelines for the multiple spurious actuation analysis and resolution methodology. The ESBWR DCD, Revision 10, states the fire hazard analysis will be conducted in accordance with RG 1.189 and NFPA 804. The staff noted that the fire hazard analysis includes a multiple spurious actuation review. The ESBWR DCD states the circuit routing will conform to methodology provided in

Revision 1 of NEI 00-01, “Guidance for Post-Fire Safe Shutdown Analysis,” in accordance with Regulatory Issue Summary (RIS) 05-030, “Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements.” The ESBWR DCD also states that post-fire safe-shutdown circuit analysis will assume that any spurious actuations associated with a postulated fire occur simultaneously or in rapid succession. The staff finds this methodology acceptable and meets the guidance found in RG 1.189. The staff finds that the response to this RAI and current language of ESBWR DCD, Revision 10 is acceptable and that there are no FSAR changes required. Therefore, this DCD item is resolved and closed.

In RAI 09.05.01-18 dated July 27, 2008 (ADAMS Accession No. ML082100346) Fire Fighting Strategies for MCR Cabinets, the staff noted that the ESBWR DCD took exception to the RG 1.189 guidance to providing smoke detectors in the MCR cabinets and consoles. However, the COL applicant lacked the detailed descriptions of the cabinet design features that would facilitate rapid identification of the specific cabinet/console that is on fire and facilitate rapid access to the cabinets/consoles for firefighting. The applicant’s response to RAI 09.05.01-18 dated September 4, 2008 (ADAMS Accession No. ML082530448), stated that the requirements to develop specific firefighting procedures and train fire brigade members are addressed in the ESBWR DCD and in the North Anna 3 COL FSAR. ESBWR DCD, Section 9.5.1.15.5 requires that procedures be developed to, in part, define the strategies established for fighting fires in safety-related areas and areas presenting a hazard to safe shutdown equipment. Strategies for fighting fires in the MCR will be included in these procedures and will address specific cabinet design features, as appropriate. The development of these procedures will be as per North Anna 3 COL FSAR, Table 13.5-202. The staff finds that the response to this RAI is acceptable and that there are no FSAR changes required.

9.5.1.5 Post Combined License Activities

The applicant identified the following items:

- STD COL 9.5.1-2-A commits to testing each secondary firewater pump prior to fuel receipt to verify it can supply a minimum of 2,130 gpm with a minimum pressure of 107 psig line pressure at the Turbine Building/Yard interface boundary. (see FSAR 9.5.1.4 and 14.2.8.1.39)

- STD COL 9.5.1-5-A commits to having specific design and certification test results for penetration seals and electrical raceway fire barrier systems available for inspection 6 months prior to fuel receipt to address COL Item STD COL 9.5.1-5-A. (see FSAR 9.5.1.10)

- STD COL 9.5.1-6-A commits to establishing procedures for manual smoke control as part of the Fire Protection Program implementation to address COL Item 9.5.1-6-A. The smoke removal provisions will be completed in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.11)

- STD COL 9.5.1-7-A commits to performing an as-built design compliance review against the assumptions and requirements stated in the FHA to address COL tem 9.5.1-7-A. The as-built FHA will be completed in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.12)

- STD COL 9.5.1-8-A commits to having the Fire Protection Program operational to address COL Item 9.5.1-8-A. The Fire Protection Program elements necessary to support receipt and storage of fuel onsite for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area will be fully operational prior to receipt for new fuel. The remaining required elements of the Fire Protection Program will be fully operational prior to initial fuel load. The Fire Protection Program elements will be operational in accordance with the milestone schedule established in FSAR Section 13.4. (see FSAR 9.5.1.15)

- NAPS COL 9.5.1-10-A commits to providing for fire brigade implementation in accordance with the milestones in FSAR Section 13.4 to address COL Item 9.5.1-10-A. In addition, the applicant's response to RAI 09.05.01-18 commits to developing fire-fighting strategies for the MCR complex along with those procedures discussed in ESBWR DCD, Section 9.5.1.15.5 and in accordance with North Anna 3 COL FSAR, Table 13.5-202. (see FSAR 9.5.1.15.4 and 9.5.1.15.5)

9.5.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the FPS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the MWS that were incorporated by reference are resolved.

The staff concludes that the relevant information presented within the COL FSAR is acceptable and meets the requirements of GDC 3, 5, 19, and 23 of Appendix A to 10 CFR Part 50, 10 CFR 50.48 and is in conformance with RG 1.189, SECY-90-016, SECY-93-087, and SECY-94-084. The staff based this conclusion on the above technical evaluations of the relevant information given in the COL and Supplemental Information Items, and responses to RAIs.

9.5.2 Communication Systems

9.5.2.1 Introduction

This section of the North Anna 3 COL FSAR describes the communication systems which provide interplant communications and plant-to-offsite communications during normal, maintenance, transient, fire, and accident conditions.

9.5.2.2 Summary of Application

Section 9.5.2, "Communication System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.5.2, "Communication System," of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.2.5, the applicant provided the following:

COL Items

- NAPS COL 9.5.2.5-1-A Emergency Notification System

This COL Item requested a description of the Emergency Notification System (ENS). The applicant stated that the information required is addressed in FSAR Section 9.5.2.2.

- NAPS COL 9.5.2.5-2-A Grid Transmission Operator

This COL Item requested a description of the transmission system operator communication link. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.F.1.

- NAPS COL 9.5.2.5-3-A Offsite Interfaces (1)

This COL Item requested a description of the means of communication with the MCR, TSC, emergency operations facility (EOF), state and local emergency operation centers and radiological field personnel in accordance with NUREG–0696, "Functional Criteria for Emergency Response Facilities," February 1981 and NUREG–0654,"Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.E.1 and II.F.1.

- NAPS COL 9.5.2.5-4-A Offsite Interfaces (2)

This COL Item requested a description of the communication methods from the MCR, TSC, and EOF to the NRC headquarters including establishment of Emergency Response Data Systems (ERDS) in accordance with NUREG–0696. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2 and in the EP Sections II.E.1 and II.F.1.

- NAPS COL 9.5.2.5-5-A Fire Brigade Radio System

This COL Item requested a description of the Fire Brigade Radio System. The applicant stated that the information required is addressed in FSAR Section 9.5.2.2.

9.5.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD.

In addition, the relevant requirements of the Commission regulations for the communications systems and the associated acceptance criteria are given in SRP Section 9.5.2.

The applicable regulatory requirements for the ENS and prompt communications among principal response organizations and emergency response personnel are as follows:

- 10 CFR Part 50, Appendix E, Part IV.E.9
- 10 CFR 50.47(b)(5) and (b)(6)

The related acceptance criteria are as follows:

- NRC Bulletin (BL) 80-15, “Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power,” June 18, 1980

- NUREG–0696, February 1981.

- NUREG–0654/FEMA-REP-1, Revision 1

- RG 1.189, Section 4.1.7

- GL 91-14, “Emergency Telecommunications,” dated September 23, 1991

9.5.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.5.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff’s review confirms that the information in the application and the information incorporated by reference address the required information related to the Communication Systems.

The staff examined the EP Sections II.E and II.F which are relevant to the COL Item responses. The detailed review of EP Sections II.E and II.F is reflected in SER Section 13.3, “Emergency Planning.” The detailed review of the completely independent radio subsystem for security purposes is reflected in SER Section 13.6, “Physical Security.” The staff’s review confirmed that the information contained in the application and incorporated by reference addresses the relevant information related to the communications system. The staff reviewed conformance of Section 9.5.2 of the North Anna 3 COL FSAR to the guidance in RG 1.206, Section C.III.1, Chapter 9, C.I.9.5.2, “Communications Systems.” The staff’s review finds that the applicant appropriately incorporates by reference Section 9.5.2 of the ESBWR DCD, Revision 10.

The ESBWR DCD, Section 9.5.2, “Communications System," lists communications systems that are to provide the means to conveniently and effectively communicate between various parts of the nuclear power plant and with offsite company, governmental, support agencies, and other locations during normal operations, testing and drills, and during maintenance, transient, fire, emergency, and accident conditions under maximum potential noise levels.

In addition, DCD Section 9.5.2 identified site communication systems that are made up of the following subsystems

- Plant page/party-line subsystem;
- Private automatic branch exchange subsystem;
- Plant sound-powered telephone subsystem;
- Plant radio subsystem;
- Evacuation alarm and remote warning subsystem;

- Emergency offsite communication subsystem; and
- Completely independent radio subsystem for security purposes.

DCD Section 9.5.2.1 provides the safety design basis and the power generation design basis while DCD Section 9.5.2.2 provides a summary system description for these site communications except for the completely independent radio subsystem for security purposes that is described in DCD Section 13.6.

The staff reviewed the relevant information in the North Anna 3 COL Part 2: FSAR and examined the relevant information in Part 5: EP, Sections II.E and II.F. The detailed review of the completely independent radio subsystem for security purposes is reflected in SER Section 13.6, "Physical Security," of this SER.

The communications system is considered a nonsafety system, because it serves no safety-related function and the reactor can be shut down without the communications system. However, an adequate communications system is both required by regulation and considered important to overall safety as well as power generation. The subsystems identified above are independent of one another such that a failure in one subsystem does not adversely affect the performance of the other subsystems.

Based on the capability of these communications described in Section 9.5.2, the staff finds the design of the communications system adequately meets the requirements of 10 CFR Part 50, Appendix E, Section IV.E.9, because the multiple communication subsystems provide at least one onsite and one offsite communications system with each system having a backup power source.

COL Items

- NAPS COL 9.5.2.5-1-A Emergency Notification System

The staff reviewed NAPS COL 9.5.2.5-1-A related to the ENS included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-1-A states that "The COL applicant will describe the ENS provisions required by 10 CFR 50.47(b)(6) and address recommendations described in BL 80-15." The applicant addressed this Item in Section 9.5.2.5 with departure/supplement NAPS COL 9.5.2.5-1-A in their application by stating, "This COL Item is addressed in Section 9.5.2.2." The staff reviewed the resolution to the DCD COL Item 9.5.2.5-1-A involving the ENS included under Section 9.5.2.2 of the North Anna 3 COLA. In Section 9.5.2.2 under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-1-A)" in the first bullet is replaced by a paragraph labeled "NAPS COL 9.5.2.5-1-A" that describes key features of the ENS.

The regulation at 10 CFR 50.47(b)(6) requires that provisions exist for prompt communications among response organizations to emergency personnel and to the public. The key provisions of NRC BL 80-15 states in part that, " … all extensions of the ENS located at your facility(ies) would remain fully operable from the facility(ies) to the NRC Operations Center in the event of a loss of offsite power to your facility(ies)." The ENS phone lines are fiber-optic phone lines through a telephone utility switch that is located on site in the telephone equipment building. They are routed directly to the local telephone company central office. The normal power source for the ENS telephone utility switch is nonsafety-related station power, which will be lost during a loss of offsite power event. The phone system normal power source is provided with a battery backup that lasts for a period of approximately 8 hours. Through NAPS

COL 9.5.2.5-1-A, North Anna 3 will take action to ensure that the ENS is in compliance with the recommendations of NRC BL 80-15, which is concerned with having a "… safeguards instrumentation bus backed up by automatic transfer to batteries and an inverter or equally reliable power supply." Accordingly, based on the description provided in NAPS COL 9.5.2.5-1-A, and North Anna 3 COLA Part 5, EP, Section F on emergency communications, and the IBR ESBWR DCD, Section 9.5.2, and verification by ITAAC in North Anna 3 COLA Part 10: Table 2.3-1, Section 3.0, the ENS has adequately addressed the recommendations in NRC BL 80-15. As a backup, in addition to the circuits to the local telephone company, a separate Company-owned communication network exists which provides communication between the nuclear power station, the Company system operations center, and the NRC. Based on the above, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-1-A.

- NAPS COL 9.5.2.5-2-A Grid Transmission Operator

The staff reviewed NAPS COL 9.5.2.5-2-A related to the grid transmission operator communications included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-2-A states "The COL applicant will describe the voice communication link availability with the grid transmission operator." The applicant addressed this Item in Section 9.5.2.5 with departure/supplement NAPS COL 9.5.2.5-2-A by stating "This COL Item is addressed in Section 9.5.2.2 and EP Section II.F.1. "

The staff reviewed the resolution to the DCD COL Item 9.5.2.5-2-A involving the grid transmission operator communication link included under Section 9.5.2.2 of the North Anna 3 COLA and addressed in EP Section II.F.1. In Section 9.5.2.2 under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-1-A)" in the last bullet is replaced by a paragraph labeled "NAPS COL 9.5.2.5-2-A" that states "Transmission System Operator Communications Link: Voice communications with the grid operator are provided via a Company-owned and maintained fiber optic transmission system that allows telephone communications with the entire Corporate System. Access to this mode of transmission is made via the plant telephone system. A dedicated handset is provided between the Control Room and the power system operator." Further, this mode of communication to the grid transmission operator is backed up by the regular commercial telephone system. The North Anna 3 COLA Part 5: EP, Section II.F.1 states that the applicant maintains reliable, 24-hour per day communications links within the plant and the plant and external emergency response organizations. Based on this, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-2-A.

- NAPS COL 9.5.2.5-3-A Offsite Interfaces (1)

The staff reviewed NAPS COL 9.5.2.5-3-A related to the offsite interfaces included under Section 9.5.2 of the North Anna 3 COL FSAR and examined the EP, Sections II.E and II.F as related to emergency communications. The DCD COL Item 9.5.2.5-3-A states "the COL applicant will describe the means of communication between the control room, TSC, EOF, state and local emergency operation centers and radiological field personnel in accordance with NUREG–0696 and NUREG–0654." The applicant addressed this item with departure/supplement NAPS COL 9.5.2.5-3-A stating, "this COL Item is addressed in Section 9.5.2.2 and EP Sections II.E.1 and II.F.1." In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-3-A)" in the second bullet is replaced with "NAPS COL 9.5.2.5-3-A. The Health Physics Network (HPN) is described in the Emergency Plan." In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-3-A)" in the fourth bullet is replaced with "NAPS COL 9.5.2.5-3-A

The crisis management radio system is part of the plant radio system described in DCD Section 9.5.2.2." In Section 9.5.2.2, under Emergency Communication Systems, the following is added as an additional bullet after the last bullet "NAPS COL 9.5.2.5-3-A, Insta-Phone System." The primary method for notification of State and local authorities is the Insta-phone, which is accessible from the MCR, TSC, and EOF. The Insta-phone is described in the Emergency Plan." The North Anna 3 COLA Part 5: EP, including Sections II.E and II.F, is evaluated in SER Section 13.3, "Emergency Planning."

In the North Anna 3 COLA Part 5: EP, Section II.E and II.F, the applicant states that systems and procedures needed to provide the capability for 24-hour per day prompt notification to affected Commonwealth of Virginia, risk jurisdiction, and Federal authorities following the declaration of any emergency condition, consistent with emergency classification and action levels, are provided and maintained. The primary notification and communication method is the Insta-phone system, which is accessible from the MCR, TSC, and EOF. Back-up notification and communication is through the commercial telephone network system. Message content and verification methods are established in advance in implementing procedures. Communication systems that allow communications between the site and fixed and mobile medical support facilities are maintained and include both commercial telephone communications with fixed facilities and radio communications to ambulances. Further, the equipment, methods, and procedures for communication are tested and evaluated on a periodic basis through test and drills. For example, communications with the facility and EOF and the Commonwealth of Virginia and risk jurisdiction warning points are tested monthly, while communications between Virginia/risk jurisdiction emergency operating centers and field assessment teams are tested annually. Battery backup or alternate power in the case of the loss of AC power is provided for most subsystems. The North Anna 3 COLA Part 5: EP lists the requirements and the corresponding COLA EP provision where the requirement is addressed. Based on the above and that onsite and offsite emergency communications will be verified by ITAAC described in COLA Part 10: Table 2.3-1, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-3-A.

- NAPS COL 9.5.2.5-4-A Offsite Interfaces (2)

The staff reviewed NAPS COL 9.5.2.5-4-A related to the offsite interfaces included under Section 9.5.2 of the North Anna 3 COL FSAR and examined the EP Sections II.E and II.F. The DCD COL Item 9.5.2.5-4-A states "the COL applicant will describe the communication method from the control room, TSC, and EOF to NRC headquarters, including establishment of Emergency Response Data Systems (ERDS) in accordance with NUREG–0696." The applicant addressed this Item with departure/supplement NAPS COL 9.5.2.5-4-A stating "this COL Item is addressed in Section 9.5.2.2 and EP Sections II.E.1 and II.F.1." In Section 9.5.2.2, under Emergency Communication Systems, the parenthetical "(COL 9.5.2.5-4-A)" in the third bullet is replaced with "NAPS COL 9.5.2.5-4-A." Communication from the MCR, TSC, and EOF to NRC headquarters including establishment of ERDS is described in the EP. The North Anna 3 COLA Part 5: EP including Sections II.E and II.F is evaluated in SER Section 13.3, "Emergency Plan."

In the North Anna 3 COLA Part 5: EP, Section II.F.1, the applicant states that separate telephone lines are dedicated and maintained for communications with the NRC. These include the ENS, the Management Counterpart Link (MCL), the HPN, the Reactor Safety Counterpart Link (RSCL), the Protective Measures Counterpart Link (PMCL), the Local Area Network (LAN) Access, and an ERDS. The ENS lines located in the MCR, TSC, and EOF are used for initial notifications, as well as ongoing information about plant systems, status, and parameters. The MCL lines located in the TSC and EOF provide for internal discussion between the NRC

Executive Team Director and members of his/her team and the NRC site director, or between licensee site management. The HPN lines located in the TSC and EOF provide for communication concerning radiological and meteorological matters. The RSCL lines located in the TSC and EOF provide for internal NRC discussions regarding plant and equipment conditions. PMCL lines located in the TSC and EOF provide for internal NRC discussions on radiological releases, meteorological conditions, and protective measures. The LAN Access with jacks in the TSC and EOF provides access to the NRC LAN. The applicant will take action to ensure that North Anna 3 will have an ERDS that will be activated within 1 hour of the declaration of an Alert or higher emergency classification in accordance with regulations and facility procedures. The North Anna 3 COLA Part 5: EP lists the requirements and the corresponding COLA EP provision where the requirement is addressed. Based on the above and that offsite communication with the NRC including the ERDS between the onsite computer system and the NRC Operations Center will be verified by ITAAC described in COLA Part 10: Table 2.3-1, the staff finds that the applicant has adequately addressed the DCD COL Item 9.5.2.5-4-A.

- NAPS COL 9.5.2.5-5-A Fire Brigade Radio System

The staff reviewed NAPS COL 9.5.2.5-5-A related to the Fire Brigade Radio System included under Section 9.5.2 of the North Anna 3 COL FSAR. The DCD COL Item 9.5.2.5-5-A states "the COL applicant will describe the Fire Brigade Radio System." The applicant addressed this item with departure/supplement NAPS COL 9.5.2.5-5-A stating "This COL Item is addressed in Section 9.5.2.2." In Section 9.5.2.2 under Emergency Communication Systems the parenthetical "(COL 9.5.2.5-5-A)" in the fifth bullet is replaced with "NAPS COL 9.5.2.5-5-A. The Fire Brigade Radio System is part of the plant radio system described in DCD Section 9.5.2.2." The ESBWR DCD, Section 9.5.2.2 described the plant radio system for use during normal and emergency communications within the plants. The plant radio system radios are equipped with multiple channels including a fire brigade channel and an emergency channel, each which can be used as alternate security channels if required. Portable, hand-held radios provide two-way voice communication between the various units for fire brigade members who need mobile communications and communications to communication consoles in selected plant locations including the MCR and remote shutdown rooms. The radio system includes antennas distributed throughout the plant with a centralized rebroadcast transmitter providing communication within the plant and satellite buildings. Lower power portable radios are used with this system to ensure that there is no Electromagnetic Interference with Instrumentation and Control circuits, and operate at frequencies that ensure they do not interfere with the plants instrument and controls distributed control and information systems (DCIS) functions. By using radio equipment equipped with tone-coded squelch communications can be directed to an individual, all-channel (zoned), or all-system calls except the emergency channel is not coded. Capability is provided whereby calls can be made between the telephone system and the in-plant radio system. The power for base stations and consoles is provided by security system power supply backed by batteries and a standby generator. Based on the above, the staff finds that the applicant adequately addressed the DCD COL Item 9.5.2.5-5-A.

9.5.2.5 Post Combined License Activities

There are no post COL activities related to this section.

9.5.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the communication systems, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the communication systems that were incorporated by reference are resolved.

In addition, to the extent that an item addresses that portion of the communications system used in intra-plant and plant-to-offsite communications, the staff concludes that the site-specific COL information items discussed in this section of the COL FSAR are acceptable and meet the requirements of 10 CFR Part 50, Appendix E, Section IV.E.9 and 10 CFR 50.47(b)(5) and (b)(6); and guidance in RG 1.189, Regulatory Position 4.1.7. The staff bases its conclusion on the following: (1) The design provides for at least one acceptable onsite and one acceptable offsite communication system, each with a backup power source as described directly through COLA information or information incorporated by reference of the ESBWR DCD; (2) the design provides communications systems with a capability for prompt notification and continuing communication to the NRC; (3) the design provides communications systems with capability for prompt notification and continuing communication with site, local and state response organizations; (4) the design provides a variety of diverse communication systems involving both private links, commercial links, site public address, microwave, facsimiles, and radio with the capability of adequately supporting both normal use and emergency situations; and (5) the nonsafety communication systems do not prevent completion of safety functions.

9.5.3 Lighting System

Section 9.5.3, "Lighting System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.3, "Lighting System" of the certified ESBWR DCD, Revision 10 referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.5.3 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the "Lighting System," that were incorporated by reference have been resolved.

9.5.4 Diesel Generator Fuel Oil Storage and Transfer System

9.5.4.1 Introduction

This section of the North Anna 3 COL FSAR describes the diesel generator (DG) fuel oil system which stores and transfers fuel oil for the diesel engines that provide standby onsite power. The system for each diesel engine includes a fuel oil storage tank, fuel oil day tank, fuel oil transfer pump, strainers/filters, oil purifier (or tank connections for tying into a purification system), instrumentation, controls, and the necessary interconnecting piping and valves. The ESBWR design provides two sets of DGs – standby diesel generators (SDGs) and ancillary diesel generators (ADGs).

9.5.4.2 Summary of Application

Section 9.5.4, “Diesel Generator Fuel Oil Storage and Transfer System,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 9.5.4, “Diesel Generator Fuel Oil Storage and Transfer System,” of the ESBWR DCD, Revision 10.

In addition, in FSAR Section 9.5.4, the applicant provided the following:

COL Items

- STD COL 9.5.4-1-A Fuel Oil Capacity

The applicant provided additional information in STD COL 9.5.4-1-A to address DCD COL Item 9.5.4-1-A. The applicant described the procedural controls in place to ensure that sufficient fuel oil is available onsite to allow each DG to operate continuously for 7 days at its calculated design load.

- NAPS COL 9.5.4-2-A Protection of Underground Piping

The applicant provided additional information in NAPS COL 9.5.4-2-A to address DCD COL Item 9.5.4-2-A. The applicant stated that the underground piping portion of the fuel oil transfer system is made of carbon steel and that it is protected with a waterproof coating and an impressed current cathodic protection system to control external corrosion.

9.5.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER for the ESBWR DCD. In addition, the relevant requirements of the Commission regulations for the Diesel Generator Fuel Oil Storage and Transfer System (DGFOSTS) and the associated acceptance criteria are in SRP Section 9.5.4.

The specific regulatory requirements are as follows:

- GDC 17, “Electric power systems,” requires an onsite electric power system to permit functioning of SSCs important to safety. The SDGs and ADGs are not classified as safety- related. However, since the SDGs and ADGs are RTNSS Criterion B and C systems respectively, availability of both SDGs and ADGs are required according to the Availability Controls Manual (Availability Control Limiting Condition for Operation 3.8.1 and 3.8.2).

- RG 1.137, “Fuel-Oil Systems for Standby Diesel Generators,” provides regulatory guidance with respect to maintaining a 7-day supply of fuel oil and for protection of the system from internal and external corrosion.

9.5.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 9.5.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 9.5.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirms that the information in the application and the information incorporated by reference address the required information related to the DGFOSTS.

The SDG and ADG are not classified as safety-related. However, since the diesels are RTNSS Criterion B and C systems, availability of both SDG and ADG is required according to the Availability Controls Manual (Availability Control Limiting Condition for Operation 3.8.1 and 3.8.2).

COL Items

- STD COL 9.5.4-1-A Fuel Oil Capacity

The staff reviewed STD COL 9.5.4-1-A related to the fuel oil capacity included under Section 9.5.4 of the North Anna 3 COL FSAR. DCD COL Item 9.5.4-1-A in Section 9.5.4.6, "COL Information," of the ESBWR DCD specifies that the COL applicant needs to establish procedural controls to ensure a minimum fuel oil capacity is maintained onsite. In FSAR Section 9.5.4.2, "System Description," the applicant addressed DCD COL Item 9.5.4-1-A (STD COL 9.5.4-1-A) by indicating that procedures will be developed in accordance with the milestone and processes described in FSAR Section 13.5, "Plant Procedures." Those procedures will ensure sufficient diesel fuel oil inventory is available onsite so that the DG can operate continually for 7 days. The procedures will ensure that the quantity of DG fuel oil in the fuel oil storage tanks is monitored on a periodic basis and that the diesel fuel oil usage is tracked against planned deliveries. Regular transport will replenish the fuel oil inventory during periods of high demand and ensure continued supply in the event of adverse weather conditions. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.5.4-1A in that the necessary procedures will be developed in accordance with FSAR Section 13.5.

The applicant stated that the procedures will ensure sufficient fuel oil to operate the DGs continually for 7 days. In RAI 09.05.04-2 dated June 24, 2008 (ADAMS Accession No. ML081760334), the staff asked the applicant to verify that enough fuel oil inventory is available to operate the DGs at continuous maximum rating for 7 days. In their response to RAI 09.05.04-2 dated August 4, 2008 (ADAMS Accession No. ML081760334), the applicant provided an FSAR markup stating that procedures ensure sufficient diesel fuel oil inventory is available onsite so that the SDGs and ADGs can operate continually for 7 days with each operating at its calculated design load, with appropriate margins. The staff found that the term "appropriate margins" is an ambiguous term for use in the FSAR. Therefore the staff requested the applicant in supplemental RAI 09.05.04-7 dated May 6, 2009 (ADAMS Accession No. ML091260337), to specify that the margins are in accordance with American Nuclear Society 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators."

In response to supplemental RAI 09.05.04-7 dated August 3, 2009 (ADAMS Accession No. ML092180975), the applicant (Dominion) stated that ANS 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators," is not applicable to the ESBWR nonsafety-related SDGs and ADGs. The applicant updated the North Anna FSAR to describe the sufficient margin for the 7-day fuel oil inventory requirement that accounts for usable fuel in the tank, level instrument uncertainty, and the potential for future load growth. The staff finds this response acceptable since the 7-day fuel oil inventory is maintained in accordance with RG 1.137 with sufficient margin that is clearly defined in the FSAR. Therefore, this RAI 09.05.04-7 is closed.

The staff evaluated COL Item STD COL 9.5.4-1-A to the relevant NRC regulations and acceptance criteria in SRP Section 9.5.4. The staff finds that the applicant has satisfactorily addressed DCD COL Item 9.5.4-1*.*

- NAPS COL 9.5.4-2-A Protection of Underground Piping

The staff reviewed NAPS COL 9.5.4-2-A related to the protection of underground piping included under Section 9.5.4 of the North Anna 3 COL FSAR. DCD COL Item 9.5.4-2-A in Section 9.5.4.6, “COL Information,” of the ESBWR DCD specifies that the COL applicant needs to describe the material and corrosion protection for the underground piping portion of the fuel oil transfer system. In FSAR Section 9.5.4.2, the applicant addressed DCD COL Item 9.5.4-2-A (NAPS COL 9.5.4-2-A) by indicating that the material for the underground piping portion of the fuel oil transfer system is carbon steel and that a corrosion protection system is in place for the internal and external surfaces of piping systems. The buried section of the piping is protected with a waterproof protective coating and an impressed current type cathodic protection is used to control external corrosion.

Section 9.5.4.2 of the DCD states the system will be designed and constructed according to “the latest industry standards for buried pipe including provisions for corrosion protection,” but it does not identify the standards to be used. Therefore, the staff asked the applicant to clarify the corrosion protection methods for the internal and external surfaces of buried DG fuel oil piping and identify the applicable industry standards in RAI 09.05.04-6 dated October 20, 2008 (ADAMS Accession No. ML082940356).

The applicant’s response to RAI 09.05.04-6 dated December 3, 2008 (ADAMS Accession No. ML083460148), stated a corrosion allowance, rather than a corrosion protection system, is included in the pipe wall thickness to address the possibility of internal corrosion. This is acceptable to the staff because it is a method listed in ASME B31.1, which is the code applicable to this piping system. For the coating and impressed current cathodic protection system for external corrosion control, the applicant stated it would follow the applicable guidance in ASME B31.1 Non-mandatory Appendix IV (“Corrosion Control for ASME B31.1 Power Piping Systems”) and American Petroleum Institute (API) Recommended Practice 1632 (“Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems”). The staff finds the API Recommended Practice acceptable because it refers users to National Association of Corrosion Engineers (NACE) RP-0169 and recommends the same corrosion protection criteria contained therein. NACE RP-0169 is the cathodic protection guidance accepted by RG 1.137. ASME B31.1 Appendix IV is an acceptable industry standard for external corrosion control because it addresses underground piping.

Based on the RAIs, the applicant proposed the paragraph below for NAPS COL 9.5.4-2-A. This deletes the reference to a corrosion protection system for the internal surface and adds a sentence to identify piping as the only underground component:

> The only underground component of the SDGs fuel oil storage and transfer system is carbon steel piping. A corrosion protection system consistent with the guidance contained in ASME B31.1, Power Piping Code, Nonmandatory Appendix IV, Corrosion Control for ASME B31.1 Power Piping Systems, and American Petroleum Institute (API) Recommended Practice 1632 is provided for external surfaces of buried piping systems.

The buried sections of the piping are provided with waterproof protective coating and an impressed current type cathodic protection to control external corrosion.

As discussed above, the corrosion control methods and industry standards applied to the buried piping are appropriate and meets the industry acceptance criteria as stated. Since the applicant included this statement in its FSAR, Revision 8, the staff considers this issue and RAI closed.

9.5.4.5 Post Combined License Activities

There are no post COL activities related to this section.

9.5.4.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the DGFOSTS, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the DGFOSTS that were incorporated by reference are resolved.

In addition, the staff compared the additional COL supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 9.5.4, and other NRC regulatory guides. The staff's review concludes that the applicant's information in this section of the COL FSAR is acceptable and meets the requirements of GDC 17 and RG 1.137. The staff also finds that the applicant has satisfactorily addressed DCD COL Items 9.5.4-1-A and 9.5.4-2-A.

9.5.5 Diesel Generator Jacket Cooling Water System

Section 9.5.5, "Diesel Generator Jacket Cooling Water System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.5, "Diesel Generator Jacket Cooling Water System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.5.5 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator jacket cooling water system, that were incorporated by reference have been resolved.

9.5.6 Diesel Generator Starting Air System

Section 9.5.6, "Diesel Generator Starting Air System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.6, "Diesel Generator Starting Air System" of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.5.6 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator starting air system, that were incorporated by reference have been resolved.

9.5.7 Diesel Generator Lubrication System

Section 9.5.7, "Diesel Generator Lubrication System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.7, "Diesel Generator Lubrication System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.5.7 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator lubrication system, that were incorporated by reference have been resolved.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

Section 9.5.8, "Diesel Generator Combustion Air Intake and Exhaust System," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference, with no departures or supplements Section 9.5.8, "Diesel Generator Combustion Air Intake and Exhaust System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. As documented in NUREG–1966, the staff reviewed and approved Section 9.5.8 of the certified ESBWR DCD. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1]

The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information related to this section that remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E to 10 CFR Part 52, all nuclear safety issues relating to the diesel generator combustion air intake and exhaust system, that were incorporated by reference have been resolved.

References

1. 10 CFR 20.11019(b), "Radiation protection programs."

2. 10 CFR 50.47, "Emergency plans."

3. 10 CFR 50.48, "Fire protection."

4. 10 CFR 50.62, "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants."

5. 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants."

6. 10 CFR 52.63, "Finality of standard design certification."

7. 10 CFR 52.80, "Contents of applications; additional technical information."

8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

10. 10 CFR Part 50, Appendix A, GDC 1, "Quality standards and records."

11. 10 CFR Part 50, Appendix A, GDC 17, "Electric power systems."

12. 10 CFR Part 50, Appendix A, GDC 19, "Control room."

13. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

14. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

15. 10 CFR Part 50, Appendix A, GDC 23, "Protection system failure modes."

16. 10 CFR Part 50, Appendix A, GDC 26, "Reactivity control system redundancy and capability."

17. 10 CFR Part 50, Appendix A, GDC 27, "Combined reactivity control systems capability."

18. 10 CFR Part 50, Appendix A, GDC 3, "Fire protection."

19. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."

20. 10 CFR Part 50, Appendix A, GDC 44, "Cooling water."

21. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of cooling water system."

22. 10 CFR Part 50, Appendix A, GDC 46, "Testing of cooling water system."

23. 10 CFR Part 50, Appendix A, GDC 5, "Sharing of structures, systems, and components."

24. 10 CFR Part 50, Appendix A, GDC 60, "Control of releases of radioactive material to the environment."

25. 10 CFR Part 50, Appendix A, GDC 61, "Fuel storage and handling and radioactivity control."

26. 10 CFR Part 50, Appendix A, GDC 62, "Prevention of criticality in fuel storage and handling."

27. 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases."

28. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

29. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

30. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

31. ANS 59.51-1997, "Fuel Oil Systems for Safety-Related Emergency Diesel Generators."

32. ANSI N14.6-1993, "Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More."

33. ANSI/ASME B30.10-2009, "Hooks."

34. ANSI/ASME B30.11-2010, "Monorails and Underhung Cranes."

35. ANSI/ASME B30.16-2007, "Overhead Hoists (Underhung)."

36. ANSI/ASME B30.2-2005, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)."

37. ANSI/ASME B30.9-2006, "Slings."

38. API Recommended Practice 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," Third Edition, January 1, 1996.

39. ASHRAE, "2005 ASHRAE Handbook - Fundamentals - I-P Units," 2005.

40. ASHRAE, "2009 ASHRAE Handbook - Fundamentals," 2009.

41. ASME B31.1, "Non-mandatory Appendix III, Rules for Nonmetallic Piping and Piping Lines with Nonmetals."

42. ASME B31.1-2004, "Power Piping."

43. ASME B31.3-2002, "Process Piping."

44. ASME Boiler and Pressure Code (BPVC).

45. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

46. ASME BPVC, Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

47. ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear

48. ASME OM Code-2001 including Addenda through 2003, "Code for Operation and Maintenance of Nuclear Power Plants."

49. ASME OM-S/G-2003, "Standards and Guides for Operation and Maintenance of Nuclear Power Plants."

50. ASME Section VIII, "Rules for Construction of Pressure Vessels," 2001 Edition, 2003 Addenda.

51. ASME, BPVC, Section VIII, "Rules for Construction of Pressure Vessels," Division 1, 2001 Edition, 2003 Addenda.

52. ASTM E119, "Standard Test Methods for Fire Tests of Building Construction and Materials," 2010.

53. EPRI, NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines," Revised 1987.

54. EPRI, NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations," Revised September 1987.

55. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

56. ICC IBC (2003), the International Building Code Chapter 16, "Structural Design," applies for seismic capability.

57. IEEE Std 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

58. NACE RP0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems"; reaffirmed as Standard Practice (SP) 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," 2007.

59. NEI 00-01, Revision 3, "Guidance for Post-Fire Safe Shutdown Circuit Analysis, " October 2011 (ADAMS Accession No. ML112910147).

60. NEI 06-13A, Revision 2, "Template for an Industry Training Program Description," March 2009 (ADAMS Accession No. ML090910554).

61. NEI 09-14, Revision 1, "Guideline For The Management Of Underground Piping And Tank Integrity," December 2010 (ADAMS Accession No. ML110700122).

62. NFPA 13, "Standard for Installation of Sprinkler Systems," 2013.

63. NFPA 20, "Standard for the Installation of Stationary Pumps for Fire Protection," 2010.

64. NFPA 251, "Standard Method of Tests of Fire Resistance of Building," 2006.

65. NFPA 801, "Standard for Fire Protection for Facilities Handling Radioactive Materials," 2008.

66. NFPA 804, "Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants," 2006.

67. NRC BL 80-15, "Possible Loss of Emergency Notification System (ENS) with Loss of Offsite Power," June 18, 1980 (ADAMS Accession No. ML031210543).

68. NRC BTP SPLB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," 2003 (ADAMS Accession No. ML070660454).

69. NRC GL 1989-013, "Service Water System Problems Affecting Safety-Related Equipment," July 18, 1989 (ADAMS Accession No. ML031150348).

70. NRC GL 1991-014, "Emergency Telecommunications," September 23, 1991 (ADAMS Accession No. ML031140150).

71. NRC RG 1.137, Revision 2, "Fuel Oil Systems For Emergency Power Supplies," (ADAMS Accession No. ML12300A122).

72. NRC RG 1.160, Revision 2, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997, (ADAMS Accession No. ML003761662).

73. NRC RG 1.174, Revision 1, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," May 2011, (ADAMS Accession No. ML100910008).

74. NRC RG 1.188, Revision 1, "Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses," September 2005, (ADAMS Accession No. ML051920430).

75. NRC RG 1.189, Revision 2, "Fire Protection for Operating Nuclear Power Plants," October 2009 (ADAMS Accession No. ML092580550).

76. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

77. NRC RG 1.27, Revision 2, "Ultimate Heat Sink for Nuclear Power Plants (for Comment)," January 1976. (ADAMS Accession No. ML003739969).

78. NRC RG 1.29, Revision 4, "Seismic Design Classification," March 2007 (ADAMS Accession No. ML070310052).

79. NRC RIS 05-030, "Clarification of Post-Fire Safe-Shutdown Circuit Regulatory Requirements," December 20, 2005 (ADAMS Accession No. ML053360069).

80. NRC RIS 2005-25, Supplement 1, "Clarification of NRC Guidelines for Control of Heavy Loads," May 29, 2007 (ADAMS Accession No. ML071210434).

81. NRC SECY-90-016, "Evolutionary Light-Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," January 12, 1990 (ADAMS Accession No. ML003707849), and the related SRM, dated June 26, 1990 (ADAMS Accession No. ML003707885).

82. NRC SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," April 2, 1993 (ADAMS Accession No. ML003708021), and the related SRM, dated July 21, 1993 (ADAMS Accession No. ML003708056).

83. NRC SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs," March 28, 1994 (ADAMS Accession No. ML003708068), and the related SRM, dated June 30, 1994 (ADAMS Accession No. ML003708098).

84. NRC SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," May 22, 1995 (ADAMS Accession No. ML003708005), and the related SRM, dated June 28, 1995 (ADAMS Accession No. ML003708019).

85. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

86. NRC Staff NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," July 1980 (ADAMS Accession No. ML070250180).

87. NRC Staff NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML 040420012).

88. NRC Staff NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML040420012).

89. NRC Staff NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 28, 1981 (ADAMS Accession No. ML051390358).

90. NRC Staff NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 28, 1981. (ADAMS Accession No. ML051390358.) NRC TSTF-419, "Analysis of NRC Position Regarding TSTF-363, 408, and 419," September 9, 2001 (ADAMS Accession No. ML012690166).

91. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

92. NUMARC 93-01, Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 1996 (ADAMS Accession No. ML101020415).

93. VUSBC (Virginia Statewide Building Code), July 14, 2014 incorporates by reference the IBC (2003).

10.0 STEAM AND POWER CONVERSION SYSTEM

10.0 STEAM AND POWER CONVERSION SYSTEM

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation and introduces the principle design features, systems, and components of the North Anna 3 Combined License (COL) steam and power conversion system of the Economic Simplified Boiling–Water Reactor (ESBWR) design. The systems discussed in this chapter include the turbine generator system used to convert energy in the steam from the nuclear steam supply system (NSSS) into electrical energy, the main steam supply system used to transport steam from the NSSS to the power conversion system and various safety related and nonsafety related auxiliaries, and other features of the steam and power conversion system.

10.1 Summary Description

Section 10.1 of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference Section 10.1, "Summary Description," of the ESBWR Design Control Document (DCD), Revision 10, referenced in Title10 *Code of Federal Regulations* (CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the ESBWR Design," without any departures or supplements. The staff's finding related to information incorporated by reference is in NUREG 1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," issued April 2014, and it's Supplement 1, issued September 2014. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review[1]. The staff's review confirmed that no outstanding information related to this section is expected to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues related to the summary description that were incorporated by reference have been resolved.

10.2 Turbine Generator

10.2.1 Introduction

This FSAR section describes the turbine generator equipment design and design bases, including programs to ensure the integrity of the turbine rotor to minimize potential impacts on safety related structures, systems, and components (SSCs).

10.2.2 Summary of Application

Section 10.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 10.2, the applicant provided the following information:

COL Items

- STD COL 10.2-1-A Turbine Maintenance and Inspection Program

The applicant addressed DCD COL Item 10.2 1 A in FSAR Section 10.2.2.4, "Turbine Overspeed Protection System"; Section 10.2.2.7, "Testing"; Section 10.2.3.6, "In-service

[1] See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

Maintenance and Inspection of Turbine Rotors"; and Section 10.2.3.7, "In-service Inspection of Turbine Valves." In FSAR Section 10.2.3.6, the applicant stated that DCD, Tier 2, Sections 10.2.2.7, 10.2.3.5, and 10.2.3.6 and General Electric (GE) ST 56834/P, "ESBWR Steam Turbine—Low Pressure Rotor Missile Generation Probability Analysis," Revision 4, dated October 18, 2011, describe the Turbine Maintenance and Inspection Program that supports the original equipment manufacturers (OEM's) turbine missile generation probability calculation. GE ST 56834/P, Revision 4, is a bounding missile probability calculation report that sets forth the associated maintenance and inspection recommendations.

The applicant further addressed COL Item 10.2 1 A in FSAR Section 10.2.3.7. This section states that the inspection of all valves of one functional type or size will be conducted if a detrimental, unusual condition is discovered during the inspection of any single valve. This section also states that GE ST-56834/P, Revision 4, describes the Valve Inspection Program, including the valve and control system maintenance, inspections, testing, and associated frequencies.

In FSAR Sections 10.2.2.4 and 10.2.2.7, the applicant described how the information in Sections 10.2.3.6 and 10.2.3.7 applies to the turbine overspeed protection system and nonreturn valve inspection and testing.

- STD COL 10.2-2-A Turbine Missile Probability Analysis

In FSAR Section 10.2.3.8, the applicant provided information to address DCD COL Item 10.2-2-A. The applicant stated that the probability of generating a turbine missile is based on bounding material property values in the GE ST-56834/P, Revision 4 report. Because the applicant relies on this report to address the COL items described above, the staff reviewed it as part of the technical evaluation of the North Anna 3 COL application (COLA).

Supplemental Information

- STD SUP 10.2-1 Turbine Design

In FSAR Section 10.2.3.4, the applicant identified the turbine design model as N3R-6F52 from the GE nuclear steam turbine series.

10.2.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is in NUREG 1966. In addition, Section 10.2, "Turbine Generator," of NUREG 0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), includes the relevant requirements of the Commission's regulations for the turbine generator and the associated acceptance criteria.

The following documents establish the applicable regulatory requirements and associated guidance for the turbine generator:

- General Design Criterion (GDC) 4, "Environmental and Dynamic Effects Design Bases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," as it relates to SSCs important to safety being appropriately protected against the effects of missiles that may result from a turbine rotor failure

- Regulatory Guide (RG) 1.115, Revision 2, "Protection against Turbine Missiles," issued January 2012.

- NUREG–0800, SRP Section 3.5.1.3, "Turbine Missiles," and SRP Section 10.2.3, "Turbine Rotor Integrity"

10.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 10.2 of the certified ESBWR DCD. The staff reviewed Section 10.2 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of information in the COL FSAR and information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the turbine generator.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 10.2-1- A Turbine Maintenance and Inspection Program

DCD COL 10.2-1-A requires the COL applicant to provide a description of the plant-specific Turbine Maintenance and Inspection Program required to satisfy the OEM's turbine missile generation probability calculation, including the acceptance criteria listed in Section II of SRP Section 3.5.1.3, and to address any valve and control system maintenance, inspections, and tests that are needed.

In Revision 1 of FSAR Section 10.2.3.6, the applicant addressed COL Item 10.2-1-A, "Turbine Maintenance and Inspection Program," which stated that "the turbine maintenance and inspection frequencies will be established upon completion of the bounding missile probability analysis." This analysis was then scheduled to be completed in the second quarter of 2009, and the FSAR would be revised to incorporate the maintenance and inspection frequencies as part of a subsequent FSAR update. The staff tracked this activity as Open Item 10.2-1 from the North Anna 3 Phase 2 SER.

In a letter dated June 24, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14199A360), the applicant submitted Revision 8 of the COL FSAR, which changed how it addressed STD COL 10.2 1 A. The applicant addressed DCD COL Item 10.2 1 A in FSAR Sections 10.2.2.4, 10.2.2.7, 10.2.3.6, and 10.2.3.7. In Section 10.2.3.6, the applicant stated that the Turbine Maintenance and Inspection Program supports the OEM's turbine missile generation probability calculation and is described in DCD Tier 2, Sections 10.2.2.7, 10.2.3.5, and 10.2.3.6 and in GE ST 56834/P, Revision 4, which is a bounding missile probability calculation report that sets forth the associated maintenance and inspection recommendations.

The applicant further addressed COL Item 10.2-1-A in FSAR Section 10.2.3.7. This section states that the inspection of all valves of one functional type or size will be conducted if a detrimental, unusual condition (as defined by the turbine Valve Inspection Program) is discovered during the inspection of any single valve. This section also states that the bounding missile probability analysis report (GE ST 56834/P, Revision 4) describes the Valve Inspection Program, including the valve and control system maintenance, inspections, testing, and associated frequencies.

In FSAR Sections 10.2.2.4 and 10.2.2.7, the applicant described how the information in Sections 10.2.3.6 and 10.2.3.7 applies to the turbine overspeed protection system and nonreturn valve inspection and testing.

In a letter dated December 6, 2013 (ADAMS Accession No. ML13346A647), the applicant provided the bounding missile probability analysis report (GE ST–56834/P Revision 4) for North Anna 3, which used Detroit Edison Company's (DTE's) responses to requests for additional information (RAIs) concerning this same technical topic on the Fermi 3 COL docket and is now part of the North Anna 3 COLA. The staff reviewed STD COL 10.2-1-A as submitted on the North Anna COL docket. Similar to the staff's review of the Fermi 3 COLA on this technical topic in the Fermi 3 docket, the review includes the bounding missile probability analysis report (ST–56834/P Revision 4). For both Fermi 3 COL Safety Evaluation Report (SER) Section 10.2.4 and this section of the North Anna 3 SER, this information satisfies the OEM's missile probability calculation called for in DCD COL Item 10.2-1-A. In addition, the applicant submitted a supplemental letter dated September 30, 2014 (ADAMS Accession No. ML14274A285), which also identifies the Fermi 3 RAI responses concerning this topic that are now submitted on the docket as part of an incorporation by reference per 10 CFR 52.8(b). The Fermi 3 RAIs referred to are 10.02.03-3, 10.02.03-7, 10.02.03-8, 10.02.03-9, and 10.02.03-10.

DCD COL Item 10.2-1-A states that "the COL applicant will provide a description of the plant specific turbine maintenance and inspection program required to satisfy the OEM's turbine missile generation probability calculation including each of the criteria identified in Section II of SRP Section 3.5.1.3, and to address any valve and control system maintenance, inspections, and tests that are needed."

The applicant addressed COL Item STD COL 10.2-1-A in the following four FSAR Sections, which also correspond to the Section numbers and titles in the DCD:

1) Section 10.2.2.4, "Turbine Overspeed Protection System," which states that "inspection programs required by the turbine missile probability analysis and implementation of the inspection, maintenance, and testing programs discussed in Section 10.2.3.6 and Section 10.2.3.7 ensure operability."

2) Section 10.2.2.7, "Testing," which states that "non-return valves are inspected and tested in accordance with vendor recommendations, as discussed in Section 10.2.3.7."

3) Section 10.2.3.6, "In-service Maintenance and Inspection of Turbine Rotors."

4) Section 10.2.3.7, "In-service Inspection of Turbine Valves." The description of the valve in-service inspection provision in this Section is consistent with the DCD and refers to the bounding missile probability analysis in the ST–56834/P Revision 4 report for the valve and control system maintenance, inspections, testing, and associated frequencies.

The staff confirmed that Section 10.2 of GE ST 56834/P, Revision 4, contains this information. The staff therefore finds that the portion of COL Item STD COL 10.2-1-A that is in FSAR Section 10.2.2.4 is acceptable. Based on its review of the turbine bounding missile probability analysis in the GE ST 56834/P, Revision 4, the staff finds the analysis acceptable. This SER further discusses this topic below under COL Item STD COL 10.2 2 A.

According to Acceptance Criterion 4 of SRP Section 3.5.1.3, an applicant obtaining a turbine from a manufacturer with an NRC-approved missile probability analysis for the turbine should meet the probabilities listed in SRP Table 3.5.1.3-1 based on the turbine orientation. This table includes the probability of a turbine failure resulting in the ejection of turbine rotor fragments through the turbine casing, P_1, of less than $1x10^{-4}$ per year for loading a favorably oriented turbine and bringing the system online. For the ESBWR, Section 10.2.1 of DCD Tier 2 states that a more conservative P_1 value of less than 10^{-5} per year will be used if the recommended inspections and tests are conducted at the recommended frequencies.

Acceptance Criterion 4 of SRP Section 3.5.1.3 also states that the turbine manufacturer should provide applicants with the relationship between the probability and the time that can be used to establish the in-service inspection and valve testing intervals that meet the missile probability criterion. Because the North Anna 3 applicant (similar to the Fermi 3 applicant) submitted a missile probability analysis from the manufacturer for NRC approval as part of the COL application, the manufacturer should also provide the inspection and valve testing intervals. In Sections 10.2.3.6 and 10.2.3.7 of the FSAR, Revision 8, the applicant stated that DCD Sections 10.2.2.7, 10.2.3.5, and 10.2.3.6 and GE ST 56834/P, Revision 4, describe this information.

The staff finds the FSAR discussions acceptable because referencing GE ST 56834/P, Revision 4, provides additional maintenance and inspection information to supplement the DCD requirements. The staff discusses its review of GE ST 56834/P, Revision 4, below under COL Item STD COL 10.2 2 A. This information therefore satisfies the OEM’s missile probability calculation called for in DCD COL Item 10.2 1 A.

The staff reviewed the entire turbine missile probability analysis in GE ST 56834/P, Revision 4, as discussed below under COL Item STD COL 10.2 2 A. GE ST 56834/P addresses the maintenance and inspection of rotors in Section 10.1 and the inspection of turbine valves in Section 10.2. Section 10.1 of the report is divided into Section 10.1.1, “In service Volumetric Rotor Inspections,” and Section 10.1.2, “Rotor Dovetail Inspections,” and includes the following types of inspections:

- visual, magnetic particle, and ultrasonic examination of all accessible surfaces of the rotors
- visual and magnetic particle or liquid penetrant examination of all turbine blades
- visual and magnetic particle examination of couplings and coupling bolts
- rotor dovetail inspections

DCD Tier 2, Section 10.2.3.6, also lists the first three types of inspections. The description of the maintenance and inspection program in Section 10.1 of GE ST 56834/P is consistent with the DCD. In addition, for all of these inspections, GE ST 56843/P recommends an interval of no more than 12 years. This recommendation applies to the surfaces of both high pressure and low pressure rotors and rotor dovetails. The DCD identifies the inspection interval and the rotor dovetail inspections. Therefore, the staff reviewed this issue as new information that the applicant provided as part of COL Item STD COL 10.2 1 A.

The in-service inspections for the rotors consist of visual, surface, and volumetric examinations, as described above. Section 10.1.1 of GE ST 56834/P also states that performing a volumetric examination of 100 percent of the rotor is not possible because of the outside surface geometry and features. The report states that this inspection is not essential for meeting the missile probability requirements, because the growth of an internal flaw in the rotor body to the critical crack size is never the most probable missile generation mechanism. Because a 100 percent in-service volumetric examination is not possible, GE uses controls on the rotor metallurgy; the manufacturing; and the preservice inspection to limit undetected flaws in the rotor. Section 3.1.3 of the ST–56834/P report describes the preservice inspection and testing, which includes a 100 percent volumetric examination and a 100 percent surface examination (including the bore surface of the bored rotors).

As discussed in the GE ST-56834/P report, the probability of a missile generation is dominated by a turbine overspeed in the first 15 to 20 years of operation and by stress corrosion cracking (SCC) in an axial-entry dovetail slot bottom thereafter. Section 10.1.2 of the ST–56834/P report addresses the rotor dovetail inspections and recommends the following:

- magnetic particle surface examination of axial entry wheel dovetail faces
- ultrasonic examination of axial entry dovetail bottoms
- inspection of tangential entry dovetails (Stages 1 through 4) using a technique such as the phased array ultrasonic examination
- engineering disposition of flaw indications (and the possible removal of buckets for the additional surface examination)
- in-service inspection measurements used to recalculate a missile probability and to determine subsequent inspection intervals if necessary (e.g., if cracks are found)

The applicant's bounding missile probability analysis in the ST–56843/P Revision 4 report shows that the criterion of a 10^{-5} annual missile generation probability is met for both bored and solid rotors for a period longer than the proposed 12-year inspection interval. The staff finds that the applicant's proposed rotor inspection program, including the 12-year inspection interval, is consistent with the DCD and meets the missile probability criterion in SRP Section 3.5.1.3 for bounding material properties. The program is therefore acceptable.

The staff finds that the information in Section 10.2 of the COL FSAR describes the Turbine Maintenance and Inspection Program, which is used to satisfy the manufacturer's turbine missile generation probability calculation. The staff finds that the program description is consistent with the corresponding information in the DCD and meets the criteria in SRP Section 3.5.1.3, which is related to periodic inspection and testing. The applicant's information in STD COL 10.2-1-A as updated in the North Anna 3 FSAR Revision 8, is therefore acceptable with respect to valve maintenance, inspections, testing, and frequency of the Turbine Valve Inspection Program. Open Item 10.2-1, from the North Anna 3 Phase 2 SER is thus resolved and closed. The staff also evaluated these requirements and frequencies as part of the review of COL Item STD COL 10.2-2-A, the missile probability analysis, which is described below.

- STD COL 10.2-2-A Turbine Missile Probability Analysis

DCD COL Item 10.2-2-A requires the COL applicant to provide an evaluation of the probability of a turbine missile generation using criteria in accordance with NRC requirements (based, if necessary, on bounding material property values until the actual material specimens are available).

In FSAR Revision 1 Section 10.2.3.8, the applicant provided information to address DCD COL Item 10.2-2-A. This COL item states that the COL applicant will provide an evaluation of the main turbine missile generation analysis in accordance with the acceptance criterion of SRP Section 3.5.1.3. The applicant stated that the bounding analysis would be completed in the second quarter of 2009, and the FSAR would be revised to reflect this analysis as part of a subsequent FSAR update. The staff tracked this activity from the Phase 2 North Anna 3 SER as Open Item 10.2-2.

In the letter dated December 6, 2013, the applicant provided the bounding missile probability analysis report (GE ST–56834/P, Revision 4) to address DCD COL Item 10.2-2-A. According to this COL item, "The COL applicant will provide an evaluation of the probability of a turbine missile generation using criteria in accordance with NRC requirements. If necessary, bounding material property values may be used to perform the analysis until actual material test specimens are available for testing (Section 10.2.3.8)."

The staff reviewed the applicant's information on COL Item STD COL10.2-2-A, which is related to providing the turbine missile probability analysis using the criteria and guidance in Regulatory Guide (RG) 1.115, Revision 2 and in SRP Section 3.5.1.3 and Section 10.2.3. The staff's review of the turbine missile probability analysis included the sequential RAI responses in the Fermi 3 COLA (the response dated October 5, 2010, to RAIs 10.02.03-1 through 10.02.03-11 [ADAMS Accession No. ML102800185]; the response dated July 29, 2011, to RAIs 10.02.03-12 through 10.02.03-16 [ADAMS Accession No. ML112140345]; and the response dated October 28, 2011, to RAIs 10.02.03-17 through 10.02.03-19 [ADAMS Accession No. ML113050573]), which resulted in corresponding changes to the missile analysis report as summarized in the following paragraphs.

In the letter dated December 6, 2013, the applicant provided the bounding missile probability analysis report (GE ST–56834/P, Revision 4) for North Anna 3 that uses DTE's responses to RAIs concerning the same technical topic on the Fermi 3 COL docket, which is now part of the North Anna 3 COLA. The staff reviewed STD COL 10.2-2-A as submitted on the North Anna 3 COL docket and is similar to the staff's review of the Fermi 3 COLA and this technical topic on the Fermi docket, which includes the bounding missile probability analysis report (ST–56834/P Revision 4). In addition, the applicants supplemental letter dated September, 30, 2014, also identifies that the Fermi 3 RAI responses concerning this topic are now submitted on the docket as part of an incorporation by reference per 10 CFR 52.8(b). The Fermi 3 RAIs referred to are 10.02.03-3, 10.02.03-7, 10.02.03-8, 10.02.03-9, and 10.02.03-10. For Fermi 3 COL SER, Section 10.2.4 and for this section of the North Anna 3 SER, this information provides the OEM's missile probability calculation called for in DCD COL Item 10.2-2-A.

The staff noted that Revision 4 of ST–56834/P is referenced as the applicant's turbine missile probability analysis for the GE turbine generator, model number N3R-6F52. The analysis applies to both the Fermi 3 and North Anna 3 turbine generators.

The GE ST-56834/P report provides the analysis for the probability of generating missiles for GE turbine generator model number N3R-6F52, which the COL applicant specified in Supplemental Information STD SUP 10.2-1. GE ST-56834/P, Revision 4 provides the methodology, assumptions, and results of the turbine missile generation probability, along with the manufacturer's recommendations for in-service testing and inspections. The methodology is consistent with the GE report entitled, "Probability of Missile Generation in General Electric Nuclear Turbines," issued in January 1984, as approved by the NRC in Appendix U, "Probability of Missile Generation in General Electric Nuclear Turbines," to NUREG 1048, "Safety Evaluation

Report Related to the Operation of Hope Creek Generating Station," Supplement 6, issued July 1986. GE ST–56834/P, Revision 4 also updates data such as valve failure rates to demonstrate that the destructive overspeed analysis is conservative. The methodology used consists of calculating the probability of a turbine overspeed in conjunction with the probability of a rotor burst and the probability of a turbine rotor fragment penetrating the turbine casing. The failure modes assumed in the analysis include a ductile burst (destructive overspeed), a brittle fracture of a missed internal flaw growing to a critical size due to cyclic fatigue, and SCC at the rotor dovetails.

The material used for the rotor forgings is a nickel-chromium-molybdenum-vanadium (NiCrMoV) alloy. The staff first reviewed the detailed description of the material in Revision 2 of GE ST-56834/P, which states in Section 3.1 that the rotor material will be produced in accordance with GE material specification B50A373B8. The staff determined that Revision 2 of GE ST-56834/P did not provide enough details about the material properties, including the chemistry, as required by the ESBWR DCD. In addition, the staff's SER for ESBWR DCD (NUREG-1966) Section 10.2.3.2.3 states that the COL applicant will provide the material properties (e.g., sulfur and phosphorus content) as part of the turbine missile analysis. In the responses to Fermi 3 RAI 10.02.03-4 and RAI 10.02.03-12 dated October 5, 2010, and July 29, 2011, respectively; DTE states that the rotors for the subject turbine use GE material specification B50A373B8 or an equivalent specification with a more restrictive chemistry. The responses point out that this material has been used since the 1980s for numerous integral (nonbored) rotors, with no rotor failures. The responses also state that the geometry of the buckets has been modified since the 1980s to reduce the stresses, and the use of shot-peening applies compressive forces on the surfaces of the rotor to mitigate SCC.

However, the staff requested DTE to provide the material specification for the staff's review to ensure that the material specification, including the chemistry, is adequate to meet the guidance in SRP Section 10.2.3 concerning the chemistry and processing to ensure characteristics such as adequate fracture toughness for the turbine rotor. The DTE response to Fermi 3 RAI 10.02.03-12 dated July 29, 2011, clarifies that GE material specification B50A373B8 was revised to GE material specification B50A373B12. The only change in this revision (from B8 to B12) was to restrict the nickel range to achieve the desired material properties in nuclear nonbored monoblock rotor forgings. The staff conducted an audit of the GE material specification documented in an NRC memorandum dated September 26, 2011 (ADAMS Accession No. ML112640028). The audit confirmed that the material has been used since the 1980s for turbine rotors and was only revised to restrict the nickel range. The staff also confirmed that the material is a vacuum-treated NiCrMoV alloy with the amounts of alloying impurity elements in the range of typical modern nuclear turbines, which is consistent with Section 10.2.3.1 of the ESBWR DCD and SRP Section 10.2.3. Therefore, the staff found in Section 10.2.4 of the Fermi 3 SER that the material composition included in Revision 4 of GE ST-56834/P is acceptable and will be used for the procurement of the Fermi 3 and North Anna 3 turbine rotors.

In the response to Fermi 3 RAI 10.02.03-17 dated October 28, 2011, DTE refers to bounding material properties and states that Revision 4 of ST–56834/P was updated to include the bounding assumption of the minimum tensile strength in the material specification. The bounding fracture appearance transition temperature (FATT) value of -1.1 degrees Celsius (C) (+30 degrees Fahrenheit [F]) described in the ESBWR DCD and the applicable GE material specification B50A373B12 were also used in Revision 4 of the analysis, as discussed in DTE's response to Fermi 3 RAI 10.02.03-13 dated July 29, 2011. As stated in the response to Fermi 3 RAI 10.02.03-5 dated October 5, 2010, this FATT value of -1.1 degrees C (+30 degrees F) will be determined on the site-specific rotor forgings using deep-seated impact specimens machined from radial trepans between the rotor wheels to ensure that the specified FATT value in the internal rotor region is met. In addition, the responses to Fermi 3 RAIs 10.02.03-6 and 10.02.03-7 dated October 5, 2010, show that 11 nuclear turbine rotor forgings in the past 20 years have been tested and the corresponding FATT values were well below -1.1 degrees C (+30 degrees F) throughout the rotor forgings. Statistically, the forging data resulted in a mean FATT value of -36.7 degrees C (-34 degrees F) with a plus two-sigma value (two standard deviations) of 6.1 degrees C (+11 degrees F), which demonstrates that these large monoblock forgings can achieve the specified FATT value of -1.1 degrees C (+30 degrees F). Accordingly, the staff finds that the bounding material properties of the turbine rotor were used in the analysis.

In addition, in the response to Fermi 3 RAI 10.02.03-18 dated October 28, DTE clarified that the analysis used design overspeed stresses based on the postulated conditions and events in Section 7 of GE ST-56834/P. The design overspeed was clarified to be 120 percent of the rated speed in the October 5, 2010, response to Fermi 3 RAI 10.02.03-3, which is consistent with the ESBWR design overspeed. In the response to Fermi 3 RAI 10.02.03-15 dated July 29, 2011, DTE stated that the tangential stresses at the slot bottoms of the axial entry dovetails are lower than the previous shrunk-on-wheel keyways and therefore, the use of the shrunk-on-wheel crack initiation and growth characteristics is conservative. The Fermi 3 RAI response also stated that shot-peening the rotor imparts compressive stresses to remove tensile residual stresses on the surface, thereby reducing the occurrence of SCC. Therefore, based on the above information, the staff finds that the analysis used conservative and appropriate stresses in the turbine rotor.

The cyclic propagation of an assumed internal forging defect due to tangential stresses from mechanical and thermal loading was performed in the analysis. As stated in the response to Fermi 3 RAI 10.02.03-18 dated October 28, 2011, the loading was determined based on both normal and abnormal turbine speeds with an assumed annual cyclic loading resulting from starts, stops, and load swings of the turbine. These stresses were derived using a finite element analysis based on the geometry for the N3R-6F52 rotor using corresponding startup transient thermal loadings, as clarified in the response to Fermi 3 RAI 10.02.03-9 dated October 5, 2010.

The ST–56834/P report includes an analysis of a rupture of the turbine rotor due to SCC in the slot bottoms of the rotor dovetails for the axial entry dovetails. The crack growth rate of shrunk-on-wheel keyways was used as a conservative basis, because operating experience indicates that stresses at these keyways are higher than those in the current monoblock forgings. The tangential stress of the dovetail slots in the monoblock forgings is much lower than in the previous shrunk-on-wheel keyways, as illustrated in the October 5, 2010, response to Fermi 3 RAI 10.02.03-10. Also, shot-peening of the turbine rotor surfaces reduces residual stresses and adds compressive stresses to mitigate the occurrence of SCC, as discussed in the July 29, 2011, response to Fermi 3 RAI 10.02.03-15. The analysis demonstrated that the critical crack size in the dovetail slots would be reached in approximately 40 years and the crack size is well within the nondestructive inspection capabilities, as discussed in the July 29, 2011, response to Fermi 3 RAI 10.02.03-13.

The ductile tensile burst of the rotor was analyzed using the average tangential stress of each rotor stage and the corresponding tensile strength of the material. The minimum ultimate tensile strength of the material specification was used in order to be a bounding analysis.

These three failure modes—cyclic fatigue, SCC, and ductile tensile burst—were used to calculate the probability of rupturing the rotor; and they were then combined to achieve a single probability of rupturing a turbine rotor. This probability analysis was conducted for various scenarios and turbine speeds and the resulting probabilities of rupturing a rotor, combined with the probability of the ruptured rotor fragment penetrating the turbine casing, resulted in a final probability of generating a turbine missile. Figures 9-1 and 9-2 of ST–56834/P present the results of the annual probability of generating a turbine missile.

These annual probability results in Figures 9-1 and 9-2 of ST–56834/P demonstrate that the probability of generating turbine missiles is less than 10^{-5} for an inspection interval greater than 12 years. Therefore, the proposed inspection interval of 12 years, as stated in Section 10.1 of GE ST-56834/P, Revision 4, meets the criteria in RG 1.115, Revision 2. Section 10.1 of GE ST-56834/P, Revision 4 also provides the turbine manufacturer's recommendations for the inspection and maintenance program description for the turbine rotors, which includes the following:

- visual, magnetic particle, and ultrasonic examination of all accessible rotor surfaces
- visual and magnetic particle or liquid penetrant examination of all turbine blades
- visual and magnetic particle examination of couplings and coupling bolts

These inspection methods are consistent with ESBWR DCD, Section 10.2.3.6. As clarified in the response to Fermi 3 RAI 10.02.03-19 dated October 28, 2011, the turbine manufacturer also recommends that the rotor dovetail inspections detailed in Section 10.1.2 of ST–56834/P, Revision 4 be performed within a 12-year interval; because in Section 9 of ST–56834/P, Revision 4, GE determined that SCC in the dovetail slot bottoms controls the probability of generating a turbine missile after 20 years of operation. The staff finds that the proposed description of the inspection program and the inspection interval of 12 years are acceptable because they meet the criteria of RG 1.115, Revision 2 and are consistent with the guidelines of SRP Section 10.2.3, thus ensuring that the turbine rotor integrity will be maintained to preclude the generation of a missile.

As DTE clarified in the response to RAI 10.02.03-2 dated October 5, 2010, the Fermi 3 turbine generator uses a MARK VIe turbine generator control system (TGCS). This TGCS has the same functional design and component specifications as previous GE turbine generators, with improvements made based on operating experience. Some of the improvements detailed in the response to Fermi 3 RAI 10.02.03-11 dated October 5, 2010, include the use of direct mechanical connections to the valve stem to reduce the number of moving parts and eliminate potential linkage binding on the control and intercept steam valves. These direct linkages have also been used in current operating plants on the main stop valve and on intercept stop valves. In addition, this Fermi 3 response includes the steam valve failure rates based on failure assessment data reports collected in 1993 and 2008, which were used in ST–56834/P for the main stop and control valves and the intermediate stop and intercept valves. As stated in the response to Fermi 3 RAI 10.02.03-16 dated July 29, 2011, the improvements made after 1984 effectively reduced the probability of failures. The failure rates are listed in Section 5 of GE ST-56834/P, Revision 4.

Section 5.4.1 of ST–56834/P, Revision 4 provides the hydraulic system reliability model based on the following common failure modes: water contamination caused by leaking oil coolers and corrosion of non-stainless steel mechanical and/or electrical hydraulic trip valves. After 1984, GE made improvements to the designs and materials in current operating plants, such as using titanium hydraulic oil coolers and new hydraulic fluid conditioning equipment that resolved these common failure modes. However, the analysis used the pre-1984 hydraulic failure rate model as a conservative assumption, which bounds the improved hydraulic system proposed for the North Anna 3 turbine. The overspeed probability from valve failures was calculated for valve test intervals of 90 and 120 days and resulted in similar annual missile probabilities, which were provided in the response to Fermi 3 RAI 10.02.03-16 dated July 29, 2011. The overspeed probability for a valve test interval of 120 days was well within the criteria of 10^{-5} per year specified in RG 1.115, Revision 2 and the guidance in SRP Section 3.5.1.3. The staff therefore finds the 120-day test interval acceptable because it meets the annual missile probability criteria of 10^{-5} per year in RG 1.115, Revision 2 and the specified guidelines in SRP Section 3.5.1.3 and Section 10.2.3, which ensure that the turbine rotor integrity is maintained to preclude the generation of missiles.

Based on the above discussion, the staff finds that the applicant's referenced turbine missile probability analysis in ST–56834/P, Revision 4 provides an acceptable analysis that substantiates the turbine manufacturer's recommendations, for inspecting and testing the turbine rotor and associated valves using the criteria in RG 1.115, Revision 2. The staff therefore determined that the applicant has adequately addressed COL Item STD COL 10.2-2-A, in the North Anna 3 FSAR Revision 8, with respect to evaluating the probability of a turbine missile generation using criteria in accordance with NRC requirements. Open Item 10.2-2 from the staff Phase 2 North Anna 3 SER is thus resolved and closed.

Supplemental Information

- STD SUP 10.2-1 Turbine Design

In FSAR Section 10.2.3.4, the applicant states that GE will manufacture the turbine and the generator for North Anna 3. The applicant selected turbine Model N3R-6F52, which is one of GE's N series nuclear steam turbines. The staff finds this turbine design model acceptable because GE has provided an acceptable turbine missile analysis for this model, as discussed above in the evaluation of STD COL 10.2-2-A.

10.2.5 Post Combined License Activities

There are no post COL activities related to this section.

10.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the turbine generator, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the turbine generator that were incorporated by reference have been resolved.

In addition, the staff compared the supplemental information in the COLA to the relevant NRC regulations, the guidance in SRP Sections 10.2 and 10.2.3, and NRC RGs. The staff's review confirmed that the applicant has adequately addressed the COL license information items in the ESBWR DCD. For the reasons set forth above, the staff concluded that the information in this section of the COL FSAR is acceptable and meets the requirements of GDC 4. Specifically, the staff evaluated COL Items STD COL 10.2-1-A and STD COL 10.2-2-A according to the relevant NRC regulations and acceptance criteria in SRP Section 10.2.3 and Section 3.5.1.3. The staff finds that the applicant has satisfactorily addressed DCD COL Item 10.2-1-A, because the proposed maintenance and inspection program is consistent with the corresponding information in the DCD and meets the criteria in SRP Section 3.5.1.3 related to periodic inspection and testing. The staff also finds that the applicant has satisfactorily addressed DCD COL Item 10.2-2-A, because the turbine missile probability analysis in GE ST–56834/P, Revision 4 provides the turbine manufacturer's recommendations for inspecting and testing the turbine rotor and associated valves using the criteria in RG 1.115, Revision 2. Additionally, the staff reviewed Supplemental Information STD SUP 10.2-1, which provides the turbine model number. The staff's review finds this supplemental information acceptable because the applicant has provided an acceptable turbine missile analysis for this turbine model, as discussed in the evaluation of COL Item STD COL 10.2-2-A.

10.3 Turbine Main Steam System

Section 10.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the turbine main steam supply system that were incorporated by reference have been resolved.

10.4 Other Features of Steam and Power Conversion System

This section of the COL FSAR describes other features of the steam and power conversion system.

The main condenser system (Section 10.4.1) functions as the steam cycle heat sink in receiving, condensing, and deaerating steam from the main turbine and other vents and drains in the steam cycle system.

The main condenser evacuation system (Section 10.4.2) establishes and maintains the main steam condenser vacuum and removes noncondensable gases and air from the main condenser.

The turbine gland seal system (Section 10.4.3) prevents air leakage into and steam out of the annulus space between the turbine and steam valve shafts.

The turbine bypass system (Section 10.4.4) enables a system to allow some main steam flow directly to the main condensers, thus bypassing the turbine.

The circulating water system (CWS) (Section 10.4.5) provides a continuous supply of cooling water to the main condenser.

The condensate purification system (CPS) (Section 10.4.6) purifies the condensate and minimizes corrosion/erosion products in the power conversion cycle.

The condensate and feedwater system (Section 10.4.7) supplies high-purity feedwater to the reactor at the required flow rate, pressure, and temperature.

10.4.1 Main Condenser

Section 10.4.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.1, "Main Condenser," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the main condenser that were incorporated by reference have been resolved.

10.4.2 Main Condenser Evacuation System

Section 10.4.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.2, "Main Condenser Evacuation System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the main condenser evacuation system that were incorporated by reference have been resolved.

10.4.3 Turbine Gland Seal System

Section 10.4.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.3, "Gland Seal Steam System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the turbine gland seal system that were incorporated by reference have been resolved.

10.4.4 Turbine Bypass System

Section 10.4.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.4, "Turbine Bypass System," of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the turbine bypass system that were incorporated by reference have been resolved.

10.4.5 Circulating Water System

10.4.5.1 Introduction

The CWS provides cooling water for the removal of the power cycle heat from the main condensers and transfers this heat to the normal power heat sink.

10.4.5.2 Summary of Application

Section 10.4.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.5 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 10.4.5.2.1, the applicant provides the following conceptual design information (CDI):

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI Circulating Water System

The applicant replaced the CDI in the DCD with a detailed description of the site-specific system for North Anna 3.

10.4.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, SRP Section 10.4.5 contains the relevant requirements of the Commission's regulations for the CWS and the associated acceptance criteria.

10.4.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 10.4.5 of the certified ESBWR DCD. The staff reviewed Section 10.4.5 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of the information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Site-Specific Information Replacing Conceptual Design Information

- NAPS CDI Circulating Water System.

The staff reviewed the NAPS CDI related to the design description and operation of the CWS in FSAR Section 10.4.5. The staff's reviews of the specific CDI sections are provided below.

- NAPS CDI FSAR Section 10.4.5.2.1, "General Description"

In FSAR Section 10.4.5.2.1, the applicant described the CWS by replacing the CDI in the DCD with a more detailed general description of the site-specific system proposed for Unit 3. The applicant provided the design for the condenser water boxes, piping, and valves; condenser tube cleaning equipment; water box drain subsystem; circulating water pumps; screens; and cooling towers. The system configuration for the CWS is depicted in FSAR Figures 10.4-201 through 10.4-203, which replaces the conceptual diagram in Figure 10.4-1 of the DCD.

FSAR Section 10.4.5.2.1 describes the CWS, which consists of four motor-driven pumps, each with the capability of pumping 25 percent of the CWS design water flow; a dry-cooling tower array; one combination (hybrid) of a wet/dry mechanical draft cooling tower; and associated piping, valves, and instrumentation. The CWS and the dry- and hybrid-cooling towers provide a heat sink for waste heat exhausted from the main steam turbine. The four motor-driven pumps normally circulate the water through the condenser and back to the cooling towers. Depending on ambient conditions and heat load, one CWS pump may be taken out of operation with the flow of the remaining three pumps providing sufficient water for condenser heat removal. The four pumps are arranged in parallel and the discharge line of each pump is fitted with a remotely operated valve. This arrangement permits the isolation and maintenance of any one pump while the other pumps remain in operation and minimizes the backward flow through a tripped pump. The staff's review of the design information in FSAR Section 10.4.5.2.1 finds that the applicant has addressed the final configuration of the North Anna 3 CWS, as specified in Section 10.4.5.2.1 of ESBWR DCD, Revision 10.

Also, in FSAR Table 10.4-3R, "Circulating Water System," the applicant provides site-specific parameters to replace the values in ESBWR DCD, Table 10.4-3. The staff finds that the operating temperatures and circulating water pump information in FSAR Table 10.4-3R are acceptable, because they are bounded by the design values of these parameters in the DCD.

Furthermore, the CWS design includes vents to help fill in and remove air and other gases from the condenser water-boxes during startup and normal operations. The system includes design features such as slow-stroke, motor-operated valves; air- and vacuum-release valves; and control and interlock features that ensure proper valve lineup between the pump's discharge valves and consistency between the pump's startup and shutdown (stop signals) sequences. The staff determined that these provisions will minimize hydraulic transients, including water hammer, during startup and normal operations of the system because they are located and sized so as to be capable of performing the required functions. Accordingly, the staff finds that these vents, air releases, and vacuum relief valve provisions in the CWS adequately address the requirements of GDC 4; as it relates to the design features to accommodate the effects of discharging water, and to prevent water hammer and subsequent CWS piping or component failures from occurring at pump startup from initial system depressurization.

- NAPS CDI FSAR Section 10.4.5.2.2, "Component Description"

In FSAR Section 10.4.5.2.2, the applicant provided information regarding industry codes and standards that are applicable to the CWS design. In FSAR Section 10.4.5.2.2, Revision 0, the applicant stated that the codes and standards applicable to the CWS are in accordance with DCD Section 3.2; with the exception of large-bore piping (i.e., piping with a nominal diameter of 700 millimeters [27.6 inches] and larger). The applicant further stated that the large-bore CWS piping is constructed using American Water Works Association (AWWA) standards, and the system is designed and constructed in accordance with Quality Group D specifications.

However the staff finds that Table 3.2-3 of the DCD specifies American Society of Mechanical Engineers (ASME) Standard B31.1, "Power Piping," for Quality Group D piping. Also, RG 1.26, Revision 4, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Revision 4, issued March 2007, recommends ASME Standard B31.1 2004. In accordance with SRP Section 10.4.5 Review Procedures Item 1, design provisions are to be incorporated that minimize the effects of hydraulic transients on the functional capability and integrity of the components of the system. Therefore, in RAI 10.4.5-1 dated June 23, 2008 (ADAMS Accession No. ML081750645), the staff asked the applicant to justify the above deviation from the DCD and its compliance with the applicable regulations. In addition, the staff asked the applicant to explain and ensure that the failure of this large-bore piping will not affect the intended functions of safety related equipment and systems.

In its response to RAI 10.4.5-1 dated August 7, 2008 (ADAMS Accession No. ML082240134), the applicant stated that it was not necessary to take an exception to DCD Section 3.2 and that it would revise FSAR Section 10.4.5.2.2 to delete this exception for large bore piping. Later, the staff confirmed that the above exception was deleted in FSAR, Revision 1. In addition, according to FSAR, Revision 8, the codes and standards in ESBWR DCD Section 3.2 are incorporated by reference into FSAR Section 10.4.5.2.2. Based on the above discussion, the staff finds that the applicant's response to RAI 10.4.5-1 is acceptable and that the staff's concerns are resolved and closed.

In FSAR Table 10.4-3R, the applicant provided site specific parameters to replace the values in ESBWR DCD Table 10.4-3. The staff finds that the operating temperatures and circulating water pump information in FSAR Table 10.4-3R are acceptable because this system does not perform any safety function and the system's failure cannot affect any safety system function.

- NAPS CDI FSAR Section 10.4.5.2.2.1, "CWS Chemical Injection"

FSAR Section 10.4.5.2.2.1 provides information about the chemical injection in the CWS that is not included in the DCD. The proposed chemical injection maintains a noncorrosive, non-scale forming condition within the CWS and ensures that any biological film growth that may affect the cooling tower and condenser heat transfer rate does not occur. Circulating water chemistry is maintained by the chemical storage and transfer system. Chemical feed equipment injects the chemicals used into the circulating water at the pump bay before water enters the circulating water pumps or into the circulating water cooling tower basin. FSAR Table 2.2-202 specifies the chemicals to be used within the system such as sodium hypochlorite, acid, bromide, dispersants, and non-oxidizing biocides, which are all compatible with selected materials or components used in the CWS. These chemicals are based upon five functions: biocide, algaecide, pH adjuster, corrosion inhibitor, and scale inhibitor. The pH adjuster, corrosion inhibitor, and scale inhibitor are metered into the system continuously or as needed to maintain proper concentrations. Biocide application frequency may vary with seasons; and algaecide is applied as needed to control algae formation in the cooling towers. Circulating water chemistry is also controlled as needed with blowdown.

The staff reviewed the information in the FSAR and finds that the applicant has adequately identified the chemicals to be used for the chemical treatment of CWS materials. The applicant also specifies the criteria that will ensure compatibility with the system materials. Furthermore, the identified chemicals will perform the appropriate functions to minimize the fouling of heat transfer surfaces and the corrosion of the CWS. Although the NRC has no specific regulatory criteria for the CWS materials and chemistry, the use of materials that are corrosion-resistant in the environment and water treatment chemicals that are compatible with system materials ensures that corrosion and biological film growth will not affect the condenser heat transfer rate.

- NAPS CDI FSAR Section 10.4.5.2.3, "System Operation"

In FSAR Section 10.4.5.2.3, the applicant described the site-specific CWS operation. The applicant stated that blowdown flow from the CWS is discharged into the plant discharge canal at a maximum temperature of 37.8 degrees C (100 degrees F). The applicant stated that leakage from the main condenser into the CWS via a condenser tube leak is not likely during power operation, because the CWS normally operates at a greater pressure than the shell (condensate) side of the condenser. The staff finds the applicant's discussion of the CWS operation acceptable.

- NAPS CDI — FSAR Section 10.4.5.5, “Instrumentation Applications”

The applicant provided the following additional measurement capability:

(1) level instrumentation in the circulating water pump forebay where the CWS pumps take suction and provide alarms in the main control room upon abnormally low or high water levels

(2) pressure indications on the CWS pump discharge and differential pressure instrumentation across the inlet and outlet to the condenser to determine the frequency of operating the condenser tube cleaning system

(3) local grab sample locations to enable periodic testing of the circulating water quality

The staff finds these additional new instrumentation and test practices acceptable, because they enhance the design and operational capability of the CWS.

- NAPS CDI — FSAR Section 10.4.5.6, “Flood Protection” and FSAR Section 10.4.5.8, “Normal Power Heat Sink”

FSAR Section 10.4.5.8 describes the site-specific normal power heat sink, which consists of the combined dry-cooling tower array and a hybrid wet/dry-cooling tower. The combination of dry- and hybrid-cooling tower arrangements supports a condenser-inlet maximum cold water temperature of 37.8 degrees C (100 degrees F). The station water system supplies makeup water to the CWS resulting from losses in evaporation and blowdown. The dry- and hybrid-cooling towers are both located at a distance from seismic Category 1 and 2 structures that is at least equal to their height. Therefore, there is no potential for the cooling towers to fall or damage safety-related structures or components. Both the dry- and the hybrid-cooling towers use fans; a failure of the fans could generate missiles. The applicant stated that the site arrangement and cooling tower construction will prevent damage to any seismic Category 1 or 2 structures or to any safety-related SSCs from possible missiles generated by the failure of a cooling tower mechanical fan, because the fans rotate at relatively slow speeds and the fan blades are made of relatively low-density material. Even if a failure of a fan could result in the generation of missiles, any damage would be confined to the cooling towers because of the site arrangement and construction of the respective towers.

However, in Revision 0 of the FSAR, the applicant did not specifically address flooding considerations from a hybrid-cooling tower failure in the application. Also, the applicant initially did not provide any information with respect to Section 10.4.5.6 of the DCD. In accordance with SRP Section 10.4.5 Acceptance Criterion Item 1, design provisions need to be provided to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. Therefore, the staff requested the applicant in RAI 10.4.5-2 (ADAMS Accession No. ML081750645), dated June 23, 2008, to provide additional information regarding the cooling tower failure analysis. In the response to RAI 10.4.5-2 (ADAMS Accession No. ML082240134), dated August, 7, 2008, the applicant stated that a failure of a pipe or component in the hybrid-cooling tower or other CWS piping in the yard would not have an adverse impact on safety-related SSCs. The bounding piping failure for the hybrid-cooling tower is a failure of the two vertical large-bore CWS pipes that connect to the distribution header of the hybrid-cooling tower. In this failure scenario, the site grading will divert the flow of water from the ruptured pipes away from the plant to the drainage ditch on the west side of the cooling tower area. A failure of the hybrid-cooling tower basin will not lead to any discharge of water to the surface, because it is an in-ground structure. The maximum water level elevation in the basin is lower than the elevations of the surrounding areas. If a surface discharge were to occur, the water would flow away from the plant toward Lake Anna.

The staff finds that the applicant's response to RAI 10.4.5-2 provides acceptable design provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS, in that a failure scenario from the cooling tower water would flow to the west side of the tower and away from the plant. The staff's concern described in RAI 10.4.5-2 is thus resolved. The staff confirmed that Revision 1 of the FSAR includes this additional information. Therefore, the staff finds that the conclusions in the ESBWR DCD FSER (NUREG–1966) regarding the requirements of GDC 4 and SRP guidance remain valid with respect to flooding.

10.4.5.5 Post Combined License Activities

There are no post COL activities related to this section.

10.4.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information related to the CWS, and that no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the CWS that were incorporated by reference have been resolved.

In addition, the staff compared the supplemental information in the COLA to the relevant NRC regulations, the guidance in SRP Section 10.4.5, and other NRC RGs. The staff's review concludes that the applicant has adequately addressed the site-specific CDI for the CWS, in accordance with the guidance in SRP Section 10.4.5 and RG 1.26 and meets the requirements of GCD 4.

10.4.6 Condensate Purification System

10.4.6.1 Introduction

This FSAR section includes information related to the purification and treatment of condensate, as needed, to maintain reactor feedwater purity. The CPS uses filtration to remove suspended solids, including corrosion products, and ion exchange to remove dissolved solids and other impurities.

10.4.6.2 Summary of Application

Section 10.4.6 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.6 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 10.4.6, the applicant provides the following:

COL Item

- STD COL 10.4-1-A Leakage (Circulating Water into the Condenser)

The applicant provided threshold values and recommended operator actions for chemistry excursions in the condensate system to address this COL item.

10.4.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of Commission regulations for the CPS and associated acceptance criteria are in SRP Section 10.4.6.

The applicable regulatory requirements and associated guidance for the CPS are as follows:

- GDC 14, "Reactor coolant pressure boundary," as it relates to the reactor coolant pressure boundary being designed, fabricated, erected, and tested; so as to have an extremely low probability of an abnormal leakage, a rapidly propagating failure, and a gross rupture.

- Electric Power Research Institute (EPRI) Report NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines," 1987 Revision.

10.4.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 10.4.6 of the certified ESBWR DCD. The staff reviewed Section 10.4.6 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of the information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 10.4-1-A Leakage (Circulating Water into the Condenser)

The applicant provided threshold values and recommended operator actions to address STD COL 10.4-1-A in FSAR Table 10.4-201, "Recommended Water Quality and Action Levels."

FSAR Table 10.4-201 summarizes the manufacturer's recommended threshold values of the chemistry parameters and the associated operator actions. These parameters enable the operation of the system within the EPRI Boiling-Water Reactor (BWR) water chemistry guidelines. The staff finds the applicant's information addressing COL Item STD COL 10.4-1-A acceptable, because the chemistry parameters meet the recommendations of SRP Section 10.4.6 and the EPRI BWR water chemistry guidelines.

10.4.6.5 Post Combined Operating License Activities

There are no post COL activities related to this section.

10.4.6.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG 1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information related to the CPS and that no outstanding information related to this section is expected to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues related to the CPS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COL application to the relevant NRC regulations, the guidance in SRP Section 10.4.6, and other NRC RGs and industry standards. The staff's review concludes that the information in this section of the North Anna 3 COL FSAR is acceptable and meets the NRC endorsed EPRI guidelines for BWR water chemistry and the requirements of GDC 14. The staff evaluated COL Item STD COL 10.4 1 A and Supplemental Information North Anna 3 SUP 10.4 1 in this section. The staff finds that the applicant has satisfactorily addressed these items.

10.4.7 Condensate and Feedwater System

Section 10.4.7 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 10.4.7, "Condensate and Feedwater System," of the certified ESBWR DCD, Revision 10, without any departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue related to this section remains for review.[1] The staff's review confirms that no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

References

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

3. 10 CFR Part 50, Appendix A, GDC 14, "Reactor coolant pressure boundary."

4. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and dynamic effects design bases."

5. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

6. ASME B31.1-2004, "Power Piping."

7. EPRI Report NP-4947-SR, "BWR Hydrogen Water Chemistry Guidelines," 1987 Revision.

8. GE ST-56834/P, "ESBWR Steam Turbine - Low Pressure Rotor Missile Generation Probability Analysis," Revision 4, October 18, 2011.

9. NRC RG 1.115, Revision 2, "Protection against Turbine Missiles," January 2012 (ADAMS Accession No. ML101650675).

10. NRC RG 1.26, Revision 4, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," March 2007.

11. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

12. NRC Staff NUREG-1048, "Safety Evaluation Report Related to the Operation of Hope Creek Generating Station," Supplement 6, Appendix U, "Probability of Missile Generation in General Electric Nuclear Turbines," July 1986.

13. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

11.0 RADIOACTIVE WASTE MANAGEMENT

11.0 RADIOACTIVE WASTE MANAGEMENT

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 radioactive waste management systems (RWMS) designed to control, collect, handle, process, store, and dispose of liquid, gaseous, and solid wastes that may contain radioactive materials. The systems include the instrumentation used to monitor and control the release of radioactive effluents and wastes and are designed for both normal operations (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection; and calibration) and anticipated operational occurrences (AOOs) (activities such as tripping of the turbine generator set, isolation of the main condenser, and loss-of-offsite power).

11.1 Source Terms

This section of the North Anna 3 Combined License (COL) final safety analysis report (FSAR) addresses sources of radioactivity that are generated within the core and have the potential of leaking into the reactor coolant system during normal operation, including an AOO, by way of defects in the fuel cladding. There are two types of source terms for the reactor primary coolant and steam. The first addresses the design basis, and the second describes the anticipated average concentrations in reactor coolant and steam over the life of a boiling-water reactor.

Section 11.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference with no departures or supplements Section 11.1, "Source Terms," of Revision 10 of the Design Control Document (DCD) for the Economic Simplified Boiling-Water Reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The staff reviewed the application and checked the referenced DCD to ensure that no issues relating to this section remained for review.[1] The staff's review confirmed that there are no outstanding issues related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the source term have been resolved.

11.2 Liquid Waste Management System

11.2.1 Introduction

The liquid waste management system (LWMS) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as a result of normal operations, including AOOs. The LWMS is designed to reduce and control radioactive releases into the environment. The LWMS is comprised of four types of major subsystems that are permanently installed equipment connected to other plant equipment, thus permitting liquid wastes from various plant systems to be segregated and processed separately:

1) equipment (low conductivity) drain subsystem;
2) floor (high conductivity) drain subsystem;
3) chemical drain subsystem; and
4) detergent drain subsystem.

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[1]See *"Finality of Referenced NRC Approvals"* in in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

The LWMS processing subsystems rely on mixed bed demineralizers, charcoal filters and beds and cartridge filters, reverse osmosis, and organic and neutralization treatments. Cross-connections between radwaste subsystems provide additional flexibility in processing wastes by alternate methods and provide redundancy if one subsystem is inoperative. The LWMS is located in the radwaste building (RWB). The LWMS is designed to process the maximum design basis input in one week, assuming a 40-hour work week, or processing one tank of liquid waste in one operating shift. Releases from the LWMS are conducted as each batch releases through a single liquid waste discharge line. The LWMS is equipped with radiation monitoring instrumentation that automatically terminates effluent releases if radioactivity levels in discharges exceed effluent concentration limits under 10 CFR Part 20. The system provides for sampling at several process points, administrative controls, and detection and alarm of abnormal conditions against accidental discharges in the environment. Radioactive liquid wastes are collected in various collection sumps and tanks located within the plant. Airborne releases from LWMS components (e.g., tanks) and ventilation exhaust systems servicing radiologically controlled areas are conducted through the radioactive waste vent stack, which is evaluated in Subsection 11.3.4 of this SER.

11.2.2 Summary of Application

Section 11.2 of the North Anna 3 COL FSAR incorporates by reference Section 11.2 of the ESBWR DCD, Revision 10. In addition, in FSAR Section 11.2 and Part 7, "Departures Report," the applicant provided the following departures, exemptions, and supplements.

Exemption and Tier 1 and Tier 2 Departures

- Exemption 4: Design Of The Cooling Tower Blow-Down Line

The applicant proposed a site-specific Tier 1 DCD departure from DCD Tier 1, Section 2.10.1, "Design Description," in regards to the design of the cooling tower blow-down line.

- NAPS DEP 12.3-1 Liquid Radwaste Effluent Discharge Piping Flow Path

This departure will change the North Anna 3 liquid effluent discharge pathway description to the environment as described in the DCD as Tier 2 information. The liquid effluent discharges from the LWMS to the environment will use only the liquid radioactive waste effluent discharge pipeline and not discharge the processed liquid effluent into the cooling tower blow-down line and then on to the environment. This departure will simplify design and construction of the cooling tower blow-down line.

COL Items

- STD COL 11.2-1-A Implementation of Inspection and Enforcement (IE) Bulletin 80-10

This COL item addresses LWMS subsystem interfaces and connections that are considered nonradioactive but that could later become radioactive through improper interfaces with radioactive systems, as described in the guidance and information in Inspection and Enforcement (IE) Bulletin 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release to Environment," dated May 6, 1980.

- STD COL 11.2-2-A Implementation of 10 CFR 20.1406

This COL item addresses compliance with 10 CFR 20.1406, “Minimization of Contamination,” as it relates to the design and operational procedures of LWMS treatment subsystems. In Subsection 11.2.2.3 of the North Anna 3 COL FSAR, the applicant provided additional information identifying various sections of the FSAR (Sections 12.3, 13.5, 12.4, and 12.5) that address how to comply with the requirements of 10 CFR 20.1406.

Supplemental Information

- NAPS SUP 11.2-1 Implementation of Section II.D of Appendix I to 10 CFR Part 50 (Cost-Benefit Analysis)

Section 11.2.1 of the North Anna 3 COL FSAR provides plant-and site-specific cost-benefit analysis. The cost-benefit analysis is based on the guidance of Regulatory Guide (RG) 1.110, “Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for Comment),” issued in March 1976. RG 1.110 describes the results that demonstrate compliance with the as low as is reasonably achievable (ALARA) cost-benefit requirements in Section II.D of Appendix I, “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion As Low as is Reasonably Achievable for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents,” to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities.” The supplemental information presents a cost-benefit analysis demonstrating that any augmentation of the LWMS treatment subsystem is not cost beneficial. The applicant provided additional information regarding the cost parameters used to determine the total annual cost for the lowest cost systemic augmentation and concluded that no augmentations would be cost beneficial.

- NAPS SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the North Anna 3 COL FSAR, the applicant provided supplemental information addressing the monitoring program for the LWMS and plant blow-down underground piping. This supplemental information describes features to reduce the potential for unmonitored and uncontrolled releases to the environment. Nuclear Energy Institute (NEI) 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” is also cited as a reference and template for monitoring for leakage downstream of LWMS connections. FSAR Section 12.3.1.5.2 also describes the ground water monitoring program.

- Branch Technical Position 11-6 Postulated Radioactive Releases Due to Liquid-containing Tank Failures

The review of the impacts of an accidental release of radioactive liquids in groundwater or surface water and effects on existing users or likely future users of groundwater or surface water resources is performed using the guidance in NUREG–0800, Standard Review Plan (SRP) Sections 2.4.1, “Hydrologic Description”; 2.4.12, “Groundwater”; and 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters”; and information and guidance from Branch Technical Position (BTP) 11-6, “Postulated Radioactive Releases Due to Liquid-containing Tank Failures”. BTP 11-6 provides guidance in assessing, in accordance with 10 CFR Part 20 concentration limits, a potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

- ISG-013 — Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks

Interim Staff Guidance (ISG)-013, issued January 2013, is used for "Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks," for a COL application (COLA). The purpose of this ISG is to clarify previous NRC guidance regarding reviewing the analysis of the radiological consequences of accidental releases of radioactive materials to groundwater and surface water. Such analyses are required as part of the licensing review for new nuclear power reactor applications under 10 CFR Part 50 and 10 CFR Part 52. SRP Sections 2.4.13 and 11.2, and BTP 11-6, describe acceptable guidance on how to assess the radiological consequences of such releases.

11.2.3 Regulatory Basis

The regulatory basis for information incorporated by reference is in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," (the Final Safety Evaluation Report related to the ESBWR DCD). In addition, the relevant requirements of the Commission regulations for the LWMS, and the associated acceptance criteria, are in SRP Section 11.2.

The staff also followed the guidance in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," issued in June 2007, to evaluate Section 11.2 of the North Anna 3 FSAR for compliance with NRC regulations.

An applicant who seeks to depart from information in Tier 1 of a DCD for a certified standard design must request an exemption, as does an applicant who believes its proposed design need not comply with one or more NRC regulations. Exemptions are submitted pursuant to 10 CFR 52.7 and 52.93 and special circumstances as defined in 10 CFR 50.12(a) must be present.

In particular, the regulatory basis for the acceptance of the COL items and supplementary information on the LWMS appears in the following:

- Appendix B, "Annual Limits on Intake and Derived Air Concentrations of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage," to 10 CFR Part 20, "Standards for Protection against Radiation";

- 10 CFR 20.1406;

- 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents—nuclear power reactors";

- Sections II.A and II.D of Appendix I to 10 CFR Part 50;

- 10 CFR Part 52.63(b)(1); and

- 10 CFR 52.93, exceptions and variances.

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

- ISG-013, SRP Sections 2.4.13 and 11.2 with BTP 11-6 address the radiological consequences of an accidental release of radioactive liquid to the environment. The focus and objective of each guidance document, however, is different.

- BTP 11-6, SRP Section 11.2, “Liquid Waste Management System,” and BTP 11-6, “Postulated Radioactive Releases Due to Liquid-Containing Tank Failures,” as they relate to the assessment of radiological impacts associated with liquid effluent releases.

- RG 1.109, Revision 1, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I,” issued October 1977.

- RG 1.110, Revision 1, “Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors,” issued October 2013.

- IE Bulletin 80-10

- NEI 08-08A, “Nuclear Energy Institute, Generic FSAR Template Guidance for Life Cycle Minimization of Contamination.” (ADAMS Accession Nos. ML093220461, ML093220530).

11.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 11.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic[1]. The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to the LWMS.

In addition, the staff reviewed the applicant’s proposed resolution to the departures, exemptions, COL items, and supplemental information, in the North Anna 3 COL FSAR, Section 11.2 and in the COL Part 7, “Departures Report” as follows.

Exemption and Tier 1 and Tier 2 Departures

- Exemption 4: Design Of The Cooling Tower Blow-Down Line

As permitted by 10 CFR 52.7 and Section VIII.A.4 of the Design Certification Rule, an exemption is requested for certain information described in ESBWR DCD Tier 1, Section 2.10.1, “Design Description.” The last sentence of the fourth paragraph states: “The LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system.” This description is revised to: “The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline." This departure is included in Section 11.2.3.2. This departure also changes the label in FSAR Figure 11.2-1bR to: "Discharge via Radiation Monitor to Liquid Radwaste Effluent Discharge Pipeline." DCD Section 12.3.1.5.1, "Design Considerations," indicates the "Cooling Tower Blowdown Line" is one of four piping segments designed to contain radioactive materials, will have to run underground, and will be designed to preclude inadvertent or unidentified leakage to the environment. DCD Tier 1 describes the use of the circulating water system for discharge of LWMS effluent. The applicant requests an exemption from DCD Tier 1 information in Part 7 of the COLA (Exemption 4).

The ESBWR DCD Tier 1, Section 2.10.1, describes that the LWMS discharges processed water "to the environment via the circulating water system." This description refers to the expected use of the cooling tower blow-down line in the circulating water system to transfer liquid radwaste effluent to the environment. To simplify the design of the cooling tower blow-down line for North Anna 3, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blow-down line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB to the environment. As a result, an exemption from ESBWR DCD, Tier 1 to revise the discharge piping information for the LWMS was requested by the applicant.

An exemption must be obtained if information proposed in the COLA is inconsistent with one or more NRC regulations. Exemptions are submitted pursuant to 10 CFR 52.7 and 10 CFR 52.93 and must comply with the special circumstances in 10 CFR 50.12(a).

Pursuant to 10 CFR 52.7 and Section VIII.A.4 of the Design Certification Rule, Dominion requests an exemption from ESBWR DCD, Tier 1 information. The applicant proposed this exemption to allow Departure 12.3-1. The basic exemption request is to change the last sentence of the fourth paragraph. The sentence reads: "The LWMS either returns processed water to the condensate system or discharges to the environment via the circulating water system". This description would be changed to read: "The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline."

This departure refers to the initial expected Tier 1 design of the cooling tower blow-down line in the circulating water system to provide dilution water flow to transfer liquid radwaste effluent to the environment and at the same time decrease the concentration and liquid effluent dose to the environment by maintaining at least a dilution factor (DF) of 1000.

In a Request for Additional Information (RAI) 11.02-8, dated November 14, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML14318A620), the staff requested that the applicant provide information concerning the "independent dilution pump," its location, general procedure for use, interlocks, actuations and capabilities. This information should be able to support and maintain the liquid effluent release DF of 1000 for North Anna 3, with or without the dilution flow from Units 1 and 2. This information should also be described in the FSAR.

In its response to RAI 11.02-8, dated January 8, 2015 (ADAMS Accession No. ML15009A235), the applicant stated that the LWMS will be designed to recycle all processed water with a goal to operate North Anna 3 as a zero liquid release plant. Under some conditions such as high water inventory some liquid effluent release may be required (Reference FSAR Section 12.2.2.3). Liquid effluent releases are batch processes that are considered to be infrequent evolutions, and a liquid effluent release from North Anna 3 will be procedurally controlled to occur when adequate dilution flow is available. FSAR Section 11.2.3.2 describes that a release point DF of 1000 (minimum) is maintained, with dilution flow provided by either Units 1 or 2's circulating water system or an independent dilution pump. FSAR Section 11.2.3.2 was written to provide the option to use an alternate dilution method, an independent dilution pump, in the event circulating water flow from Units 1 and 2 was unavailable (e.g., both units shut down and their circulating water systems out of service). However, Dominion does not intend to install an alternate method of providing dilution and will rely on the existing Units 1 and 2 circulating water systems to provide the required dilution flow.

Additionally, in an RAI 12.03-55 (ADAMS Accession No. ML14318A573), dated November 14, 2014**,** the staff requested additional design information concerning the changes to be made to accommodate the new liquid effluent release point. These questions related to: 1) providing drawings and distances for the routing of the radwaste effluent discharge line, 2) questions on whether the discharge line is accessible for inspection, how much of the line is buried, how it will be monitored for leak detection, 3) the material and diameter of the discharge line, 4) at what point will the dilution in the route of the discharge line be input, 5) what criteria will be used for dilution from the independent dilution pump or the Unit 1 and 2 circulating water system, 6) what design features will be employed to meet the requirements of 10 CFR 20.1406, and 7) clarify the use of in-line components in this radwaste effluent discharge line. These specific items related to the radwaste effluent discharge line are addressed in Section 12.3 of this SER.

To simplify the design of the cooling tower blow-down line, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blow-down line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment. In order to maintain a DF of 1000 while releasing liquid radwaste effluent to the environment, the applicant must ensure that the circulating water system from Units 1 and 2 must be turned on. The applicant, by providing dilution water flow to maintain a DF of 1000 during liquid effluent releases from North Anna 3, has met the effluent release requirements as described in the application. An exemption from DCD Tier 1 to revise the discharge piping information for the LWMS is acceptable by the staff based upon the applicant maintaining a DF of 1000 as described in Section 11.2.3.2 of this SER. Therefore, RAI 12.03-55 is resolved and closed.

Exemption Approval determination:

In the North Anna 3 COLA, Revision 8, Part 7, "Departures Report," the applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix E, Section III.B, "Design Certification Rule for the ESBWR Design, Scope and Contents," which requires an applicant referencing a certified design to incorporate by reference Tier 1 information. Specifically, in North Anna Part 7, Exemption 4, the applicant proposed to revise the ESBWR DCD, Tier 1, Section 12.3.1.5.1, "Design Considerations," to accommodate site specific design considerations that would simplify the cooling tower blow-down line by not sending liquid radwaste discharge through that section of piping.

<u>Regulations</u>

- 10 CFR Part 52, Appendix E, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). 10 CFR Part 52, Appendix E, Section VIII.A.4 also states that the Commission will deny such a request if it finds that the design change will result in a significant reduction in the level of safety otherwise provided by the design.

- 10 CFR Part 52.63(b)(1) allows an applicant to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it determines that the request complies with the requirements of 10 CFR 52.7, which, in turn, points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by 10 CFR Part 52, Appendix E must meet the requirements of 10 CFR 50.12, 10 CFR 52.7, and 10 CFR 52.63(b)(1).

Evaluation of Exemption

As stated in 10 CFR Part 52, Appendix E, Section VIII.A.4, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, as long as the criteria given in 10 CFR 50.12 are met and the special circumstances as defined by 10 CFR 50.12 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). 10 CFR 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "…[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below.

Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 information. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section III.B.
As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, Tier 1. The staff determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The underlying purpose of ESBWR DCD, Tier 1, design of the cooling tower blow-down line identifies the standard ESBWR cooling tower blow-down configuration that will function in a manner in which the staff has determined, satisfies NRC requirements. The change in design function of the cooling tower blow-down line will not change the requirements of liquid rad-waste release and the applicant has stated that there will not be plans to release liquid rad-waste from the plant except in unusual circumstances where the releases will be done in a controlled procedure manner ensuring that the proper amount of effluent dilution is available. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the LWMS release requirements and the associated design function. These proposed changes are evaluated and found to be acceptable. Therefore, the staff finds the exemption presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to particular Tier 1 information. Subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of the specific ESBWR DCD, Tier 1, cooling tower blow-down line being modified is to allow liquid radwaste effluent dilution when discharging to the environment. Since North Anna 3 does not plan to discharge any liquid waste referred to as a "0" release plant except under very unusual circumstances where dilution from the North Anna 1 or North Anna 2 plants are available in accordance with procedures. Accordingly, special circumstances are present because application of the requirement to incorporate the certified design information in specific ESBWR DCD, Tier 1, Section 12.3.1.5.1, "Design Considerations," is not necessary to achieve the underlying purpose of the rule. Therefore, the staff finds that special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from Tier 1, exist.

Special Circumstances Outweigh Reduced Standardization

This exemption would allow the applicant to change certain ESBWR DCD, Tier 1 information proposed in the North Anna 3 COLA. The key design functions of the LWMS will be maintained. Based on the nature of the proposed changes to the generic ESBWR DCD, Tier 1 cooling tower blow-down line design, and the understanding that these changes support the design function of the LWMS, it is likely that all other ESBWR licensees and applicants would request the same exemption given a similar "0" liquid release operational consideration.

However, this exemption request and the associated changes to North Anna 3 COL Tier 1 information, demonstrate that there is a minimal change from the standard information provided in the ESBWR DCD. Consequently, the decrease in safety due to reduced standardization would also be minimal. For this reason, the staff determined that even if other ESBWR licensees and applicants do not request similar departures, the special circumstances outweigh the potential decrease in safety due to reduced standardization of the ESBWR design, as required by 10 CFR 52.63(b)(1).

No Significant Reduction in Safety

The proposed exemption would modify the function of the North Anna 3 LWMS discharge flow path described in the ESBWR DCD. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4.

Conclusion

For the reasons set forth above, the staff has concluded that pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law, (2) presents no undue risk to the public health and safety, (3) is consistent with the common defense and security, (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization, and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff finds that the applicant's request to depart from the information in ESBWR DCD Tier 1, design of the cooling tower blow-down line, to be acceptable and the applicant's request for an exemption from these Tier 1 requirements is granted.

- NAPS DEP 12.3-1 Liquid Radwaste Effluent Discharge Piping Flow Path

This Tier 2 departure is permitted by 10 CFR 52.7 and Section VIII.A.3 of the Design Certification Rule. This Tier 2 departure from the ESBWR DCD describes the liquid radwaste effluent discharge piping flow path. The pipeline to transfer liquid radwaste from the RWB to the environment does not adversely affect any intended DCD design function. This departure evaluation was determined to comply with the requirements of the ESBWR Design Certification Rule, 10 CFR Part 52, Appendix E, Section VIII.B.5.b which states that an applicant who references this appendix may depart from Tier 2 information, without prior NRC approval.

The staff has reviewed this departure submittal and agrees with the applicant's determination concerning the departure to describe the liquid radwaste effluent discharge and this Tier 2 departure does not change the function of this line as described in the ESBWR DCD. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment only as necessary.

COL Items

- STD COL 11.2-1-A Implementation of IE Bulletin 80-10

The guidance from IE Bulletin 80-10 includes information on the identification and restriction of non-contaminated systems that have the potential of becoming contaminated. The applicant has addressed this COL information item in the COLA with STD COL 11.2-1-A. In FSAR Section 11.2.2.3, "Detailed System Component Description," the applicant proposes to use specific equipment connection configurations and plant sampling. Specifically, the use of double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. A tell-tale connection is proposed for installation in each line to confirm the integrity of the line and check valves. The FSAR stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling of these systems further upstream has been included in the plant sampling program.

FSAR Section 11.2.2.3 presents an updated description of some portions of the LWMS that sample the permanently installed non-radioactive plant system in upstream locations of radioactive systems, to avoid uncontrolled and unmonitored releases into the environment. A review of that information indicates that there is no specific information describing those sampling provisions or where samples would be collected to confirm that clean plant systems have not been cross-contaminated by radioactive process streams. This information would ensure that appropriate provisions are identified in advance and would not likely be omitted during the development of the sampling and analysis program for the North Anna 3 Offsite Dose Calculation Manual (ODCM), confirming compliance with liquid effluent concentration limits of Table 2 in Appendix B to 10 CFR Part 20 and design objectives in Appendix I to 10 CFR Part 50. The applicant provided additional information and proposed a revision to STD COL 11.2-1-A. The revision clarified that the plant procedures would describe the sampling of non-radioactive systems that could become potentially contaminated through the improper interface with radioactive systems. The proposed revision also notes that the determination of which system to consider and sample would be based on the requirements contained in the plant ODCM. The ODCM takes into account site-specific conditions and guidance from RG 1.109 in identifying exposure pathways and offsite dose receptors. The staff finds that these design features and operational program demonstrate compliance with IE Bulletin 80-10 and are therefore acceptable.

The staff thus concluded that STD COL 11.2-1-A is consistent with IE Bulletin 80-10 and is therefore acceptable.

- STD COL 11.2-2-A Implementation of 10 CFR 20.

Subsection 12.3.1.5 of the North Anna 3 COL FSAR addresses this COL item by providing information on design, operational, and programmatic considerations to minimize contamination and ensure compliance with 10 CFR 20.1406. The staff's evaluation of this information is in Section 12.3.4 of this SER.

Supplemental Information

- NAPS SUP 11.2-1 Implementation of Section II.D of Appendix I to 10 CFR Part 50 (Cost-Benefit Analysis)

FSAR Section 11.2.1 (STD SUP 11.2-1) includes the basis of the cost-benefit analysis in justifying, in part, the LWMS design. This is a plant and site-specific cost-benefit analysis demonstrating compliance with Section II.D of Appendix I to 10 CFR Part 50. The applicant is to provide sufficient information for the staff to evaluate the bases and assumptions used in the analysis and for the staff to conduct an independent confirmation of compliance with NRC regulations and guidance. The FSAR includes the results of a cost-benefit analysis and supporting data using the guidance in RG 1.110. The applicant's analysis showed that the lowest-cost option for the LWMS augment is a 20 gallon per minute (gpm) filter cartridge at a cost of $11,380 per year, resulting in a corresponding collective dose of 11.38 person-rem to the total body or thyroid.

FSAR Section 12.2.2.4.2 states that annual collective population doses due to liquid effluent releases are estimated to be 0.84 person-rem to the total body and 0.99 person-rem to the thyroid, based on the LWMS described in the ESBWR DCD. Assuming that the 20 gpm filter cartridge augment removes all remaining radioactivity in liquid effluents after treatment through the LWMS, the resulting lowest cost liquid radwaste augment is $11,380/year. This value is above the $1,000 per person-rem (total body or thyroid) ALARA criterion in Section II.D of Appendix I to 10 CFR Part 50 for both the total body and the thyroid. Thus, the applicant concluded that the LWMS meets the ALARA requirement and no further system augments are necessary.

The staff conducted an independent assessment of the applicant's cost-benefit analysis using the information presented in FSAR Sections 11.2.1 and 12.2.2.4.2 and the NRC calculated collective population doses, and guidance in RGs 1.110 and 1.109. The staff analysis confirmed the applicant's conclusions.

None of the radwaste augments that are provided in RG 1.110 are found to be cost beneficial in reducing the annual population total body and thyroid doses. The staff analysis also confirmed that the cost-benefit ratios are above the $1,000 per person-rem (total body or thyroid) ALARA criterion in Section II.D of Appendix I to 10 CFR Part 50 and that the LWMS augment would not further reduce collective doses below the FSAR estimates. The staff found that NAPS-SUP-11.2-1 meets the requirements of Section II.D of Appendix I to 10 CFR Part 50 and is therefore acceptable.

The staff's review and evaluation of compliance with liquid effluent concentration limits and dose limits for maximally exposed individuals are addressed in Section 12.2 of the North Anna 3 FSAR and Section 12.2 of this SER.

- NAPS SUP 11.2-2 Ground Water Protection

In Subsection 11.2.3.2 of the North Anna 3 COL FSAR, the applicant provided supplemental information addressing the monitoring program for the LWMS and plant blow-down underground piping. In SER Section 12.3.4 under COL Item STD COL 12.3-4-A, the staff evaluated the required monitoring program for the underground piping to ensure that the potential for unmonitored, uncontrolled releases of radioactivity into the environment is minimized, in accordance with the requirements of 10 CFR 20.1406. Therefore, the staff found NAPS SUP 11.2-2 acceptable.

- Branch Technical Position 11-6

The review of the impacts of an accidental release of radioactive liquids in groundwater or surface water and effects on existing users or likely future users of groundwater or surface water resources is performed using the guidance in SRP Sections 2.4.1, "Hydrologic Description;" 2.4.12, "Groundwater;" and 2.4.13, "Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters;" and information and guidance from BTP 11-6, "Postulated Radioactive Releases Due to Liquid-Containing Tank Failures." BTP 11-6 provides guidance in assessing, in accordance with 10 CFR Part 20 concentration limits, a potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

The primary focus of ISG-013, is to provide guidance defining the mechanism of the assumed tank failure, development of the radioactive source term, assumptions and level of conservatism used in the analysis, and approach applied in assessing the radiological impacts at the assumed location of the dose receptor. Because of the complexity of the issues related to the radiological consequences of groundwater contamination, guidance on this topic has been divided between this ISG-013 and ISG-014," Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks in Ground and Surface Waters for Combined License Applications." These two ISGs are intended to be used together.

Concerning liquid containing tank failure, the applicant is responsible for providing site-specific hydrogeological data (such as contaminant migration time), and analysis to demonstrate that the potential groundwater contamination resulting from radioactive release due to liquid containing tank failure is bounded by the analysis. This information is usually discussed in FSAR Subsection 11.2.3.2. From the staff's review of FSAR Sections 11.2.3.2 and 2.4.13 the staff determined that information in the FSAR required updating and/or needed to be addressed for conformance to SRP Sections 11.2.3 and 2.4.13, and BTP 11-6. As a result, the staff requested in RAI 11.02-9 (ADAMS Accession No. ML14318A702), dated November 14, 2014, that the applicant update FSAR Sections 11.2.3.2 and 2.4.13. ESBWR DCD Section 11.2.3.2, states that an assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6 is provided in DCD Section 15.3.16. FSAR Section 15.3.16 did not contain an assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6. Neither BTP 11-6 nor ISG-013 are mentioned in FSAR Section 15.3.16.

The applicant responded to RAI 11.02-9, by letter dated November 8, 2014, (ADAMS Accession No. ML15009A235), concerning information added in FSAR Sections 2.4.13, 15.3.16 and 11.2.3.2. The applicant's response addressed the staff's concerns by adding additional information in FSAR Sections 15.3.16 and 11.2.3.2 stating that the assessment of liquid releases following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6 is addressed in FSAR Section 2.4.13. Additionally, the applicant's assessment of liquid release following a postulated failure of a LWMS tank and its components in accordance with BTP 11-6, in FSAR Section 2.4.13, did not include reference to a source term utilized to aid in the assessment of a postulated liquid tank rupture. As a result, the staff requested in RAI 2.4.13-06 (ADAMS Accession No. ML14347A001) dated January 07, 2014, that the applicant provide the source term for the postulated Condensate Storage Tank (CST), liquid tank rupture, and list the source term in the FSAR. In its response to RAI 2.4.13-06 (ADAMS Accession No. ML15028A392), dated January 27, 2015, the applicant described the CST source term in FSAR Section 2.4.13, and provided the basis for the CST source term in the RAI response. The applicant then provided a table of the CST source term developed in FSAR Section 12.2, FSAR Table 12.2-205, "Bounding Radionuclide Concentration in the Condensate Storage Tank."

Finally, the applicant's assessment of the dose to the environment, in FSAR Section 2.4.13, resulting from the postulated CST liquid tank rupture, in accordance with ISG-013, did not provide a summary all of the parameters used, with the CST source term, to develop a dose assessment evaluation of 28 mrem, using the NRC approved computer code LADTAP II. This evaluation is to demonstrate that the applicant can show the dose assessment is within the 10 CFR 20.1301 regulation limit of 100 mrem. As a result, in RAI 2.4.13-05 (ADAMS Accession No. ML14353A468), dated December 19, 2014, the staff requested that the applicant provide the information used to determine the effluent dose assessment evaluation, the input and output files from the LADTAP II analysis, and any basis required for any input parameters to the LADTAP II computer code.

In its response to RAI 2.4.13-05 (ADAMS Accession No. ML15042A219), dated January 29, 2015, the applicant provided the standard information described in SRP Section 2.4.13 as necessary to perform the dose assessment relating to the postulated CST liquid tank rupture. The staff evaluated the body of information provided in response to RAIs 2.4.13-05, RAI 2.4.13-06, and 11.02-9, to show compliance with 10 CFR 20.1301 and consistent with BTP 11-6. The staff determined that this package of material, along with a staff analysis to verify and validate the applicant's calculations, was acceptable. Therefore, RAIs 2.4.13-05, RAI 2.4.13-06, and 11.02-9 are resolved and closed. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicants response to RAIs 2.4.13-05, 2.4.13-06, and 11.02-9. Therefore Confirmatory Item 11.2-01 from the staff advanced SER for North Anna 3 is resolved and closed.

11.2.5 Post Combined License Activities

There are no post COL activities for this section.

11.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff finds that the application included all required information related to the LWMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the LWMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 11.2, NRC RGs, and industry standards. The staff's review concluded that the LWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to control releases of radioactive materials in liquid effluents, in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concluded that the LWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 1.109, RG 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant has met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50. The staff considered the potential effectiveness of augmenting the LWMS using items of reasonably demonstrated technology. The staff determined that further treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than $1,000 per person-rem or person-thyroid-rem.

- The staff determined that the applicant has adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.

- The staff found it reasonable that the identified Tier 2 departure regarding the description of the LWMS flow path is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix E, Section VIII.B.5.

- To simplify the design of the cooling tower blow-down line, the liquid radwaste effluent discharge pipeline in the LWMS will be designed to not discharge to the cooling tower blow-down line. The liquid radwaste effluent discharge pipeline will be extended to transfer liquid radwaste effluent from the LWMS in the RWB directly to the environment. In order to maintain a DF of 1000 while releasing liquid radwaste effluent to the environment, the applicant must ensure that the circulating water system from Units 1 and 2 must be turned on. The applicant, by providing dilution water flow to maintain a DF of 1000 during liquid effluent releases from North Anna 3, has met the effluent release requirements as described in the application. An exemption from DCD Tier 1 to revise the discharge piping information for the LWMS is approved by the staff based upon the applicant maintaining a DF of 1000 as described in Section 11.2.3.2.

11.3 Gaseous Waste Management System

11.3.1 Introduction

The gaseous waste management system (GWMS) is designed to receive and process radioactive gases and hydrogen-bearing gases generated during process operation. The gaseous radioactive effluents come from two main sources in the plant: (1) building ventilation systems servicing radiologically controlled areas; and (2) the power cycle off gas system (OGS). The GWMS and its OGS are used to control, collect, process, hold for decay, and discharge gaseous radioactive wastes generated during normal operation, including AOOs. The OGS is located in the turbine building and its major components include preheaters; recombiners; cooler/condensers; dryers; activated charcoal beds (guard and delay); and associated valves, pumps, and instrumentation. The gases removed from the condenser are radioactive. They must therefore be treated before being released into the environment to ensure that radioactivity levels are reduced to acceptable levels and are ALARA. The GWMS is designed to reduce and control radioactivity releases into the environment. Releases from the OGS are conducted via the turbine building stack. Releases from building ventilation exhaust systems servicing radiologically controlled areas are conducted through their respective buildings: reactor/fuel building stack, turbine building stack, and RWB stack.

11.3.2 Summary of Application

Section 11.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 11.3 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 11.3, the applicant provided the following:

COL Items

- NAPS ESP COL 11.1-1 — Implementation of Section II.D of Appendix I to10 CFR Part 50 (cost-benefit analysis)

A COL or construction permit applicant should verify that the calculated gaseous and liquid effluent concentrations and radiological doses to members of the public from radioactive gaseous and liquid effluents for any facility to be built on the North Anna site are bounded by the radiological doses and gaseous and liquid effluent concentrations included in the Early Site Permit (ESP) application and reviewed by the NRC. The COL applicant should also include in the radwaste (gaseous and liquid effluents) system all items of reasonably demonstrated technology that effect reductions in population dose to maintain doses ALARA in accordance with Appendix I, Section II.D, to 10 CFR Part 50.

The applicant used RG 1.110 as the basis for a cost-benefit evaluation to assess gaseous radwaste system augmentations. The results of the cost-benefit analysis demonstrate compliance with the ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50. The applicant considered augmentations applicable to the ESBWR conceptual design and concluded that no gaseous radioactive waste system augmentations are cost beneficial.

11.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the GWMS and the associated acceptance criteria are in Section 11.3 of the SRP.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.3 of the North Anna 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on GWMS appears in the following:

- 10 CFR 50.34a.
- Sections II.B, II.C, and II.D of Appendix I to 10 CFR Part 50.
- The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:
- RG 1.109
- RG 1.110

11.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 11.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.3 of the North Anna 3 COL FSAR Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the GWMS.

The staff reviewed the relevant information in the FSAR supplement. The following paragraphs discuss the staff's evaluations of the applicant's information on specific technical and regulatory topics.

COL Items

- NAPS ESP COL 11.1-1 — Implementation of Section II.D of Appendix I to10 CFR Part 50 (cost-benefit analysis)

The applicant included a plant and site-specific cost-benefit analysis to justify, in part, the FSAR Section 11.3 GWMS design. The cost-benefit analysis is based on the guidance in RG 1.110 and 1.109, with the results demonstrating compliance with ALARA cost-benefit requirements in Section II.D of Appendix I to 10 CFR Part 50.

The applicant considered the lowest-cost option for a gaseous radwaste treatment system augment that applies to a boiling-water reactor (BWR) as a threshold cost value. The lowest-cost option for a gaseous radwaste treatment system augment that applies to BWRs is the 1000 cfm Charcoal/HEPA Filtration System at $7,960 per year, which yields a threshold value of 7.96 person-rem whole body or thyroid from gaseous effluents for BWRs.

As shown in FSAR Table 12.2-204, the calculated North Anna 3 whole body dose is 4.3 person-rem, which is lower than 7.96 person-rem whole body dose. This comparison determines by the guidance in RG 1.110 that there is not any gaseous radwaste treatment system augment that is cost beneficial at $1,000 per person-rem to reduce whole body dose.

The North Anna 3 thyroid dose shown in FSAR Table 12.2-204 from gaseous effluents is 25 person-rem/yr, which exceeds the 7.96 person-rem/yr threshold value for a BWR. Additional analysis was provided to address the thyroid dose. Based on the estimated 25 person-rem/year thyroid dose, those radwaste augments with a total annual cost (TAC) values less than $25,000 were considered. In some cases, the radwaste augments had insufficient capacity to be considered. Other radwaste augments with greater process capacities were eliminated because they had TAC values greater than $25,000. RG 1.110 radwaste system augments were considered, including the 15,000 cfm HEPA Filtration System, the 3-Ton Charcoal Adsorber, a Charcoal/(HEPA) Filtration System, a 600 ft3 Gas Decay Tank, or a 1000 cfm Charcoal/HEPA Filtration System.

In some cases, the normal flow rates exceed the proposed HEPA filtration system and the augment is not effective for North Anna 3, and is eliminated from further consideration. Other plant design capacities of a system, the normal design flow exceeds the design capacity of the radwaste augment, therefore, this augment is not effective for North Anna 3 and is eliminated from further consideration. Additional radwaste augments provide minimal reduction in the thyroid dose such that the calculated annual benefit is less than the annual cost of the radwaste augment and is eliminated from further consideration. None of the gaseous radwaste augments are cost-beneficial in reducing the annual thyroid dose from gaseous effluents for Unit 3.

The staff evaluated this analysis and determined that in accordance with RG 1.110 guidance there were no radwaste augments that are cost-beneficial in reducing either the annual whole body or thyroid dose. Based on this comparison, no gaseous radwaste treatment system augment is cost-beneficial in reducing annual whole body or thyroid dose and the cost-benefit analysis demonstrates compliance with 10 CFR 50, Appendix I, Section II.D.

11.3.5 Post Combined License Activities

There are no post COL activities for this section.

11.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all required information related to the GWMS relevant to this section and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the GWMS that were incorporated by reference, have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 11.3, NRC RGs, and industry standards. The staff concluded that the GWMS includes the equipment necessary to control releases of radioactive materials in gaseous effluents in accordance with the requirements in 10 CFR 50.34a. Furthermore, the staff concluded that the GWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110.

11.4 Solid Waste Management System

11.4.1 Introduction

The solid waste management system (SWMS) is designed to provide collection, processing, packaging, and storage for radioactive wastes such as spent resins, sludge, oil waste, and dry active waste produced during normal operation and AOOs including startup, shutdown, and refueling operations. The SWMS is located in the RWB and is designed to collect, process, control, package, and temporarily store wet and dry solid radioactive wastes before shipment. The SWMS processes wastes from the LWMS, reactor water cleanup/shutdown cooling system, fuel and auxiliary pools cooling system, and condensate purification system. The SWMS comprises the following four subsystems: SWMS collection subsystem, SWMS processing subsystem, dry solid waste accumulation, and conditioning subsystem container storage subsystem.

The SWMS collection subsystem consists of high- and low-activity resin holdup tanks, phase separators, a condensate resin holdup tank, decant pumps, sampling points, control panels, instrumentation, vents and drains, and high and low activity transfer pumps. There are no provisions to release liquid and gaseous wastes directly from the SWMS system. All liquid effluent releases are conducted through the LWMS for process liquids generated during the operation of the SWMS. Airborne releases from the SWMS and ventilation exhaust systems servicing radiologically controlled areas, where process equipment is located, are monitored and discharged through the RWB stack.

The container storage subsystem and the dry solid waste accumulation and conditioning subsystem are conceptual descriptions of methods the COL licensee would use to handle and process solid wastes and packaged solid wastes. Therefore, the DCD describes the process without including equipment and system flow diagrams. Figures 11.4-1 and 11.4-4 in DCD Tier 2 provide overviews of the processes that would be used to handle dry solid and wet wastes. The COL licensee will address the actual processes in the operational programs and procedures, which will consider the regulatory requirements of the NRC, U.S. Department of Transportation (DOT), and State and local agencies for processing, storing, packaging, shipping, radiological monitoring, and disposing of radioactive wastes.

11.4.2 Summary of Application

Section 11.4 of the North Anna 3 COL FSAR incorporates by reference Section 11.4 of the ESBWR DCD, Revision 10.

North Anna 3 COL FSAR Section 11.4 describes the development and implementation of a plant-specific process control program (PCP) for operating procedures and technical specifications on the classification, treatment, and disposal of radioactive wastes processed by the SWMS. The applicant endorses by reference NEI Template 07-10, "Generic FSAR Template Guidance for Process Control Program (PCP)," for the development of the PCP in meeting the intent of Generic Letter (GL) 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program." The implementation milestone for the development of the PCP is described in FSAR Section 13.4. FSAR Section 11.5 describes the process to control and monitor all liquid and gaseous effluent releases associated with the processing of radioactive wastes. FSAR Section 12.2 presents information on the estimated amounts of radioactivity in liquid and gaseous effluent releases, effluent concentrations released into the environment, and associated doses to members of the public. FSAR Section 13.5 outlines the types of operational procedures that would be used to operate the SWMS. FSAR Section 14.2 describes the initial test program, including pre-operational and startup tests for the SWMS. North Anna 3 COLA, Part 10: Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) presents the specific ITAAC for the SWMS.

In addition, in FSAR Section 11.4, the applicant provided supplemental information as follows:

Tier 2 Departure Not Requiring Prior NRC Approval

- NA3 DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that the RWB provides onsite storage space for a 6-month volume of packaged waste. The applicant stated that Departure NA3 DEP 11.4-1 configures the North Anna 3 RWB to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This departure is accomplished by reconfiguring the arrangement of systems and components within the design of the ESBWR RWB. The applicant provided various revised tables and figures for the new arrangement of systems and components in the reconfigured RWB.

COL items

- STD COL 11.4-1-A — SWMS Processing Subsystem Regulatory Guide Compliance

The COL applicant is responsible for ensuring that SWMS subsystems comply with the guidance of RG 1.143, Revision 2 and RG 8.8, Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," issued in June 1978 for the testing and operation of all SWMS subsystems. The applicant provided additional information regarding the SWMS testing according to guidance in RG 1.143 and RG 8.8.

- STD COL 11.4-2-A Compliance with IE Bulletin 80-10

This COL item evaluates SWMS subsystems against the guidance and information in IE Bulletin 80-10 in identifying and rectifying connections to systems that are considered nonradioactive, but that could become radioactive through improper interfaces with radioactive systems (i.e., a nonradioactive system that could become contaminated as a result of leakage, valving errors, or other operating conditions in radioactive systems). The applicant provided additional details about the types of design features, including the installation of double check valves and tell-tale connections, for the purpose of confirming the integrity of SWMS piping and connections. There are normal sample points further upstream that will be included in the plant-specific sampling program.

- STD COL 11.4-3-A Process Control Program

The applicant included, by reference, NEI 07-10A Revision 0, “Generic FSAR Template Guidance for Process Control Program (PCP),” issued in March 2009 (ADAMS Accession No. ML091460627), as the basis for the PCP. The applicant noted that Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the PCP.

- STD COL 11.4-4-A Temporary Storage Facility

In the North Anna 3 COL FSAR, the applicant indicated that the RWB was reconfigured to accommodate at least 10 years of packaged Class B and C waste and approximately 3 months of packaged Class A waste, during routine operations and AOOs. The COL item addresses the use of a temporary storage facility and an overall site management plan for radioactive wastes using the guidance in SRP Section 11.4 (March 2007).

- STD COL 11.4-5-A Compliance with 10 CFR 20.1406

This COL item addresses site-specific information for demonstrating compliance with 10 CFR 20.1406 and RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning,” issued in June 2008, as it relates to the design and operational procedures of SWMS treatment subsystems to minimize contamination, facilitate eventual decommissioning, and minimize the generation of radioactive waste. In Section 11.4.1 of the North Anna 3 COL FSAR, the applicant provided additional information identifying various sections of the FSAR (Sections 12.3, 12.4, 12.5, and 13.5) that address how to comply with the implementation of 10 CFR 20.1406.

Supplemental Information

- STD SUP 11.4-1 Implementation of Section II.D of Appendix I to 10 CFR Part 50 (Cost-Benefit Analysis)

In Section 11.4.1 of the North Anna 3 COL FSAR the applicant presented supplemental information regarding the cost-benefit analysis for the SWMS and references the cost-benefit analyses in FSAR Sections 11.2.1 and 11.3.1, for processing and treating liquid and gaseous effluents as byproducts of the SWMS operation. Hence, no augmentations are needed for the SWMS.

11.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the SWMS, and the associated acceptance criteria, are in SRP Section 11.4.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.4 of the North Anna 3 COL FSAR for compliance with NRC regulations.

In particular, the regulatory basis for acceptance of the supplementary information on the SWMS appears in the following:

- 10 CFR 20.1406.
- Sections II.A, II.B, II.C and II.D of Appendix I to 10 CFR Part 50.
- 10 CFR Part 61, “Licensing Requirements for Land Disposal of Radioactive Waste.”

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

- RG 1.109.
- IE 80-10.
- RG 8.8, Revision 3.
- RG 1.143, Revision 2.
- GL 89-01.

In addition, in accordance with Section VIII, “Processes for Changes and Departures,” of “Appendix E to Part 52-Design Certification Rule for the Economic Simplified Boiling Water Reactor,” the applicant identified a Tier 2 departure. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

11.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 11.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the SWMS.

The staff reviewed the applicant's proposed resolution to the COL items and the departure included in Section 11.4 of the North Anna 3 COL FSAR as follows:

Tier 2 Departure Not Requiring Prior NRC Approval

- NAPS DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that the RWB provides onsite storage space for a 6-month volume of packaged waste. The applicant stated that Departure NAPS3 DEP 11.4-1 configures the North Anna 3 RWB to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste.

This departure identifies a plant-specific deviation from design information in the ESBWR DCD for low-level radioactive waste storage. The North Anna 3 RWB is configured to accommodate a minimum of 10 years of Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. The departure is accomplished by reconfiguring the arrangement of systems and components within the ESBWR RWB. The applicant provided various figures and tables in Section 11.4 of the North Anna 3 COL FSAR to identify changes in equipment and systems. The applicant also added figures and tables to Section 12.3 that identify the revised layout and radiation protection needs. The major change to Section 11.4 is the elimination of the condensate resin transfer pumps and the addition of high- and low-activity circulation pumps (Figures 11.4-1R and 11.4-2R and Table 11.4-1R). In addition, the applicant identified the estimated annual volume of radwaste requiring long-term management in FSAR Table 11.4-2R.

In Part 7, "Departure Report," of the COLA, the applicant provided the results of the evaluation of this departure. The applicant added that the departure affects Tier 2 information, but the departure has no safety significance.

The staff reviewed the applicant's information in Parts 2, 7, and 10 of the COLA. The changes affecting the RWB layout, specifically to the renaming of the assigned locations does not present a risk to public health and safety.

During the review of Section 11.4, the staff noticed in Section 11.4.2.2.4, "Container Storage Subsystem," that the high integrity containers (HICs) are provided with shield "bells." The applicant stated, a shield bell is a steel, vertical right circular cylinder with an open bottom. It is capable of venting to the general area. Shield bells are placed over HICs to provide radiation shielding and also provide structural integrity to permit stacking of HICs.

The guidance contained in RG 1.206 notes that the applicant is to describe the design features provided to maintain occupational radiation exposure (ORE) ALARA. The guidance contained in SRP Appendix 11.4-A, "Design Guidance for Temporary Storage of Low-Level Radioactive Waste," states that storage plans should address container protection and that good engineering judgment should be used to ensure that radioactive materials are contained safely. The guidance of SRP Appendix 11.4-A also states that when significant handling and personnel exposure can be anticipated, licensees should incorporate ALARA methodology in accordance with RG 8.8.

North Anna 3 COL FSAR 11.4.2.2, "Container Storage Subsystems," states, "Shield bells also provide structural integrity to permit stacking of HICs. The HICs must be stacked two levels high to accommodate the storage needs." CNS-8 120B is the designation for a shielded transportation cask that is not designed to be stacked. HICs such as the model PL8-120 High Density Polyethylene (HDPE) or L8-120 carbon steel containers are also not designed to be directly stacked. However, North Anna 3 COL FSAR 11.4.2.2.4 states that "The HICs are provided with shield “bells.” A shield bell is a steel, vertical right circular cylinder with an open bottom. It is capable of venting to the general area. Shield bells are placed over HICs to provide radiation shielding.”

In RAI 11.04-12, dated December 05, 2014 (ADAMS Accession No. ML14344A105), the staff requested that the applicant revise and update the North Anna 3 COL FSAR Section 11.4.2.2.4 to appropriately describe the waste storage container (i.e., container type and volume), the design features provided to protect the structural integrity of stored waste and the design provisions for maintaining ORE ALARA while stacking waste containers, or provide the specific alternative approaches used and the associated justification. The staff also requested that the applicant revise and provide the design to be used (e.g., stacking rings) to allow stacking HICs two levels high.

In its response to RAI 11.04-12 (ADAMS Accession No. ML15022A198), dated January 20, 2015, the applicant stated that the FSAR will be revised to clarify the design characteristics of the HICs and the design features provided for stacking HICs in order to maintain structural integrity and ORE ALARA. The shield bells will provide the full structural support to permit stacking of the 120 cubic foot HICs. The HICs themselves will not support any load due to stacking. The FSAR Section 11.4.2.2.4, “Container Storage Subsystem,” has been revised to clarify the design features that allow the stacking of HICs. The HDPE HICs will have shield bells that provide complete structural integrity to permit the stacking of HICs two levels to accommodate storage needs. The staff finds that this clarification is acceptable, and RAI 11.04-12 is resolved and closed. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicants’ response to RAI 11.04-12. Therefore Confirmatory Item 11.2-02 from the staff advanced SER for North Anna 3 is resolved and closed.

With regard to storage capacity, Table 11.4-2-R shows that Class B and C wastes are generated at a rate of about 15.6 cubic meters per year (m^3/yr) (552 cubic feet per year [ft^3/yr]), requiring 156 m^3 (5,520 ft^3) of storage volume for a 10-year inventory. The same table shows a 3-month Class A waste volume of 91 m^3/yr (3,210 ft^3/yr) for dry active waste and about 24 m^3/yr (874.6 ft^3/yr) for wet solid waste. Figure 1.2-23R (depicting the RWB at elevation 4650) indicates the storage of Class B and C wastes in Room 6390, Class A wet solid waste in Room 6391, and Class A dry active waste in Room 6392. The staff reviewed these rooms and determined that all three rooms have sufficient surface area and volume to store the waste for the required period. Therefore, the staff concluded that the new storage areas for managing Classes A, B, and C radioactive wastes have sufficient volume to accommodate the accumulated waste.

The applicant stated that Departure North Anna 3 DEP 11.4-1 only affects Tier 2, and its evaluation determined that this departure does not require prior NRC approval in accordance with Appendix E to 10 CFR Part 52. The staff found it reasonable that the departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

COL Items

- STD COL 11.4-1-A SWMS Processing Subsystem Regulatory Guide Compliance

The COL item addresses the compliance of the SWMS subsystems with the guidance in RG 1.143, Revision 2, and RG 8.8 for the testing and operation of all SWMS subsystems. The applicant addressed this information item in STD COL 11.4-1-A. The applicant noted that SWMS subsystems used to process wet solid radioactive wastes, are tested using a process that complies with RG 1.143. The staff determined that the information provided by the applicant is acceptable. Therefore, COL Item 11.4.-1-A has been satisfied. The evaluation of the compliance with RG 8.8 is addressed in Section 12.1 of the SER.

The applicant supplemented STD COL 11.4-1-A with North Anna 3 SUP 11.4-1. As described in Section 12.1 of the SER, the applicant's additional information is consistent with RG 1.143 and RG 8.8 and is therefore acceptable.

- STD COL 11.4-2-A Compliance with IE Bulletin 80-10

The COL item addresses the evaluation of the SWMS subsystems against the guidance and information in IE Bulletin 80-10. The purpose is to identify and rectify connections to systems that are considered nonradioactive but that could become radioactive through improper interfaces with radioactive systems (i.e., a non-radioactive system that could become contaminated due to leakage, valving errors, or other operating conditions in radioactive systems). IE Bulletin 80-10 includes information on identifying and restricting non-contaminated systems that could become contaminated.

The applicant has addressed this COL information item in the COLA with STD COL 11.4-2-A. FSAR Section 11.4.2.3, "Detailed System Component Description," presents an updated description of some portions of the SWMS on sampling permanently installed non-radioactive plant system in upstream locations of radioactive systems. These provisions are intended to avoid uncontrolled and unmonitored releases into the environment. Specifically, the applicant proposed using double-check valves in each line where a non-radioactive system is connected to a radioactive or potentially radioactive system. These valves are expected to service subsystems connected to non-radioactive portable systems. The installation of tell-tale connection in each line is expected to confirm the integrity of the line and check valves. The FSAR stated that to ensure that contamination has not occurred in permanently installed clean systems, sampling these systems further upstream is included in the plant sampling program.

In Subsection 11.4.2.3.5 of the North Anna 3 COL FSAR, the applicant stated that the plant-specific procedures describe the sampling of nonradioactive systems that could potentially become contaminated by cross-connecting with systems that contain radioactive material. In addition, the ODCM will address potential conditions where normally nonradioactive systems might become contaminated. The staff found this information to be consistent with IE Bulletin 80-10 and is therefore acceptable.

- STD COL 11.4-3-A Process Control Program

The COL item addresses the implementation of a plant-specific PCP using operating procedures and technical specifications, as they relate to the classification, treatment, and disposal of radioactive wastes processed by the SWMS in accordance with the

NRC, DOT and State and local agency regulatory requirements. The applicant included, by reference, NEI Template 07-10A as the basis for the PCP. The NEI template presents the functional elements of a PCP, which, if met, would demonstrate compliance with 10 CFR 50.34a and 50.36a, "Technical specifications on effluents from nuclear power reactors." The template describes technical and regulatory considerations used to process solid, wet, and liquid wastes with selected waste processing technologies and methods. The PCP identifies surveillance requirements that are consistent with the plant's technical specifications, administrative procedures, operational procedures, quality assurance and quality control program, radiological controls and monitoring program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, instructions on using the NRC uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the North Anna 3 PCP and its supporting procedures. The basis for acceptance in the staff's review is conformance of the applicant's endorsement of the DCD SWMS design and proposed North Anna 3 PCP. The milestones for the development and implementation of the PCP are addressed in FSAR Section 13.4 of the North Anna 3 COL. The staff determined that this item is satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the PCP before fuel load, with the requirement identified as a license condition. The applicant updated FSAR Section 11.4.2.3, STD COL 11.4-3-A by referencing NEI PCP Template 07-10A in applicable FSAR subsections and references. NEI PCP Template 07-10A (Revision 0, March 2009) has been reviewed and found acceptable by the staff. The staff concluded that STD COL 11.4-3-A meets the requirements and is acceptable (process control program compliance with 10 CFR 50.34a and 50.36a).

In Subsection 11.4.2.3.5 of the North Anna 3 COL FSAR, the applicant's resolution of STD COL 11.4-3-A for waste classification and process control is consistent with NEI 07-10A and is therefore acceptable. Section 13.4, "Operational Programs Required by NRC Regulations," of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the PCP before the fuel loading. In Table 13.4-201, "Operational Programs Required by NRC Regulations," the applicant identified the implementation milestones for operational programs including the operational program related to the PCP. The staff reviewed the applicant's milestones for developing and implementing the PCP and found the applicant's license condition of North Anna 3 COL Part 10, Section 3.6, "Operational Program Readiness," to be acceptable.

- STD COL 11.4-4-A Temporary Storage Facility

In previous revisions of the North Anna 3 COL FSAR, the applicant stated that North Anna 3 does not use any temporary storage facilities to support plant operation. The corresponding ESBWR DCD, Tier 2 COL item states that it is the responsibility of the COL applicant to consider the development of an overall site management plan for the storage of radioactive waste using the guidance of SRP Section 11.4. In the RAI 11.04-3 response dated May 21, 2009, ADAMS Accession No. ML091540526) the applicant stated that temporary storage would be added as necessary if needed.

- STD COL 11.4-5-A Compliance with 10 CFR 20.1406

The applicant stated that Subsection 12.3.1.5 addresses this COL item. Subsection 12.3.1.5 provides information on design features as well as on measures used in operating procedures to minimize contamination and to ensure compliance with 10 CFR 20.1406. Section 12.3.4 of this SER provides the staff's evaluation of this information.

Supplemental Information

- STD SUP 11.4-1 — Implementation of Section II.D of Appendix I to 10 CFR Part 50 (cost-benefit analysis)

The applicant added a new supplement (STD SUP 11.4-1) to Section 11.4.1 of the North Anna 3 COL FSAR, which states that the cost-benefit analyses in Sections 11.2.1 and 11.3.1 include the incremental amounts of liquid and gaseous wastes that would be produced during the operation of the SWMS. As a result, no other SWMS design augmentations are necessary to handle the incremental amounts of liquid and gaseous wastes. The staff found the applicant's supplemental information acceptable because the cost-benefit analyses in FSAR Sections 11.2 and 11.3 consider routinely expected sources of radioactivity discharged via the three plant stacks. For example, releases from the RWB ventilation exhaust systems servicing radiologically controlled areas—including the SWMS components—and the venting of SWMS tanks and vessels are conducted through the RWB stack. As a result, all releases from the SWMS are monitored and controlled at the release point, and all releases controlled through the implementation of the ODCM. Therefore, the staff concluded that the applicant has adequately addressed STD SUP 11.4-1.

11.4.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff has identified the following license condition from North Anna 3 COL Part 10, Section 3.6, which establishes the operational program for process and effluent monitoring and sampling (including the PCP):

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site-specific Severe Accident Management Guidelines.
> - The spent fuel rack coupon monitoring program implementation.

The applicant's Table 13.4-201, included the following elements:

a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls.

b. Offsite Dose Calculation Manual.

c. Radiological Environmental Monitoring Program.

11.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff determined that the application includes all required information relating to the SWMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the SWMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 11.4, NRC RGs, and industry standards. The staff concluded that the SWMS (as a permanently installed system and in combination with other plant systems) includes the equipment necessary to process liquid, wet, and dry solid wastes and contains provisions for controlling the release of radioactive materials in effluents in accordance with the requirements in 10 CFR 50.34a. The staff's review concluded that the SWMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance in RGs 8.8, 1.143, 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- Using site-specific conditions, the applicant has met the ALARA criterion required in Section II.D of Appendix I to 10 CFR Part 50 because all associated effluent releases are expected to be managed through the operation of the LWMS and GWMS. The staff considered the potential effectiveness of augmenting the LWMS and GWMS using items of reasonably demonstrated technology. The staff determined that additional treatment is not expected to produce further reductions in collective population doses reasonably expected within an 80-kilometer (50-mile) radius of the reactor, at a cost of less than $1,000 per person-rem or person-thyroid-rem.

- The staff determined that the applicant has adequately addressed the standard COL items regarding IE Bulletin 80-10 and 10 CFR 20.1406.

- The applicant's proposed PCP as it relates to classifying, processing, and disposing of radioactive wastes meets the requirements of 10 CFR Part 61. The staff concluded that the endorsement of NEI 07-10A, Revision 0, and the SWMS supplemental information in FSAR Section 11.4 are consistent with the requirements of GL 89-01.

11.5 Process Radiation Monitoring System

11.5.1 Introduction

The process radiation monitoring system (PRMS), is used to monitor liquid and gaseous process streams and effluent releases from the RWMS during normal operation, AOOs, and post-accident conditions. The system includes radiation monitors to detect and measure radioactivity and radiation levels and to provide indication of radioactive release rates or concentration levels in process and effluent streams. The PRMS includes sampling systems to extract samples from process or effluent streams and to provide the means to collect samples on filtration and in adsorbent media. The PRMS provides the means to establish alarm set points for the purpose of indicating when excessive radioactivity levels are present, track and record rates of radioactivity releases, and initiate protective isolation actions, such as terminating or diverting process or effluent flows.

Typically, the system consists of skid-mounted radiation monitoring equipment and permanently installed sampling lines with the equipment being located at points to measure radioactivity or collect samples that are representative of process flows and effluent releases. Samples collected on filtration and in adsorbent media are evaluated by laboratory analyses in confirming measurement results recorded by radiation monitors and determining radioactivity levels associated with radionuclides that are not readily detected by radiation monitoring devices. The system includes local instrumentation readout panels and alarm functions in addition to those located in control rooms. The PRMS does not generate additional sources of radioactive materials associated with its operation given that it is used only to control and monitor liquid and gaseous process streams and effluents discharged to the environment. Fluid samples collected from process and effluent streams are returned to their origins and are not discharged locally.

11.5.2 Summary of Application

Section 11.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 11.5 of the ESBWR DCD, Revision 10. In addition, in FSAR Section 11.5, the applicant provided the following:

COL Items

- STD COL 11.5-1-A — Sensitivity or Subsystem Lower Limit of Detection

This COL item addresses the derivation of lower limits of detection or detection sensitivity levels for each PRMS effluent subsystem, following the requirements of the ODCM for North Anna 3. The applicant stated that the ODCM provides the methodology for deriving the lower limit of detection for each effluent monitor.

- STD COL 11.5-2-A — Offsite Dose Calculation Manual (ODCM)

This COL item addresses the development of a plant- and site-specific ODCM for calculating offsite doses resulting from liquid and gaseous effluents. In FSAR Subsection 11.5.4.5, the applicant incorporated by reference NEI 07-09A, Revision 0, “Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description,” dated March 31, 2009 (ADAMS Accession No. ML091050234). The ODCM is used to control and monitor all liquid and gaseous effluent releases and to implement an environmental sampling and monitoring program. Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for the development and implementation of the ODCM.

- STD COL 11.5-3-A — Process and Effluent Monitoring and Sampling Program

This COL item addresses the implementation of a site-specific monitoring and sampling program, as described in the ODCM for North Anna 3. In addition, the applicant included Table 11.5-201 as a replacement for Table 11.5-5 in ESBWR DCD, Tier 2, which details provisions for sampling liquid streams.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 for controlling doses to a hypothetical maximally exposed member of the public and populations living near North Anna 3.

- STD COL 11.5-5-A Instrumentation Sensitivities

The COL item addresses the derivation of instrumentation detection sensitivity levels and bases for sampling all expected liquid and gaseous effluent release points described in the ODCM for North Anna 3.

11.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is NUREG–1966. In addition, the relevant requirements of the Commission regulations for the PRMS and the associated acceptance criteria are in SRP Section 11.5.

The staff also followed the guidance in RG 1.206 to evaluate Section 11.5 of the North Anna 3 FSAR for compliance with NRC regulations.

In particular, the regulatory basis for accepting the additional information related the PRMS appears in the following:

- 10 CFR 20.1301(e),
- 10 CFR 20.1302, “Compliance with dose limits for individual members of the public.”
- 10 CFR 50.34a.
- 10 CFR 50.36a.
- Sections II.A, II.B, II.C, and II.D of Appendix I to 10 CFR Part 50.

The following RGs and NRC documents contain regulatory positions and guidance in demonstrating compliance with the relevant requirements of the regulations identified above:

Additional requirements include those of 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) for monitoring gaseous effluents from potential accident release points, consistent with GDC 63,” Monitoring Fuel and Waste Storage” and GDC 64, “Monitoring Radioactivity Releases.”

SRP acceptance criteria include industry codes and standards, such as American National Standards Institute/Health Physics Society N13.1,”Sampling and Monitoring Releases of Airborne Radioactive Substances From The Stacks and Ducts of Nuclear Facilities,” and American National Standards Institute (ANSI) N42.18,” Specification and Performance of on-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents,” and the guidance in the following NRC documents:

- RG 1.109.

- RG 1.110.

- RG 1.206.

- RG 1.21, Revision 1, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants,” June 1974.

- RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operation),” February 1978.

- RG 1.97, Revision 4, “Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” June 2006.

- RG 4.1, Revision 2, “Radiological Environmental Monitoring for Nuclear Power Plants,” June 2009.

- RG 4.15, Revision 2, “Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment,” July 2007.

- BTP 7-10, Revision 5, “Guidance on Application of Regulatory Guide 1.97,” issued March 2007, in SRP Section 7.5.

- GL 89–01.

- IE Bulletin 80-10.

11.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 11.5 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 11.5 of North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the PRMS.

The staff reviewed the applicant's proposed resolution to the COL items included under Section 11.5 of the North Anna 3 COL FSAR as follows:

<u>*COL Items*</u>

- STD COL 11.5-1-A Sensitivity or Subsystem Lower Limit of Detection

The COL item addresses the derivation of lower limits of detection for each effluent PRMS subsystem, following the requirements of the ODCM for North Anna 3. The applicant outlined, given the endorsement of NEI ODCM Template 07-09A, methods used to derive the lower limits of detection for PRMS subsystems in monitoring and controlling liquid and gaseous effluent releases. The milestones for the development and implementation of the ODCM are addressed in FSAR Section 13.4 of the North Anna 3 COL. The staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the ODCM before fuel load, as a license condition as described in North Anna 3 COLA Part 10, Section 3.6, “Operational Program Readiness.”

In Subsection 11.5.4.7 of the North Anna 3 COL FSAR, the applicant stated that the ODCM will provide the methodology for deriving the lower limit of detection for the PRMS subsystem in monitoring and controlling liquid and gaseous effluent releases. DCD Tables 11.5-2 and 11.5-4 provide the estimated sensitivities of process radiation monitors. If the plant configuration and radiation background require changes to these sensitivity ranges, the ranges will be adjusted in accordance with written procedures consistent with the bases defined in DCD Table 11.5-9. The applicant will update the FSAR if changes to values in DCD Tables 11.5-2 and 11.5-4 are needed. The staff’s review found that the applicant’s response adequately addresses STD COL 11.5-1-A and the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10.

- STD COL 11.5-2-A Offsite Dose Calculation Manual

The COL item addresses the development of a plant- and site-specific ODCM for calculating offsite doses resulting from liquid and gaseous effluents. In the North Anna 3 FSAR, Section 11.5.4.5 the applicant endorsed by reference, NEI ODCM Template 07-09A as the basis of its ODCM as an operational program document. The NEI template presents the functional elements of an ODCM that, if met, would demonstrate compliance with Part 50.34a and 50.36a and Appendix I to 10 CFR Part 50. The NEI ODCM Template identifies monitoring criteria, liquid and gaseous radiological effluent controls, monitoring instrumentation, methods for deriving lower limits of detection and detection sensitivities, methods for establishing instrumentation alarm set-points, dose limits for members of the public, requirements for process and effluent sampling in various plant systems, requirements limiting effluent releases, surveillance requirements, methods for calculating effluent release rates and doses, elements of a radiological environmental monitoring program, elements of a quality assurance and quality control program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, process for initiating and documenting changes to the North Anna 3 ODCM and supporting procedures, and record keeping. The staff finds this item satisfactorily addressed in FSAR Section 13.4, Table 13.4-201 (Item 9), which lists the milestones for the development and implementation of the ODCM before fuel load as a license condition in North Anna 3 COL Application Part 10, Section 3.6, “Operational Program Readiness.” Accordingly, the applicant updated the provisions of FSAR Section 11.5.4.5, (STD COL 11.5-2-A), by referencing NEI ODCM Template 07-09A in applicable FSAR subsections and references.

In addition, the applicant will include in the ODCM, before fuel load, the provisions for sampling liquid and gaseous waste streams identified in Table 11.5-201 and DCD Table 11.5-7 and batch liquid releases identified in DCD Table 11.5-7. Section 13.4, “Operational Programs Required by NRC Regulations,” of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the ODCM.

- STD COL 11.5-3-A Process and Effluent Monitoring Program

This COL item addresses the development and implementation of a site-specific monitoring and sampling program described in the ODCM for North Anna 3. Section 13.4 of the North Anna 3 COL FSAR addresses the milestones for developing and implementing the radiological environmental monitoring program in Table 13.4-201 under Item 9.

Subsection 11.5.4.6 of the North Anna 3 COL FSAR, regarding process and effluent monitoring and sampling presents information in Table 11.5-201, "Provisions for Sampling Liquid Streams," on sampling for several North Anna 3 plant systems, including the plant service water system (PSWS) (Item 2), storm drains and cooling tower blow-down (Item 11), and sanitary wastewater (Item 14).

The staff verified that the applicant has incorporated the changes noted above in the North Anna 3 COL FSAR. In addition, STD COL 11.5-3-A is acceptable because it meets the guidance in RGs 1.21, 1.33, 1.97, 1.206, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10.

- STD COL 11.5-4-A Site-Specific Offsite Dose Calculation

This COL item addresses compliance with the design objectives in Appendix I to 10 CFR Part 50 of controlling doses to a hypothetical, maximally exposed member of the public and populations living near North Anna 3. In Subsection 11.5.4.8 of the North Anna 3 COL FSAR, the applicant stated that the ODCM addresses the guidelines in Appendix I to 10 CFR Part 50 and FSAR Section 12.2.2 provides the site-specific doses to members of the public. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM, which is in compliance with Sections II.A through II.C of Appendix I to 10 CFR Part 50. The staff determined that the applicant's response adequately addresses this COL item, and is therefore acceptable.

- STD COL 11.5-5-A Instrumentation Sensitivities

In Subsection 11.5.4.9 of the North Anna 3 COL FSAR, the applicant stated that the ODCM will describe the instrument sensitivities, sampling, and analytical frequencies and the basis for each gaseous and liquid sample. The applicant referenced FSAR Subsection 11.5.4.5 for a discussion on the development and implementation of the ODCM. The staff's evaluation under COL Item STD COL 11.5-2-A provides further discussion on the ODCM (in terms of compliance with the guidance in RGs 1.21, 1.33, 1.97, 4.1, and 4.15 and complies with 10 CFR Part 20, 10 CFR Part 50, and BTP 7-10). The staff found that the applicant adequately addresses STD COL 11.5-5-A, and is therefore acceptable.

11.5.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff has identified the following license condition from North Anna 3 COL Part 10, Section 3.6:

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site-specific Severe Accident Management Guidelines.

- The spent fuel rack coupon monitoring program implementation.

The applicant's Table 13.4-201, includes the following elements:

a. Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls.

b. Offsite Dose Calculation Manual.

c. Radiological Environmental Monitoring Program.

11.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff determined that the application includes all required information related to the PRMS relevant to this section, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the PRMS that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 11.5, NRC RGs, and industry standards. The staff's review concluded that the applicant has presented adequate information in the North Anna 3 COL FSAR to meet the requirements of the PRMS, which includes the equipment necessary to monitor process and effluent streams; describes an operational program to control releases of radioactive materials associated with the operation of the LWMS, GWMS, and SWMS; and incorporates provisions to implement a sampling and monitoring program. Furthermore, the staff concluded that the PRMS is acceptable and meets the requirements in 10 CFR 50.34a and Section II.D of Appendix I to 10 CFR Part 50, as well as the guidance of RGs 1.109 and 1.110 and IE Bulletin 80-10. This conclusion is based on the following:

- The PRMS includes the instrumentation for monitoring and sampling radioactivity in contaminated liquid and gaseous process and effluent streams and in solid wastes during routine operations, AOOs, and accident conditions. The staff evaluated the proposed provisions for sampling and monitoring appropriate process streams and effluent release points, including nonradioactive systems that could become contaminated through interfaces with radioactive systems.

- The applicant's proposed development of the ODCM for North Anna 3, as it relates to controlling and monitoring effluent releases and doses to members of the public, meets the requirements of Appendix I to 10 CFR Part 50; 10 CFR 20.1301(e); and 10 CFR 20.1302. Therefore, the staff concluded that the endorsement of NEI 07-09A, Revision 0, and the PRMS supplemental information in FSAR Section 11.5 are consistent with GL 89-01.

References

1. 10 CFR 20.1301, "Dose limits for individual members of the public."

2. 10 CFR 20.1302, "Compliance with dose limits for individual members of the public."

3. 10 CFR 20.1406, "Minimization of contamination."

4. 10 CFR 50.12, "Specific exemptions."

5. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

6. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

7. 10 CFR 50.36, "Technical specifications."

8. 10 CFR 50.59, "Changes, tests and experiments."

9. 10 CFR 52.63, "Finality of standard design certification."

10. 10 CFR 52.7, "Specific exemptions."

11. 10 CFR 52.93, "Exemptions and variances."

12. 10 CFR 52.98, "Finality of combined licenses; information requests."

13. 10 CFR Part 20, "Standards for Protection against Radiation."

14. 10 CFR Part 20, Appendix B, "Annual Limits on Intake and Derived Air Concentrations of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

15. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

16. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

17. 10 CFR Part 50, Appendix A, GDC 63, "Monitoring fuel and waste storage."

18. 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases."

19. 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

20. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

21. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

22. 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste."

23. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

24. IEEE/ANSI N42.18-1980," Specification and Performance of on-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents."

25. NEI 07-09A, Revision 0, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," March 2009 (ADAMS Accession No. ML091050234).

26. NEI 07-10A, Revision 0, "Generic FSAR Template Guidance for Process Control Program (PCP)," March 2009 (ADAMS Accession No. ML091460627).

27. NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," October 2009 (ADAMS Accession No. ML093220530).

28. NRC BL 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment," May 6, 1980 (ADAMS Accession No. ML031210532).

29. NRC BTP 11-6, "Postulated Radioactive Releases Due to Liquid-Containing Tank Failures," March 2007 (ADAMS Accession No. ML070720635).

30. NRC BTP 7-10, "Guidance on Application of Regulatory Guide 1.97," March 2007 (ADAMS Accession No. ML070550082).

31. NRC GL 1989-001, Supplement 1, "Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors," November 14, 1990 (ADAMS Accession Nos. ML031290465, ML031290469).

32. NRC ISG-13, "Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks."

33. NRC ISG-14," Assessing the Radiological Consequences of Accidental Releases of Radioactive Materials from Liquid Waste Tanks in Ground and Surface Waters for Combined License Applications."

34. NRC RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," October 1977 (ADAMS Accession No. ML003740384).

35. NRC RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for comment)," March 1976 (ADAMS Accession No. ML003740332).

36. NRC RG 1.143, Revision 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," November 2001 (ADAMS Accession No. ML013100305).

37. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

38. NRC RG 1.21, Revision 1, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," June 1974 (ADAMS Accession No. ML003739960).

39. NRC RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)," February 1978 (ADAMS Accession No. ML003739995).

40. NRC RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," June 2006 (ADAMS Accession No. ML061580448).

41. NRC RG 4.1, Revision 1, "Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants," April 1975 (ADAMS Accession No. ML003739496).

42. NRC RG 4.15, Revision 2, "Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)-Effluent Streams and the Environment," July 2007 (ADAMS Accession No. ML071790506).

43. NRC RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," June 2008 (ADAMS Accession No. ML080500187).

44. NRC RG 8.8, Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," June 1978 (ADAMS Accession No. ML003739549).

45. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

46. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

47. U.S. Code- 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

12.0 RADIATION PROTECTION

12.0 RADIATION PROTECTION

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 radiation protection methods and estimated occupational radiation exposures (ORE) of operating and construction personnel during normal operations (including refueling; purging; fuel handling and storage; radioactive material handling, processing, use, storage, and disposal; maintenance; routine operational surveillance; in-service inspection (ISI); and calibration), and anticipated operational occurrences (AOO). Specifically, this chapter provides information on facility and equipment design, planning and procedures programs, and techniques and practices employed by the applicant to meet the radiation protection standards set forth in Title 10 of the *Code of Federal Regulations* (CFR) Part 20, "Standards for Protection Against Radiation," and to be consistent with the guidance given in the appropriate regulatory guides (RG), where the practices set forth in such guides are used to implement the NRC regulations. Finally, this chapter provides updated information that supplements the certified Economic Simplified Boiling-Water Reactor (ESBWR) Design Control Document (DCD) with a site-specific assessment of doses to members of the public from anticipated routine liquid and airborne effluent releases.

12.1 Ensuring that Occupational Radiation Exposures are As Low as Is Reasonably Achievable

12.1.1 Introduction

Section 12.1 addresses policy and design considerations to ensure that the ORE to personnel will be kept as low as is reasonably achievable (ALARA). The ALARA program and Radiation Protection Program (RPP) are addressed in Appendices 12AA and 12BB, respectively, in the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR). The North Anna 3 COL FSAR adopts the following final versions of the Nuclear Energy Institute (NEI) generic templates accepted by the NRC: NEI 07-03A, "Generic FSAR Template Guidance for Radiation Protection Program Description" (Agencywide Documents Access and Management System (ADAMS) Accession Number No. ML091490684) and NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures are as Low as is Reasonably Achievable (ALARA)" (ADAMS Accession No. ML093220178).

12.1.2 Summary of Application

Section 12.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 12.1 of the ESBWR DCD, Revision 10, referenced in Appendix E, "Design Certification Rule for the ESBWR Design," to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," In addition, in FSAR Section 12.1, the applicant provides the following:

COL Items

- STD COL 12.1-1-A Regulatory Guide 8.10

The applicant is responsible for demonstrating compliance with the guidance of RG 8.10 Revision 1-R, "Operating Philosophy for Maintaining Occupational Radiation Exposures ALARA." The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07–08A and NEI 07–03A to meet the needs of this COL item.

- STD COL 12.1-2-A Regulatory Guide 1.8

The applicant is responsible for demonstrating compliance with the guidance of RG 1.8, Revision 3, “Qualification and Training of Personnel for Nuclear Power Plants.” The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07-03A to meet the needs of this COL item.

- STD COL 12.1-3-A Operational Considerations

The applicant is responsible for providing criteria and conditions for implementing various operating procedures and techniques ensuring that occupational exposures are ALARA according to the guidance of NUREG–1736, “Consolidated Guidance: 10 CFR Part 20 — Standards for Protection Against Radiation.” The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07–08A and NEI 07–03A to meet the needs of this COL item.

- STD COL 12.1-4-A Regulatory Guide 8.8

The applicant is responsible for demonstrating compliance with the guidance of RG 8.8, Revision 3, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be ALARA.” The applicant references FSAR Appendices 12AA and 12BB, which in turn adopt NEI 07–08A and NEI 07–03A to meet the needs of this COL item.

Supplemental Information

- STD SUP 12.1-1 ALARA Program

The applicant provides supplemental information in FSAR Appendices 12AA and 12BB to address the ALARA Program and the RPP at the site. These appendices reference NEI 07–08A and NEI 07–03A, which in turn provide additional operating policy guidance for developing and implementing an ALARA program.

12.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, “Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling Water Reactor Standard Design.”

The staff followed the guidance in RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” to evaluate North Anna 3 FSAR Section 12.1 for compliance with NRC regulations.

The relevant requirements of the Commission regulations for ensuring that occupational radiation exposures are ALARA, and the associated acceptance criteria, are in Section 12.1 of NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, (LWR Edition),” the Standard Review Plan (SRP).

In particular, the regulatory basis for the acceptance of the COL items and the supplemental information is established in 10 CFR 19.12, “Instructions to workers”; 10 CFR Part 20; and the guidance of RG 1.206; RG 8.10, Revision 1-R; RG 1.8, Revision 3; and RG 8.8, Revision 3.

Moreover, the acceptance of the COL items and the supplemental information in this section are based on guidance in the following RGs and NEI templates:

- RG 8.2, “Guide for Administrative Practices in Radiation Monitoring”
- RG 8.7, Revision 2, “Instructions for Record Keeping and Recording Occupational Radiation Exposure Data”
- RG 8.9, Revision 1, “Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program”
- RG 8.13, Revision 3, “Instruction Concerning Prenatal Radiation Exposure”
- RG 8.15, Revision 1, “Acceptable Programs for Respiratory Protection”
- RG 8.27, “Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants”
- RG 8.28, “Audible-Alarm Dosimeters”
- RG 8.29, Revision 1, “Instructions Concerning Risks from Occupational Radiation Exposure”
- RG 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.”
- RG 8.35, “Planned Special Exposures”
- RG 8.36, “Radiation Dose to the Embryo/Fetus”
- RG 8.38, Revision 1, “Control of Access to High and Very High Radiation Areas in Nuclear Power Plants”
- RG 1.206, NEI 07–03A, and NEI 07–08A

12.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 12.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 12.1 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to “Ensuring that Occupational Radiation Exposures are ALARA.”

In addition, the staff reviewed the applicant’s proposed resolution to the COL items and the supplemental information included under Section 12.1 of the North Anna 3 COL FSAR. In this review, the staff used the applicable sections of the SRP and RG 1.206 as guidance.

[1] See “*Finality of Referenced NRC Approvals*” in SER Section 1.2.2 for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

Section 1.2.3 of this safety evaluation report (SER) discusses the NRC's strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER for the Fermi 3 application are equally applicable to the North Anna 3 COL application (COLA), the staff undertook the following reviews:

- The staff compared the Fermi 3 COL FSAR, Revision 8, to the North Anna 3 COL FSAR, Revision 8. In this comparison, the staff considered changes to the North Anna 3 COL FSAR (and other parts of the COLA, as applicable) resulting from requests for additional information (RAI) identified in the Fermi SER.

- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the Fermi SER) evaluation.

- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the Fermi standard content to be directly applicable to the North Anna 3 COLA.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 12.1-1-A Regulatory Guide 8.10

The applicant provided additional information in STD COL 12.1-1-A to address the resolution of DCD COL Item 12.1-1-A, which states:

> The COL applicant will demonstrate compliance with Regulatory Guide 8.10

The FSAR states that this COL information item is addressed in NEI Template 07-03A, which is referenced in Appendix 12BB of the FSAR.

The staff reviewed NEI 07-03A with respect to compliance with RG 8.10. RG 8.10 describes the operating philosophy for maintaining OREs ALARA and states that the management of the licensed facility should be committed to maintaining exposures ALARA, and the personnel responsible for radiation protection should be continually vigilant for means to reduce exposures. NEI 07-03A states that the plant management will establish a written policy on radiation protection that is consistent with the guidance in RG 8.10. The radiation protection responsibilities of the Radiation Protection Manager will be consistent with the guidance in RG 8.10 and will include establishing, implementing, and enforcing the RPP. In addition, management is committed to assuring that each individual working at the facility understands and accepts the responsibility to follow radiation protection procedures and instructions provided by radiation protection staff and to maintain his or her dose ALARA.

In North Anna 3 COL FSAR Revision 8, the applicant states that compliance with RG 8.10 is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07–03A for meeting the needs of this COL item. The staff has reviewed and approved these NEI templates for addressing this COL item (ADAMS Accession Nos. ML090510379 and ML091130034).

Therefore, the applicant has adequately addressed COL Item STD COL 12.1-1-A (compliance with the guidance of RG 8.10).

- STD COL 12.1-2-A Regulatory Guide 1.8

The applicant provided additional information in STD COL 12.1-2-A to address the resolution of DCD COL Item 12.1-2-A, which states:

> The COL applicant will demonstrate compliance with Regulatory Guide 1.8.

The FSAR states that this COL information item is addressed in NEI Template 07-03A, which is referenced in Appendix 12BB of the FSAR.

The staff has reviewed NEI 07-03A with respect to compliance with RG 1.8. RG 1.8 states that the American National Standards Institute (ANSI)/American Nuclear Society (ANS)-3.1-1993, with certain additions, exceptions, and clarifications delineated in the RG, provides acceptable criteria for the selection, qualification, and training of personnel for nuclear power plants. NEI 07-03A states that the Radiation Protection Manager, Radiation Protection Technicians, and Radiation Protection Supervisory and Technical Staff will be trained and qualified in accordance with the guidance in RG 1.8.

In North Anna 3 COL FSAR, Revision 8, the applicant states that compliance with this RG is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07–08A and NEI 07–03A to meet the needs of this COL item. The staff has reviewed and approved these NEI templates for addressing this COL item; therefore, the applicant has adequately addressed COL Item STD COL 12.1-2-A (compliance with the guidance of RG 1.8).

- STD COL 12.1-3-A Operational Considerations

The applicant provided additional information in STD COL 12.1-3-A to address the resolution of DCD COL Item 12.1-3-A, which states:

> The COL applicant will provide the criteria and/or conditions under which various operating procedures and techniques will be implemented to ensure that occupational radiation exposures are ALARA using the guidance of NUREG–1736, to the level of detail provided in RG 1.206.

The staff reviewed the applicant's response to STD COL 12.1-3-A related to criteria and conditions under which various operating procedures and techniques will be implemented to ensure that OREs are ALARA, using the guidance in NUREG–1736 to the level of detail provided in RG 1.206. The staff also reviewed the applicant's response to ensure that the applicant has committed to follow the guidance in the following RGs: 8.2, 8.7, 8.9, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38. The criteria and conditions in STD COL 12.1-3-A are addressed in NEI 07-03A, which is referenced in Appendix 12 BB of the FSAR. NEI 07-03A addresses various operating procedures and techniques used in dose-related activities found in typical nuclear plants. These activities include refueling, in-service inspections, radwaste handling, spent fuel handling, normal operations, routine maintenance, sampling, and calibration. The template allows for COL applicant's to modify procedures based on design-specific and site-specific information. The staff reviewed the categories listed in the template for coverage of the ESBWR activities. On the basis of this review, the staff determined that NEI 07-03A, as supplemented by material presented in the DCD, provides the criteria and/or conditions under which various operating procedures and techniques will be implemented to ensure that OREs are ALARA.

In North Anna 3 COL FSAR Revision 8, the applicant states that the operational considerations for the ALARA Program are addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07-08A and NEI 07–03A to meet the needs of this COL item. The staff has reviewed and approved these NEI templates for addressing this COL item; therefore, the applicant has adequately addressed COL Item STD COL 12.1-3-A (providing criteria and conditions for implementing various operating procedures and techniques to ensure that occupational exposures are ALARA, according to the guidance of NUREG–1736 to the level of detail in RG 1.206).

- STD COL 12.1-4-A Regulatory Guide 8.8

The applicant provided additional information in STD COL 12.1-4-A to address the resolution of DCD COL Item 12.1-4-A, which states:

> The COL applicant will demonstrate compliance with Regulatory Guide 8.8.

The FSAR states that this COL information item is addressed in NEI Template 07-03A, which is referenced in Appendix 12BB of the FSAR. The staff has reviewed NEI 07-03A with respect to compliance with RG 8.8. NEI 07-03A addresses the operational portions of RG 8.8 that were not addressed in the ESBWR DCD, including a description of the plant organization, personnel, and personnel responsibilities; facilities (to the extent that they were not described in the DCD), instrumentation, and equipment. NEI 07-03A also includes a description of radiation protection procedures sufficient to provide adequate control over the receipt, possession, use, transfer, and disposal of byproduct, source, and special nuclear material and assure compliance with the applicable requirements in 10 CFR Parts 19, 20, 50, 70, “Domestic Licensing of Special Nuclear Material,” and 71, “Packaging and Transportation of Radioactive Material.” The procedures described in NEI 07-03A include procedures for radiation protection training, access control of radiation areas, methods to maintain exposures ALARA, personnel monitoring, respiratory protection, and contamination control.

In North Anna 3 COL FSAR Revision 8, the applicant states that compliance with this RG is addressed in Appendices 12AA and 12BB, which in turn adopt NEI 07–08A and NEI 07–03A to meet the needs of this COL item. The staff has reviewed and approved these NEI templates for addressing this COL item; therefore, the applicant has adequately addressed COL Item STD COL Item 12.1-4-A (compliance with the guidance of RG 8.8).

Supplemental Information

- STD SUP 12.1-1 ALARA Program

The STD SUP 12.1-1 of the North Anna COL FSAR references Appendices 12 AA and 12 BB for a description of the ALARA program. Appendix 12 AA refers to NEI 07-08A and Appendix 12 BB refers to NEI 07-03A. The staff reviewed NEI Templates 07-08A and 07-03A with respect to a description of the ALARA program. NEI 07-08A states that company and station policies are to keep all radiation exposures of personnel within the limits defined by 10 CFR Part 20. The ALARA policy is consistent with and will be implemented in accordance with the ALARA provisions of RGs 8.8 and 8.10. As stated in FSAR Section 13.1, “Organizational Structure of Applicant,” and in NEI 07-03A, specific individuals will be assigned the responsibility and authority for implementing the ALARA policy at North Anna 3. All station personnel are responsible for the ALARA program. Individual workers are responsible for complying with ALARA requirements, which are presented in worker training in accordance with the training requirements contained in 10 CFR 19.12. The extent of the training is commensurate with the worker's job responsibilities.

North Anna's ALARA policies and practices are consistent with the applicable regulations in 10 CFR Part 20 and the guidance in RGs 1.8, 1.206, 8.2, 8.7, 8.8, 8.9, 8.10, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38 and the applicable portions of NUREG–1736.
The ALARA program is based on mature programs in use at other operating commercial nuclear facilities and incorporates lessons-learned from plant operating experience. Industry operating experience is regularly reviewed and applicable exposure control technique lessons-learned are incorporated into plans, procedures, and policies developed in accordance with RGs 1.8, 8.8, and 8.10.

Overall facility operations, as well as the RPP, integrate the procedures necessary to ensure that radiation doses are ALARA. Radiation protection procedures, which are described in FSAR Section 12.5, are developed in FSAR Sections 13.5 and 17.5 and meet the applicable requirements in 10 CFR Parts 19, 20, 50, 70, and 71. Examples of some ALARA work practices incorporated in these procedures, and described in NEI 07-08A, to help ensure that exposures to personnel will be ALARA include use of:

- Appropriate dosimetry to record personnel doses

- Pre-job briefings and post-job debriefings to ascertain lessons-learned

- Dry-run training and mockups to improve worker efficiency for complex jobs in high-radiation areas

- Protective clothing, respiratory equipment, and special ventilation systems for working in contaminated environments

- Remote monitoring of personnel to reduce worker exposures, and the establishment of low dose "waiting areas," and

- Permanent or temporary shielding to reduce worker exposure at the work site

In North Anna 3 COL FSAR, Revision 8, the applicant provides supplemental information in Appendices 12AA and 12BB to address the ALARA Program and the RPP at the site. These appendices reference NEI 07–08A and NEI 07–03A, which provide additional operating policy guidance for developing and implementing an ALARA Program. The applicant also provides site-specific information regarding access control in these appendices. The staff's evaluation of the site-specific information on access control is in Section 12.5 of this SER.

As stated earlier, the staff reviewed and approved these NEI templates for addressing the ALARA Program. Therefore, the applicant has adequately addressed the ALARA Program and has identified the locations of very high radiation areas that require access control.

12.1.5 Post Combined License Activities

There are no post COL activities related to this section.

12.1.6 Conclusion

The staff's findings related to information incorporated by reference are documented in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to policy and design considerations to ensure that ORE to personnel will be kept ALARA, and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to "Ensuring that Occupational Radiation Exposures Are ALARA" that were incorporated by reference are resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 12.1, and other pertinent NRC RGs. The staff's review concludes that the applicant has adequately addressed the following:

- STD COL Items 12.1-1-A through 12.1-4-A, relating to ALARA and operational considerations and conformance with RGs 1.8, 8.8, and 8.10, are acceptable because the applicant incorporates approved references NEI 07–03A (which incorporates the guidance in RGs 1.8, 8.8, and 8.10) and NEI 07-08A into the North Anna 3 COL FSAR and meets the applicable regulatory requirements and guidance specified in Sections 12.1.3 and 12.1.4 of this SER.

- STD SUP 12.1-1 pertains to the ALARA Program at the site. NEI Templates NEI 07-03A and 07-08A, which are addressed in FSAR Appendices 12AA and 12BB, describe an ALARA program that meets the ALARA provisions in 10 CFR 20.1101(b), the training requirements in 10 CFR 19.12, and the guidance in RGs 8.8 and 8.10. These templates meet the acceptance criteria defined in SRP Section 12.1. Therefore, the staff finds STD SUP 12.1-1 acceptable because the information contained in these templates adequately addresses an acceptable ALARA program.

The staff concludes that the information pertaining to North Anna COL FSAR Section 12.1 is within the scope of the DC and adequately incorporates by reference Section 12.1 of the ESBWR DCD. The information is thus acceptable.

12.2 <u>Plant Sources</u>

12.2.1 Introduction

Section 12.2 addresses the issues related to contained radiation sources and airborne radioactive material sources during normal operations, AOOs, and accident conditions affecting in-plant radiation protection.

This section also addresses doses to members of the public from radioactive effluent releases. All liquid effluent releases are conducted and monitored through the liquid waste management system (LWMS) for process liquids generated during the operation of the LWMS, the gaseous waste management system (GWMS), and the solid waste management system (SWMS). Airborne releases from the operation of the LWMS, GWMS, and SWMS and ventilation exhaust systems servicing radiologically controlled areas, where process equipment are located, are monitored and discharged through their respective stacks, specifically, the reactor/fuel building stack, turbine building stack, and the radwaste building (RWB) stack.

12.2.2 Summary of Application

Section 12.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 12.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E.

In addition, in FSAR Section 12.2, the applicant provides the following:

Departures

- NAPS DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The ESBWR DCD identifies that on-site storage space for a 6-month volume of packaged waste is provided in the RWB. In this departure, the North Anna 3 RWB is configured to accommodate a minimum of 10 years volume of packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This departure reconfigures the arrangement of systems and components within the ESBWR RWB volume. The systems, structures, and components requiring re-arrangement are associated with the LWMS and SWMS. The existing RWB Fire Protection and heating, ventilation, and air conditioning systems have sufficient capacity to accommodate the extra volume of Class B and C wastes, and require no modification.

COL Items

- NAPS COL 12.2-2-A — Airborne Effluents and Doses

The applicant provided updated information to supplement the DCD with the site-specific parameters for addressing DCD COL Item 12.2-2-A, airborne effluent releases and doses to members of public. This information addresses compliance with the regulatory dose limits in Sections II.B and II.C of Appendix I to 10 CFR Part 50; compliance Section II.D of Appendix I to Part 50; airborne effluent concentration limits in Table 2 (Column 1) of Appendix B to 10 CFR Part 20; and dose limits in 10 CFR 20.1301 and 20.1302. Compliance with the requirements in Section II.D of Appendix I to Part 50 for airborne effluents is addressed in FSAR Section 11.3.1.

- NAPS COL 12.2-3-A — Liquid Effluents and Doses

The applicant provided updated information to supplement the DCD with the site-specific parameters for addressing DCD COL Item 12.2-3-A, liquid effluent releases and doses to members of public. This information addresses compliance with the regulatory dose limits in Section II.A of Appendix I to 10 CFR Part 50; compliance with Section II.D of Appendix I to Part 50; liquid effluent concentration limits in Table 2 (Column 2) of Appendix B to 10 CFR Part 20; and dose limits in 10 CFR Parts 20.1301 and 20.1302. Compliance with the requirements in Section II.D of Appendix I to Part 50 for liquid effluents is addressed in FSAR Section 11.2.1.

- NAPS COL 12.2-4-A — Other Contained Sources

In Subsection 12.2.1.5, “Other Contained Sources,” the applicant provided information about additional contained radioactive sources not described in the DCD that contain by-product, source, or special nuclear materials that may be maintained on site. These contained sources, which are not part of the permanent plant design, are used as calibration, check, or radiography sources.

- NAPS ESP COL 11.1-1 Compliance with 10 CFR Part 50, Appendix I, Section II.D

The applicant provided updated information to supplement the DCD with a site-specific analysis in addressing North Anna 3 Early Site Permit (ESP) COL 11.1-1. This information addresses compliance with the requirements in Section II.D of Appendix I to Part 50 for liquid and airborne effluents in confirming that liquid and gaseous radwaste systems include all items of reasonably demonstrated technology in reducing population doses to ALARA levels. FSAR Section 12.2.2 includes assessments of population doses for both liquid and gaseous effluents. The results of the 10 CFR Part 50, Appendix I, Section II.D, cost-benefit analyses are presented in FSAR Section 11.2.1 for liquid effluents and FSAR Section 11.3.1 for gaseous effluents.

Variances

A *variance* is a plant-specific deviation from one or more of the site characteristics, design parameters, or terms and conditions of an ESP or from the site safety analysis report (SSAR). A variance to an ESP is analogous to a departure from a standard DC. The applicant provided a request for a variance from a site characteristic for the North Anna ESP and from the ESP SSAR. The requests comply with the requirements of 10 CFR 52.39(d) and 10 CFR 52.93(b). To support a decision whether to grant a variance, each variance request provides the technical justification and supporting cross-references to the North Anna 3 FSAR information that meet the technically relevant regulatory acceptance criteria.

- NAPS ESP VAR 12.2-1 Gaseous Pathway Doses

The applicant submitted, under variance NAPS ESP VAR 12.2-1, a request to use updated information on offsite doses associated with gaseous effluents. The request states that the variance is necessary because FSAR dose estimates are higher than those reported in the North Anna ESP SSAR and the ESP-Environmental Review (ER). The doses are higher because of a change in long-term atmospheric dispersion and deposition parameters.

- NAPS ESP VAR 12.2-3 Annual Liquid Effluent Releases

The applicant submitted, under variance NAPS ESP VAR 12.2-3, a request to use updated information for the estimate of liquid effluent releases. The request states that the variance is necessary because FSAR estimates are different from those reported in the North Anna ESP SSAR and ESP-ER. The differences are associated with ESP estimates that were based on a composite source term reflecting different types of reactor technologies, while the FSAR applies the ESBWR DCD, Tier 2, source term. Also, the FSAR estimates for some radionuclides are higher than the ESP because the source term is based on the ESBWR design.

- NAPS ESP VAR 12.2-4 Existing Units' and Site Total Doses

The applicant submitted, under variance NAPS ESP VAR 12.2-4, a request to use updated dose information in characterizing doses from both existing units and total offsite doses. The request states that the variance is necessary as FSAR dose estimates are higher in the FSAR than that reported in the North Anna ESP SSAR and ESP-ER. The doses are higher because of the application of conservative assumptions used in presenting doses from the existing units and the Independent Spent Fuel Storage Installation (ISFSI) facility.

North Anna 3 COL FSAR, Sections 11.2, 11.3, and 11.5 present supporting details on the operation of the LWMS, GWMS, and the Process Radiation Monitoring System (PRMS). North Anna 3 COL, FSAR Section 13.5 describes the major elements of the operational procedures that will be used to operate the LWMS, GWMS, and PRMS. North Anna 3 FSAR Section 13.4 presents the milestones for the development and implementation of the offsite dose calculation manual (ODCM), standard radiological effluent controls (SREC), and radiological environmental monitoring program (REMP) for controlling all radioactive effluent releases and limiting doses to members of the public. In FSAR Section 11.5.4.5, NAPS COL 11.5-2-A, the applicant commits to the development of these programs using NEI ODCM Template 07-09A in monitoring and controlling effluent releases and doses to members of the public. The NEI ODCM Template 07-09A (Revision 0, March 2009) has been reviewed and found acceptable by the staff (see the staff's SER (in ADAMS Accession No. ML083530745) and NEI ODCM Template 07-09A (in ADAMS Accession No. ML091460258)). The staff's evaluation of these systems and operational programs is addressed in their respective sections of this SER.

- NAPS ESP VAR 12.2-5 Annual Gaseous Effluent Releases

The applicant submitted, under variance NAPS ESP VAR 12.2-5, a request to use updated information for the estimate of gaseous effluent releases. The request states that the variance is necessary because FSAR estimates are different from those reported in the North Anna ESP SSAR and ESP-ER. The differences are associated with ESP estimates that were based on a composite source term reflecting different types of reactor technologies, while the FSAR applies the ESBWR DCD, Tier 2, source term. Also, the FSAR estimates for some radionuclides are higher than the ESP because the source term is based on the ESBWR design.

Supplemental Information

- STD SUP 12.2-1

The applicant provides supplemental information in FSAR Subsection 12.2.1.1.2, "Other Radioactive Sources," to provide details regarding the Californium-252 (Cf-252) reactor startup source.

North Anna 3 COL, FSAR Sections 11.2, 11.3, and 11.5 present supporting details on the operation of the LWMS, GWMS, and the PRMS. North Anna 3 COL, FSAR Section 13.5 describes the major elements of the operational procedures that will be used to operate the LWMS, GWMS, and PRMS. North Anna 3 FSAR Section 13.4 presents the milestones for the development and implementation of the ODCM, SREC, and REMP for controlling all radioactive effluent releases and limiting doses to members of the public. In FSAR Section 11.5.4.5, NAPS COL 11.5-2-A, the applicant commits to the development of these programs using NEI ODCM Template 07-09A in monitoring and controlling effluent releases and doses to members of the public. The NEI ODCM Template 07-09A (Revision 0, March 2009) has been reviewed and found acceptable by the staff (see the staff's SER in (ADAMS Accession No. ML083530745) and NEI ODCM Template 07-09A in (ADAMS Accession No. ML091460258). The staff's evaluation of these systems and operational programs is addressed in their respective sections of this SER.

12.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the radiation sources, and the associated acceptance criteria, are in SRP Section 12.2.

The staff followed the guidance in RG 1.206 to evaluate North Anna 3 FSAR Section 12.2 for compliance with NRC regulations.

In accordance with Section VIII, "Processes for Changes and Departures," of Appendix E to Part 52, the applicant identifies one Tier 2 departure. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59, "Changes, tests, and experiments."

The regulatory basis for the acceptance of the COL items in this section include the applicable requirements of 10 CFR Part 20, 10 CFR Part 50, and the guidance of RG 1.206.
In particular, the regulatory basis for the acceptance of the COL Items for assessing doses to members of the public from liquid and gaseous effluent releases in unrestricted areas is established in:

- 10 CFR 20.1301(e), 10 CFR 20.1302, 10 CFR 50.34a, and 50.36a.
- Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, General Design Criterion (GDC) 60, "Control of releases of radioactive materials to the environment," and GDC 64, "Monitoring radioactivity releases."
- Appendix I to 10 CFR Part 50, Sections II.A, II.B, II.C, and II.D.

The regulatory basis for the performance of the LWMS, GWMS, and SWMS is in 10 CFR 52.80(a) and Generic Letter (GL) 89–01, "Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications." The criteria for a variance from an ESP is found in 10 CFR 52.39(d).

The SRP acceptance criteria include:

- RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I."
- RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for comment)."
- RG 1.111, Revision 1, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."
- RG 1.112, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors."
- RG 1.113, Revision 1, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."

* RG 1.206.

Full descriptions of the applicable regulatory and acceptance criteria are in SRP Section 11.1 through Section 11.5.

12.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 12.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 12.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.1 The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to "Radiation Sources."

In addition, the staff reviewed the applicant's proposed departure, variances from the North Anna 3 ESP, and the proposed resolution to the COL items included under Section 12.2 of the North Anna 3 COL FSAR. The staff's review used the applicable sections of the SRP and RG 1.206 as guidance. The staff performed an independent evaluation of doses from liquid and gaseous effluents using the LADTAP II computer code (NUREG/CR–1276, "User's Manual for LADTAP II – A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents") and the GASPAR II computer code (NUREG/CR–4653, "GASPAR II – Technical Reference and User Guide"). The staff reviewed the basis for the liquid and gaseous effluents source terms and the applicant's assumptions and data used to model exposure pathways and to estimate doses to offsite receptors.

Section 1.2.3 of this SER discusses the NRC's strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER for the Fermi 3 application are equally applicable to the North Anna 3 COLA, the staff undertook the following reviews:

* The staff compared the Fermi 3 COL FSAR, Revision 8, to the North Anna 3 COL FSAR, Revision 8. In this comparison, the staff considered changes to the North Anna 3 COL FSAR (and other parts of the COLA, as applicable) resulting from RAIs in the Fermi SER.

* The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the Fermi SER) evaluation.

* The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the Fermi standard content to be directly applicable to the North Anna 3 COLA.

The staff reviewed the following information in the North Anna 3 COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

- NAPS DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The North Anna 3 RWB was reconfigured to accommodate a minimum 10-year volume of packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This reconfiguration results in changes to equipment location and layout. The applicant provides revised radiation source parameters in FSAR Table 12.2-22R. The staff reviewed the equipment location and compared FSAR Table 12.2-22R with DCD Tier 2, Table 12.2-22. This comparison confirmed that the radiation source parameters remained unchanged, except for sources in DCD Rooms 6171 and 6172, which are now located in the reconfigured FSAR Room 6171. In the new configuration, the equipment drain sample tank and floor drain sample tank will be in one room (FSAR Room 6171). These tanks were originally in two separate rooms (DCD Rooms 6171 and 6172). A review of DCD Figure 12.3-19 and FSAR Figure 12.3-19R revealed that FSAR Room 6171 has a larger overall area than the two DCD rooms (6171 and 6172) combined. The staff therefore concluded that given the size of Room 6171, the radiation level and the required shielding will remain the same as those identified for Rooms 6171 and 6172 in the DCD, regardless of the tank locations.

The applicant's evaluation determined that this departure does not require prior NRC approval in accordance with 10 CFR Part 52, Appendix E, Section VIII.B.5. Within the review scope of this section, the staff finds it reasonable that the departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the certified ESBWR DCD is subject to NRC inspections.

COL Items

- NAPS COL 12.2-2-A — Airborne Effluents and Doses, (including NAPS ESP COL 11.1-1, Compliance with 10 CFR Part 50, Appendix I, Section II.D; NAPS ESP VAR 12.2-1, Gaseous Pathway Doses; NAPS ESP VAR 12.2-4, Existing Units' and Site Total Doses; and NAPS ESP VAR 12.2-5, Annual Gaseous Effluent Releases)

The applicant provides information for compliance with the airborne effluent requirements in FSAR Subsections 12.2.2.1, 12.2.2.2, and Table 2.0-201 which address the resolution of NAPS COL 12.2-2-A, which states:

> The COL Applicant is responsible for ensuring that offsite dose (using site-specific parameters) due to radioactive airborne effluents complies with the regulatory dose limits in Sections II.B and II.C of 10 CFR Part 50, Appendix I. In addition, the COL Applicant is responsible for compliance with Section II.D of 10 CFR Part 50, Appendix I; airborne effluent concentration limits of 10 CFR Part 20, Appendix B (Table 2, Column 1); and dose limits of 10 CFR Parts 20.1301 and 20.1302 to members of the public (Subsection 12.2.2.2).

The staff reviewed the North Anna 3 FSAR for compliance with the NAPS COL Items. The FSAR also presents comparisons with the information presented in the ESP Application and ER for North Anna 3. These comparisons and variances from the ESP are identified as NAPS ESP COL 11.1-1, and NAPS ESP VAR 12.2-1 and 12.2-4 (North Anna 3 Part 7, Departures Report). Any ESP variance or ESP COL Item in the FSAR and the ESP and ER are reviewed to ensure all regulatory requirements have been addressed in the application.

In addition, the staff listed parts of the gaseous and liquid effluent compliance process defined in the COL items to ensure compliance with the regulations noted above. These parts are the effluent Source Term, the 10 CFR Part 20 Gaseous Compliance, and the 10 CFR Part 50, Appendix I Gaseous Dose Compliance.

Airborne Source Term

In the staff review of the gaseous effluent source term, the staff used the design basis noble gas, iodine, and other fission product concentrations (uCi/g) for the reactor coolant from the tables in the ESBWR DCD Chapter 11. Airborne sources (Ci/yr) for normal operating releases are calculated using the source terms given in DCD Section 11.1 along with the site design specific parameters from FSAR Table 12.2-15R (the same parameters from DCD Table 12.2-15) for North Anna 3. The staff used the boiling water reactor (BWR) methodology of NUREG–0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE CODE)," January 1979, (GALE) in determining the annual airborne sources release values (Ci/yr) presented in DCD Table 12.2-16. The staff found that the site-specific design parameters and the approved DCD Section 11.1 source term information was appropriate for the gaseous source term released from the North Anna 3 reactor design.

10 CFR Part 20 Gaseous Compliance

In addition, the COL applicant is responsible for compliance with site airborne effluent concentration limits of 10 CFR Part 20, Appendix B (Table 2, Column 1), effluent concentration limits (ECL). The annual North Anna 3 airborne sources release values presented in DCD Table 12.2-16 (Ci/yr) are utilized with the site-specific parameters listed in FSAR Table 12.2-15R including the meteorology dispersion values to determine the concentrations released to the environment to the site boundary from North Anna 3. The North Anna 3 concentrations are then combined with the North Anna Units 1 and 2 concentrations to determine a total site concentration. These total site release concentrations are compared to the 10 CFR Part 20, Appendix B, Table 2, Column 1 ECL concentration values to determine if the sum of the ratios of the calculated concentration values divided by the 10 CFR Part 20, Table 2, Column 1 ECL values are less than 1.0 (Unity). Table 12.2-17R indicates that the applicant fraction of ECLs for all site radionuclides concentrations is 0.053 and is less than 1.0 (Unity). The staff reviewed the FSAR information submitted and verified all applicant calculations presented. The staff also verified the applicant methodology and results by independently calculating the gaseous effluent concentrations and comparing with the applicant results. The staff finds that these site-specific gaseous effluent releases comply with the ECLs in Table 2, Column 1 of Appendix B to 10 CFR Part 20 using the sum-of-fractions given in FSAR Tables 12.2-17R.

As the applicant points out in its variance request (See NAPS ESP COL 11.1-1; NAPS ESP VAR 12.2-1; NAPS ESP VAR 12.2-4; NAPS ESP VAR 12.2-5; FSAR sections 12.2.2.2; 12.2.2.4; 12.2.2.5; and 12.2.2.6), there are various values of North Anna 3 doses and curies per year released that are higher than the North Anna 3 ESP calculated curies per year and regulatory compliance required.

The applicant's variance request, NAPS ESP VAR 12.2-5, "Annual Gaseous Effluent Releases," states:

> This is a request to use the Unit 3 maximum annual gaseous effluent release values provided in FSAR Table 12.2-17R rather than the corresponding ESP values in EIS (Reference 6) Appendix I and ESP-ER Section 5.4, as referenced in SSAR Section 2.3.5.1. The Unit 3 values for some nuclides do not fall within (are larger than) the ESP and ER values, as shown in bold font in FSAR Table 12.2-17R. This variance results from a change in the annual release values for the ESBWR since the ESP-ER table was submitted. ESP-ER Table 5.4-7 presented the annual release values for a single unit nuclear plant, based on a composite of possible radionuclide releases from a number of reactor designs, including the ESBWR. ESP-ER Table 5.4-7 also contained more radionuclides than FSAR Table 12.2-17R, due to the use of the composite set of nuclides from multiple reactor designs.

The staff reviewed variance NAPS ESP VAR 12.2-5, and found that the applicant incorporated by reference the major parts of Section 12.2.2.2 of the ESBWR DCD concerning airborne dose evaluation offsite. The applicant also provided information in the COLA as required by the ESBWR DCD for a site-specific application. However, additional information had been supplied from the North Anna 3 ESP or ER site evaluation. When changes are made from the ESP results, it is designated as a variance. The variance applied in Section 12.2.2.2 of the FSAR, states that the Unit 3 values for some nuclides are larger than the ESP and ER values, as shown in bold font in FSAR Table 12.2-17R. This variance results from a change in the annual release values for the ESBWR since the original ESP and ER and tabulated results were submitted. ESP-ER Table 5.4-7 presented the annual release values for a single unit nuclear plant, based on a composite of possible radionuclide releases from a number of reactor designs, including the ESBWR. The staff reviewed the change and the justification of the change and found the change acceptable because the estimated North Anna 3 concentrations of normal gaseous effluent releases remain within the 10 CFR Part 20 concentration limits and the annual doses from normal gaseous effluent releases also remain within 10 CFR Part 50 limits. These calculation results are acceptable based on the use of approved industry standards and industry practices. The applicant's variance is acceptable because the estimated North Anna 3 concentrations of normal gaseous effluent releases for all nuclides meet the 10 CFR Part 20 concentration limits as shown in FSAR Table 12.2-17R. Therefore, the staff considers NAPS ESP VAR 12.2-5 to be acceptable and the issue is therefore resolved.

10 CFR Part 50, Appendix I Gaseous Dose Compliance

The FSAR Tables 12.2-18aR and 12.2-18bR present information submitted to demonstrate compliance with Sections II.B and II.C of Appendix I to Part 50. The parameters used for the calculation of NA3 airborne offsite doses are provided in Table 12.2-18aR. The methodology of RG 1.109 was used in determining the annual airborne dose values. The bases include values that are default parameters in RG 1.109 and other values that are site-specific NA3 parameters. The annual gaseous pathway doses are provided in Table 12.2-18bR and FSAR Table 12.2-201, "Comparison of Annual Doses to the MEI from Gaseous Effluents per Unit." The applicant's estimated annual doses from North Anna 3 to the maximally exposed individual (MEI) from gaseous effluent releases are compared with the applicable regulatory limits in FSAR Table 12.2-201. The North Anna 3 doses are within the 10 CFR Part 50, Appendix I, gaseous effluent limits, and most of the North Anna 3 dose estimates are lower than the corresponding ESP values. (See variance NAPS ESP VAR 12.2-1 below)

The staff reviewed the parameters submitted by the applicant as well as the results and the computer input and output data files submitted for GASPAR II dose calculations. In its review, the staff found insufficient information provided in the North Anna 3 FSAR to independently confirm the calculated individual doses and annual population pathway doses for compliance to applicable regulations. Therefore, in RAI 12.02-18, dated August 01, 2014 (ADAMS Accession No. ML14283A559), the staff requested additional information to include design parameters and values used in the applicant's GASPAR II code calculation, including value derivations and references. In addition, the staff requested that the applicant provide any changes made to the GASPAR II code input/output files used in the calculation of the gaseous effluent doses in Table 12.2-18bR, of the North Anna 3 FSAR, and provide a detailed breakdown of population doses by pathway and organ. On August 26, 2014, the applicant provided the details to validate the information in North Anna 3 FSAR Table 12.2-bR (ADAMS Accession No. ML14241A467). Therefore, RAI 12.02-18 is resolved and closed.

The RG 1.111 states that for gaseous effluents released from points less than the height of adjacent solid structures, ground-level release should be assumed. Ground-level releases under these circumstances account for the initial mixing of the effluent plume within the building wake.

In considering the source configuration criteria set forth in RG 1.111 and the modeling methodology used in the ESBWR DCD, the staff determined that the FSAR should be updated to include a justification for modeling the RWB vent stack as a mixed-mode release or to implement the ground-level source configuration guidance provided in RG 1.111.

Therefore, on September 09, 2014, in RAI 02.03.05-5 (ADAMS Accession No. ML 14283A554), the staff requested information regarding long-term atmospheric dispersion estimates for routine releases, the staff noted that the North Anna 3 COL, FSAR Section 2.3.5, "Long-Term (Routine) Diffusion Estimates," which describes the input data and assumptions that are used in the XOQDOQ model for routine effluent releases from the vent stacks on the Reactor Building/Fuel Building, Turbine Building, and RWB, are all modeled as mixed-mode releases. The North Anna COL FSAR also states that the RWB stack is close enough to the Turbine Building that the stack will experience building downwash effects from the Turbine Building. According to Tier 2, Table 2B-1 of the ESBWR DCD, the RWB stack height is 18.15 m (59.5 ft) above grade whereas the Turbine Building height is 52.0 m (170.6 ft) above grade.

The applicant responded on October 17, 2014, to RAI 02.03.05-5 (ADAMS Accession No. ML14295A659). After further consideration of the source configuration criteria set forth in RG 1.111, the applicant changed the type of release assumed for modeling routine releases from the RWB ventilation stack from mixed-mode to a ground-level release. The applicant stated that estimates of long-term atmospheric dispersion from routine effluent releases will be updated, and associated dose calculations, which use the estimated X/Q and D/Q from the RWB vent stack as inputs, will be revised to implement the updated values. The COLA will be revised to reflect updated values for long-term X/Q and D/Q from the RWB vent stack releases, along with the associated doses. The resulting doses remain within the appropriate acceptance criteria. The affected sections included FSAR Sections 2.3.5.1, 11.3.1, 12.2.2.2.2, and 12.2.2.4.4 and FSAR Tables 1.8-202, 2.0-201, 2.3-16R, 2.3-208, 2.3-209, 2.3-210, 2.3-211, 2.3-212, 2.3-213, 2.3-214, 2.3-215, 12.2-17R, 12.2-18bR, 12.2-201, 12.2-203, and 12.2-204. This change also involved extensive changes in ER sections 2.7.6 and 5.4.2.2 and many ER Tables. Since the applicant revised its Radwaste Stack release point to align with the guidance of RG 1.111, the staff finds that RAI 02.03.05-5 is resolved and closed. The staff verified that the

North Anna 3 COLA Part 2 FSAR Revision 9, Part 3 Revision 8, and Part 7, Revision 7, incorporated the appropriate changes described in the applicant's response to RAI 02.03.05-5. Therefore Confirmatory Item 12.2.4-01 from the staff advanced SER for North Anna 3 is resolved and closed.

The staff found, while reviewing the new effluent information provided by the applicant in response to RAI 02.03.05-5, which the dose quantities in FSAR Table 12.2-17R required additional information in order to evaluate the source term values listed in this table. The staff requested in RAI 12.02-21, that the applicant provide the calculations for all radionuclides in uCi/cc, and Ci/yr, and provide footnote(s) at the end of the Table 12.2-17R for explanation.

The applicant's response on January 08, 2015 (ADAMS Accession No. ML15009A235), explained the assumptions and equations used to calculate the concentrations and quantities of all radionuclides in the gaseous effluents from North Anna 3. This calculational process was included in the RAI response, and the applicant provided footnotes at the end of Table12.2-17R that also explained the Table 12.2-17R radionuclide values. The staff again reviewed and compared the applicant results by independently calculating the gaseous effluent doses based upon the new information provided by the applicant. Table 12.2.4-1 below indicates the comparison of the staff review and the applicant results. The comparison of the MEI doses from the gaseous pathway yielded mostly consistent results, for the Air-Gamma and Air-Beta Design Objective. The applicant Total Body, Organ (Thyroid) dose and Skin doses were acceptable and below the regulatory requirements. The NRC confirmatory results verified that the applicant's data provided and the applicant's results were acceptable. The NRC finds that the applicant has shown that offsite dose (using site-specific parameters) due to radioactive airborne effluents complies with the regulatory dose limits in Sections II.B and II.C of 10 CFR Part 50, Appendix I.

This additional information allowed the staff to complete their review understanding the bases for the gaseous effluent against applicable regulatory requirements. Therefore, RAI 12.02-21, is resolved and closed.

Table 12.2.4-1 Site-Specific Gaseous Effluent Doses

Description	Design Objective[1] Or Dose Limit	Applicant Site-Specific Calculated Dose	NRC Staff Calculated Doses
MEI doses from gaseous pathway[1,2]	10 mrad/yr (Air-gamma)	0.27 mrad/yr (Air-gamma)	0.28 mrad/yr (Air-gamma)
	20 mrad/yr (Air-beta)	0.25 mrad/yr (Air-beta)	0.25 mrad/yr (Air-beta)
	5 mrem/yr (Total Body)	0.32 mrem/yr (Total Body)	0.18 mrem/yr (Total Body)
	15 mrem/yr (Skin)	0.59 mrem/yr (Skin)	0.43 mrem/yr (Skin)
	15 mrem/yr (Organ)	4.4 mrem/yr (Organ)	4.56 mrem/yr (Organ)
Population doses from gaseous pathway[2]	-	4.5 person-rem/yr (Total Body)	4.5 person-rem/yr (Total Body)
	-	25.0 person-rem/yr (Thyroid)	25.3 person-rem/yr (Thyroid)

Table 12.2.4-1 Notes:

1. Numerical design objectives in 10 CFR Part 50, Appendix I for estimating annual doses above background from gaseous effluents for any individual in an unrestricted area, for one unit, from all exposure pathways are 5 mrem/yr (Total Body) or 15 mrem/yr (Organ).

2. FSAR Section Table 12.2-18bR, Table 12.2-201 and FSAR Table 12.2-204

The applicant's variance request, NAPS ESP VAR 12.2-1, is a request to use updated information for Unit 3 gaseous effluent doses rather than the SSAR information, which referred to ESP-ER Section 5.4. Several of the gaseous pathway doses to the MEI in FSAR Table 12.2-18bR do not fall within (are greater than) the corresponding values in ESP-ER Table 5.4-9. The North Anna 3 values which are higher are shown in bold font in FSAR Table 12.2-18bR. This variance is due in part to changes in maximum long-term dispersion estimates from those used in the ESP application as discussed above under NAPS ESP VAR 2.0-1. The variance is also due to changes in maximum annual gaseous release values from those used in the ESP Application, as discussed below in NAPS ESP VAR 12.2-5.

Compliance with the U.S. Environmental Protection Agency Standard 40 CFR Part 190

Compliance with the U.S. Environmental Protection Agency (EPA) standard in 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations," as implemented under 10 CFR Part 20.1301(e), is demonstrated in FSAR Tables 12.2-201 and 12.2-203. The applicant estimated the site-specific dose calculations from gaseous and liquid effluent releases for all three North Anna nuclear station units to address the North Anna 3 NAPS COL 12.2-2-A item and to demonstrate compliance with the dose limits to members of the public specified in 10 CFR 20.1302 and 40 CFR Part 190 as referenced in 10 CFR 20.1301(e).

The applicant addressed this requirement in FSAR 12.2.2.4.4, stating that "This section demonstrates that offsite doses due to North Anna 3, combined with offsite doses due to Units 1 and 2 and the NAPS independent spent fuel storage installation (ISFSI), comply with the regulatory limits in 10 CFR 20.1301 for doses to members of the public." The applicant used the North Anna 3 gaseous and liquid effluent release activities in FSAR Tables 12.2-17R for gaseous effluents and Table 12.2-19bR for liquid effluents, and the total annual doses to the MEI and the population resulting from North Anna 3 liquid and gaseous effluents calculated and presented in FSAR Tables 12.2-203 and 12.2-204.

The applicant states that the direct radiation contribution due to contained sources from operation of North Anna 3 is negligible. The direct dose contribution due to Turbine Building skyshine from North Anna 3 at two distances is provided in DCD Table 12.2-21. That table shows the annual dose at 1000 m (0.62 miles) to be 1.66E-06 mSv/yr (1.66E-04 mrem/yr). Section 9.3.9 shows that North Anna 3 uses hydrogen water chemistry, and DCD Section 12.2.1.3 explains that the direct dose contribution takes into account hydrogen water chemistry. The distance from North Anna 3 to the nearest residence is assumed to be 1190 m (0.74 miles) in the NW direction, as described in Section 2.3.5.1. The distance from North Anna 3 to the location on the site boundary with the highest gaseous effluent annual dose is 1416 m (0.88 miles) in the NNE direction. This is the distance from North Anna 3 to the site boundary, that is, the exclusion area boundary or as commonly referred to as the "EAB" in the direction of maximum annual χ/Q, as shown in Table 2.3-16R. These distances from North Anna 3 to each type of receptor location are greater than those presented in the DCD, so the North Anna 3 direct radiation dose rate at each location is even lower than the very low rate cited above for 1000 m (0.62 miles).

The total annual doses to the MEI resulting from North Anna Units 1 and 2 liquid and gaseous effluents are provided in Table 12.2-203. The values shown are representative based on review of Units 1 and 2 annual radiological environmental operating reports (e.g., Reference 12.2-203). The direct radiation contribution from operation of Units 1 and 2 is negligible. An evaluation of operating plants by the NRC states that:

> …because the primary coolant of an LWR is contained in a heavily shielded area, dose rates in the vicinity of light water reactors are generally undetectable and are less than 1 mrem/year at the site boundary.

The staff concludes that the direct radiation from normal operation results in “small contributions at site boundaries” (Reference 12.2-204, Section 4.6.1.2). For the North Anna Power Station site, the nearest residence is at a distance typical of a site boundary evaluated by NRC. An assumed value of 1E-2 mSv/yr (1 mrem/yr) is included in Table 12.2-203 to account for the dose to the MEI at the nearest residence from operation of Units 1 and 2.

Discharged fuel assemblies from North Anna Units 1 and 2 are stored in the North Anna ISFSI (Reference 12.2-205). The direct radiation contribution from operation of the North Anna ISFSI is small, both at the residence nearest to the ISFSI, which is south and slightly east of the ISFSI at about 870 m (0.54 miles), and at the closest point to the site boundary, which is south and slightly west of the ISFSI at approximately 760 m (0.47 miles). The annual contribution at the site boundary from the ISFSI is no more than 3.6E-02 mSv/yr (3.6 mrem/yr). This value is based on a conservatively estimated peak dose rate from a fully-filled ISFSI with 84 casks/modules, which bounds the planned 68 casks, containing NAPS Units 1 and 2 fuel assemblies and the distance from the ISFSI to the site boundary, which is shorter than that to the residence nearest the ISFSI. This ISFSI dose contribution is then conservatively applied to the MEI for the nearest residence from North Anna 3, which is assumed to be 760 m (0.47 miles) in the northwest direction and even further from the ISFSI.

Table 12.2-203 shows that the total North Anna site doses resulting from the normal operation of Units 1, 2, and 3 and applied at the nearest residence meet 10 CFR 20.1301(e) and are well within the regulatory limits of 40 CFR Part 190. These doses are applied at the distance to the nearest residence from North Anna 3, which is assumed to be 760 m (0.47 miles). These doses bound those at the site boundary.

The staff has reviewed the information provided by the applicant and has displayed the data in SER Table 12.2.4-2, “Estimated Site Gaseous and Liquid Effluent Doses,” shown below. The staff has used the Total Body, Thyroid, and Bone (or Organ) doses for 1) liquid effluents; 2) gaseous effluents; 3) Direct dose maximum from the ISFSI (provided by the applicant); and 4) the total dose from the existing two units on site to calculate the maximum hypothetical maximum dose from all sources at this site to compare to the EPA standard doses in 40 CFR Part 190. As shown in the SER Table 12.2.4-2, using the four inputs stated above for the maximum site dose, the staff calculates a maximum 9.02E-2 mSv/yr (9.02 mrem/yr) Total Body dose, 13.56E-2 mSv/yr (13.56 mrem/yr) Thyroid dose, and 10.22E-2 mSv/yr (10.22 mrem/yr) Bone (Organ) dose, compared to the EPA 40 CFR 190 Limits of 25E-2, 75E-2, and 25E-2 mSv/yr (25, 75, and 25 mrem/yr) for Total Body, Thyroid and Bone (Organ) doses, respectively. These maximum doses are within the guidelines of 40 CFR Part 190.

Investigating the applicant's total site doses listed in FSAR Table 12.2-203, their similar totals are 6.8E-2 mSv/yr (6.8 mrem/yr) total body, 27E-2 mSv/yr (27 mrem/yr) thyroid, and 12E-2 mSv/yr (12 mrem/yr), within the EPA 40 CFR Part 190 limits and lower than the staff calculations. Further review shows that by excluding the maximum ISFSI direct dose provided by the applicant, 3.6E-2 mSv/yr (3.6 mrem/yr), in FSAR section 12.2.2.4.4, in the staff maximum dose calculations in SER Table 12.2.4-2, and replacing the maximum dose from the ISFSI with the FSAR Table 12.2-203, footnote 2, combined ISFSI and the two existing units dose of 1.0E-2 mSv/yr (1.0 mrem/yr) due to direct radiation used by the applicant, the staff total doses compare very favorably with the applicant's total doses. Again, well below the EPA 40 CFR 190 dose limits.

Therefore, the staff has reviewed the information presented in the FSAR including the variance 12.2-1 to the ESP by the applicant and found it acceptable for compliance with 20.1301(e), which references EPA 40 CFR Part 190, as demonstrated in FSAR Tables 12.2-202 and 12.2-203. The compliance with this regulatory requirement has been independently reviewed and is considered acceptable to the staff.

Table 12.2.4-2 Estimated Site Gaseous and Liquid Effluent Doses.

	NRC calculated individual doses			Existing unit doses	NRC calculated total dose	NRC calculated total dose without direct[2]	40 CFR 190 dose limit	Applicant Totals[3]
	Liquid mrem/yr	Gas mrem/yr	Direct (mrem/yr)[1]					
Total Body	0.08	0.34	3.6	5	9.02	5.42	25	5.5
Thyroid	0.26	4.6	3.6	5.1	13.56	9.96	75	10
Bone	1.1	0.42	3.6	5.1	10.22	6.62	25	6.8

Notes:

1. Maximum direct dose assumed from fully loaded ISFSI pad from applicant

2. NRC totals without the maximum direct dose contribution

3. The applicant states that the existing units consider 1 mrem/yr direct dose radiation, which includes the ISFSI doses

The applicant's variance request, NAPS ESP VAR 12.2-4, "Existing Units' and Site Total Doses," states:

> This is a request to use updated information for doses for the existing units and the site total doses in FSAR Table 12.2-203 rather than the information in SSAR Section 2.3.5.1 that refers to ESP ER Section 5.4, which contains ESP ER Table 5.4-11. The doses for total body, thyroid, and bone due to the existing units, as shown in FSAR Table 12.2-203, do not fall within (are greater than) the corresponding values in ESP ER Table 5.4-11. Because these values are higher, they are shown in bold font in FSAR Table 12.2-203. This variance is due to the conservative dose estimates for direct radiation from Units 1 and 2 and the Independent Spent Fuel Storage Installation

(ISFSI), which were added to the doses for liquid and gaseous effluents from Units 1 and 2. The direct radiation dose contributions were included in the FSAR dose estimates, but not in the ESP Application dose estimates. The addition of these direct radiation doses to the existing units' doses (annual total body, thyroid, and bone) caused the FSAR values to exceed the SSAR values."

The applicant justification states:

> This variance is acceptable because the dose estimates are more conservative and complete with the addition of the dose contributions from direct radiation from the existing units and the ISFSI. As shown in FSAR Table 12.2-203, the annual total body, thyroid, and bone doses for the site, including the doses from the existing units and the ISFSI, meet the applicable 40 CFR 190 limits."

The staff review of variance NAPS ESP VAR 12.2-4, found that the applicant incorporated by reference the major parts of Section 12.2.2.2 of the ESBWR DCD concerning airborne dose evaluation offsite. The applicant also provided information in the COLA as required by the ESBWR DCD for a site-specific application. However, additional information has been supplied concerning the possible design and the site by the ESP or ER. This particular variance, as stated above, applied in section 12.2.2.2 of the FSAR, is a request stating this variance is due to the conservative dose estimates for direct radiation from Units 1 and 2 and the ISFSI, which were added to the doses for liquid and gaseous effluents from Units 1 and 2. The staff reviewed the change and the justification of the change and found that, as shown in FSAR Table 12.2-203, the doses are acceptable because the dose estimates are more conservative and complete with the addition of the dose contributions from direct radiation from the existing units and the ISFSI. The doses from the existing units and the ISFSI meet the applicable 40 CFR Part 190 limits, as referenced in 10 CFR 20.1301(e). The calculations and results requirements are acceptable based on the use of the applicable industry standards and industry practices. Therefore, the staff considers NAPS ESP VAR 12.2-4 to be acceptable and that the issue is resolved.

10 CFR Part 50 Compliance with Section II.D of Appendix I

The 10 CFR Part 50, as it relates to ALARA, is addressed in FSAR Section 11.3 for gaseous effluents. Evaluation of 10 CFR Part 50, Appendix I, Section II.D is performed in the North Anna 3 Chapter 11 SER, Section 11.3, using data from FSAR Table 12.2-204, Collective Total Body (Population) Doses Within 50 Miles. The compliance with this regulatory requirement has been reviewed and is considered acceptable to the staff.

- NAPS COL 12.2-3-A — Liquid Effluents and Doses, (NAPS ESP COL 11.1-1, Compliance with 10 CFR Part 50, Appendix I, Section II.D; NAPS ESP VAR 12.2-3, Annual Liquid Effluent Releases; and NAPS ESP VAR 12.2-4, Existing Units' and Site Total Doses)

The applicant provides information for compliance with the liquid effluent requirements in FSAR Subsections 11.2.1, 11.2.2.3, 11.2.3.2, 12.2.2.4.1-6, Tables 12.2-19bR, 12.2-20aR, 12.2-20bR, and Table 2.0-202 which address the resolution of NAPS COL 12.2-3-A, which states:

> As stated in DCD section 12.2.4, the COL Applicant is responsible for ensuring that offsite dose (using site-specific parameters) due to radioactive liquid effluents complies

with the regulatory dose limits in Section II.A of 10 CFR 50, Appendix I. In addition, the COL Applicant is responsible for compliance with Section II.D of 10 CFR Part 50, Appendix I; liquid effluent concentration limits of 10 CFR Part 20, Appendix B (Table 2, Column 2); and dose limits of 10 CFR Parts 20.1301 and 20.1302 to members of the public (Subsection 12.2.2.4).

The staff reviewed the various aspects of the FSAR for compliance with the NAPS COLs, "Departures, Variances, and Exemptions." The FSAR also presents comparisons with the information presented in the ESP application and ER for North Anna 3. These comparisons and variations are identified as NAPS ESP COL 11.1-1, and NAPS ESP VAR 12.2-1 and 12.2-4 (Part 7, Departures Report). Any ESP variances or ESP COLs noted in the FSAR and the ESP and ER are presented to ensure all commitments have been made in the application.

In addition, the staff listed parts of the gaseous and liquid effluent compliance process defined in the COLs to ensure compliance with the regulations noted above. These parts are the effluent Source Term, the 10 CFR Part 20 Liquid Compliance, and the 10 CFR Part 50, Appendix I Liquid Dose Compliance.

Liquid Source Term

Liquid sources (Ci/yr) for normal operating releases are calculated using the reactor coolant system source terms given in ESBWR DCD Section 11.1 along with the site-specific design parameters from ESBWR DCD Table 12.2-19a for North Anna 3. The staff used the BWR methodology of NUREG–0016 (GALE) in determining the annual airborne sources release values (Ci/year) presented in DCD Table 12.2-19b and FSAR Table 12.2-19bR. The staff found that the site-specific design parameters and the approved DCD Section 11.1 source term information was determined to be appropriate for the liquid source term released from the North Anna 3 reactor design.

10 CFR Part 20 Liquid Compliance

In addition, the COL applicant is responsible for compliance with site liquid effluent concentration limits of 10 CFR Part 20, Appendix B (Table 2, Column 1), ECLs. The annual North Anna 3 liquid sources release values presented in DCD Table 12.2-19b (and FSAR Table 12.2-19bR) (Ci/yr) are utilized with the site-specific parameters to determine the concentrations released to the environment to the site boundary from North Anna 3 in FSAR Table 12.2-19bR. The North Anna 3 concentrations are combined with the North Anna Units 1 and 2 concentrations in FSAR Table 12.2-19bR to determine a total site concentration. These total site release concentrations are compared to the 10 CFR Part 20, Appendix B, Table 2, Column 1 ECL concentration values to determine if the sum of the ratios of the calculated concentration values divided by the 10 CFR Part 20 Table 2, Column 1 ECL values is less than 1.0 (Unity). Table 12.2-19bR indicates that the applicant's fraction of ECLs for all site radionuclides concentrations is 0.22.

The staff issued RAI12.02-22 dated November 14, 2014 (ADAMS Accession No. ML14318A652), after the review of the independent source term and dose calculations for the purpose of assessing the performance of the LWMS against the NRC requirements of 10 CFR 20.1302; Table 2, of Appendix B to 10 CFR Part 20; and the dose objectives of Appendix I to 10 CFR Part 50. The calculations in Table 12.2-19bR concerning the concentrations of radioactive materials in liquid effluents released to unrestricted areas should not exceed the concentration limits in Table 2, of Appendix B, to 10 CFR Part 20. The staff requested that the applicant explain the source term calculations related to assessing the 10 CFR Part 20 requirement calculation(s) involved for all radionuclide values in the Annual Release column, Ci/yr and the Concentration, uCi/ml column in a footnote or note at the end of the table. The current calculations for FSAR Table 12.2-19bR require additional information to evaluate the source term quantities.

The applicant responded on January 8, 2015 (ADAMS Accession No. ML15009A235), and provided the explanations required to calculate the source term and concentrations in FSAR Table 12.02-19bR. The revised response provides further clarification of the information presented in FSAR Table 12.2-19bR, as requested by the NRC during an audit of the underlying calculations on July 1, 2015. FSAR Table 12.2-19bR was revised to include footnotes that explain the source term calculations related to 10 CFR Part 20 requirements for all radionuclide values in columns 2-5 of the table. Examples were also provided explaining the calculations of the values for particular radionuclides. The applicant also provided models showing the discharge canal and the dilution and evaporation terms for the North Anna Reservoir and the Waste Heat Treatment Facility (WHTF). The applicant also provided the equations used to calculate the values seen in the FSAR table.

The staff reviewed the FSAR information submitted and compared all of the applicant's calculation results by independently calculating the liquid effluent concentrations. The staff concludes that liquid effluents released in unrestricted areas comply with effluent concentration requirement in Table 2 (Column 1) of Appendix B to Part 20.

As the applicant points out (See NAPS ESP COL 11.1-1, NAPS ESP VAR 12.2-3, NAPS ESP VAR 12.2-4, sections 12.2.2.4.2, 12.2.2.4.4 and 12.2.2.4.6) there are various values of North Anna 3 curies per year released that are higher than the NA3 ESP calculated curies per year.

The applicant's variance request, ESP VAR 12.2-3, states:

> This is a request to use the North Anna 3 maximum annual liquid release values provided in FSAR Table 12.2-19bR rather than the corresponding ESP values in EIS Appendix I (Reference 6) and ESP-ER Section 5.4 as referenced in SSAR Section 2.3.5.1. The North Anna 3 values for some nuclides do not fall within (are larger than) the ESP and ER values, as shown in bold font in FSAR Table 12.2-19bR.
>
> This variance results from a change in the annual release values for the ESBWR since the ESP-ER table was submitted. ESP-ER Table 5.4-6 presented the annual release values for a single unit nuclear plant, based on a composite of possible radionuclide releases from a number of reactor designs including the ESBWR. ESP-ER Table 5.4-6 also contained more radionuclides than FSAR Table 12.2-19bR, due to the use of the composite set of nuclides from multiple reactor designs.

The applicant's justification states:

> This variance is acceptable because the estimated North Anna 3 concentrations of normal liquid effluent releases remain within the applicable concentration limits and the annual doses from normal liquid effluent releases remain within applicable limits. The estimated Unit 3 concentrations of normal liquid effluent releases for all nuclides meet the 10 CFR Part 20 concentration limits as shown in FSAR Table 12.2-19bR. The estimated annual doses from Unit 3 to the MEI from liquid effluents are compared with the applicable limit in FSAR Table 12.2-202. The Unit 3 dose meets the 10 CFR Part 50,

Appendix I, limit, and the Unit 3 dose estimates are lower than the corresponding ESP values.

The staff's review of variance NAPS ESP VAR 12.2-3 found that the applicant incorporated by reference the major parts of Section 12.2.2.2 of the ESBWR DCD concerning airborne dose evaluation offsite. The applicant also provided information to the COL as required by the ESBWR DCD for a site-specific application. However, additional information has been supplied concerning the possible design and the site by the ESP or ER. This variance as stated above, applied in Section 12.2.2.2 of the FSAR, is a request stating that the North Anna 3 values for some nuclides are larger than the ESP and ER values, as shown in bold font in FSAR Table 12.2-19bR. This variance results from a change in the annual release values for the ESBWR since the ESP-ER table was submitted. ESP-ER Table 5.4-6 presented the annual release values for a single unit nuclear plant, based on a composite of possible radionuclide releases from a number of reactor designs including the ESBWR. The staff reviewed the change and the justification of the change and found that acceptable because the estimated North Anna 3 concentrations of normal liquid effluent releases remain within the applicable concentration limits and the annual doses from normal liquid effluent releases remain within applicable limits. The estimated North Anna 3 concentrations of normal liquid effluent releases for all nuclides meet the 10 CFR Part 20 concentration limits as shown in FSAR Table 12.2-19bR. The calculations and results requirements are acceptable based on the use of the applicable industry standards and industry practices. The applicant provided an acceptable reason that this variance is acceptable because the North Anna 3 dose meets the 10 CFR Part 50, Appendix I, limit, and the North Anna 3 dose estimates are lower than the corresponding ESP values. Therefore, the staff considers NAPS ESP VAR 12.2-3 to be acceptable and therefore the issue is resolved.

10 CFR Part 50, Appendix I Liquid Dose Compliance

The FSAR Tables 12.2-20aR and 12.2-20bR present information submitted to demonstrate compliance with Sections II.B and II.C of Appendix I to 10 CFR Part 50. The parameters used for the calculation of North Anna 3 liquid offsite doses are provided in Table 12.2-20aR. The methodology of RG 1.109 was used in determining the annual liquid dose values. The basis include values that are default parameters in RG 1.109 and other values that are North Anna 3 parameters. The annual liquid pathway doses are provided in Table 12.2-20bR and FSAR Table 12.2-202, "Comparison of Annual Doses to the MEI from Liquid Effluents per Unit." The applicant's estimated annual doses from North Anna 3 to the MEI from liquid effluent releases are compared with the applicable regulatory limit in FSAR Table 12.2-202. The North Anna 3 doses are within the 10 CFR Part 50, Appendix I, liquid effluent limits, and the North Anna 3 dose estimates are lower than the corresponding ESP values.

The staff reviewed the parameters submitted by the applicant as well as the results and the computer input and output data files submitted for LADTAPII dose calculations. The staff also compared the applicant's results by independently calculating the liquid effluent doses to the MEI. The table below indicates the comparison of the staff review and the applicant results. The staff used the input provided by the applicant and duplicated the applicant's results. Therefore the staff accepts the liquid dose calculations provided.

Table 12.2.4-3 Site-Specific Liquid Effluent Doses

Description	Design Objective[1] Or Dose Limit	Applicant Site-Specific Calculated Dose	NRC Staff Calculated Doses
MEI doses from liquid pathway[1,2]	3.0 mrem/yr (Total Body)	0.079 mrem/yr (Total Body)	0.08 mrem/yr (Total Body)
	10.0 mrem/yr (Bone)	1.1 mrem/yr (Bone)	1.1 mrem/yr (Bone)
Population doses from liquid pathway[2]	-	0.84 person-rem/yr (Total Body)	0.84 person-rem/yr (Total Body)
	-	0.99 person-rem/yr (Thyroid)	0.99 person-rem/yr (Thyroid)

Notes:

1. Numerical design objectives in 10 CFR Part 50, Appendix I for estimating annual doses above background from liquid effluents for any individual in an unrestricted area, for one unit, from all exposure pathways are 3 mrem/yr (Total Body) or 10 mrem/yr (Organ).

2. FSAR Section Table 12.2-20aR, Table 12.2-20bR, Table 12.2-202, Table 12.2-203 and Table 12.2-204.

Compliance with the U.S. Environmental Protection Agency Standard 40 CFR Part 190

Compliance with the EPA standard in 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), is demonstrated in FSAR Table 12.2-204. (Liquid and Gaseous). Compliance with the EPA standard in 40 CFR Part 190, as implemented under Part 20.1301(e), is demonstrated in FSAR Table 12.2-203. The compliance with this regulatory requirement has been reviewed in Table 12.2.4-2 and is considered acceptable to the staff.

10 CFR Part 50 Compliance with Section II.D of Appendix I

The 10 CFR Part 50 on ALARA is addressed in FSAR Section 11.2 for liquid effluents. Evaluation of 10 CFR Part 50 Appendix I Section II.D is performed in the North Anna 3, Chapter 11 SER, Section 11.2, using data from FSAR Table 12.2-204, “Collective Total Body (Population) Doses Within 50 Miles.” The compliance with this regulatory requirement has been reviewed and is considered acceptable to the staff.

- STD COL 12.2-4-A Other Contained Sources

The applicant provided additional information under STD COL 12.2-4-A that addresses the resolution of DCD COL Item 12.2-4-A, which states:

> The COL applicant will address any additional contained radiation sources (including sources for instrumentation and radiography) not identified in Subsection 12.2.1.5.

The COL applicant stated that additional contained sources which contain by-product, source, or special nuclear materials may be used and maintained on site. These sources are typically used as calibration or radiography sources. In addition, the contained sources described in Subsection 12.2.1.5 will also be used as check sources.

Calibration sources will be used to calibrate the process and effluent radiation monitors, the area radiation monitors, and portable and laboratory radiation detectors and radiation measurement instruments. In addition to gamma calibration sources, beta and alpha calibration radiation sources are also available. All calibration sources will be traceable to the National Institute of Standards and Technology, or equivalent. Radiography sources will be surveyed upon entry to the site and radiation protection personnel will maintain copies of the most recent leak test records for owner-controlled sources. Radiography will be conducted in accordance with approved procedures. Check sources, which are not necessarily calibrated, are used to confirm the continuing satisfactory operation of an instrument. The applicant stated that check sources which are an integral part of (i.e., physically located in) area, process, and effluent monitors and are not easily removed do not require special handling, storage, or use procedures for radiation protection purposes. The staff finds this acceptable, since these check sources consist of small quantities of by-product material and access to these sources would require procedures and tools to disassemble components of the monitors. Except for check sources physically located in monitors, as described above, and exempt quantities or concentrations of solid and liquid sources used for instrument calibration, the applicant stated that RPP procedures will be used to govern the use and control of these additional contained radiation sources. The applicant stated that these procedures will consider guidance provided in RG 8.8 to ensure that occupational doses from the control and use of these sources are ALARA.

In addition, Section 12.5.4.10 of NEI 07-03A, referenced in the North Anna 3 COL FSAR Appendix 12BB, describes RPP radioactive material control procedures. This section states that procedures will be established, implemented, and maintained to ensure compliance with the relevant requirements in 10 CFR Part 20 to ensure positive control over licensed radioactive material to avoid unnecessary or inadvertent exposures and releases of such material into uncontrolled areas in a manner that is not authorized by regulation or the license. The applicant verified that these procedures will apply to byproduct, source, and special nuclear material, including the contained sources described in Subsection 12.2.1.5. The staff has reviewed and approved NEI 07-03A and the staff, therefore, finds this acceptable.

The RG 1.206 states that the applicant should describe any required radiation sources containing byproduct, source, and special nuclear material that may warrant shielding considerations, and, for any such sources, should provide a listing by isotope, quantity, form, and use for all of these sources that exceed 3.7 E+9 Bq (100 millicuries). FSAR Appendix 12BB (which incorporates by reference NEI 07-03A) addresses shielding requirements for all byproduct, source, and special nuclear material, including the portable sources described in NA3 FSAR Subsection 12.2.1.5. The applicant stated that they will utilize two standard calibration sources, a neutron (Am-Be) source and a Cs-137 source, that exceed 3.7 E+9 Bq (100 millicuries). Details of isotope type, quantity, form, shielding requirements, and use of future contained sources will be available when these required sources are purchased. As discussed above, these sources will be controlled by the applicant's RPP.

On the basis of the information provided in Subsection 12.2.1.5 of the North Anna 3 FSAR, the staff finds that the applicant has adequately addressed DCD COL Item 12.2-4-A regarding the description of any other contained radiation sources not described in Subsection 12.2.1.5 of the ESBWR DCD. Therefore, the staff finds DCD COL Item 12.2-4-A to be resolved.

As stated above, the applicant's radioactive material control procedures (which are part of the RPP) will apply to byproduct, source, and special nuclear materials. FSAR Subsection 12.2.1.5 provides a description of the specific types of byproduct, source, and special nuclear materials (including their chemical or physical forms and maximum quantities held at any one time) for the requested material licenses under 10 CFR Part 30, “Rules of General Applicability to Domestic Licensing of Byproduct Material”; 10 CFR Part 40, “Domestic Licensing of Source Material”; and 10 CFR Part 70) that will be received; possessed; or used during the period between the issuance of the COL and the 10 CFR 52.103(g) finding.

In FSAR Subsection 12.2.1.5, the applicant states that no 10 CFR Part 40 (“Domestic Licensing of Source Material”) specifically licensed material—including natural uranium, depleted uranium, or uranium hexafluoride—will be received; possessed; or used during the period between the issuance of the COL and the 10 CFR 52.103(g) finding. Pursuant to 10 CFR Part 30, the FSAR provides a description of the nominal values of projected radioactive byproduct materials (in the form of sealed sources) that will be used for radiation monitoring and laboratory and portable monitoring instrumentation. This information is in FSAR Table 12.2-206. The applicant stated that no byproduct material will be received, possessed, or used in a physical form that is “in unsealed form, on foils or plated sources, or sealed in glass,” and that exceeds the quantities in Schedule C in 10 CFR 30.72, “Schedule C–Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release.” The applicant stated that special nuclear material shall be in the form of reactor fuel and spent fuel, in accordance with limitations for storage and amounts required for reactor operation as described in COLA Part 2. Pursuant to 10 CFR Part 70, the FSAR provides a description of the non-fuel special nuclear material specifically required for use at North Anna 3. This non-fuel special nuclear material consists of local power range monitor assemblies and startup range nuclear monitor assemblies. This information is listed in FSAR Table 12.2-207. The applicant stated that the special nuclear material to be received, possessed, or used does not involve enriched uranium for which a criticality accident alarm system is required; uranium hexafluoride in excess of 50 kilograms (110 pounds) in a single container or 1,000 kilograms (2,200 pounds) total; or plutonium in excess of 7.4E+10 Becquerels (Bq) (2 curies (Ci)) in an unsealed form or on foils or plated sources. The staff finds that the specific material information described above satisfies the requirements of 10 CFR 30.32, “Application for specific licenses”; 10 CFR 40.31, “General domestic licenses for byproduct material”; 10 CFR 70.21, “filing”; and 10 CFR 70.22, “Contents of applications,” to receive, possess, and use byproduct, source, and special nuclear material. Therefore, this information is acceptable.

In addition, as part of the North Anna 3 review of plant-specific information on other contained sources under COL Item STD COL 12.2-4-A, the staff issued RAI 02.04.13-6 to determine the applicant’s basis and assumptions used to develop the condensate storage tank (CST) radionuclide inventories listed in North Anna 3 FSAR Table 12.2-205. The staff also issued RAI 12.02-20 requesting that the applicant describe the dimensions, wall composition, and wall thickness of the CST and provide the applicant’s basis for stating in the FSAR that the maximum expected exposure rate at 30 centimeters (cm) (1 ft) from the outside surface of the CST would not exceed 5E-2 mSv/hr (5 mrem/hr). The staff requested this information to evaluate the dose rates in the vicinity of the CST and ascertain whether the applicant will need to implement any physical or administrative features to limit the access to the CST to ensure that radiation exposures to personnel in the vicinity of the tank are maintained ALARA. In the applicant’s response to RAI 02.04.13-16 dated January 27, 2015 (ADAMS Accession No. ML15028A392), the applicant stated that the CST is fed by the following four fluid streams; makeup water transfer pumps, control rod drive pump recirculation, LWMS, and condensate reject. Of these four CST input streams, only the streams from the LWMS and condensate reject contribute to the CST radionuclide inventory. The applicant first determined the activity concentrations of the radionuclides in the CST input streams from both the LWMS and condensate reject. Then, in order to ensure the highest potential radionuclide material inventory is represented in the CST, the applicant selected the bounding concentration for each radionuclide from these two CST input streams to be the maximum concentration from all contaminated CST input streams.

In the applicant's responses to RAI 12.02-20 dated December 3, 2014 and August 31, 2015 (ADAMS Accession No. ML14338A782 and ADAMS Accession No. ML15245A229, respectively), the applicant provided the requested information including the projected CST design dimensions and material of construction and the estimated radionuclide inventory of the CST based on the various potentially contaminated liquid inputs into the tank. The applicant amended the FSAR to include a new table (Table 12.2-205), which lists the estimated radionuclide source term concentrations and source term inventories in the CST. The ESBWR DCD states that the capacity of the CST is 4,885 cubic meters (1.29 million gallons). The ESBWR DCD does not provide any further design parameters for the CST, so the applicant considered two different CST design configurations based on tank aspect ratios (ratio of the tank height to tank diameter) of 0.5 and 2 that limit the tank diameter and height. Based on these tank configurations, the applicant calculated the potential dose rate at 30 cm (1 ft) from the surface of the tank to be 1.84E-2 mSv/hr (1.84 mrem/hr) for the shorter tank (aspect ratio of 0.5) and 1.78E-2 mSv/hr (1.78 mrem/hr) for the taller tank (aspect ratio of 2). Because these estimated dose rates are below the threshold considered to be a radiation area per 10 CFR 20.1003, the applicant concluded that no special physical or administrative features are needed to maintain the exposures ALARA in the vicinity of the CST.

The staff reviewed the applicant's information, assumptions, and the method of analysis and found them acceptable. The staff performed confirmatory analyses to determine the expected dose rates in the vicinity of the CST. The staff's analyses confirmed the applicant's cited results. Therefore, the staff considers RAI 12.02-20, resolved and closed. Overall, the staff finds that the applicant's resolution of COL Item STD COL 12.2-4-A meets the requirements of 10 CFR Part 20 and is therefore acceptable. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicant's responses to RAI 12.02-20 and RAI 02.04.13-16. Therefore Confirmatory Item 12.2.4-02 from the staff advanced SER for North Anna 3 is resolved and closed.

Supplemental Information

- STD SUP 12.2-1

The STD SUP 12.2-1 specifies that each of the required six Cf-252 sealed sources required for reactor startup contains 0.5 to 0.822 mg (1.76E-5 to 2.9E-5 ounces (oz)) of Cf-252, for a total of 3 to 5 mg (1.06E-4 to 1.74E-4 oz) of Cf-252. This supplemental information relating to the material description of the Cf-252 reactor startup source satisfies the requirements of 10 CFR 30.32 and, therefore, the staff finds STD SUP 12.2-1 to be acceptable.

12.2.5 Post Combined License Activities

There are no post COL activities related to this section.

12.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information relating to plant radiation sources, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the radiation sources that were incorporated by reference are resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 12.2, and other NRC RGs.

- STD COL 12.2.4-A states that the applicant should provide information about additional contained radioactive sources not described in the DCD that contain by-product, source, or special nuclear materials that may be maintained on site. In response to this COL information item, the applicant specified that the additional sources not described in the DCD would be used as calibration, radiography, or check sources. The staff concluded that the applicant had adequately responded to this DCD COL information item by providing a description of the contained sources that were not described in the ESBWR DCD. In the response to this DCD COL information item, the applicant also stated that the procedures used to govern the control and use of these contained sources considers the guidance in RG 8.8.

- STD SUP 12.2-1-As discussed in the staff's evaluation above, the staff finds the information in STD SUP 12.2-1 acceptable.

12.3 Radiation Protection Design Features

12.3.1 Introduction

The FSAR Section 12.3 addresses the issues related to radiation protection equipment and design features used to ensure that occupational radiation exposures are ALARA. The discussion takes into account design dose rates, AOOs, and accident conditions. These issues include the facility design features, shielding, ventilation, area radiation and airborne radioactivity monitoring instrumentation, and dose assessment.

12.3.2 Summary of Application

Section 12.3 of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 12.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E.
In addition, in FSAR Section 12.3, the applicant provided the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- NAPS DEP 11.4-1 — Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The North Anna 3 RWB was reconfigured to accommodate a minimum 10 years of volume from packaged Class B and C waste, while maintaining space for at least 3 months of packaged Class A waste. This reconfiguration results in changes in equipment location and layout affecting various DCD figures and tables. The replacement table and figures are in: FSAR Sections 1.2.2.10.2, 1.2.2.16.9, 11.4, 11.4.1, 11.4.2.2.1, 11.4.2.2.2, 11.4.2.2.4, 11.4.2.3.1, 12.2 and 12.3; FSAR Tables 1.9-11R, 9A.5-5R, 11.4-1R, 11.4-2R, 12.2-22R, and 12.3-8R; and FSAR Figures 1.2-21R, 1.2-22R, 1.2-23R, 1.2-24R, 1.2-25R, 9A.2-20R, 9A.2-21R, 9A.2-22R, 9A.2-23R, 9A.2-24R, 11.4-1R, 11.4-2R, 12.3-19R, 12.3-20R, 12.3-21R, 12.3-22R, 12.3-39R, 12.3-40R, 12.3-41R, 12.3-42R, 12.3-61R, 12.3-62R, 12.3-63R, and 12.3-64R. The applicant performed a qualitative evaluation of each wall in the reconfigured RWB against the same wall and functions described in the DCD. This evaluation confirmed that the radiation zones in the departure will be maintained the same as those in the DCD.

COL Items

- STD COL 12.3-2-A Operational Considerations

The STD COL 12.3-2-A addresses the operational considerations for airborne radiation monitoring, such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors. The applicant references NEI 07-03A for addressing the resolution of DCD COL Item 12.3-2-A.

- CWR COL12.3-4-A Compliance with 10 CFR 20.1406

This COL item addresses the operational and post-construction objectives of RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning." The applicant states that implemented programs and procedures are consistent with NEI 08–08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination" (ADAMS Accession No. ML093220530) and meet the objectives of RG 4.21 and the requirements of 10 CFR 20.1406, "Minimization of contamination."

Supplemental Information

- NAPS SUP 12.3-1 Radwaste Building

In FSAR Subsection 12.3.1.4.5, "Radwaste Building," the applicant adds the following design features to minimize occupational exposure:

- Provision for control of fluids exiting high activity rooms, including provision to isolate floor drains, and remote operation of control valves from the radwaste control room.
- Piping from high activity rooms (process and drain piping) are arranged to minimize exposure to normally occupied areas, and are designed to maintain radiation levels in the RWB process system area, as shown in Figure 12.3-19R through Figure 12.3-22R.

- NAPS SUP 12.3-2 North Anna 3 Groundwater Monitoring

In FSAR Subsection 12.3.1.5, "Minimization of Contamination and Radioactive Waste Generation," the applicant adds a description of the North Anna 3 groundwater monitoring program which meets the guidelines established in NEI 08-08A.

12.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the radiation protection design features, and the associated acceptance criteria, are in SRP Section 12.3-12.4.

The staff followed the guidance in RG 1.206 to evaluate North Anna 3 FSAR Section 12.3 for compliance with NRC regulations.

In accordance with Section VIII, "Processes for Changes and Departures," of "Appendix E to Part 52, the applicant identifies two Tier 2 departures. Tier 2 departures not requiring prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix E, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

In particular, the regulatory basis for the acceptance of the COL items and the supplemental information is in the applicable requirements of 10 CFR Part 20; Part 50; and Part 70; and in the following guidelines:

- Item III.D.3.3 of NUREG–0737, "Clarification of TMI Action Plan Requirements"
- RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants"
- RG 4.21, RG 8.2, and RG 8.8

12.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 12.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 12.3 of the North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the "Radiation Protection Design Features."

The staff also reviewed the applicant's proposed departure, the proposed resolution to the COL items, and the supplemental information included under Section 12.3 of the North Anna 3 COL FSAR. In the review, the staff used the applicable sections of the SRP and RG 1.206 as guidance.

Section 1.2.3 of this SER discusses the NRC's strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER issued for the Fermi 3 application are equally applicable to the North Anna 3 COLA, the staff undertook the following reviews:

- The staff compared the Fermi 3 COL FSAR Revision 8, to the North Anna 3 COL FSAR, Revision 8. In this comparison, the staff considered changes to the North Anna 3 COL FSAR (and other parts of the COLA, as applicable) resulting from RAIs identified in the Fermi SER.

- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the Fermi SER) evaluation.

- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the Fermi standard content to be directly applicable to the North Anna 3 COLA.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Tier 2 Departure Not Requiring Prior NRC Approval

- NAPS DEP 11.4-1 Long-Term, Temporary Storage of Class B and C Low-Level Radioactive Waste

The FSAR Section 12.3, Revision 2, provides revised DCD tables and figures as a result of Departure NAPS DEP 11.4-1. In Part 7 of the North Anna 3 COLA, the applicant states that, consistent with the guidance of SRP, Section 11.4, the North Anna 3 RWB waste storage space is configured to accommodate approximately 10 years of Class B and C waste generated during plant operation. In addition, a shielding analysis was performed for this design change showing that the resultant dose rates in surrounding areas—within the building and externally—are maintained below the allowable limits in accordance with the radiological area classification in DCD Tier 2, Subsection 12.3.1.3. Long-term temporary storage of Class B and C waste in high integrity containers, with design lifetimes of 300 years, will not adversely affect the integrity of the waste containers. Furthermore, periodic inspections will be performed to confirm container integrity during storage.

The staff reviewed the information in Part 7 of the COLA. A comparison of the revised FSAR tables and figures with those in Section 12.3 of the DCD Tier 2, Revision 7 revealed numerous changes in room layout and dimensions, with some FSAR rooms/walls showing elevations above the grade level, where, as in Section 12.3 of the DCD, they are below grade. Although this departure reconfigured the RWB to accommodate increased storage space capacity for Class B and C solid waste, the applicant stated that the equipment size, content, and source terms remained unchanged. The applicant revised the thickness of various RWB shield walls to maintain the same radiation zones in accessible areas as those identified in the DCD. The staff finds that the revised configuration enhances the arrangement of equipment locations. In this arrangement, the rooms with lower radiation zones are usually located between the corridor and the rooms with equipment containing higher radiation sources. Equipment cubicles with high radiation sources that are adjacent to a corridor have thicker concrete walls than the comparable cubicle walls in the DCD, in order to reduce the doses in the adjacent corridors. North Anna 3 FSAR Table 12.3-8R and Figures 12.3-19R through 12.3-22R show the revised wall thicknesses and the reconfigured equipment locations in the RWB. The staff reviewed the applicant's information, compared the revised figures and tables against those in the DCD, and found the changes in accordance with this departure to increase storage space beyond the requirements of the DCD is acceptable.

COL Items

- STD COL 12.3-2-A Operational Considerations

The applicant provided additional information in STD COL 12.3-2-A to address the resolution of DCD COL Item 12.3-2-A, which states:

> Airborne radiation monitoring operational considerations, such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors, are the COL applicant's responsibility.

The staff reviewed STD COL 12.3-2-A in regards to airborne radiation monitoring operational considerations included in Section 12.3.4 of the North Anna COL FSAR. The COL applicant stated that the airborne radioactivity monitors are classified as non-safety related. Although airborne radioactivity monitors are classified as non-safety related, they are necessary to show compliance with 10 CFR 20.1501.

The COL applicant stated that operation considerations and portable monitor placement are discussed in COL Section 12.5. COL Section 12.5 references NEI 07-03A. NEI 07-03A describes several monitoring instruments that will be maintained and used at the facility, including:

- High and low volume air samplers used to take grab samples to assess airborne radioactivity concentrations to determine respiratory protection measures;
- Continuous air monitors (CAM) to observe trends in airborne radioactivity concentrations and to alert personnel of sudden changes in airborne radioactivity concentrations;
- Portable air sampling and analysis system to determine airborne radioiodine concentrations during and following an accident; and
- Portable sampling and on-site analysis capability to assess airborne radio-halogens and particulates released during and following an accident.

Section 12.5.4.1 of NEI 07-03A describes the operational considerations of these monitors. The template states that airborne radioactivity levels are surveyed by using CAMs and by taking grab samples using portable high and low volume air samplers. The CAM alarm set points are set at a fraction of the concentration values in 10 CFR Part 20, Appendix B, Table 1 (Column 3) for radionuclides expected to be encountered.

Section 12.5.4.1 of NEI 07-03A also describes calibration frequency and procedures for airborne monitors. The template states that CAMs have daily operational checks to test function or response. All monitors used to perform surveys are calibrated before initial use, after maintenance or repairs that might affect the calibration, and at least annually. In addition, emergency and special-use monitors will have operational checks on a regular schedule as specified in written procedures.

Section 12.5.3.2 of NEI 07-03A states that CAMs equipped with local alarm capability are used in occupied areas where needed to alert personnel to sudden changes in airborne radioactivity concentrations. This section also states that radiation monitoring instrumentation and equipment will provide the appropriate detection capabilities, ranges, sensitivities, and accuracies required for the types and levels of radiation anticipated in the plant and in the environs during routine operations, major outages, abnormal occurrences, and postulated accident conditions. Milestone 1.c. of NEI 07-03A ensures that an adequate number of instruments is available to provide for appropriate detection capabilities to conduct radiation surveys in accordance with 10 CFR 20.1501 and 20.1502, including the capability to sample air at all normally occupied locations where airborne radioactivity may exist. The staff finds that the applicant has adequately described the airborne radiation monitoring operational considerations to resolve DCD COL Item 12.3-2-A.

The 10 CFR 20.1101, “Radiation Protection Programs,” states that the licensee shall use, to the extent practical, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses that are ALARA. Cobalt-60 is one of the primary long-term source of radiation fields in BWRs. Minimizing the plateout of radioactive cobalt on reactor coolant piping can lead to potentially lower dose rates in the vicinity of this piping and result in correspondingly lower doses to personnel in the portions of the plant containing this piping. In order to minimize the plateout of radioactive cobalt on reactor coolant piping and other components, the North Anna 3 design will incorporate a Zinc Injection System (ZNIS). This system, which is described in North Anna 3 FSAR Section 9.3.11, “Zinc Injection System,” is available at startup, along with the Hydrogen Water Chemistry System and On-Line Noble Chem, to provide defense-in-depth against the plateout of radioactive cobalt. The presence of trace quantities of zinc injected into the reactor feedwater reduces occupational exposure to plant personnel by forming a thin oxide layer on stainless steel piping and components. This protective oxide layer inhibits corrosion by reducing soluble Co-60 buildup and is a primary factor in reducing shutdown dose rates on piping and components in low flow rate areas, like the vessel lower plenum, and in primary piping like the Reactor Water Cleanup/Shutdown Cooling System. The use of the ZNIS complies with the requirements of 10 CFR 20.1101 since its use contributes to a reduction in occupational exposure and the decontamination burden.

- CWR COL 12.3-4-A Compliance with 10 CFR 20.1406

The applicant provided information in CWR COL 12.3-4-A related to compliance with 10 CFR 20.1406 in regards to operating procedures that the applicant will implement to prevent the spread of contamination and thereby facilitate decommissioning. This information is described in the COL FSAR Section 12.3.1.5.2. The COL applicant lists several measures used to prevent the spread of contamination, including the use of engineering controls to reduce concentrations of radioactivity in air or fluids; criteria for selecting tools, materials, and equipment used in contaminated areas; the segregation of contaminated tools and equipment from clean tools and equipment; the use of containments, caches, and enclosures to promptly contain spills and releases; conducting surveys of potentially contaminated systems, equipment, and components; and the use of procedures that ensure that equipment performs and is operated in accordance with the design requirements. Most of the items listed in CWR COL 12.3-4-A were taken from the list of practical measures to prevent the spread of contamination in Section 12.5.4.8 of NEI 07-03A. The applicant references this NEI template in Appendix 12BB of the North Anna 3 COL FSAR.

The applicant implements programs and procedures that are consistent with NEI 08-08A, to meet the operational and post-construction objectives of RG 4.21 and the requirements of 10 CFR 20.1406. These objectives include:

- Periodic review of operational practices to ensure that operating procedures reflect the installation of new or modified equipment, personnel qualification and training are kept current, and personnel are following the operating procedures.
- Maintenance of records relating to facility design and construction, facility design changes, site conditions before and after construction, onsite waste disposal and contamination, and results of radiological surveys. Maintenance of such records will be beneficial during decommissioning.
- Maintenance of a conceptual site model based on site characterization and facility design and construction.
- Evaluation of the final site configuration after construction to assist in preventing the migration of radionuclides offsite via unmonitored pathways.
- Implementation of an onsite contamination monitoring program along the potential pathways from the release sources to the receptor points.

The staff finds that these objectives agree with the objectives listed in RG 4.21 and are therefore acceptable and meet the requirements of 10 CFR 20.1406.

Section 12.3.1.5.1 of the COL FSAR lists the radwaste effluent discharge pipeline as one of the three piping systems contain segments that will have to be run underground at North Anna 3. All three of these piping systems are required to have features to minimize contamination or to have monitoring to ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment is minimized. Subsection 12.3.1.5.1 of the ESBWR DCD, Tier 2, Revision 10, states that these lines will be kept as short and direct as possible, and they will be designed to preclude inadvertent or unidentified leakage into the environment.

The NAPS SUP 11.2-2, in COL FSAR Section 11.2.3.2, provides a description of the features associated with the radwaste effluent discharge pipeline that will ensure that the potential for unmonitored, uncontrolled releases of radioactivity to the environment from this pipeline will be minimized, in accordance with the guidance in RG 4.21 and the requirements of 10 CFR 20.1406. The radwaste effluent discharge pipeline is used to route liquid radioactive waste generated as a result of plant operations from the RWB to the North Anna 3 discharge structure, where it then flows into the discharge canal. Dilution flow is provided by the North Anna Units 1 and 2 circulating water system which also discharges into the discharge canal. The mixed stream flows through the discharge canal into the WHTF and then out into the Lake Anna Reservoir. At the point where the mixed stream enters the WHTF, the mixture meets the release limits of 10 CFR Part 20, Appendix B Table II, Column 2.

The applicant states that the piping associated with the radwaste effluent discharge pipeline is designed to preclude inadvertent or unidentified leakage to the environment. The buried portion of the piping is enclosed within a guard pipe and monitored for leakage and the other portion of the piping is accessible for visual inspection via a tunnel. This piping incorporates several features to reduce the potential for unmonitored and uncontrolled releases to the environment, in accordance with the guidance provided in RG 4.21. Threaded and flanged pipe connections are kept to a minimum. Other joints, depending on piping material, are welded or otherwise permanently bonded. Fittings are kept to a minimum and no in-line components, such as valves, are incorporated into this line outside of the power block.

In order to obtain additional information regarding the routing of the radwaste effluent discharge pipeline and design features incorporated to preclude inadvertent or unidentified leakage from this pipe into the environment, the staff issued RAI 12.03-55. The applicant provided an initial response to this this RAI on January 8, 2015 (ADAMS Accession No. ML15009A235), and a supplemental response on June 30, 2015 (ADAMS Accession No. ML15187A050). In response to this RAI, the applicant provided a drawing and description of the radwaste effluent discharge pipeline. This pipeline will run from the RWB to the North Anna 3 discharge structure, where it then flows into the discharge canal. The portion of the pipeline that is located in the RWB and the Turbine Building (approximately 76.2 meters (m) (250 feet (ft)) is a single walled pipe which is accessible for inspection. The remainder of the pipeline (approximately 649.2 m (2130 ft)), which runs from the Turbine Building to the discharge structure, is a double walled pipe which has leak detection of the inner pipe. The portion of this pipeline between the Turbine Building and an existing tunnel is buried. The remainder of the pipeline is routed through a buried tunnel that provides access to the inner pipe leak detection as well as visual inspection of the outer guard pipe. The above ground portions of the pipeline are stainless steel while HDPE (high density polyethylene) is used (for both the inner pipe and guard pipe) for the underground portions. NAPS SUP 11.2-2 states that no in-line components (e.g., valves) are incorporated into the radwaste effluent discharge pipeline outside of the power block. In the applicant's response to RAI 12.03-55, the applicant clarified NAPS SUP 11.2-2 by stating that the portion of the radwaste effluent discharge pipeline outside of the power block will not include in-line components such as vacuum breakers or vent valves. The use of these in-line components on the radwaste effluent discharge pipeline could increase the probability of inadvertent or unidentified leakage to the environment. On the basis of the additional information that the applicant provided in response to RAI 12.03-55, on the design of the radwaste effluent discharge pipeline, the staff finds the applicant's response to this RAI acceptable. Therefore, the staff considers RAI 12.03-55, resolved and closed. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicant's response to RAI 12.03-55. Therefore Confirmatory Item 12.3.4-01 from the staff advanced SER for North Anna 3 is resolved and closed.

The NEI 08-08A, referenced above, provides a description of the operational and programmatic elements and controls that minimize contamination of the facility, site, and the environment in order to meet the requirements of 10 CFR 20.1406. NEI 08-08A also states that the COL applicant should establish an on-site groundwater monitoring program to ensure timely detection of inadvertent radiological releases to the groundwater.

Supplemental Information

- NAPS SUP 12.3-2 North Anna 3 Groundwater Monitoring

In response to discussions held with the staff, the applicant supplemented the North Anna 3 FSAR to add a more detailed description of the North Anna 3 groundwater monitoring program. The North Anna 3 groundwater monitoring program, which is included in the North Anna site Groundwater Protection Program, is implemented to meet the guidelines established in NEI 08-08A. The Groundwater Monitoring Program is part of the applicant's Radiological Environmental Monitoring Program. The North Anna 3 Groundwater Monitoring Program will include a network of wells to ensure timely detection of inadvertent radiological releases to the ground water, in accordance with the guidance of RG 4.21. Some of these wells are placed downgradient from North Anna 3, based on hydrogeological studies. Other wells are placed close to structures, systems, and components (SSCs) judged to have greater potential for inadvertent radiological releases. In addition, the applicant utilizes groundwater monitoring wells for Units 1 and 2, where feasible, for North Anna 3 groundwater monitoring. NAPS SUP 12.3-2 includes a listing of areas of the North Anna 3 site considered for groundwater monitoring. The applicant monitors potential radiation exposure pathways for groundwater contamination as part of the site REMP. Units 1 and 2 station procedures for the ODCM establish the requirements for the REMP, per the guidance in NEI 07-09A, Attachment 9, “Radiological Environmental Monitoring Program.”

As discussed above, the applicant will implement the groundwater monitoring program consistent with the guidelines established in NEI 08-08A to meet the objectives of RG 4.21. Therefore, the staff finds the information contained in NAPS SUP 12.3-1 to be acceptable.

- NAPS SUP 12.3-1 Radwaste Building

In FSAR Subsection 12.3.1.4.5, “Radwaste Building,” the applicant adds the following design features to minimize occupational exposures in the RWB:

- Provision for control of fluids exiting high activity rooms, including provision to isolate floor drains, and remote operation of control valves from the radwaste control room.
- Piping from high activity rooms (process and drain piping) are arranged to minimize exposure to normally occupied areas, and are designed to maintain radiation levels in the RWB process system area, as shown in Figure 12.3-19R through Figure 12.3-22R.

The first supplemental provision provides an isolation capability (both local and remote) to prevent the spread of contamination to undesired areas. Remote isolation capability minimizes occupational exposure in the event that such isolation is necessary. The second supplemental provision minimizes occupational exposures from radioactive fluids in the piping in the RWB. RG 8.8 contains guidelines related to facility and equipment design, including pipe routing and shielding, to minimize occupational exposures. The staff finds that these two supplemental provisions to FSAR Subsection 12.3.1.4.5 incorporate the guidance of RG 8.8 for preventing the spread of contamination and minimizing OREs. Therefore the staff finds the information contained in NAPS SUP 12.3-1 to be acceptable.

Operational Program

- Operational Program Item Number 22 Lifecycle Minimization of Contamination

In Operational Program Item Number 22 of North Anna 3 FSAR Table 13.4-201, “Operational Programs Required by NRC Regulations,” the applicant committed to develop an operational program for the lifecycle minimization of contamination, before fuel loading, in compliance with 10 CFR 20.1406. This operational program will be a license condition. This license condition states:

> Prior to initial fuel load, the licensee shall implement an operational program for lifecycle minimization of contamination.

Operational Program Item Number 22 in Table 13.4-201 is composed of a number of elements and considerations that are described in NEI 08–08A. Because the operational program incorporates by reference NEI 08–08A into FSAR Subsection 12.3.1.5.2, the staff finds this program milestone acceptable.

12.3.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff identifies the following license condition:

- License Condition - Prior to initial fuel load, the licensee shall implement an operational program for lifecycle minimization of contamination.

12.3.6 Conclusion

The staff's findings related to information incorporated by reference are documented in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to the radiation protection design features, and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the radiation protection design features that were incorporated by reference are resolved.
In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 12.3-12.4, and other NRC RGs. The staff's review also finds that the applicant has adequately addressed the following:

- STD COL 12.3-2-A, which addresses the operational considerations for airborne radiation monitoring, such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors, is acceptable because the applicant has incorporated the approved reference NEI 07-03A into the NAPS COL FSAR and meets the applicable regulatory requirements and guidance specified in Sections 12.3.3 and 12.3.4 of this SER.

- CWR COL 12.3-4-A, which address the programs and procedures implemented to minimize contamination in order to facilitate decommissioning, consistent with NEI 08-08A and the requirements of 10 CFR 20.1406, is acceptable because it meets the applicable regulatory requirements and guidance specified in Sections 12.3.3 and 12.3.4 of this SER.

Section 12.3 of the North Anna 3 COL FSAR also includes a discussion of NAPS DEP 11.4-1, the applicant's proposed departure to reconfigure the North Anna RWB waste storage space to accommodate approximately 10 years of Class B and C waste generated during plant operation. On the basis of the staff's review of this departure, the staff finds the RWB reconfiguration departure to be reasonable and in accordance with 10 CFR 52.63(b)(2).

The staff concludes that the information pertaining to North Anna COL FSAR Section 12.3 is within the scope of the DC and adequately incorporates by reference Section 12.3 of the ESBWR DCD. The information is thus acceptable.

12.4 <u>Dose Assessment</u>

12.4.1 Introduction

Section 12.4 addresses the issues related to estimating the annual personal doses associated with operation, normal maintenance, radwaste handling, refueling, ISI, and special maintenance (e.g., maintenance that goes beyond routine scheduled maintenance, modification of equipment to upgrade the plant, and repairs to failed components).

12.4.2 Summary of Application

Section 12.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 12.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E.

In addition, in FSAR Section 12.4, the applicant provides the following:
<u>Supplemental Information</u>

- NAPS SUP 12.4-1 Annual Doses to Construction Workers

This site-specific supplemental information addresses the potential dose to construction workers from radiation sources associated with the routine operation of the existing Units 1 and 2 at the nearby site.

12.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the dose assessment, and the associated acceptance criteria, are in SRP Section 12.3-12.4.

The staff followed the guidance in RG 1.206 to evaluate North Anna 3 FSAR Section 12.4 for compliance with NRC regulations.

In particular, the regulatory basis for the acceptance of the supplemental information is in the applicable requirements of 10 CFR Part 20 and the guidance in RG 1.206 and in Section 4.5, “Radiation Exposure to Construction Workers,” of NUREG–1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environment Standard Review Plan.”

12.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 12.4 of the certified ESBWR DCD. The staff reviewed Section 12.4 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information related to “Dose Assessment.”

In addition, the staff reviewed the supplemental information under Section 12.4 of the North Anna 3 COL FSAR. The staff used the applicable sections of the SRP and RG 1.206 as guidance.

Section 1.2.3 of this SER discusses the NRC's strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER for the Fermi 3 application are equally applicable to the North Anna 3 COLA, the staff undertook the following reviews:

- The staff compared the Fermi 3 COL FSAR, Revision 8, to the North Anna 3 COL FSAR, Revision 8. In this comparison, the staff considered changes to the North Anna 3 COL FSAR (and other parts of the COLA, as applicable) resulting from RAIs identified in the Fermi SER.

- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the Fermi SER) evaluation.

- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the Fermi standard content to be directly applicable to the North Anna 3 COLA.
The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- NAPS SUP 12.4-1 Annual Doses to Construction Workers

This supplemental information discusses the potential sources of radiation exposure to construction workers and provides the basis for the applicant's annual and collective dose estimates to construction workers. The sources of radiation exposures to site preparation and construction workers include direct radiation and gaseous and liquid radioactive effluents from North Anna 1 and 2 operations.

A. Direct Radiation Dose

The applicant states that the principal radiation sources from Units 1 and 2 (which are located to the east of the North Anna 3 construction site) that contribute to direct radiation exposure at the North Anna 3 construction site are the boron recovery tanks and the low-level contaminated storage area. Another source of direct radiation is the ISFSI, which is located south of the construction area.
The applicant used Thermo-luminescent dosimeter (TLD) measurements taken at a location near operating Units 1 and 2 and at locations in the vicinity of the ISFSI to determine the direct dose contributions to the construction work force. The staff issued RAI 12.03-52 (ADAMS Accession No. ML14329B372) dated November 25, 2014, in order to determine the locations of the TLDs used and the quarterly dose measurements recorded at each of these TLD locations. In the response to RAI 12.03-52, dated January 23, 2015 (ADAMS Accession No. ML15028A184), the applicant provided a site map showing the location of the requested TLDs. For each of these TLDs, the applicant also provided tables showing the quarterly TLD readings measured at each of these locations over a several year period. On the basis of the information provided, the staff finds the applicant's response to RAI 12.03-52 acceptable. Therefore, the staff considers RAI 12.03-52 resolved and closed. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicant's response to

RAI 12.03-52. Therefore Confirmatory Item 12.3.4-02 from the staff advanced SER for North Anna 3 is resolved and closed.

The TLD readings at the west protected area fence of Units 1 and 2 indicate an average annual dose of 7.2E-1 millisievert (mSv) (72 millirem (mrem)). This equates to a continuous dose rate of 8.22E-5 mSv/hr (8.22E-3 mrem/hr) along the eastern edge of the North Anna 3 construction area. The ISFSI is located on the southern edge of the North Anna 3 construction area and there are two TLDs located along the ISFSI perimeter fence, one on the northern perimeter fence closest to the North Anna 3 construction area and one on the southern perimeter fence further from the North Anna 3 construction area. The licensee conservatively used the higher TLD reading from the southern perimeter fence as the estimated dose from the north side of the ISFSI closest to the North Anna 3 construction area. This maximum quarterly dose reading of 1.92 mSv (192 mrem) was taken when there were a total of 40 casks on the two pads of the ISFSI. The applicant stated that the planned capacity of the two fully loaded ISFSI pads is 68 casks. Therefore, to be conservative, the applicant assumed that the quarterly dose rate at the ISFSI perimeter fence from a fully loaded ISFSI would be double the measured quarterly dose, or 3.84 mSv (384 mrem). This equates to a continuous dose rate of 1.76E-3 mSv/hr (0.176 mrem/hr) at the ISFSI fence.

Since the ISFSI perimeter fence is nearly 300 feet (ft) from the southern portion of the construction area boundary, the applicant calculated that the dose rate at the construction area boundary nearest a fully loaded ISFSI would be approximately 3.04E-4 mSv/hr (3.04E-2 mrem/hr). The estimated construction worker dose at the center of the construction area (approximately 486 m (1600 ft from the ISFSI)) is 5.98E-6 mSv (5.98E-4 mrem/hr) from a fully loaded ISFSI. The staff reviewed the applicant's method of calculating these estimated dose rates and finds this method to be acceptable.

B. Gaseous Effluent Sources

The sources of gaseous effluent releases at Units 1 and 2 include the waste decay tanks, boron recovery and high-level waste tanks, containment purge system, auxiliary building vent, main condenser air ejector vents, auxiliary steam drain receiver, Turbine Building ventilation exhaust, and gland seal ejector vent. On the basis of information contained in the applicant's annual radioactive effluent release reports for the years 2001 to 2011, the average annual gaseous releases from Units 1 and 2 are 1.776e+12Bq **(**48 curies (Ci)) of fission and activation gases and 2.04E+12 Bq (55 Ci) of tritium. The resulting average doses (calculated in accordance with the ODCM for Units 1 and 2) to the maximally exposed member of the public from these gaseous releases are 1.01E-4 mSv/yr (1.01E-2 mrem/yr) for the whole body and 1.29E-3 mSv/yr (1.29E-1 mrem/yr) for the critical organ. The maximally exposed member of the public who would receive these doses is located at or beyond the site boundary. Since the North Anna 3 construction area is closer to the effluent release point than is the site boundary, the applicant increased the estimated average dose estimates from gaseous effluents to a construction worker by a factor of ten (the ratio of the χ/Q values for these two areas) to get 1.01E-3 mSv/yr (0.101 mrem/yr) for the whole body and 1.29E-2 mSv/yr (1.29 mrem/yr) for the critical organ.

C. Liquid Effluent Sources

Effluents from the liquid waste disposal system of Units 1 and 2 are the source of small amounts of radioactivity in the North Anna Reservoir and the WHTF. The applicant's annual radioactive effluent release reports for the years 2001 to 2011 indicate average annual liquid releases of

7.4E+9 Bq (0.2 Ci) of fission and activation products and 3.6E+13 Bq (966 Ci) of tritium. The resulting average doses (calculated in accordance with the ODCM for Units 1 and 2) to the maximally exposed member of the public from these liquid releases are 3.57E-3 mSv/yr (0.357 mrem/yr) for the whole body and 4.35E-3 mSv/yr (0..435 mrem/yr) for the critical organ.

D. Annual Construction Worker Dose

The applicant estimated that the peak loading during the construction of North Anna 3 will be 4,088 construction workers per year and each worker will work 2,500 hours per year. The North Anna 3 construction workers may be exposed to direct radiation and gaseous and liquid radioactive effluents from North Anna 1 and 2 operations. As discussed above, the North Anna 3 construction workers will be exposed to a both a direct dose rate contribution of 8.22E-5 mSv/hr (8.22E-3 mrem/hr) from Units 1 and 2 along the eastern edge of the North Anna 3 construction area and a larger direct dose rate contribution of approximately 3.04E-4 mSv/hr (3.04E-2 mrem/hr) from the ISFSI along the southern edge of the construction area. Even though these two locations are separated by more than 1,000 ft, the applicant conservatively added these two direct radiation dose rates to get a total dose rate of 3.86E-4 mSv/hr (3.86E-2 mrem/hr). Adjusting for the construction worker residence time of 2,500 hours per year, a North Anna 3 construction worker would receive a maximum annual dose of 9.64E-1 mSv (96.4 mrem) from direct radiation.

Although the southern portion of the North Anna 3 construction area near the ISFSI has the highest direct dose rate, the applicant states that the center of the construction area is representative of the location of the average member of the construction workforce over the course of a year. Adding the dose rate from Units 1 and 2 along the eastern edge of the North Anna 3 construction area to the calculated ISFSI dose rate at the center of the construction area yields a total dose rate of 8.82E-5 mSv/hr (8.82E-3 mrem/hr). Adjusting for the construction worker residence time of 2,500 hours per year, the applicant stated that a North Anna 3 construction worker would receive an annual dose of 2.2E-1 mSv (22.0 mrem) from direct radiation at this location.

As stated above, the applicant calculated that the estimated average dose rates in the construction area from gaseous effluents from Units 1 and 2 would be 1.01E-3 mSv/yr (0.101 mrem/yr) for the whole body and 1.29E-2 mSv/yr (1.29 mrem/yr) for the critical organ. For an expected occupancy time of 2,500 hours per year, a construction worker would be expected to receive an annual dose of 2.89E-4 mSv (2.89E-2 mrem) to the whole body and 3.68E-3 mSv (0.368 mrem) to the critical organ from gaseous effluents. Converting these doses into the total effective dose equivalent (TEDE) (by applying a weighting factor of 0.3 to the critical organ dose and adding the product to the whole body dose) yields an annual construction worker dose of 1.39E-3 mSv (0.139 mrem) TEDE from gaseous effluents.

The applicant calculated that the estimated average dose rates from liquid effluents from Units 1 and 2 would be 3.57E-3 mSv/yr (0.357 mrem/yr) for the whole body and 4.35E-3 mSv/yr (0.435 mrem/yr) for the critical organ. These estimated average dose rates are what the maximally exposed member of the public would receive due to the release of liquid effluents from Units 1 and 2. Although construction workers are not expected to be exposed to liquid effluents from Units 1 and 2, the applicant assumed that construction workers are exposed to the same dose rates as the maximally exposed member of the public. For an expected occupancy time of 2,500 hours per year, a construction worker would receive an annual dose of 1.02E-3 mSv (0.102 mrem) to the whole body and 1.24E-3 mSv (0.124 mrem) to the critical organ. This is equivalent to an annual dose of 1.39E-3 mSv (0.139 mrem) TEDE for liquid effluents.

The applicant considers construction workers working at the North Anna 3 construction area to be members of the general public. 10 CFR 20.1301, "Dose limits for individual members of the public," states that the total effective dose equivalent for members of the public from licensed operations not exceed 1 mSv (100 mrem) in a year and 2E-2 mSv (2 mrem in any 1 hour). The applicant states that the total annual dose to the maximally exposed construction worker will not exceed 9.7E-1 mSv (97 mrem) TEDE (sum of the construction worker dose from direct radiation (9.64E-1 mSv/yr (96.4 mrem/yr) TEDE), from gaseous effluents (1.39E-3 mSv (0.139 mrem) TEDE), and from liquid effluents (1.39E-3 mSv (0.139 mrem) TEDE)). The maximum dose rate in the construction area is less than 4E-4 mSv (4E-2 mrem) in any 1 hour. Since these calculated doses meet the public dose limits of 10 CFR 20.1301, the construction workers would not need to be classified as radiation workers, in accordance with the requirements of 10 CFR 19.12.

The total annual dose to an average member of the construction workforce is based on the dose to a worker who would spend most of the time working near the center of the construction area. The total annual dose to an average member of the construction workforce is 2.2E-1 mSv (22.0 mrem) TEDE. With a peak loading of 4,088 construction workers per year, the estimated construction worker collective dose would be 9.1E-1 person-sieverts (91 person-rem).

Since the applicant's estimate of 9.7E-1 mSv (97 mrem) TEDE to the maximally exposed construction worker is very close to the 10 CFR 20.1301 limit of 1.0 mSv (100 mrem) to a member of the public, the staff requested RAI 12.03-58) (ADAMS Accession No. ML14329B372) that the applicant provide a description of dose reduction measures identified or taken as a result of the dose assessment process to ensure that worker doses are maintained as low as is reasonably achievable and do not exceed the applicable dose limits. In the applicant's January 8, 2015 (ADAMS Accession No. ML14329B372), response to RAI 12.03-58, the applicant provided a number of conservative assumptions that they made in their construction worker dose assessment.

- In calculating the direct dose to a construction worker working in the southern part of the construction area closest to the ISFSI, the applicant added the full direct dose component of 2.05E-1 mSv (20.5 mrem) from Units 1 and 2 (measured at the eastern edge of the construction area) to the ISFSI direct dose component, without adjusting the dose from Units 1 and 2 based on the distance from the ISFSI. Since the eastern and southern edges of the construction area are separated by more than 1,000 feet, the component of the dose from Units 1 and 2 at the southern edge of the construction area would be negligible compared to the ISFSI dose of 7.59E-1 mSv (75.9 mrem). By making this distance adjustment to the direct dose contribution from Units 1 and 2 at the ISFSI, the estimated construction worker direct dose component would have been reduced by 27 percent.

- The applicant based the direct dose component to the construction workers from the ISFSI on a loading of 80 spent fuel casks, when the current plan is to load a maximum of 68 spent fuel casks into the ISFSI. If the dose assumption had been based on the lower number of casks, the estimated direct dose would have been reduced by 18 percent.

- Although the North Anna 3 construction area is on the north side of the ISFSI, the applicant conservatively used the higher dose reading from the TLD located on the south side of the ISFSI to determine the construction worker dose from the ISFSI.

- The applicant assumed that the construction worker spends the entire 2,500 hours per year working on the southern perimeter of the construction area near the ISFSI, where the dose rate is maximized. Realistically, a construction worker would work in different areas with varying dose rates throughout the construction area, resulting in an exposure to a lower average dose rate for the year.

In evaluating the applicant's calculations to determine the estimated dose to North Anna 3 construction workers from the ISFSI and from operating Units 1 and 2, the staff reviewed the dose conservatisms used by the applicant and described in the applicant's response to RAI 12.03-58. On the basis of these conservatisms, the staff agrees that the applicant's estimated maximum annual construction worker dose of 9.64E-1 mSv (96.4 mrem) from direct radiation is conservative and the actual measured doses to the North Anna 3 construction workers could be lower than the applicant's dose estimates. In the applicant's response to RAI 12.03-58, the applicant also stated that the construction area will be continually monitored during the construction period and that the applicant will take appropriate actions, as necessary, to ensure that doses to the construction workers will be maintained ALARA. The staff agrees that the applicant's construction worker dose estimates are conservative and that the applicant is committed to ensuring that doses to construction workers during the construction of North Anna 3 will be maintained ALARA. Therefore, the staff finds the applicant's response to RAI 12.03-58 to be acceptable and considers RAI 12.03-58 resolved and closed.

On the basis of the above evaluation, the staff finds that the applicant's estimates of doses to construction workers during the construction of North Anna 3 are within the applicable limits of 10 CFR 20.1301; and 10 CFR Part 50, Appendix I (for gaseous effluents) and are, therefore, acceptable.

12.4.5 Post Combined License Activities

There are no post COL activities related to this section.

12.4.6 Conclusion

The staff's findings related to information incorporated by reference are documented in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information relating to dose assessment, and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to dose assessments that were incorporated by reference are resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations, the guidance in SRP Section 12.3-12.4, and other NRC RGs. The staff's review also finds that the applicant has adequately addressed the following:

- NAPS SUP 12.4-1, which provides site-specific supplemental information to address dose to construction workers, is acceptable because the applicant has demonstrated compliance with the applicable requirements of 10 CFR 20.1101, 20 CFR 20.1301, and 10 CFR 20.1302. The applicant has also demonstrated compliance with the acceptance criteria in Section 4.5, "Radiation Exposure to Construction Workers," of NUREG–1555 and the applicable acceptance criteria provided SRP Section 12.3-12.4.

12.5 Operational Radiation Protection Program

12.5.1 Introduction

Section 12.5 addresses the operational RPP, which is designed to maintain occupational and public doses below regulatory limits and ALARA. The operational RPP is designed with the following objectives:

- Providing the capability for administrative control of the activities of plant personnel to limit personnel exposures to radiation and radioactive materials ALARA and within the guidelines in 10 CFR Part 20.

12.5.2 Summary of Application

Section 12.5 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 12.5 of the certified ESBWR DCD Revision 10, referenced in 10 CFR Part 52, Appendix E.

In addition, in FSAR Section 12.5, the applicant provides the following:

COL Items

- STD COL12.5-1-A — Equipment, Instrumentation, and Facilities

This DCD COL item requires the applicant to describe radiation protection equipment, instrumentation, and facilities. The applicant references Appendix 12BB, which in turn adopts NEI 07–03A to address the needs of this standard COL item.

- STD COL 12.5-2-A — Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR Part 50 and NUREG–0737, Item III.D.3.3

This DCD COL item requires the applicant to describe portable instruments for measuring radioiodine concentrations under accident conditions and the training and procedures on the use of these instruments, in compliance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the guidance of NUREG–0737, Item III.D.3.3. The applicant references Appendix 12BB, which in turn adopts NEI 07–03A to address the needs of this standard COL item.

- STD COL12.5-3-A — Radiation Protection Program

This DCD COL item requires the applicant to provide a description of the Operational RPP and to include descriptions of access controls to “Very High Radiation Areas.” The applicant references Appendix 12BB, which in turn adopts NEI 07–03A to address the needs of this standard COL item.

Operational Program

- Operational Program Item Number 10 Radiation Protection Program

The DCD Tier 2, Section 13.4 directs the COL applicant to develop and implement the required operational programs. The applicant provides Operational Program Item Number 10, "Radiation Protection Program," in FSAR Table 13.4-201, which identifies the program milestones.

12.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the Operational RPP, and the associated acceptance criteria, are in SRP Section 12.5.

The staff followed the guidance in RG 1.206 to evaluate North Anna 3 FSAR Section 12.5 for compliance with NRC regulations.

In particular, the regulatory basis for the acceptance of the COL items is established in the following requirements and guidance documents:

- Management and organization are established in RG 1.8, Revision 3, RG 8.2, Revision 1, RG 8.8, Revision 3, and RG 8.10, Revision 1-R; as required by 10 CFR 20.1101; and 10 CFR 20.2102, "Records of radiation protection program."

- Adequate facilities are established in RG 1.97, Revision 4, RG 8.8, Revision 3, RG 8.9, Revision 1, RG 8.15, Revision 1, RG 8.20, Revision 1, "Applications of Bioassay for I-125 and I-131," and RG 8.28; as required by 10 CFR 20.1801, "Security of stored material"; 10 CFR 20.1802, "Control of material not in storage"; and 10 CFR 20.1906, "Procedures for receiving and opening packages."

- Instrumentation and equipment are established in 10 CFR 20.1501, "General"; 10 CFR 20.1502, "Conditions requiring individual monitoring of external and internal occupational dose"; 10 CFR 50.34(f)(2)(xxvii); and the criteria in Item III.D.3.3 of NUREG–0737.

- Training and procedures are established in RG 1.8, Revision 3, RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)," RG 8.2, Revision 1, RG 8.7 Revision 2, RG 8.8, Revision 3, and RG 8.10, Revision 1-R; as required by 10 CFR 19.11, "Posting of notices to workers"; 10 CFR 19.12, "Instruction to workers"; and the applicable requirements in 10 CFR Part 20, Part 50, Part 70, and Part 71.

The regulatory basis for acceptance of the resolution to Operational Program Number 10 in Table 13.4-201, which addresses the RPP, is satisfied based on meeting the requirements of 10 CFR 20.1101.

12.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 12.5 of the certified ESBWR DCD. The staff reviewed Section 12.5 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to the "Operational Radiation Protection Program."

In addition, the staff reviewed the applicant's proposed resolution to the COL items and the description of the Operational RPP included under Section 12.5 of the North Anna 3 COL FSAR. The staff used the applicable sections of the SRP and RG 1.206 as guidance.

Section 1.2.3 of this SER discusses the NRC's strategy for performing one technical review for each standard issue outside the scope of the DC and to use this review to evaluate the subsequent COL applications. To ensure that the staff's findings on the standard content that were documented in the SER for the Fermi 3 application are equally applicable to the North Anna 3 COLA, the staff undertook the following reviews:

- The staff compared the Fermi 3 COL FSAR, Revision 8, to the North Anna 3 COL FSAR, Revision 8. In this comparison, the staff considered changes to the North Anna 3 COL FSAR (and other parts of the COLA, as applicable) resulting from RAIs identified in the Fermi SER.

- The staff confirmed that the applicant has endorsed all responses to the RAIs in the corresponding standard content (the Fermi 3 SER) evaluation.

- The staff verified that the site-specific differences are not relevant to this section.

The staff completed the review and finds the evaluation of the Fermi standard content to be directly applicable to the North Anna 3 COLA.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>COL Items</u>

- STD COL12.5-1-A Equipment, Instrumentation, and Facilities

The applicant provided additional information in STD COL 12.5-1-A to address the resolution of DCD COL Item 12.5-1-A, which states:

> The COL applicant will provide a description of plant health physics equipment, instrumentation, and facilities.

The FSAR states that this COL information item is addressed in NEI 07-03A, which is referenced in Appendix 12BB of the FSAR. The staff has reviewed and accepted NEI Template 07-03A for addressing this COL item. NEI 07-03A thoroughly describes radiation protection facilities and monitoring instrumentation and equipment.

The radiation protection facilities described in NEI 07-03A include a radiochemistry laboratory, personnel and equipment decontamination facilities, an access control facility, radiation protection offices, portable instrument calibration and respirator facilities, storage and issue areas for contaminated tools and equipment, a machine shop for activated/contaminated components and equipment, radioactive materials storage area, facilities for dosimetry processing and bioassay, and a laundry facility. The ESBWR DCD provides additional information for the personnel decontamination area, radiation protection offices, and a portable instrument calibration facility that is consistent with NEI 07-03A. Equipment to be used for radiation protection purposes includes portable radiation survey instruments, personnel monitoring equipment, fixed and portable area and airborne radioactivity monitors, laboratory equipment, air samplers, respiratory protective equipment, and protective clothing.

The staff finds that the applicant has adequately described the plant health physics equipment, instrumentation, and facilities addressed by DCD COL Item 12.5-1-A and this information is sufficient to resolve DCD COL Item 12.5-1-A.

- STD COL 12.5-2-A — Compliance with Paragraph 50.34(f)(2)(xxvii) of 10 CFR Part 50 and NUREG–0737, Item III.D.3.3

The applicant provided additional information in STD COL 12.5-2-A to address the resolution of DCD COL Item 12.5-2-A, which states:

> The COL applicant will provide a description of the portable instruments that accurately measure radio-iodine concentrations in plant areas under accident conditions and of the training and procedures on the use of these instruments.

The FSAR states that this COL information item is addressed in NEI 07-03A, which is referenced in Appendix 12BB of the FSAR. The licensee must show compliance with 10 CFR 50.34(f)(2)(xxvii) and Item III.D.3.3 of NUREG–0737 in order to resolve this COL action item. 10 CFR 50.34(f)(2)(xxvii) (as supplemented by the criteria in Item III.D.3.3 of NUREG–0737) requires the licensee to provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident. NEI 07-03A discusses procedures to be used to collect and analyze samples to detect and measure radioiodine. This template states that radiation protection technicians will be trained and qualified under a program established in accordance with 10 CFR 50.120. This training, along with the procedures on radiological surveillance described in NEI 07-03A, will ensure that the radiation protection technicians will have the capability of determining the airborne iodine concentrations in areas within the facility where personnel may be present during an accident and for a broad range of routine conditions. Milestone 1.c. of NEI 07-03A ensures that an adequate number of instruments are available to provide for appropriate detection capabilities to conduct radiation surveys in accordance with 10 CFR 20.1501 and 20.1502, including the capability to determine the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

The staff finds that the applicant has provided an adequate description of the portable instruments that accurately measure radio-iodine concentrations in plant areas under accident conditions and of the training and procedures provided on the use of these instruments. Therefore, the staff finds that the applicant has provided sufficient information in the FSAR to resolve DCD COL Item 12.5-2-A.

- STD COL 12.5-3-A — Radiation Protection Program

The applicant provided additional information in STD COL 12.5-3-A to address the resolution of DCD COL Item 12.5-3-A, which states:

> The COL applicant will provide a description of the operational Radiation Protection Program.

The FSAR states that this COL information item is addressed in NEI 07-03A, which is referenced in Appendix 12BB of the FSAR. NEI 07-03A provides a detailed description of the RPP.

Access to very high radiation areas is discussed in Section 12.5 of the North Anna 3 FSAR as part of the operational program for radiation protection. In Section 12.5.3 of the North Anna 3 COL FSAR, the applicant states that the operational program for radiation protection is addressed in Appendix 12BB. Appendix 12BB references NEI 07-03A as the generic FSAR template guidance for the description of North Anna's RPP.

Section 12.5.4.4 of NEI 07-03A (specifically the bracketed "Note" portion of Section 12.5.4.4) states that each COL applicant should provide additional plant-specific information in the FSAR to describe each Very High Radiation Area (VHRA) and to refer to each location on the plant layout diagrams in FSAR Section 12.3. The description of additional administrative controls for restricted access to each VHRA is required by 10 CFR 20.1602. Section 12.5.4.4 of NEI 07-03A also states that applicant's should provide detailed drawings of each VHRA and indicate physical access controls for each of these areas. Appendix 12BB of the North Anna 3 FSAR includes a table which lists all the accessible VHRAs in the plant (those VHRAs which are normally submerged are identified in the DCD Section 12.3 layout drawings), along with their cubicle numbers and a reference to the DCD plant layout drawings which depict each of these areas. The accessible VHRAs are located in the upper and lower drywells, in the Inclined Fuel Transfer Tube Room, and in other areas adjacent to the Inclined Fuel Transfer tube. In addition, Appendix 12BB includes a description of administrative controls which the licensee will implement to control entrance into VHRAs. The applicant states that, in the unlikely event that access to a VHRA is required, entry into will be controlled in accordance with the requirements of a specific (Special) radiation work permit. The applicant also described, in Appendix 12BB, the physical barriers and controls which are in place to preclude inadvertent access to each of the identified VHRAs. These include postings, barricades, physical barriers, and the use of locks that are keyed so only keys designated as VHRA can open the locks. The existence of the barriers, interlocks, and alarms used to control access to areas immediately adjacent to the Inclined Fuel Transfer System is verified via Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) which are identified in DCD Tier 1, Table 2.5.10-1.

By incorporating the guidance of NEI 07-03A, the staff finds that the applicant has provided an adequate description of the operational RPP. Therefore, the staff finds that the applicant has provided sufficient information in the FSAR to resolve DCD COL Item 12.5-3-A.

Operational Program

- Operational Program Item 10 Radiation Protection Program

The applicant provided implementation schedules and milestones to address Operational Program Number 10, which is associated with the RPP, as required by 10 CFR Part 20.1101. In Table 13.4-201 of the North Anna 3 FSAR, the applicant lists four milestones for the RPP implementation. The four listed milestones are:

1. Prior to initial receipt of byproduct, source, or special nuclear materials (excluding Exempt Quantities as described in 10 CFR 30.18) for those elements of RPP necessary to support such receipt.

2. Prior to fuel receipt for those elements of RPP necessary to support receipt and storage of fuel onsite.

3. Prior to fuel load for those elements of RPP necessary to support fuel load and plant operation.

4. Prior to the first shipment of radioactive waste for those elements of the RPP necessary to support shipment of radioactive waste.

The RPP is composed of a number of elements that are described in NEI 07-03A. Since the applicant incorporates by reference NEI 07–03A into FSAR Appendix 12BB, the staff finds these program milestones acceptable.

For operational program readiness in Section 3.6 of Part 10 of the COLA, the applicant provides a general implementation plan for operational programs that are listed in Table 13.4-201. This implementation plan states that:

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

The staff finds the applicant's general implementation plan for operational programs in Table 13.4-201 to be consistent with the guidance in SECY-05-197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria." In addition, in FSAR Appendix 12BB, the applicant incorporates by reference NEI 07–03A (which provides the RPP milestones). Therefore, the staff finds that the applicant adequately addresses Operational Program Item Number 10.

12.5.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff identifies the following two license conditions:

- License Condition – The licensee shall implement the RPP (including the ALARA principle) or applicable portions thereof, on or before the associated milestones identified below:

  a. Receipt of Materials – Prior to initial receipt of byproduct, source, or special nuclear materials onsite (excluding exempt quantities as described in 10 CFR 30.18, "Exempt quantities.")

  b. Fuel Receipt – Prior to initial receipt and storage of fuel onsite

  c. Fuel Loading – Prior to initial fuel load

  d. Waste Shipment – Prior to first radioactive waste shipment

- License Condition – No later than 12 months after issuance of the COL, the licensee shall submit to the Director, NRO a schedule that supports planning for and conduct of NRC inspections of the operational program (Radiation Protection Program). The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until this operational program has been fully implemented.

12.5.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the relevant information relating to the operational RPP, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the operational RPP that were incorporated by reference are resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in SRP Section 12.5, and other pertinent NRC RGs. The staff's review concludes that the applicant has adequately addressed the following:

- STD COL 12.5-1-A requires the applicant to describe radiation protection equipment, instrumentation, and facilities. The FSAR states that this COL information item is addressed in NEI Template 07-03A which is referenced in Appendix 12BB of the FSAR. The staff has reviewed and accepted NEI 07-03A for addressing this COL item. This template thoroughly describes radiation protection facilities and monitoring instrumentation and equipment. The staff finds that the applicant has adequately described the plant health physics equipment, instrumentation, and facilities addressed by DCD COL Item 12.5-1-A and this information is sufficient to resolve DCD COL Item 12.5-1-A.

- STD COL 12.5-2-A requires the applicant to describe portable instruments for measuring radioiodine concentrations under accident conditions and the training and procedures on the use of these instruments, in compliance with the requirements of 10 CFR 50.34(f)(2)(xxvii) and the guidance of NUREG–0737 Item III.D.3.3. The applicant references FSAR Appendix 12BB, which in turn adopts NEI 07–03A to address the needs of this standard COL item. The staff has reviewed and accepted NEI Template 07-03A for addressing this COL item. This template discusses the procedures to be used to collect and analyze samples to detect and measure radioiodine. It also states that radiation protection technicians will have sufficient training (in accordance with the requirements of 10 CFR 50.120) to ensure that they will have the capability of determining the airborne iodine concentrations in areas within the facility where personnel may be present during an accident and for a broad range of routine conditions. The staff finds that the applicant has adequately described the portable instruments for measuring radioiodine concentrations under accident conditions and the training and procedures on the use of these instruments addressed by DCD COL Item 12.5-2-A and this information is sufficient to resolve DCD COL Item 12.5-2-A.

- STD COL 12.5-3-A requires the applicant to provide a description of the operational RPP and to include the locations of the VHRA in the plant and as well as descriptions of the access controls for each of these areas. FSAR Section 13.5 includes a description of the plant procedures that comprise the operational RPP. The applicant references FSAR Appendix 12BB, which in turn adopts NEI 07–03A to address the needs of this standard

COL item. NEI 07-03A describes a RPP that is sufficient to ensure compliance with the requirements of 10 CFR 19.12, 10 CFR 19.13, 10 CFR Part 20, and the applicable parts of 10 CFR 50, 52 and 71. The RPP described in NEI 07-03A is also consistent with the guidance in RGs 1.8, 8.2, 8.4, 8.6, 8.7, 8.8, 8.9, 8.10, 8.13, 8.15, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38 and with the applicable portions in NUREG–1736. In addition to describing each VHRA in the plant, FSAR Appendix 12BB includes a description of additional administrative controls for restricted access to each VHRA, as required by 10 CFR 20.1602. The staff finds that this information is acceptable to resolve DCD COL Item 12.5-3-A.

The applicant also lists Operational Program Item Number 10, which pertains to the RPP and its implementation milestones, in FSAR Table 13.4-201. As stated above, the overall description of the applicant's operational program for radiation protection is in FSAR Appendix 12BB, which references NEI 07–03A. On the basis of the staff's review of the applicant's operational RPP described above, the staff finds the applicant's operational RPP and the associated milestones to be acceptable.

References

1. 10 CFR 19.12, "Instructions to workers."

2. 10 CFR 20.1101, "Radiation protection programs."

3. 10 CFR 20.1301, "Dose limits for individual members of the public."

4. 10 CFR 20.1302, "Compliance with dose limits for individual members of the public."

5. 10 CFR 20.1406, "Minimization of contamination."

6. 10 CFR 20.1501, "General."

7. 10 CFR 20.1502, "Conditions requiring individual monitoring of external and internal occupational dose."

8. 10 CFR 20.1801, "Security of stored material."

9. 10 CFR 20.1802, "Control of material not in storage."

10. 10 CFR 20.1906, "Procedures for receiving and opening packages."

11. 10 CFR 30.18, "Exempt quantities."

12. 10 CFR 30.72, "Schedule C-Quantities of radioactive materials requiring consideration of the need for an emergency plan for responding to a release."

13. 10 CFR 50.120, "Training and qualification of nuclear power plant personnel."

14. 10 CFR 50.59, "Changes, tests, and experiments."

15. 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigations."

16. 10 CFR Part 20, "Standards for Protection against Radiation."

17. 10 CFR Part 20, Appendix B, "Radiation Protection Programs."

18. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

19. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

20. 10 CFR Part 50, Appendix A, GDC 60, "Control of releases of radioactive materials to the environment."

21. 10 CFR Part 50, Appendix A, GDC 64, "Monitoring radioactivity releases."

22. 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

23. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

24. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

25. 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material."

26. 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

27. 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

28. ANSI/ANS-3.1-1993, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants."

29. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

30. NEI 07-03A, Revision 0, "Generic FSAR Template Guidance for Radiation Protection Program Description," May 2009. (ADAMS Accession No. ML091490684.)

31. NEI 07-08A, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)," October 2009 (ADAMS Accession No. ML093220178).

32. NEI 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," March 2009, (ADAMS Accession No. ML091460258) and (see also the staff's SER in ADAMS Accession No. ML083530745).

33. NEI 08-08A, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," October 2009 (ADAMS Accession No. ML093220530).

34. NRC GL 89-01, "Implementation of Programmatic and Procedural Controls for Radiological Effluent Technical Specifications," January 31, 1989 (ADAMS Accession No. ML031140051).

35. NRC RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," October 1977 (ADAMS Accession No. ML003740384).

36. NRC RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors (for comment)," March 1976 (ADAMS Accession No. ML003740332).

37. NRC RG 1.111, Revision 1, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," July 1977 (ADAMS Accession No. ML003740354).

38. NRC RG 1.112, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," March 2007 (ADAMS Accession No. ML070320241).

39. NRC RG 1.113, Revision 1, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1997 (ADAMS Accession No. ML003740390).

40. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

41. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

42. NRC RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," June 2006 (ADAMS Accession No. ML061580448).

43. NRC RG 4.21, "Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning," June 2008 (ADAMS Accession No. ML080500187).

44. NRC RG 8.10, Revision 1-R, "Operating Philosophy for Maintaining Occupational Radiation Exposures ALARA," May 1977 (ADAMS Accession No. ML003739563).

45. NRC RG 8.13, Revision 3, "Instruction Concerning Prenatal Radiation Exposure," June 1999 (ADAMS Accession No. ML003739505).

46. NRC RG 8.15, Revision 1, "Acceptable Programs for Respiratory Protection," October 1999 (ADAMS Accession No. ML003739528).

47. NRC RG 8.2, Revision 1, "Guide for Administrative Practices in Radiation Monitoring," May 2011 (ADAMS Accession No. ML110460093).

48. NRC RG 8.27, "Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants," March 1981 (ADAMS Accession No. ML003739628).

49. NRC RG 8.28, "Audible-Alarm Dosimeters," August 1981 (ADAMS Accession No. ML003739382).

50. NRC RG 8.29, Revision 1, "Instructions Concerning Risks from Occupational Radiation Exposure," February 1996 (ADAMS Accession No. ML003739438).

51. NRC RG 8.34 "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses," July 1992 (ADAMS Accession No. ML090770221).

52. NRC RG 8.35, "Planned Special Exposures," June 1992 (ADAMS Accession No. ML003739507).

53. NRC RG 8.36, "Radiation Dose to the Embryo/Fetus," July 1992 (ADAMS Accession No. ML003739548)

54. NRC RG 8.38, Revision 1, "Control of Access to High and Very High Radiation Areas in Nuclear Power Plants," May 2006 (ADAMS Accession No. ML061350096).

55. NRC RG 8.7, Revision 2, "Instructions for Record Keeping and Recording Occupational Radiation Exposure Data," November 2005 (ADAMS Accession No. ML052970092).

56. NRC RG 8.8, Revision 3, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," June 1978 (ADAMS Accession No. ML003739549).

57. NRC RG 8.9, Revision 1, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program," July 1993 (ADAMS Accession No. ML003739554).

58. NRC SECY-05-197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005, (ADAMS Accession Nos. ML052770225, ML052770257), and the related SRM, dated February 22, 2006. (ADAMS Accession No. ML060530316).

59. NRC Staff NUREG/CR-1276, "User's Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents," March 1980.

60. NRC Staff NUREG/CR-4653, "GASPAR II - Technical Reference and User Guide," March 1987.

61. NRC Staff NUREG-0016, Revision 1, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE CODE)," January 1979.

62. NRC Staff NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980 (ADAMS Accession No. ML051400209).

63. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

64. NRC Staff NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," October 1999 and supplements in 2007 and 2013.

65. NRC Staff NUREG-1736 "Consolidated Guidance: 10 CFR Part 20-Standards for Protection against Radiation," October 2001 (ADAMS Accession No. ML013330179).

66. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

13.0 CONDUCT OF OPERATIONS

13.0 CONDUCT OF OPERATIONS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 programs relating to the preparations and plans for the design, construction, and operation of a nuclear plant. The purpose of this chapter is to provide reasonable assurance that the Combined License (COL) applicant will establish and maintain a staff of adequate size and technical competence to ensure that the operating plans the licensee will follow are adequate to protect public health and safety.

13.1 <u>Organizational Structure of Applicant</u>

13.1.1 Introduction

The organizational structure of the applicant, as described in the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 8, includes the design, construction, preoperational, and operational responsibilities. The management and technical support organization includes a description of the Dominion Virginia Power (Dominion) corporate or home office organization, its functions and responsibilities, and the number and the qualifications of personnel. Its activities include facility design, design review, design approval, construction management, testing, and operation of the plant. The descriptions of the design, construction and preoperational responsibilities include the following:

- How these responsibilities are assigned by the headquarters staff and implemented within the organizational units,
- The responsible working- or performance-level organizational unit,
- The estimated number of persons to be assigned to the unit with responsibility for the project,
- The general educational and experience requirements for identified positions or classes of positions, and
- Early plans for providing technical support for the operation of the facility.

The operating organization includes a description of the structure, functions, and responsibilities of the onsite organizations established to operate and maintain the plant. The applicant renumbered Section 13.1.1 and added other Sections in FSAR Section 13.1. Several of these Sections are new and differ from the structure in Section 13.1 of Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

13.1.2 Summary of Application

Section 13.1, "Organization Structure of Applicant," of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 13.1, "Organization Structure of Applicant," of Revision 10 of the Design Control Document (DCD) for the Economic Simplified Boiling Water Reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in

FSAR Section 13.1, the applicant provided the following supplemental items:

COL Items

- NAPS COL 13.1-1-A Management and Technical Support Organization

NAPS COL 13.1-1-A provides site-specific information to resolve DCD COL 13.1-1-A, which requires the COL applicant to describe the organizational structure. EF3 COL 13.1-1-A describes organizational positions at the nuclear power station and in the owner/applicant corporations, in addition to the associated functions and responsibilities.

- NAPS COL 9.5.1-10-A Fire Brigade

NAPS COL 9.5.1-10-A is the North Anna 3 response to DCD COL 9.5.1-10-A, which requires the COL applicant to provide a milestone for implementing in all plant areas manual firefighting capability provisions.

13.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG–1966,“Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” (the Final Safety Evaluation Report (FSER) related to the ESBWR DCD). In addition, the relevant requirements of the Commission regulations for the applicant’s organizational structure, and the associated acceptance criteria, are in SRP Sections 13.1.1 and 13.1.2-13.1.3 of NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” the Standard Review Plan (SRP).

The regulatory guidance for the acceptance of the organizational structure of the applicant is as follows:

- American National Standards Institute/American Nuclear Society (ANSI/ANS) -3.1-1993, as endorsed and amended by RG 1.8, Revision 3, “Qualification and Training of Personnel for Nuclear Power Plants.”

The regulations and regulatory guidance for the acceptance of the management, technical support, and operating organizations of the applicant are as follows:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.40(b), “Common standards”
- 10 CFR 50.54, “Conditions of licenses” items (i) through (m)
- RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operation)”

13.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the DCD and the COL application represent the complete scope of information related to this review topic[1]. The staff's review confirmed that the information contained in the application and incorporated by reference addresses the required information relating to the management, technical support, and operating organizations.

COL Items

- NAPS COL 13.1-1-A Management and Technical Support Organization

NAPS COL 13.1-1-A is related to the organizational structure of the COL applicant. This COL item describes organizational positions and associated functions and responsibilities at a nuclear power plant and in the corporations of the owner/applicant.

The applicant provided the following additional North Anna 3 site-specific COL information to resolve COL Item 13.1-1-A. DCD COL Item 13.1-1-A states:

> The COL Applicant referencing the ESBWR will submit documentation that demonstrates that their organizational structure is consistent with the ESBWR Human Factors Engineering (HFE) design requirements and complies with the requirements of 10 CFR 50.54 (i) through (m).

The applicant provided additional information as part of the North Anna 3 COL FSAR to describe the organizational positions at the nuclear power station, in owner/applicant corporations, and associated functions and responsibilities. The applicant stated that Table 13.1-201, "Generic Position/Site Specific Position Cross Reference" provides the estimated number of positions required for each function. In addition, Table 13.1-201 provides a cross-reference to identify site-specific position titles.

The applicant added new Sections and information related to the site-specific organizational structure in Section 13.1 beyond the structure given in RG 1.206. The new Section titles are:

13.1.4	"COL Information"
13.1.5	"References"
Table 13.1-201,	"Generic Position/Site-Specific Position Cross-Reference"
Table 13.1-202,	"Minimum Shift Staffing Unit 3"
Figure 13.1-201,	"Construction Organization"
Figure 13.1-202,	"Nominal Plant Staff Hiring and Training Schedule"
Figure 13.1-203,	"Shift Operation"
Figure 13.1-204,	"Operating Organization"
Figure 13.1-205,	"Corporate Organization"

[1] See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

In addition, the applicant added an appendix to Chapter 13, for future designation as historical information, titled “Appendix 13AA Design and Construction Responsibilities.” Appendix 13AA describes the applicant’s construction experience and the implementation and/or delegation of design and construction responsibilities.

The staff has reviewed North Anna 3 COL 13.1-1-A and concludes that the management, technical support, and operating organizations, as described, are acceptable and meet the requirements of the ESBWR HFE design requirements and complies with the requirements of 10 CFR 50.54 (i) through (m), 10 CFR 50.40(b), and 10 CFR 50.80, “Transfer of licenses,” as applicable. This conclusion is based on the following:

The applicant described its organization for the management of, and its means of providing technical support for the plant staff for the design, construction, and operation of the facility. The applicant has described its plans for managing the project and utilizing the nuclear steam system supplier (NSSS) vendor and architect-engineer (AE). These plans provide reasonable assurance that the applicant will establish an acceptable organization and that sufficient resources are available to provide offsite technical support and to satisfy the applicant’s commitments for the design, construction, and operation of the facility.

The applicant described the assignment of plant operating responsibilities; the reporting chain up through the President and Chief Nuclear Officer; the functions and responsibilities of each major plant staff group; the proposed shift crew complement for operation; the qualification requirements for members of its plant staff; and the qualifications of the technical support organization.

In Table 1.9-203, “Conformance with the FSAR Content Guidance in RG 1.206,” of the North Anna 3 COL FSAR, the applicant noted exceptions to the guidance of RG 1.206:

- Section C.III.I.13.1.2(1) and Section C.III.I.13.1.2(2) state the guidelines of RG 1.33 are met through equivalent administrative controls described in Chapter 17,

- Section C.III.I.13.1.3.2 states that resumes will not be included in the application, but will be available for inspection at corporate headquarters upon request.

The staff finds these exceptions to the guidance of RG 1.206 acceptable because organization charts and a description of the relationship of the nuclear-oriented portion of the organization to the rest of the corporate organization are contained in the Quality Assurance Program Description and resumes for management and principal supervisory and technical positions will be available for review after position vacancies are filled.

The applicant described the Dominion corporate organization, its functions and responsibilities, and the number and qualifications of personnel. The applicant directs attention to activities that include facility design, design review, design approval, construction management, testing, and operation of the plant.

The applicant described the Dominion management, engineering, and technical support organizations. The description includes organizational charts for the current corporate structure and operating organization and any planned modifications and additions to those organizations that reflect the added functional responsibilities associated with the design, construction, and operation of a nuclear power plant.

The applicant described how the added functional responsibilities associated with the addition of the nuclear power plant to the applicant's power generation capacity are delegated and assigned. The description includes organization charts reflecting the current corporate structure and the organization of units that provide technical support for the operation of the facility.

The applicant provided a description of the management, engineering, technical support, fire protection, and operating organizations; the plans for managing the construction of North Anna 3, the NSSS vendor and AE. The applicant provided a description of the assignment of plant operating responsibilities, the reporting chain up through the chief nuclear officer, the functions and responsibilities of each major plant staff group, and the proposed shift crew complement for operation.

The applicant provided a description of Dominion's experience in the design, construction, and operation of nuclear generating plants and responsibilities associated with six nuclear units at three sites in Virginia and Connecticut.

The applicant provided a description of the general qualification requirements in terms of educational background and experience for positions depicted in the organization charts.

The applicant provided a description of the qualification requirements in terms of experience and a description of the education, training, and experience requirements established for management, operating, technical, fire protection, and maintenance positions for the operating organization.

The applicant provided Table 13.1-201, "Generic Position/Site Specific Position Cross Reference" and Table 13.1-202, "Minimum Shift Staffing for North Anna 3," that describe the operating organization at North Anna 3 and the associated functions and responsibilities. Table 13.1-201 provides the estimated number of personnel required for each position during the operational phase of North Anna 3, the site-specific Nuclear Plant Position titles, and the associated ANSI/ANS-3.1-1993, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants," Table 13.1-202 describes the minimum composition of the operating shift crew for all modes of operation. The applicant also states that minimum shift staffing for the various modes of operation are implemented using plant administrative procedures, work-hour limitations, and shift staffing requirements defined by TMI Action Plan Item I.A.1.3.

In addition, the applicant's operating organization can be characterized as follows:

1. The applicant is technically qualified, as specified in 10 CFR 50.40(b) and 10 CFR 50.80, as applicable.

2. An adequate number of licensed operators will be available at all required times to satisfy the minimum staffing requirements of 10 CFR 50.54(i) – (m).

3. On-shift personnel are able to provide initial facility response in the event of an emergency.

4. Organizational requirements for the plant manager and radiation protection manager have been satisfied.

5. Qualification requirements and qualifications of plant personnel conform to the guidance of RG 1.8.

6. Organizational requirements conform to the guidance of RG 1.33.

7. The applicant has satisfied the requirements that a designated organization be responsible for the testing program and for plans to utilize the plant operating and technical staff to develop and conduct the testing program and to review the test results.

FSAR Table 1.9-201, "Conformance with Standard Review Plan," identifies an exception to SRP Section 13.1.1, Acceptance Criterion 1.C, as follows:

> The experience requirements of corporate staff are set by corporate policy and not provided in detail; however, the experience level of Dominion, as discussed in Section 13.1 and Appendix 13AA, in the area of nuclear plant development, construction, and management establishes that Dominion has the necessary capability and staff to ensure that design and construction of the facility will be performed in an acceptable manner.

As part of the SRP guidance, Areas of Review Item 1.B.vii in Section 13.1.1 states that the submittal should describe the general education and experience required for identified positions or classes of positions and for management and supervisory positions. The staff found that Dominion has addressed the corporate staff guidance for education and experience as recommended in SRP, Section 13.1.1 Areas of Review Item 1.B.vii. The applicant also includes in FSAR Section 13.1.1.4, qualifications for managers and supervisors in the technical support organization to meet the requirements of education and experience needed to meet requirements in ANSI/ANS-3.1–1993 and RG 1.8.

The FSAR Section 13.1.3.1 states that the qualifications for managers, supervisors, operators, and technicians in the operating organization meet the requirements for education and experience as described in ANSI/ANS-3.1-1993 and endorsed and amended in RG 1.8. For reactor operators (RO) and senior reactor operators (SRO), Section 13.2 of the COL FSAR modifies those requirements. In addition, for initial appointees to appropriate management and supervisory positions, Section 13.1.3.2 states that résumés and other documentation of qualifications and experience will be available for review after vacant positions are filled. In FSAR Table 13.1-202, "Minimum Shift Staffing for North Anna 3," the applicant describes the minimum composition of the operating shift crew for unit shutdown and operating modes. Position titles, license requirements, and minimum shift staffing for the various modes of operation are in technical specifications and administrative procedures.

The staff finds that the applicant's organizational structure as defined above complies with the requirements of 10 CFR 50.40(b). That is, the applicant is technically qualified to engage in design, construction activities and operation of a nuclear power plant; the applicant will have the necessary managerial and technical resources to support the plant staff in the event of an emergency; and the applicant identifies the organizational positions responsible for fire protection matters and delegates to these positions the authority to implement fire protection requirements.

- NAPS COL 9.5.1-10-A Fire Brigade

NAPS COL 9.5.1-10-A is related to onsite fire operations training and the schedule for implementation of the fire protection program. Based on the information provided in Table 13.4-201, "Operational Programs Required by NRC Regulations," the staff finds that the applicant's schedule for implementing the fire protection plan meets the guidance of the SRP and is therefore acceptable. The technical review for the North Anna 3 COL 9.5.1-10-A, as it relates to the fire protection programmatic requirements, is in Section 9.5 of this SER.

13.1.5 Post-Combined License Activities

There are no post-COL activities related to this Section.

13.1.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this Section. Pursuant to 10 CFR 52.63(a) (5) and 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design," Section VI.B.1, all nuclear safety issues relating to this Section that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COL application to the relevant NRC regulations, the guidance in SRP Section 13.1, and other NRC RGs. The staff's review concludes that the applicant has provided sufficient information to satisfy the requirements of NRC regulations. The staff determined that the applicant has adequately addressed North Anna 3 COL Item 13.1-1-A involving the management, technical support, and operating organizations; and North Anna 3 COL 9.5.1-10-A as it relates to the implementation of the Fire Protection Program, including the Fire Brigade. In conclusion, the staff determined that the applicant has provided sufficient information to satisfy the requirements of 10 CFR 50.40(b), 10 CFR 50.54(i–m), and 10 CFR 50.80; and no outstanding information is expected to be addressed in the COL FSAR related to this Section.

13.2 <u>Training</u>

13.2.1 Introduction

Section 13.2 of the North Anna 3 FSAR, Revision 8 includes a description of and schedule for the program to train ROs and SROs (i.e., licensed operators). The discussion addresses the scope of the licensing examinations as well as training requirements. The licensed operator training program also incorporates the requalification programs required in 10 CFR 50.54(i)(i-1) and 10 CFR 55.59, "Requalification."

In addition, this section provides a description of and schedule for the program to train non-licensed plant staff.

13.2.2 Summary of Application

Section 13.2 of North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 13.2 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 13.2, the applicant provides the following:

<u>COL Items</u>

- STD COL 13.2-1-A Reactor Operator Training

In FSAR Section 13.2.1, "Reactor Operator Training," the applicant states:

> Descriptions of the training program and licensed operator requalification program for reactor operators and senior reactor operators are addressed in Appendix 13BB. A schedule showing approximate timing of initial licensed operator training relative to fuel loading is addressed in Section 13.1. Requalification training is implemented in accordance with Section 13.4.

- STD COL13.2-2-A Training for Non-Licensed Plant Staff

In FSAR Section 13.2.2, "Training for Non-Licensed Plant Staff," the applicant states:

> A description of the training program for non-licensed plant staff is addressed in Appendix 13BB. A schedule showing approximate timing of initial training for non-licensed plant staff relative to fuel load is addressed in Section 13.1.

<u>Supplemental Information</u>

- STD SUP 13.2-1 Training

In FSAR Section 13.2 the applicant states:

> Training programs are discussed in Appendix 13BB. Implementation milestones are discussed in COL FSAR Section 13.4.

13.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for training, and the associated acceptance criteria, are in SRP Section 13.2.

In particular, the regulatory basis for accepting the applicant's information in Section 13.2 is in 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigation"; Part 26, "Fitness for Duty Programs"; Part 50, "Domestic Licensing of Production and Utilization Facilities"; Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"; and Part 55, "Operator's Licenses"; Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," of 10 CFR Part 50. Related guidance is found in RG 1.8 and RG 1.149, Revision 3, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations"; NUREG–1021, "Operator Licensing Examination Standards for Power Reactors"; and NUREG–1220, "Training Review Criteria and Procedures." The COL and supplemental information items are reviewed using the guidance in SRP, Section 13.2.1, "Reactor Operator Requalification Program; Reactor Operator Training," and Section 13.2.2, "Non-Licensed Plant Staff Training."

Regulations related to the Operational Program for the Non-Licensed Plant Staff Training Program are in 10 CFR 50.120, "Training and qualification of nuclear power plant personnel," and 10 CFR 52.79(a)(33).

Regulations related to the Operational Program for the Reactor Operator Training Program are in 10 CFR 55.13, "General exemption"; 10 CFR 55.31, "How to apply"; 10 CFR 55.41, "Written examinations: Operators"; 10 CFR 55.43, "Written examinations: Senior operators"; and 10 CFR 55.45, "Operating tests."

Regulations related to the Operational Program for the Reactor Operator Requalification Program are in10 CFR 52.79(a)(34), 10 CFR 50.54(i), and 10 CFR 55.59.

The relevant criteria for reviewing COL items which relate to the incorporation of operating experience are based on meeting the provisions of Three Mile Island Action Item I.C.5, Appendix 1A, "Feedback of Operating Experience"; and the guidance of SRP, Section 13.2, "Training."

13.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.2 of North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information contained in the application and the information incorporated by reference address the relevant information related to this Section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items

- STD COL 13.2-1-A Reactor Operator Training

The applicant provides additional information in STD COL Item 13.2.1-A, which states:

> Descriptions of the training program and licensed operator requalification program for ROs and SROs are addressed in Appendix 13BB. A schedule showing approximate timing of initial licensed operator training relative to fuel loading is addressed in Section 13.1. Requalification training is implemented in accordance with Section 13.4.

In SRP, Section 13.2.1 states that the application should contain a description of the training program for ROs and SROs. In FSAR Appendix 13BB, the applicant incorporates by reference Nuclear Energy Institute (NEI) 06-13A, "Technical Report on a Template for an Industry Training Program Description," Revision 1. The staff determined that NEI 06-13A, Revision 1, endorsed by the staff on September 5, 2007, provides an acceptable template for describing licensed operator and non-licensed plant staff training programs because it meets the criteria of SRP, Section 13.2.1.

SRP Section 13.2.1 states that the application should describe the schedule for the RO and SRO training program. NEI 06-13A, Revision 1, addresses training program schedules in Section 1, "Training Program Description." In FSAR Section 13.1, "Organizational Structure of Applicant," the applicant includes a schedule showing the approximate timing of initial licensed operator training relative to fuel loading, in conformance with NEI-06-13A, Revision 1. The staff concluded that the applicant's licensed operator training program schedule contains sufficient information to satisfy the guidance of SRP, Section 13.2.1 and is therefore acceptable.

SRP Section 13.2.1 states that the application should describe the requalification program for ROs and SROs. NEI 06-13A, Revision 1, Section 1 addresses the requalification program descriptions. In FSAR Section 13.4, "Operational Program Implementation," the applicant describes the licensed operator requalification program in conformance with NEI 06-13A, Revision 1. The staff concluded that the applicant's description of the licensed operator requalification program meets the criteria in SRP, Section 13.2.1 and is therefore acceptable.

- STD COL 13.2-2-A Training for Non-Licensed Plant Staff

The applicant provides additional information to address STD COL 13.2-2-A, which states:

> A description of the training program for non-licensed plant staff is addressed in Appendix 13BB. A schedule showing approximate timing of initial training for non-licensed plant staff relative to fuel load is addressed in Section 13.1.

In SRP, Section 13.2.2 states that the applicant's training program should meet the guidelines of RG 1.8 for non-licensed personnel. In FSAR Table 13.4-201, the applicant provides a schedule for a milestone of at least 18 months before fuel loading for the requirements of non-licensed plant staff, in accordance with the requirements of 10 CFR 50.120(b). In addition, the applicant will provide a schedule for conducting formal onsite training and on-the-job training, so that the entire plant staff will be qualified before initial fuel loading. In FSAR Table 13.4-201, Operational Program Items 11 through 13 provides additional details on the commitments and applicable requirements to be met. The staff determined that the applicant's approach is acceptable because it will include those subjects that are required by regulations for the training programs and will base the training programs on the systems approach to training (SAT), as required by regulations and in accordance with the guidance of NEI 06-13A, Revision 1. The staff concluded that the applicant has provided sufficient information to satisfy the guidance of SRP, Section 13.2.2 and is therefore acceptable.

Supplemental Information

- STD SUP 13.2-1 Training

The applicant added the following sentence in Section 13.2, "Training," to supplement the DCD; this text is also identified by the applicant as STD SUP 13.2-1:

> Training programs are addressed in Appendix 13BB. Implementation milestones are addressed in Section 13.4.

The applicant provided the following text to supplement Section 13.2, "Training," Appendix 13BB, "Training Program," to address cold license training program procedures.

> NEI 06-13A (Reference 13BB-201), Technical Report on a Template for an Industry Training Program Description, is incorporated by reference.

NEI 06–13A is a generic training program description. Revision 0 of this template, which was incorporated by reference in North Anna 3 FSAR Revision 0, did not address a cold license training plan. Revision 1 of NEI 06-13A included additional information that addresses cold license testing, and the staff has endorsed this revision. Therefore, the staff issued Request for Additional Information (RAI) 13.02.01-1, requesting Dominion to address the cold licensing process. In a letter dated September 11, 2008, Dominion stated that NEI 06-13A, Revision 1, will be incorporated by reference in Appendix 13BB. The staff verified that NEI 06-13A, Revision 1, is incorporated by reference in Appendix 13BB in COL FSAR Revision 1. North Anna FSAR table 1.6-201 lists topical reports not included in DCD Section 1.6 that are incorporated in whole or in part by reference. Because the applicant's reference to NEI 06-13A, Revision 1 has been updated to the staff-endorsed revision that addresses cold licensing, the staff determined that the change made to Appendix 13BB is acceptable and meets the guidance of SRP, Chapter 13.2.1.

SRP Section 13.2.1 states that the description of the training program should address the subject matter, duration, organization, position titles, and schedules. Section 1 of NEI 06-13A, Revision 1, includes information on subject matter, duration, organization, position titles, and schedules. The staff concluded that the description of the NEI 06-13A, Revision 1, training program provides sufficient information to satisfy the criteria in SRP Section 13.2.1 and is therefore acceptable.

SRP Section 13.2.1 states that the training program for licensed operators should include (1) the subjects in 10 CFR 55.31, 10 CFR 55.41, 10 CFR 55.43, 10 CFR 55.45, and RG 1.8; and (2) provisions for upgrading licenses. In addition, this program should use the SAT as defined in 10 CFR 55.4, "Definitions." NEI 06-13A, Revision 1, Section 1.1 states that the training program for licensed operators is in accordance with and includes the subjects in 10 CFR Part 55, specifically 10 CFR 55.41, 10 CFR 55.43, 10 CFR 55.45, and RG 1.8. NEI 06-13A, Revision 1, Section 1 states that training programs are developed, established, implemented, and maintained using the SAT, as defined by 10 CFR 55.4. The staff determined that this program is acceptable and meets the guidance of SRP, Section 13.2.1, because the applicant will include in the training programs those subjects that are required by regulations and will base the training programs on the SAT, as required by regulations and in accordance with the guidance in the staff-endorsed template in NEI 06-13A, Revision 1.

SRP, Section 13.2.1, states that the applicant should describe the requalification program for ROs and SROs. In FSAR Appendix 13BB, the applicant stated that NEI 06-13A, Revision 1, is incorporated by reference. NEI 06-13A, Revision 1, addressed the requalification program descriptions in Section 1, "Training Program Description." In FSAR Section 13.4, "Operational Program Implementation," the applicant described the licensed operator requalification program. The staff determined that this program is acceptable because it follows the staff-endorsed template in NEI 06-13A and therefore meets the criteria of SRP, Section 13.2.1.

SRP Section 13.2.1 also states that the licensed operator requalification program should include the content described in 10 CFR 55.59 or should be based on the use of the SAT, as defined in 10 CFR 55.4. Section 1.1 of NEI 06-13A, Revision 1, states that the licensed operator training program content and schedule should comply with 10 CFR 55.59. This Section also states that training programs are developed, established, implemented, and maintained using the SAT, as defined by 10 CFR 55.4. The staff found this information acceptable because the applicant will include in the training programs those subjects that are required by regulations and will base the training programs on the SAT, as required by regulations and in accordance with the guidance in NEI 06-13A, Revision 1. The staff concluded that the applicant has provided sufficient information to satisfy SRP, Section 13.2.1.

In addition, SRP Section 13.2.1 states that the program for providing the simulator capability should meet the requirements described in 10 CFR 55.31, 10 CFR 55.45, 10 CFR 55.46, "Simulation facilities," and 10 CFR 50.34(f)(2)(i); in addition to the guidance in RG 1.149. NEI 06-13A, Revision 1, Section 1.1, states that licensed operators will receive plant simulator training to demonstrate an understanding of and the ability to perform the actions listed in 10 CFR 55.45, NEI 06-13A, Revision 1, Section 1.1, also states that a simulator will be used for training licensed operators which includes the items listed in 10 CFR 55.31and for the administration of operating tests, in accordance with 10 CFR 55.46. 10 CFR 50.34(f)(2)(i), requires simulators to include the capability of simulating small-break, loss-of-coolant accidents. In North Anna 3 FSAR Table 1.9-202, "Conformance with Regulatory Guides," the applicant states that the North Anna 3 conforms to the guidance of RG 1.149, Revision 3 which includes loss of coolant accidents. The staff determined that this information is acceptable because the applicant will provide the simulator capability required by the regulation. The staff concluded that the applicant has provided sufficient information to satisfy SRP, Section 13.2.1.

SRP Section 13.2.1 states that the training program should include the means for evaluating the effectiveness of the training program in accordance with the SAT. NEI 06-13A, Revision 1, Section 1.5 includes a program to evaluate training effectiveness. It also states that training programs are to be developed, established, implemented, and maintained using the SAT as defined by 10 CFR 55.4. The staff determined that this information is acceptable and sufficient to satisfy SRP, Section 13.2.1, because the applicant will apply the SAT process in the evaluation of the training programs.

SRP Section 13.2.1 states that applicants are to provide implementation milestones for the RO training program. NEI 06-13A, Revision 1, includes implementation milestones. The staff determined that this information is acceptable because the applicant has provided implementation milestones as recommended by SRP, Section 13.2.1.

13.2.5 Post Combined License Activities

There are no post COL activities related to this Section.

13.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this Section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this Section that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL and supplemental information in the application to the relevant NRC regulations; the guidance in SRP Section 13.2 and other NRC RGs. The staff's review concludes that the applicant has adequately addressed COL Items STD COL 13.2-1-A and 13.2-2-A and Supplemental Information STD SUP 13.2-1 relating to training, in accordance with NRC regulations. These items are thus acceptable.

13.3 Emergency Planning

13.3.1 Introduction

This Section addresses the plans, design features, facilities, functions, and equipment necessary for radiological emergency planning (EP) that must be considered in a COL application (hereinafter referred to as "COLA" or "application"). This includes both the applicant's onsite emergency plan and State and local (offsite) emergency plans, which the NRC and the Federal Emergency Management Agency (FEMA) evaluated to determine whether the plans are adequate, and that there is reasonable assurance that they can be implemented. The emergency plans are an expression of the overall concept of operation and describe the essential elements of advance planning that have been considered, as well as the provisions that have been made to cope with radiological emergency situations.

Virginia Electric and Power Company, doing business as Dominion Virginia Power is the applicant for the COL (hereinafter referred to as “Dominion” or “applicant”). Dominion submitted its initial COLA on November 26, 2007 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML073320913), for one new nuclear reactor, consisting of the General Electric-Hitachi Nuclear Energy (GEH) ESBWR, which will be located on the North Anna Power Station site (North Anna site) located in Louisa County, Virginia. The new reactor is designated as North Anna 3. The NRC docketed the application on January 28, 2008 (Docket No. 52-017) (ADAMS Accession No. ML080240154). On June 28, 2010, Dominion revised its COLA to change the designation of the choice of reactor technology from the ESBWR to the Mitsubishi Heavy Industries, Ltd. US-APWR (ADAMS Accession No. ML101820627). Dominion changed the reactor technology designation back to the ESBWR on July 31, 2013 (ADAMS Accession No. ML13221A504), and updated the application on December 18, 2013, and June 24, 2014 (ADAMS Accession Nos. ML14007A541 and ML14199A360, respectively). On September 23, 2015, Dominion submitted a request for a one-time exemption from 10 CFR 50.71I(3)(iii), to postpone submission of the next FSAR annual update to no later than June 30, 2016.

On August 24, 2005, GEH submitted its ESBWR standard design certification application to the NRC, and the NRC docketed the application on December 1, 2005 (Docket No. 52-010). On December 11, 2013, GEH submitted Revision 10 of the ESBWR DCD to the NRC (ADAMS Accession No. ML14010A278), followed by an updated version of Revision 10 on April 1, 2014 (ADAMS Accession No. ML14101A028). Dominion supplemented its application in a letter dated February 10, 2014 (ADAMS Accession No. ML14043A035), which provided COLA markups that reflect the December 11, 2013, ESBWR DCD, Revision 10 changes. Dominion supplemented its application for a second time in a letter dated April 17, 2014 (ADAMS Accession No. ML14108A345), which provided additional COLA markups to reflect the April 1, 2014, updated version of ESBWR DCD, Revision 10, and to align with the February 14, 2014, Enrico Fermi Unit 3 COLA update (ADAMS Accession No. ML14055A463). On October 15, 2014, the NRC issued the ESBWR final rule (10 CFR Part 52, Appendix E) in the *Federal Register* (79 FR 61944).

Two existing nuclear reactors (i.e., North Anna Units 1 and 2) and an Independent Spent Fuel Storage Installation (ISFSI) are currently located on the North Anna site. Dominion is the licensed operator of the existing facilities, with control of the North Anna site and existing facilities. North Anna 3 will be located adjacent to and generally west of the existing reactor units. Figure 2.0-205, “Unit 3 Power Block Building Locations Within the ESP Proposed Facility Boundary,” in COLA Part 2, “Final Safety Analysis Report” (FSAR) (hereinafter referred to as “Part 2” or “FSAR”), shows that the proposed North Anna 3 footprint is located within the early site permit (ESP) plant parameter envelope. The North Anna 3 boundary is entirely within the existing North Anna site exclusion area boundary, so that for purposes of EP, little distinction exists between the North Anna site (for Units 1 and 2) and the ESP site (for North Anna 3). The COLA takes advantage of the EP resources, capabilities, and organization that currently exist at the North Anna site for Units 1 and 2.

The application includes a complete and integrated emergency plan for North Anna 3, which consists of the onsite North Anna 3 Emergency Plan in COL application Part 5, “Emergency Plan” (hereinafter referred to as “COL Plan”), and supplemental information that includes the offsite radiological emergency response plans (RERP) for the State of Maryland and

Commonwealth of Virginia (including the affected counties), and an evacuation time estimate (ETE) report for the North Anna site (hereinafter referred to as “ETE Report”). The ETE Report is discussed below in SER Section 13.3.4.17. The application also includes a listing of emergency planning inspections, tests, analyses, and acceptance criteria (ITAAC) in Table 2.3-1, “ITAAC For Emergency Planning,” of COLA Part 10, “Tier 1/ITAAC/Proposed License Conditions,” that will be completed before fuel load. Finally, the COLA incorporates by reference ESP No. ESP-003 for the North Anna ESP site and the ESBWR standard plant design.

As described below, in consultation with FEMA, the staff reviewed the COLA, the applicant’s responses to RAIs and generally available reference materials in accordance with the guidance provided in the SRP, Section 13.3, “Emergency Planning,” and SRP Section 14.3.10, “Emergency Planning – Inspections, Tests, Analyses, and Acceptance Criteria.” FEMA reviewed the offsite RERPs for the State of Maryland and Commonwealth of Virginia, and local government plans for Caroline, Hanover, Louisa, Orange, and Spotsylvania Counties in Virginia (i.e., risk jurisdictions).

In an August 22, 2008, letter to NRC, FEMA provided its Interim Findings Report for the North Anna COLA (ADAMS Accession No. ML082470307), and on December 23, 2008, its Interim Findings Report for Open Items (ADAMS Accession No. ML090070398). These reports reflected the current status of FEMA’s evaluation, including FEMA’s RAIs, associated with the offsite emergency response plans for North Anna 3. By letter dated October 24, 2008 (ADAMS Accession No. ML083080127), Dominion provided responses to FEMA’s RAIs, which had been prepared by the Commonwealth of Virginia Department of Emergency Management (VDEM) on October 22, 2008. In a March 4, 2009, letter to NRC (ADAMS Accession No. ML090790498), FEMA stated that there remained 37 open items that require resolution before it could make its finding of reasonable assurance for the offsite plans. FEMA continued to work directly with Dominion and the governmental agencies until all of the open items were resolved. In a December 7, 2009, letter to NRC (ADAMS Accession No. ML093441405), FEMA provided its Interim Finding Report for Reasonable Assurance, dated December 1, 2009 (ADAMS Accession No. ML093441481), which found that all planning standards associated with their review were adequate. The “planning standards” referred to here and below consist of the 16 planning standards (i.e., A through P) of NUREG–0654/FEMA-REP-1, Revision 1, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants” (hereinafter referred to as “NUREG–0654”).

FEMA further stated in the December 1, 2009, report that the adequacy of the COLA emergency plan review for offsite response organizations is also dependent on satisfactory demonstration of plan implementation during a joint exercise with the licensee (Dominion) and State and local governments, utilizing the North Anna 3 facilities. Exercises and drills are discussed below in SER Section 13.3.4.14, and offsite exercise objectives are addressed in SER Table 13.3-1, “NAPS Unit 3 ITAAC,” acceptance criterion 8.1.3. The staff reviewed the FEMA findings in the December 1, 2009, report, and the overall FEMA conclusions are reflected below in SER Sections 13.3.4 and 13.3.6. The applicant’s reactor technology change from the ESBWR to the US-APWR, and subsequent change back to the ESBWR, did not affect the offsite emergency plans; and therefore, FEMA’s December 1, 2009, findings remain valid.

13.3.2 Summary of Application

The COLA Part 2 (FSAR) Section 1.1.1.9, "Referencing of [ESP application] ESPA Information," incorporates by reference Revision 9 of the North Anna ESP application Site Safety Analysis Report (SSAR), as required by 10 CFR 52.79(b)(1). Dominion submitted the ESP application to the NRC on September 25, 2003 (ADAMS Accession No. ML032731511), which was docketed on October 23, 2003 (Docket No. 52-008). The NRC issued ESP-003 on November 27, 2007 (ADAMS Accession Nos. ML073180427 and ML073180440). In addition, as required by 10 CFR 52.79(d)(1), FSAR Section 1.1.1.7, "Incorporation by Reference," incorporates by reference Revision 10 of the ESBWR DCD.

FSAR Section 13.3, "Emergency Planning," incorporates by reference Section 13.3 of the ESBWR DCD, Revision 10, and Section 13.3 of the ESP SSAR. COLA Part 7, "Departures Report," includes information on departures, variances, and exemptions. With regard to EP, there are no departures from the ESBWR DCD, variances from the ESP SSAR, or requests for exemptions from NRC regulations. In addition, there are no ESP COL action items or permit conditions associated with EP.

COL Items

As reflected in ESBWR DCD Tier 2 Table 1.10-1, "Summary of COL Items," and the table's referenced Tier 2 DCD Sections, the applicant identified COL items relating to EP in COLA Part 2 (FSAR) Table 1.10-201, "Summary of FSAR Sections Where DCD COL Items Are Addressed," and FSAR Table 1C-202, "Operating Experience Review Results Summary – IE Bulletins." In FSAR Section 13.3, the applicant identified the following three Standard COL Items from the ESBWR DCD:

- STD COL 13.3-1-A: The COL applicant is responsible for identifying the operational support center (OSC) and the communication interfaces for inclusion in the detailed design of the control room and technical support center (TSC).

- STD COL 13.3-2-A: The COL applicant is responsible for the design of the communication system located in the emergency operations facility (EOF) in accordance with NUREG–0696.

- STD COL 13.3-3-A: The COL applicant will provide supplies at the site for decontamination of onsite individuals in the service building adjacent to the main change rooms.

The applicant also identified (in the respective FSAR Sections) the following three Standard COL Items from the ESBWR DCD (including ESBWR DCD Tier 2 Appendix 1C, "Industry Operating Experience," and DCD Tier 2, Table 1C-2, "Operating Experience Review Results Summary – IE Bulletins"), which relate to EP:

- STD COL 13.4-2-A: The COL applicant will provide implementation milestones for operational programs that are required by NRC regulation.

- STD COL 14.3-1-A: The COL applicant shall provide emergency planning ITAAC, based on industry guidance.

- STD COL 1C.1-2-A: COL applicant will address requirements of IE Bulletin 2005-02[2] regarding emergency preparedness and response actions for security-based events.

The staff's evaluation of the applicant's resolution of these six Standard COL Items is addressed below in SER Section 13.3.4.18.

In FSAR Section 9.5.2, "Communications System," the applicant identified four additional (ESBWR DCD) Plant-Specific COL Items associated with emergency communication systems (i.e., NAPS COL 9.5.2.5-1-A, NAPS COL 9.5.2.5-3-A, NAPS COL 9.5.2.5-4-A, and NAPS COL 9.5.2.5-5-A). Communication systems are described in ESBWR DCD Tier 2, Section 9.5.2, "Communications System," FSAR Section 9.5.2.2, COL Plan Sections II.E and II.F, ESP SSAR Sections 13.3.2.2.2.e and 13.3.2.2.2.f, and NUREG–1835[3], Sections 13.3.3.6 and 13.3.3.7; and are addressed below in SER Sections 13.3.4.5 and 13.3.4.6. Resolution of these four Plant-Specific COL Items is addressed in SER Section 9.5.2, "Communication System."

Supplemental Information

In FSAR Section 13.5.2.2.2, "Emergency Preparedness Procedures," the applicant identified the following Standard Supplemental Information to DCD Tier 2, Section 13.5.2, "Operating and Maintenance Procedures," relating to E:

- STD SUP 13.5-28: A discussion of emergency preparedness procedures can be found in the emergency plan, and that a list of implementing procedures is maintained in the emergency plan.

The staff's evaluation of the applicant's resolution of this Standard Supplemental Information item is addressed below in Section 13.3.4.18 of this report.

Onsite Emergency Plan

Emergency planning for North Anna 3 is addressed throughout COLA Part 2 (FSAR), with the North Anna 3 Emergency Plan (COL Plan) provided in COLA Part 5. The COL Plan consists of a basic plan and eight appendices (listed below), which provide additional detailed information on specific aspects of the EP, and incorporates by reference various information from Section 13.3, "Emergency Planning," of the ESP SSAR. In addition, the COLA includes the ETE Report as supplemental information to the COL Plan. COL Plan Appendix 4, below, consists of the Executive Summary from the full ETE Report.

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[2] NRC Office of Inspection and Enforcement (IE) Bulletin (BL) 2005-02, "Emergency Preparedness and Response Actions for Security-Based Events," July 18, 2005 (ADAMS Accession No. ML051740058).

[3] NUREG–1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site," September 2005 (ADAMS Accession No. ML052710305).

- Appendix 1: Reserved
- Appendix 2: Assessment and Monitoring for Actual or Potential Offsite Consequences of a Radiological Emergency
- Appendix 3: Public Alert and Notification System
- Appendix 4: Evacuation Time Estimates (summary)
- Appendix 5: Implementing Procedures – Topical List
- Appendix 6: Emergency Equipment and Supplies
- Appendix 7: Certification Letter
- Appendix 8: Cross-Reference to Regulations, Guidance, and State and Local Plans

Offsite Emergency Plans

The COLA includes supplemental information consisting of the offsite RERPs for the State of Maryland, the Commonwealth of Virginia, and the risk jurisdictions of Louisa, Spotsylvania, Orange, Caroline, and Hanover Counties in Virginia.

License Conditions

COLA Part 10 Section 3, “North Anna 3 Proposed License Conditions,” includes the following proposed license conditions related to EP actions (which are addressed below in SER Sections 13.3.4 and 13.3.6):

- License Condition 3.1 (Letters of Agreement) (See SER Section 13.3.4.16).

  Prior to loading fuel, the licensee shall update its Units 1 and 2 Letters of Agreement with the following entities or their successors:

  a. Commonwealth of Virginia Department of Emergency Management
  b. Commonwealth of Virginia Department of Health
  c. Commonwealth of Virginia Department of State Police
  d. Commonwealth of Virginia Department of Game and Inland Fisheries
  e. Virginia Commonwealth University Medical Center
  f. Louisa County Administrator
  g. Louisa County Sheriff
  h. Louisa County Department of Fire and Emergency Medical Services
  i. Spotsylvania County Sheriff
  j. Spotsylvania Department of Fire, Rescue, and Emergency Management
  k. Orange County Administrator
  l. Orange County Sheriff
  m. Caroline County Sheriff
  n. Caroline County Department of Fire, Rescue, and Emergency Management

o. Hanover County Administrator
p. Hanover County Sheriff

These updated letters of agreement will identify the specific nature of arrangements in support of emergency preparedness for the North Anna site, including North Anna 3. The emergency plan shall be revised to include these update letters of agreement after they have been executed.

- License Condition 3.7.1 (Emergency Action Levels (EAL)) (See SER Section 13.3.4.4).

  No later than 180 days prior to initial fuel load, the licensee shall submit to the Director of NRO [NRC Office of New Reactors], or the Director's designee, a fully developed set of site-specific EALs in accordance with [Nuclear Energy Institute] NEI 07-01, Revision 0, with no deviations. The EALs shall have been discussed and agreed upon with state and local officials.

- License Condition 3.7.2 (On-Shift Staffing) (See SER Section 13.3.4.2).

  The licensee shall perform a detailed analysis of on-shift staffing, in accordance with NEI 10-05, "Assessment of On-Shift Emergency Response Organization Staffing and Capabilities," Revision 0, and the licensee shall incorporate any changes to the emergency plan (EP) needed to bring staff to the required levels, prior to or concurrent with the completion of EP ITAAC 2.0 of Table 2.3-1, and no less than 180 days prior to initial fuel load.

- License Condition 3.8.1 (Fukushima Near-Term Task Force (NTTF) Recommendations) (See SER Sections 13.3.4.2 and 13.3.4.6).

  At least two years prior to scheduled initial fuel load, the licensee shall have performed an assessment of the onsite and augmented staffing capability to satisfy the regulatory requirements for response to a multi-unit event. The staffing assessment will be performed in accordance with NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," Revision 0.

  At least 180 days prior to scheduled initial fuel load, the licensee shall revise the EP to include the following:

  - Incorporation of corrective actions identified in the staffing assessment described above

  - Identification of how the augmented staff will be notified given degraded communications capabilities

  At least two years prior to scheduled initial fuel load, the licensee shall have performed an assessment of on-site and off-site communications systems and equipment required during an emergency event to ensure communications capabilities can be maintained during prolonged station blackout conditions. The communications capability assessment will be performed in accordance with NEI 12-01, "Guidance [*sic*] for

Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," Revision 0.

At least 180 days prior to scheduled initial fuel load, the licensee shall complete implementation of corrective actions identified in the communications capability assessment described above, including any related emergency plan and implementing procedure changes and associated training.

ITAAC

The COLA Part 10 Section 2.3, "Emergency planning ITAAC," includes the proposed emergency planning ITAAC (EP ITAAC) in Table 2.3-1. The application does not include EP ITAAC from either the referenced North Anna 3 ESP SSAR or ESBWR DCD, as there are none (see STD COL 14.3-1-A in SER Section 13.3.4.18, below, with regard to the ESBWR DCD). The complete set of EP ITAAC for North Anna 3 is provided below in SER Table 13.3-1.

13.3.3 Regulatory Basis

The regulatory basis of the North Anna 3 ESP SSAR information incorporated by reference is addressed in NUREG–1835. The regulatory basis of the ESBWR DCD information incorporated by reference is addressed in NUREG–1966, April 2014 (which reflects DCD Revision 9), and in Supplement 1 to NUREG–1966, September 2014 (which reflects DCD Revision 10). The applicable regulatory requirements and guidance for EP information submitted in a COLA are as follows:

- 10 CFR 52.79(a)(21) requires that the FSAR include emergency plans that comply with the requirements of 10 CFR 50.47, "Emergency plans," and 10 CFR Part 50, Appendix E. In addition, 10 CFR 52.79(a)(22)(i) requires certifications from State and local governmental agencies with EP responsibilities. The staff also considered the applicable requirements in 10 CFR 50.33(g), 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors," 10 CFR 52.79(b)(4), 10 CFR 52.80, "Contents of applications; additional technical information," 10 CFR 52.83, "Finality of referenced NRC approvals; partial initial decision on site suitability," and 10 CFR 100.21, "Non-seismic siting criteria."

- SRP identifies NUREG–0654 and other related guidance that the staff should considered during its review. The related acceptance criteria are identified in Section II, "Acceptance Criteria," SRP, Section 13.3, and the applicable regulatory guidance for reviewing emergency preparedness as an operational program is established in SRP, Section 13.4, "Operational Programs." In addition, the staff considered NUREG/CR-7002, "Criteria for Development of Evacuation Time Estimate Studies," November 2011, NUREG/CR-6863, "Development of Evacuation Time Estimate Studies for Nuclear Power Plants," January 2005; and (NRC Office of Nuclear Security and Incident Response/Division of Preparedness and Response (NSIR/DPR) Interim Staff Guidance (ISG) NSIR/DPR-ISG-01, Revision 0, "Emergency Planning for Nuclear Power Plants," November 2011 (ADAMS Accession No. ML113010523). NSIR/DPR-ISG-01 provides updated guidance based on changes to EP regulations in 10 CFR 50.47 and

10 CFR Part 50, Appendix E, which were published as a Final Rule in the *Federal Register* on November 23, 2011 (76 FR 72560)).

- 44 CFR Part 350, “Review and Approval of State and Local Radiological Emergency Plans and Preparedness,” and 44 CFR Part 352, “Commercial Nuclear Power Plants: Emergency Preparedness Planning,” provide procedures for the review and evaluation of the adequacy of offsite radiological emergency planning and preparedness. In addition, FEMA considered NUREG–0654 (FEMA-REP-1), the Radiological Emergency Preparedness (REP) Program Manual, current FEMA guidance documents, and established industry practices. Pursuant to 44 CFR Part 353, “Fee for Services in Support, Review, and Approval of State and Local Government or Licensee Radiological Emergency Plans and Preparedness,” Appendix A, “Memorandum of Understanding Between NRC and FEMA Relating to Radiological Emergency Planning and Preparedness” (58 FR 47996, September 14, 1993), FEMA provided its findings and determinations on offsite planning and preparedness to the NRC for its use in the licensing process.

13.3.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.3 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.3 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirms that the information contained in the application and the information incorporated by reference address the relevant information related to this Section. The staff reviewed the information in the North Anna 3 COLA, including FSAR, Revision 8, Section 13.3, “Emergency Planning,” and the certified ESBWR DCD, Revision 10 and the North Anna 3 ESP SSAR, for conformance with the applicable standards and requirements identified in SRP, Sections 13.3 and 14.3.10, and confirmed that the COLA addresses the required information relating to emergency planning.

The staff reviewed general and administrative information in COLA Part 1, COLA Part 2 (FSAR), the North Anna 3 Emergency Plan (COL Plan) in COLA Part 5, the Departure Report in COLA Part 7, and EP ITAAC and proposed license conditions in COLA Part 10. The complete set of EP ITAAC for North Anna 3 is provided below in SER Table 13.3-1, and various EP ITAAC are discussed throughout this SER Section. EP ITAAC are also addressed below in SER Section 13.3.4.18, which includes resolution of STD COL 14.3-1-A.

In addition, the staff reviewed selected portions of the RERPs for the State of Maryland and the Commonwealth of Virginia, including the Virginia counties of Caroline, Hanover, Louisa, Orange, and Spotsylvania, for understanding and content, in relation to consistency with various Sections of the COL Plan that address offsite support and resources (e.g., see SER Section 13.3.4.3). The staff also conducted three site area visits to the North Anna 3 on December 8, 2003, August 16, 2006, and April 16, 2008, consisting of a review of existing onsite emergency response facilities (ERF) and the various areas within and beyond the 16-km (10-mi) plume exposure pathway emergency planning zone (EPZ).

In COLA Part 1, the applicant referenced ESP-003, and in FSAR Section 1.1.1.9, incorporated Revision 9 of the SSAR from the North Anna ESP application. SSAR Section 13.3, "Emergency Planning," describes the "major features" of the emergency plan for the proposed North Anna 3 (hereinafter referred to as the "ESP Plan"), submitted by the ESP applicant (Dominion Nuclear North Anna, LLC) for the North Anna ESP site pursuant to 10 CFR 52.17(b)(2)(i). The NRC issued ESP-003 to the ESP applicant on November 27, 2007, pursuant to 10 CFR 52.24, "Issuance of Early Site Permit." The emergency planning information in the COLA supplements what was submitted in the ESP application. Consistent with 10 CFR 52.83, the staff's review of the COLA was limited by the scope and nature of the matters resolved in the staff's previous evaluation of the North Anna 3 ESP application. Without re-evaluating the matters resolved during the ESP review, the staff's review of the COLA considered Section 13.3 of the ESP SSAR and the associated NRC findings in NUREG–1835.

The staff's and FEMA's previous technical review of the ESP Plan, together with the review of the COL Plan, addressed all of the relevant evaluation criteria in the 16 planning standards of NUREG–0654 in a way consistent with SRP, Section 13.3, which cites the applicable regulations. As stated above, the proposed North Anna 3 boundary is entirely within the existing North Anna site exclusion area boundary, so that for purposes of EP, little distinction exists between the North Anna site (for the existing reactor units) and the proposed new North Anna 3. The COLA takes advantage of the EP resources, capabilities, and organization that currently exist at the North Anna site. SRP, Section 13.3, Section I, "Areas of Review," provides, in part, this guidance to the staff regarding the appropriate level of review:

> In general, if an application is for an additional reactor at an operating reactor site, and the application proposes to incorporate and extend elements of the existing emergency planning program to the new reactor (including by reference), those existing elements should be considered acceptable and adequate. The reviewer will generally focus the review on the extension of the existing program to the new reactor, and will determine whether the incorporated emergency planning program information from the existing reactor site (1) is applicable to the proposed reactor, (2) is up-to-date when the application is submitted, and (3) reflects use of the site for construction of a new reactor (or reactors) and appropriately incorporates the new reactor(s) into the existing plan.

To be consistent with this guidance, the staff focused its review on the extension of the existing North Anna site emergency preparedness program to the new unit, and considered those elements of the existing program that are unchanged in their applicability to the new unit, as acceptable and adequate.

The FSAR Section 1.1.1.7 incorporates by reference Revision 10 of the ESBWR DCD, and FSAR Section 13.3 references ESBWR DCD, Section 13.3, "Emergency Planning." COLA Part 5 provides the North Anna 3 onsite emergency plan (COL Plan), which consists of a basic plan and eight appendices (see SER Section 13.3.2, above). The basic plan follows the format of NUREG–0654, and provides detailed information about each of the 16 planning standards and associated evaluation criteria in NUREG–0654. In addition, COL Plan Section I.C, "Planning Basis and Emergency Planning Zones," states that the EPZs for the new unit are based on the guidance in NUREG–0654. As shown in COL Plan Figure I-1, the North Anna site plume exposure pathway EPZ for the North Anna site is an area surrounding the plant within a radius of approximately 16 km (10 mi). COL Plan Figure I-2 shows the North Anna site ingestion exposure pathway EPZ, which is an area surrounding the North Anna site within a radius of approximately 80 km (50 mi). The existing 16-km and 80-km (10-mi and 50-mi) EPZs for the North Anna site are used for the new unit, and the descriptions of the EPZs in ESP SSAR Section 13.3.2.2.1, “Emergency Planning Zones,” are incorporated by reference into the COLA, and are addressed in Section 13.3.3.1, “Emergency Planning Zones,” of NUREG–1835.

The SER Sections 13.3.4.1 through 13.3.4.19 describe the staff’s technical evaluation of the information provided in the COL Plan, and the review and findings in this SER apply only to the proposed new unit. Any changes to the operating North Anna Units 1 and 2 Emergency Plan would be addressed as separate licensing actions, in accordance with 10 CFR 50.54(q). The section designations of the COL Plan generally correspond to the 16 planning standard designations in NUREG–0654, Section II; specifically, COL Plan Sections II.A through II.P address NUREG–0654, “Planning Standards and Evaluation Criteria,” A through P, respectively. The format of the staff’s review of the COL Plan is patterned after these 16 planning standards, which reflect the requirements (“standards”) in 10 CFR 50.47(b)(1) through 10 CFR 50.47(b)(16). 10 CFR Part 50, Appendix E provides additional requirements that duplicate and supplement the evaluation criteria associated with the planning standards. The staff’s evaluation of the various aspects of 10 CFR Part 50, Appendix E is included within the associated NUREG–0654 planning standards review.

13.3.4.1 Assignment of Responsibility (Organization Control)

As stated in NUREG–0654, Section II, Planning Standard A, “Assignment of Responsibility (Organization Control),” 10 CFR 50.47(b)(1) requires that primary responsibilities for emergency response by the nuclear facility licensee and by State and local organizations within the EPZs have been assigned, the emergency responsibilities of the various supporting organizations have been specifically established, and each principal response organization has staff to respond and to augment its initial response on a continuous basis. In addition, 10 CFR Part 50, Appendix E, Section III requires that the emergency plans incorporate information about the emergency response roles of supporting organizations and offsite agencies, and that the incorporated information shall be sufficient to provide assurance of coordination among the supporting groups and with the licensee. 10 CFR Part 50, Appendix E, Section IV.A requires a description of the local offsite services to be provided in support of the licensee’s emergency organization; identification of, and a description of the assistance expected from, appropriate local, State, and Federal agencies with responsibilities for coping with emergencies, including hostile action at the site; and identification of the State and/or local officials responsible for planning for, ordering, and controlling appropriate protective actions, including evacuations when necessary. In addition, 10 CFR 52.79(a)(22)(i) requires the COL applicant to obtain emergency plan certifications from the State and local governmental agencies with EP responsibilities, which state that (1) the proposed emergency plans are practicable; (2) these agencies are committed to participating in any further development of the plans, including any required field demonstrations; and (3) these agencies are committed to executing their responsibilities under the plans in the event of an emergency.

In COL Plan Section II.A, “Assignment of Responsibility (Organization Control),” the applicant described the responsibilities of the applicant and of various local, State, and Federal agencies, as well as private sector organizations, that are part of the emergency response organization

(ERO) for the North Anna site and may be required to respond to an emergency at the North Anna site. The staff reviewed this Section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard A, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(1).

In COL Plan Section II.A, the applicant incorporated by reference Sections 13.3.2.2.2.a and 13.3.2.2.2.b.1 of the ESP Plan, with regard to the description of participating organizations, and the interfaces between and among the onsite and offsite functional areas of emergency response. ESP Plan Section 13.3.2.2.2.a.6 references letters of agreement with various offsite agencies and supporting organizations that are in Appendix 10.1, "Letters of Agreement," of the (Units 1 and 2) North Anna Emergency Plan (hereinafter referred to as "NAEP"), Revision 28, July 1, 2003 (not publicly available). Dominion also provided copies of these letters of agreement in support of the ESP application, which include an acknowledgement by each agency that its existing arrangements would apply to prospective additional reactors at the North Anna site. In Sections 13.3.2 and 13.3.3.2 of NUREG–1835, the staff found that this information was acceptable.

COL Plan Section II.A.3, "Written Agreements," it states that Appendix 7 (in the North Anna 3 COLA Part 5) provides a copy of the certification letter established between Dominion and the Commonwealth of Virginia and risk jurisdiction government agencies and private sector organizations committed to supporting further development and implementation of the COL Plan. The applicant also stated that no certification letters are required for many Federal agencies because their responsibilities are established in the U.S. Department of Homeland Security, "National Response Framework" (January 2008). The staff reviewed the certification letter, dated June 11, 2010, and finds it acceptable because it adequately addresses the requirements in 10 CFR 52.79(a)(22)(i), described above, in support of a new reactor at the North Anna site. Further, the 16 agencies and organizations represented in the certification letter are the same agencies and organizations represented in the letters of agreement provided by Dominion in support of the ESP application. The certification letter and letters of agreement are discussed further in SER Sections 13.3.4.3 and 13.3.4.16.

Dominion provided additional information in COL Plan Section II.A that addresses the concept of operations for the onsite organization and ERFs; the relationships with local, State, and Federal agencies; and coordination of emergency response actions taken at North Anna 3 with Units 1 and 2. The Emergency Coordinator is responsible for making notifications and subsequent communications with Units 1 and 2 staff, in order to provide for coordination of activities between onsite ERFs. Figure II-1, "Emergency Response Organization Interrelationships," provides a block diagram that illustrates the interrelationships among the station and offsite EROs. Emergency response support from offsite organizations and agencies, including expected assistance associated with hostile action at the North Anna site, is further described in COL Plan Section II.C, and addressed below in SER Sections 13.3.4.3 and 13.3.4.16.

The COL Plan Section II.A also addresses the coordination of North Anna 3 emergency response actions with other reactor sites serviced by the Central EOF (discussed below in SER

Section 13.3.4.8). In the unlikely event that the Central EOF is activated for emergencies that are declared at North Anna 3 simultaneously with another reactor site it services, the EOF Director is responsible for discharging the duties described in the COL Plan, as well as in the other affected site's emergency plan. Section II.A.1.b lists the following actions that Dominion is responsible for taking during an emergency condition:

- Assess plant conditions
- Classify emergency conditions
- Notify affected agencies of emergency conditions
- Provide technical expertise to affected agencies
- Provide support for offsite assessment and protective activities
- Make protective action recommendations (PARs)
- Mitigate the consequences of adverse plant conditions by monitoring and controlling plant parameters
- Request assistance from off-site agencies, as needed
- Provide support to affected agencies for communications with the affected public
- Terminate emergency conditions

In COL Plan Section II.A.1, Dominion stated that normal operations at North Anna 3 are conducted under the authority of the Shift Manager and directed from the North Anna 3 Control Room. Using approved operating procedures, including the EALs provided in implementing procedures, the Shift Manager determines if an emergency condition exists and, if so, the proper emergency classification. (EALs are discussed below in SER Section 13.3.4.4.) Based on this classification and plant conditions, the Shift Manager (or Unit Supervisor) assumes the role of the Emergency Coordinator, makes or directs initial notifications to affected plant staff and Commonwealth of Virginia, risk jurisdiction, and Federal authorities, and determines if activation of the Dominion ERFs is desirable or required. The OSC, which provides an operational center to provide support to the TSC and Control Room, dispatches assessment and repair teams as directed by the Emergency Coordinator, and provides operational information, radiological assessment, and manpower for in-plant functions. Table II-1, "Responsibility for Emergency Response Functions," summarizes the responsibilities and activities of the ERFs under the four emergency classifications (i.e., notification of unusual event, alert, site area emergency, and general emergency). ERFs are discussed below in SER Section 13.3.4.8.

Upon declaration of an emergency, the Emergency Coordinator is in charge of the emergency response for the facility, including directing the activities of the plant staff in performing initial assessment, corrective, and protective functions. If required by the emergency classification, or deemed appropriate by the Emergency Coordinator, emergency response personnel are notified and instructed to report to their emergency response locations. (Notification methods and procedures are discussed below in SER Section 13.3.4.5.) Following activation of the ERFs and receipt of an adequate turnover, the Site Vice President, or other designated member of the station management staff, relieves the Shift Manager of Emergency Coordinator responsibilities and directs the activities of the onsite ERO from the TSC.

If the EOF is activated, it is staffed by Dominion personnel, including the EOF Director, who directs the activities of this facility and assumes responsibility for the licensee's offsite emergency response efforts, coordinates the availability and utilization of corporate and external resources, and manages recovery efforts. The EOF may be activated concurrently with the TSC, and is always activated upon declaration of a Site Area Emergency or General Emergency. The senior Dominion representative is responsible for ensuring the EOF communicates emergency status to the Commonwealth of Virginia and risk jurisdiction governments, directs the efforts of the offsite monitoring teams, makes radiological assessments, recommends offsite protective measures to the Commonwealth of Virginia, and arranges through the company for the dispatch of any special assistance or services requested by the station. The Director Nuclear Protection Services and Emergency Preparedness reports to Dominion's senior nuclear executive, who is responsible for the total execution of the radiological emergency response effort at Dominion's fleet of nuclear power plants.

The COL Plan Sections II.A.1.e and II.A.4 state that Dominion maintains the capability for a 24-hour response, including staffing of communication links, and for continuous operations through training of multiple responders for key emergency response positions, consistent with the staffing requirements of COL Plan Section II.B.5, "Plant Emergency Response Staff," and the training requirements of Section II.O, "Radiological Emergency Response Training." The Emergency Coordinator bears responsibility for ensuring continuity of technical, administrative, and material resources during emergency operations.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has adequately assigned primary responsibilities for emergency response, and the applicant has the staff to respond to and to augment its initial response on a continuous basis. The applicant is capable of providing 24-hour-per-day emergency response and staffing of communications links, including continuous (24-hour) operations for a protracted period. In addition, the applicant identified the appropriate organizations that are intended to be part of the overall response organization, and has established the emergency responsibilities of the various supporting organizations, including providing adequate written agreements. The applicant has specified the concept of operations and its relationship to the total effort, illustrated the interrelationships in a block diagram, and has identified the individuals in charge of the emergency response and for ensuring continuity of resources.

In addition, the staff finds that the applicant has incorporated information about the emergency response roles of supporting organizations and offsite agencies, and that information is sufficient to provide assurance of coordination among the supporting groups and with the licensee. Further, the applicant has described the local offsite services to be provided in support of the licensee's emergency organization, and has identified the assistance expected from appropriate local, State, and Federal agencies, including State and/or local officials responsible for planning for, ordering, and controlling appropriate protective actions.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard A. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(1), 10 CFR Part 50, Appendix E, Sections III and IV.A, and 10 CFR 52.79(a)(22)(i), insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.2 Onsite Emergency Organization

As stated in NUREG–0654, Section II, Planning Standard B, "Onsite Emergency Organization," 10 CFR 50.47(b)(2) requires that on-shift facility licensee responsibilities for emergency response are unambiguously defined, adequate staffing to provide initial facility accident response in key functional areas is maintained at all times, timely augmentation of response capabilities is available, and interfaces among various onsite response activities and offsite support and response activities are specified. In addition, 10 CFR Part 50, Appendix E, Section IV.A requires a description of the organization for coping with radiological emergencies, including definition of authorities, responsibilities, and duties of individuals assigned to the licensee's emergency organization, and the means for notification of such individuals in the event of an emergency. This shall include a description of the normal plant operating organization, onsite ERO, headquarters personnel who will augment the onsite emergency organization, and local offsite services to be provided in support of the licensee's emergency organization. The emergency plan shall identify persons within the licensee organization who will be responsible for making offsite dose projections, and other employees with special qualifications for coping with emergency conditions that may arise. Other persons with special qualifications, who are not licensee employees and who may be called upon for assistance, shall also be identified, including a description of their special qualifications. 10 CFR Part 50, Appendix E, Section IV.A.9 requires a detailed analysis demonstrating that on-shift personnel assigned emergency plan implementation functions are not assigned responsibilities that would prevent the timely performance of their assigned functions, as specified in the emergency plan.

In COL Plan Section II.B, "Onsite Emergency Organization," the applicant described the organizational structure that would be available to respond to an emergency at the North Anna site. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard B, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(2).

In COL Plan Section II.B, the applicant incorporated by reference Section 13.3.2.2.2.b of the ESP Plan, with regard to interfaces among various onsite response activities, and the identification of offsite support and response activities. In Section 13.3.3 of NUREG–1835, the staff found this information was acceptable. In addition, COL Plan Section II.B states that Figure II-2, "North Anna 3 Emergency Response Organization On-Site," illustrates the onsite ERO and that upon the declaration of an emergency, designated members of the normal staff complement fulfill corresponding roles within the ERO. Station administrative procedures provide the details of the normal station organization, including reporting relationships, and emergency plan implementing procedures (EPIP) provide details regarding ERO position functions. The minimum staff required to conduct routine and immediate emergency operations is maintained at the station, consistent with 10 CFR 50.54(m) and the emergency plan. Staffing is further described in FSAR Section 13.1, "Organizational Structure of Applicant."

The Shift Manager/Unit Supervisor position is continuously staffed, consistent with 10 CFR 50.54(m). Upon recognition of an emergency condition, the individual filling this position assumes the duties of the Emergency Coordinator until relieved by a qualified member of the management staff or until termination of the emergency condition, whichever comes first. The Emergency Coordinator has the responsibility and authority to initiate emergency actions necessary to protect the life, health, and safety of the plant staff, and to initiate any required emergency response actions, including notification of affected Federal, Commonwealth of Virginia, and risk jurisdiction authorities and provision of PARs to offsite authorities. The non-delegable responsibilities of the Emergency Coordinator are listed in COL Plan Section II.B.4, and include classifying the emergency, authorizing offsite notifications, recommending protective measures, and authorizing emergency exposure limits. With the staffing of the ERO, the EOF Director relieves the Emergency Coordinator of responsibility for notifying and coordinating with offsite authorities.

If the Shift Manager is rendered unable to fulfill the duties and responsibilities of the Emergency Coordinator position, the Unit Supervisor or an on-shift Reactor Operator assumes the Emergency Coordinator position until relieved by a qualified member of the management staff. Figure II-1 illustrates the interfaces between and among the onsite functional areas of emergency response activity, Dominion EOF support, the affected Commonwealth of Virginia and risk jurisdiction government response organizations, the NRC, and other offsite organizations.

The staff finds that the applicant has adequately designated an individual as the Emergency Coordinator who has the authority and responsibility to initiate emergency actions, including recommending protective actions to the authorities responsible for implementing offsite emergency measures. The staff also finds that the applicant clearly specified which responsibilities may not be delegated to other elements of the emergency organization, and has identified an adequate line of succession for the Emergency Coordinator position.

In COL Plan Section II.B.5, "Plant Emergency Response Staff," the applicant stated that Dominion will establish minimum emergency response staffing consistent with Table II-2, "Plant Staff Emergency Functions," which has been based on the guidance in Table B-1, "Minimum Staffing Requirements for NRC Licensees for Nuclear Power Plant Emergencies," of NUREG–0654. Figure II-2 illustrates the plant staff emergency organization. Upon declaration of an emergency, members of the plant staff assume positions in the ERO consistent with their training and management assignments, and provide for the key functions of accident assessment, radiological monitoring and analysis, security, fire-fighting, first aid and rescue, and communications. Figure II-3, "North Anna 3 Augmented Emergency Response Organization," illustrates the augmented plant staff ERO. The ERO, when fully activated, includes the positions described in Table II-2. Additional personnel may be designated as emergency responders providing special expertise deemed beneficial, but not mandatory, to the planned response. The individuals assigned as responders for the emergency positions are designated based on the technical requirements of the position. COL Plan Appendix 5 lists an EPIP entitled "Activation of the Emergency Response Organization." The staff reviewed Table II.2, as well as the comparable North Anna Units 1 and 2 Table 5.1, "Minimum Staffing Requirements for Emergencies," of the NAEP, Revision 40, December 10, 2013 (not publicly available), and finds that the required minimum on-shift and augmentation staffing in support of North Anna 3 is acceptable because it is consistent with Table B-1 of NUREG–0654.

The COL Plan Section II.B.7, "Corporate Support for the Plant Staff," states that upon declaration of an Alert, Site Area Emergency, or General Emergency, the Emergency Coordinator directs the activation and notification of the onsite and offsite ERFs. Dominion management, technical, and administrative personnel staff the EOF and provide (or coordinate) augmented support for the plant staff. The Dominion corporate staff provides management, technical, and administrative support as needed to support the plant staff and to relieve the plant staff of external coordination responsibilities, including notification of and coordination with offsite authorities and release of information to the media. In addition to the activities identified in Table II-2, Dominion corporate staff provides logistical support for plant personnel; technical support for planning and recovery/re-entry operations; management-level interface with governmental authorities; and coordination with, and the release of information to, the news media.

ERO augmentation is also addressed in BL 2005-02, which requested in part that all holders of operating licenses provide information regarding ERO augmentation for security-based events. DCD COL Item 1C.1-2-A requires the COL applicant to address the security-related requirements of BL 2005-02, and is addressed below in SER Section 13.3.4.18. As discussed below in SER Section 13.3.4.8, COL Plan Section II.H.4 states in part that in the event the site is under threat of, or experiencing hostile action, the Louisa Fire Training Center functions as a staging area for augmentation of emergency response staff. Specific aspects of BL 2005-02 are also addressed below in SER Sections 13.3.4.4, 13.3.4.5, 13.3.4.10, and 13.3.4.14.

The Institute of Nuclear Power Operations (INPO), when notified of an emergency situation, will serve as a clearinghouse for industry wide support and provide requested emergency response technical assistance, including emergency manpower and equipment. Dominion may request that the reactor vendor, GEH, provide technical support for emergency response activities. GEH will operate primarily from its corporate offices, with a small contingent at the plant if requested. If required at the time of the event, additional resources can be obtained through purchase agreements with the supporting institutions. These agreements would be negotiated on an as-needed basis. In addition, Dominion has established and will maintain agreements for risk jurisdiction emergency response support services, including firefighting, rescue squad, and medical and hospital services. COL Plan Section II.L describes the arrangements for medical support services, including hospital and ambulance support, and is addressed below in SER Section 13.3.4.12. COL Plan Appendix 7 provides the certification letter for organizations providing these services. (Emergency response support and resources are further described below in SER Section 13.3.4.3.)

Fukushima Dai-ichi – NTTF Recommendation 9.3

On March 12, 2012, the NRC requested additional information from all power reactor licensees and holders of construction permits, associated with the NRC NTTF review of the accident at the Fukushima Dai-ichi nuclear facility (ADAMS Accession No. ML12053A340). In Recommendation 9.3, the NTTF addressed staffing and communications provisions for enhancing emergency preparedness. On January 23, 2013, the NRC issued a follow-up letter (ADAMS Accession No. ML13010A162), which identified generic technical issues that need to be addressed as part of the Recommendation 9.3 communications capability assessment.

With regard to staffing, the accident at Fukushima highlighted the need to determine and implement the required staff to fill all necessary positions responding to a multi-unit event. Specifically, NTTF Recommendation 9.3 requests that all power reactor licensees and holders of construction permits (in active or deferred status) assess their current staffing levels and determine the appropriate staff to fill all necessary positions for responding to a multi-unit event during a beyond design basis natural event, and determine if any enhancements are appropriate. Single unit sites should provide the requested information, as it pertains to an extended loss of all alternating current (AC) power and impeded access to the site. (Emergency communications are addressed in Section 13.3.4.6 of this report.)

In COLA Part 10 the applicant proposed License Condition 3.8.1 (Fukushima Near-Term Task Force (NTTF) Recommendations), which addresses both the staffing and communications areas addressed in NTTF Recommendation 9.3. The staff reviewed License Condition 3.8.1, and, with the exception of the timeframes for completion and submission of the staffing and communications capability assessments, finds that it is acceptable because it is consistent with NTTF Recommendation 9.3 and reflects the use of NEI technical report NEI 12-01, which the NRC has endorsed as an acceptable method for licensees to employ when addressing NTTF Recommendation 9.3.[4]

The staff proposes a similar timeframe for completion of the assessments, which is based on the latest date set forth in the schedule for completing the inspections, tests, and analyses in the ITAAC submitted in accordance with 10 CFR 52.99(a). In addition, the staff proposes a similar timeframe for submission of the assessments to the NRC, which is based on the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a). Therefore, consistent with the applicant's proposed License Condition 3.8.1, the staff identified the following License Conditions 1 and 2, which address enhanced staffing and communications capabilities, respectively, and include the staff's proposed timeframes for completion of the assessments and their submission to the NRC.

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[4] See (1) NRC May 15, 2012, letter, 'U.S. Nuclear Regulatory Commission Review of NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," Revision 0, dated May 2012' (ADAMS Accession No. ML12131A043); (2) NEI May 3, 2012, letter, 'Transmittal of NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," Revision 0, dated May 2012' (ADAMS Accession No. ML12125A411); and (3) NEI Report No. 12-01, Revision 0, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," May 2012 (ADAMS Accession No. ML12125A412).

License Conditions 1 and 2

1. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, the licensee shall have performed an assessment of on-site and augmented staffing capability for responding to a multi-unit event. The staffing assessment shall be performed in accordance with NEI 12-01, "Guidance for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities." At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall complete implementation of corrective actions identified in the staffing assessment described above, and identify how the augmented staff will be notified given degraded communications capabilities, including any related emergency plan and implementing procedure changes and associated training.

2. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, the licensee shall have performed an assessment of on-site and off-site communications systems and equipment relied upon during an emergency event to ensure communications capabilities can be maintained during an extended loss of ac power. The communication capability assessment shall be performed in accordance with NEI 12-01, "Guidance for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities." At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall complete implementation of corrective actions identified in the communications capability assessment described above, including any related emergency plan and implementing procedure changes and associated training.

Enhancements to Emergency Preparedness Regulations

In addition to appropriate staffing levels associated with multi-unit events (discussed above), on November 23, 2011, the NRC published a Final Rule, "Enhancements to Emergency Preparedness Regulations" (hereinafter referred to as "Final Rule"), which included a new requirement in 10 CFR Part 50, Appendix E, Section IV.A associated with on-shift ERO personnel. Specifically, 10 CFR Part 50, Appendix E, Section IV.A.9 requires that for nuclear power reactor licensees, by December 24, 2012, a detailed analysis must be performed to demonstrate that on-shift personnel assigned emergency plan implementation functions are not assigned responsibilities that would prevent the timely performance of their assigned functions, as specified in the emergency plan.

As part of the issuance of the Final Rule, NRC issued associated guidance in Interim Staff Guidance NSIR/DPR-ISG-01. In Section IV.C, "On-Shift Staffing Analysis," of NSIR/DPR-ISG-01, NRC endorsed NEI technical report NEI 10-05, Revision 0, dated June 2011 (ADAMS Accession No. ML111751698) stating in part that NEI 10-05 establishes a standard methodology for a licensee to perform the required staffing analysis (in 10 CFR Part 50, Appendix E, Section IV.A.9), and that the NRC has reviewed NEI 10-05 and found it to be an acceptable methodology for this purpose.

In COLA Part 10, the applicant proposed License Condition 3.7.2, “On-Shift Staffing,” which addresses the requirements in 10 CFR Part 50, Appendix E, Section IV.A.9 for a detailed on-shift staffing analysis associated with the emergency plan. The staff reviewed License Condition 3.7.2, and, with the exception of the timeframe for submission of the on-shift staffing analysis and changes to the emergency plan, finds that it is acceptable because it is consistent with the Final Rule and NSIR/DPR-ISG-01. The NRC endorsed guidance included in NEI 10-05 is addressed in NSIR/DPR-ISG-01, Section IV.C, “On-Shift Staffing Analysis,” which states, in part, that NEI 10-05 establishes a standard methodology for a licensee to perform the required staffing analysis, and that the NRC has reviewed NEI 10-05 and finds it an acceptable methodology for this purpose.

The staff proposes 2-year timeframe for completion of the on-shift staffing analysis, which is similar to that proposed for completion of the on-site and augmented staffing capability assessment addressed in proposed License Condition 1, above. The staff also proposes a similar timeframe for submission of the on-shift staffing analysis to the NRC, which is based on the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a). In addition, the staff has eliminated the applicant’s proposed link between ITAAC 2.0 and incorporation of any needed changes to the emergency plan, because it is unnecessary. Therefore, consistent with the applicant’s proposed License Condition 3.7.2, the staff identified the following License Condition 3, which addresses an analysis of on-shift personnel assigned emergency plan implementation functions, and includes the staff’s proposed timeframes for completion of the on-shift staffing analysis, and submission to the NRC.

License Condition 3

3. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, the licensee shall have performed an assessment of on-shift staffing in accordance with NEI 10-05, “Assessment of On-Shift Emergency Response Organization Staffing and Capabilities.” At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall incorporate any changes to the emergency plan needed to bring staffing to the required levels.

Subject to License Conditions 1, 2, and 3, the staff finds that the applicant sufficiently defined its responsibilities for emergency response, has adequate staffing to provide and maintain at all times initial facility accident response in key functional areas, and is capable of timely augmentation of the response capabilities. In addition, the applicant adequately specified the interfaces among various onsite and offsite support and response activities. In addition, the applicant described the organization for coping with radiological emergencies, including the authorities, responsibilities, and duties of individuals assigned to the licensee’s emergency organization and the means for their notification in the event of an emergency. The applicant also described the normal plant operating organization, the onsite ERO, and the headquarters and local offsite personnel and services that will augment and support the onsite organization. Further, licensee employees who are responsible for making offsite dose projections, and licensee and other persons with special qualifications for coping with emergency conditions, are also identified.

Conclusion

Subject to License Conditions 1, 2, and 3, the staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard B and NSIR/DPR-ISG-01, Section IV.C. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(2) and 10 CFR Part 50, Appendix E, Section IV.A, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.3 Emergency Response Support and Resources

As stated in NUREG–0654, Planning Standard C, "Emergency Response Support and Resources," 10 CFR 50.47(b)(3) requires that arrangements for requesting and effectively using assistance resources have been made, arrangements to accommodate State and local staff at the licensee EOF have been made, and other organizations capable of augmenting the planned response have been identified. In addition, 10 CFR Part 50, Appendix E, Section III requires that the emergency plans incorporate information about the emergency response roles of supporting organizations and offsite agencies, and that that information shall be sufficient to provide assurance of coordination among the supporting groups and with the licensee. 10 CFR Part 50, Appendix E, Section IV.A.7 requires identification of, and a description of the assistance expected from, appropriate local, State, and Federal agencies with responsibilities for coping with emergencies, including hostile action at the site.

In COL Plan Section II.C, "Emergency Response Support and Resources," the applicant addressed the responsibilities and concepts of operations for the various organizations that would support the North Anna site, including North Anna 3, in an emergency. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard C, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(3).

In COL Plan Section II.C, the applicant incorporated by reference Section 13.3.2.2.2.c of the ESP Plan, with regard to arrangements for emergency response support and resources. In Section 13.3.3.4 of NUREG–1835, the staff found this information was acceptable. The applicant provided additional information in COL Plan Section II.C, including identifying the Emergency Coordinator/EOF Director as the person who may request Federal Radiological Monitoring and Assessment Center (FRMAC) assistance through the NRC. Dominion estimates that a FRMAC Advance Party could be expected at the site within 6 to 14 hours following the order to deploy, based on the availability of airports near the North Anna site,[5] and expects NRC

[5] U.S. Department of Energy (DOE) Radiation Emergency Assistance Center/Training Site (REAC/TS) staff is available 24 hours a day, 7 days a week, to deploy and provide emergency medical consultation for incidents involving radiation anywhere in the world. REAC/TS provides direct support for the National Nuclear Security

assistance from NRC's offices in Atlanta, Georgia will arrive in the (North Anna) site vicinity within 7 to 8 hours following notification. (The DOE FRMAC Operations Plan is addressed below in SER Section 13.3.4.16.) Dominion provides facilities and resources needed to support the Federal response at the TSC and EOF. Dominion does not expect risk jurisdiction representatives to be present at the EOF. A VDEM State On-Scene Coordinator serves as the Commonwealth's representative to provide interface between the utility and the Commonwealth of Virginia and risk jurisdiction governments.

The North Anna maintains fixed laboratory equipment to support sampling analysis and monitoring. The equipment includes multichannel analyzers, proportional counters, a tritium analyzer, and whole body counters; arrangements are maintained for reading thermoluminescent dosimeters. These resources are supplemented by offsite radiological laboratory facilities, listed in COL Plan Section II.C.3, "Radiological Laboratories," and ESP SSAR Section 13.3.2.2.2.c.2, which are available to support emergency response activities on a 24-hour per day basis. In addition, COL Plan Section II.C.4, "Other Supporting Organizations," states that Dominion has made arrangements to obtain additional emergency response support from the INPO Fixed Nuclear Facility Voluntary Assistance Agreement signatories and the REAC/TS.

The scope of expected support from additional agencies and organizations that can be relied upon in an emergency to provide assistance is outlined in the certification letter in COL Plan Appendix 7, and reflected in the letters of agreement that were provided in support of the ESP application. As described in SER Sections 13.3.4.1 and 13.3.4.16, the staff reviewed these letters of agreement and determined that they were broadly written; such that they could cover an expanded North Anna site use to include North Anna 3. In addition, while not specifically addressed, they could also include expected assistance associated with hostile action at the site. In order to clarify that the expected assistance from offsite agencies includes hostile action at the site, consistent with 10 CFR Part 50, Appendix E, Section IV.A.7, the staff has included this requirement in proposed License Condition 5 (addressed below in SER Section 13.3.4.16). In addition, License Condition 5 addresses updating the Units 1 and 2 letters of agreement to reflect North Anna 3.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

Subject to License Condition 5, the staff finds that the applicant has made arrangements for requesting and effectively using assistance resources, including arrangements to accommodate State and local staff at the EOF, and has identified other organizations capable of augmenting the planned response. In addition, the applicant has made adequate provisions for incorporating the Federal response capability into its operation plan, and has identified radiological laboratories and other organizations that can be relied on in an emergency to provide assistance. The staff also finds that the emergency plans incorporate information about the emergency response roles of supporting organizations and offsite agencies, and that the information is sufficient to provide assurance of coordination among the supporting groups and

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Administration's Office of Emergency Response and the FRMAC (source: http://orise.orau.gov/reacts/, visited March 27, 2014).

the licensee. Finally, the applicant has identified appropriate local, State, and Federal agencies with responsibilities for coping with emergencies (including hostile action at the North Anna 3 site), as well as the expected assistance from each.

Conclusion

Subject to License Condition 5, the staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard C. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(3) and 10 CFR Part 50, Appendix E, Sections III and IV.A.7, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.4 Emergency Classification System

As stated in NUREG–0654, Planning Standard D, "Emergency Classification System," 10 CFR 50.47(b)(4) requires that a standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee, and that State and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures. In addition, 10 CFR Part 50, Appendix E, Section IV.B requires a description of the means to be used for determining the magnitude, and for continually assessing the impact, of the release of radioactive materials, including EALs that are to be used as criteria for determining the need for offsite agency notifications and participation, and when and what types of protective measures should be considered. The EALs must include hostile actions that might adversely affect the nuclear power plant. The initial EALs shall be discussed and agreed on by the applicant or licensee and State and local governmental authorities, and approved by the NRC. Thereafter, EALs shall be reviewed with State and local governmental authorities on an annual basis. 10 CFR Part 50, Appendix E, Section IV.C requires a description of EALs and emergency conditions that involve alerting or activating the total emergency organization, including communication steps to be taken under each emergency class. The emergency classes defined shall include (1) notification of unusual event, (2) alert, (3) site area emergency, and (4) general emergency. 10 CFR Part 50, Appendix E, Section IV.C.2 requires the capability to assess, classify, and declare an emergency condition within 15 minutes after the availability of indications to plant operators that an EAL has been exceeded, and to promptly declare the emergency conditions as soon as possible after the identification of the appropriate emergency classification level.

In COL Plan Section II.D, "Emergency Classification System," the applicant described the emergency classification and action level scheme used to determine the minimum response to an abnormal event at the plant. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard D, which provides detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(4).

In COL Plan Section II.D, the applicant incorporated by reference Section 13.3.2.2.2.d of the ESP Plan, with regard to the description of the emergency classification system. In Section 13.3.2.2.2.d, Dominion described the four emergency classes (identified above), and stated that Dominion would propose site-specific EALs in the COL application. Further, the EALs would be discussed and agreed on with the Commonwealth of Virginia and local governmental authorities, and submitted to the NRC for approval. Thereafter, they would be reviewed with the Commonwealth of Virginia and local governmental authorities on an annual basis. After initial approval, changes to these EALs and initiating criteria would be made without NRC approval only if the changes do not decrease the effectiveness of the [emergency] plans, and the revised plans continue to meet the standards of 10 CFR 50.47(b)(4) and the requirements of 10 CFR Part 50, Appendix E. In Section 13.3.3.5 of NUREG–1835, the staff found this information acceptable.

At the COL application stage, the requisite EAL information is limited and consists of four critical elements: (1) An overview of the EAL scheme, including a definition of the four emergency classification levels and general list of licensee actions; (2) a commitment to develop the remainder of the EAL scheme using a specified NRC-endorsed guidance document; (3) a proposed license condition that addresses EAL completion, agreement with State and local officials (as appropriate), and submission of the fully developed EALs to the NRC; and (4) maintaining the EALs in a document controlled by 10 CFR 50.54(q). The information associated with these critical elements provides a sufficient level of applicable detail to support the staff's reasonable assurance evaluation.

In COLA Plan Section II.D, the applicant stated that Dominion uses a standard emergency classification scheme, based on system and effluent parameters, which allows affected Commonwealth of Virginia and risk jurisdiction response organizations to determine initial offsite response measures. Section II.D also contains an overview of the EAL scheme, which includes a definition of the four emergency classes (identified above) and a general list of licensee actions for each. The description of EALs in ESP Plan Section 13.3.2.2.2.d is supplemented by Section II.D, which states that implementing procedures provide the parameter values and equipment status that are indicative of each emergency class. Once indications are available to plant operators that an EAL has been exceeded, the event is promptly assessed and classified, and the corresponding emergency classification level is declared. This declaration occurs as soon as possible, and within 15 minutes of when these indications become available. COL Plan Appendix 5 lists an EPIP entitled "Emergency Classification." In addition, the applicant proposed License Condition 3.7.1, which includes a commitment to develop an EAL scheme with fully developed site-specific EALs, in accordance with NRC-endorsed guidance document NEI 07-01, Revision 0.

The staff finds the description of the EAL scheme is acceptable because it is consistent with 10 CFR Part 50, Appendix E, Section IV.C, and addresses critical element (1). The applicant's incorporation of the fully developed site-specific EAL scheme into implementing procedures is acceptable because it ensures that the EALs are maintained in a document controlled by 10 CFR 50.54(q) (i.e., EPIPs), and therefore addresses critical element (4). With regard to critical elements (2) and (3), in COLA Part 10, the applicant proposed License Condition 3.7.1 (Emergency Action Levels (EALs)), which includes a commitment to develop an EAL scheme with fully developed site-specific EALs in accordance with NRC-endorsed guidance document NEI 07-01, Revision 0. In addition, License Condition 3.7.1 requires a discussion and agreement with State and local officials, and submission of the fully developed EALs to the NRC. The EAL scheme is also addressed in BL 2005-02, which requested in part that all holders of operating licenses provide information regarding the identification of emergency classification levels and EALs for security-based events. In NEI 07-01, Revision 0, the emergency classification scheme for security events, including hostile actions, is addressed in Section 5.9, "Hazards or Other Conditions Affecting Plant Safety EALs."

The staff reviewed License Condition 3.7.1, and with the exception of the timeframe for submission of the EALs, finds that it is acceptable because it is consistent with NEI 07-01, Revision 0. The staff proposes a similar timeframe for submission of the EALs to the NRC, which is based on the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a). Therefore, consistent with the applicant's proposed License Condition 3.7.1, the staff identified the following License Condition 4, which includes the staff's proposed timeframe for submission of the EALs to the NRC.

License Condition 4

4. No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR § 52.103(a), the licensee shall submit to the Director of NRO, or the Director's designee, in writing, a fully developed set of plant-specific emergency action levels (EALs) for North Anna 3, in accordance with NEI 07-01, "Methodology for Development of Emergency Action Levels. Advanced Passive Light Water Reactors," Revision 0, with no deviations. The EALs shall have been discussed and agreed upon with State and local officials.

For the reasons discussed above, the staff finds that the applicant adequately addressed the four critical elements (identified above) that comprise the required EAL information in the COL application. EALs are also addressed in the various ITAAC in COL Plan Attachment 10 and reflected in Table 13.3-1 of this report. These include ITAAC 1.1.1, which states that the specific parameters identified in the EAL thresholds listed in the EPIPs have been retrieved and displayed in the control room, TSC, and EOF. ITAAC 1.1.2 states that the ranges available in the control room, TSC, and EOF encompass the values for the specific parameters identified in the EAL thresholds listed in the EPIPs. Finally, full-participation exercise ITAAC 8.1.1.A states that the licensee will demonstrate the ability to identify initiating conditions, determine EAL parameters, and correctly classify the emergency throughout the exercise.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

Subject to License Condition 4, the staff finds that the applicant established a standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, which includes the four emergency classes identified above. The applicant described EALs and emergency conditions that involve ERO activation, including steps to be taken under each emergency class. The applicant also described the means to determine the magnitude of, and for continually assessing the impact of, the release of radioactive materials, and EALs (including those pertaining to hostile actions) that are used to determine the need for offsite notifications and protective measures. In addition, the applicant has the capability to assess, classify, and declare an emergency condition within 15 minutes after the availability of indications to plant operators that an EAL has been exceeded, and to promptly declare the emergency condition.

Conclusion

Subject to License Condition 4, the staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard D. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(4) and 10 CFR Part 50, Appendix E, Sections IV.B and IV.C, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.5 Notification Methods and Procedures

As stated in NUREG–0654, Planning Standard E, "Notification Methods and Procedures," 10 CFR 50.47(b)(5) requires that procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations and the public has been established; and that the means to provide early notification and clear instruction to the populace within the 16-km (10-mi) plume exposure pathway EPZ have been established. In addition, 10 CFR Part 50, Appendix E, Section IV.A.4 requires a description of how offsite dose projections will be made and the results transmitted to State and local authorities, NRC, and other appropriate governmental entities. 10 CFR Part 50, Appendix E, Section IV.C requires a description of EALs and emergency conditions that involve alerting or activating the emergency organization, including communication steps to be taken under each class of emergency, and the existence of a message-authentication scheme. 10 CFR Part 50, Appendix E, Section IV.D.1 requires a description of administrative and physical means for notifying local, State, and Federal officials and agencies and agreements reached with these officials and agencies for the prompt notification of the public and for public evacuation or other protective measures. The description shall include identification of the appropriate officials, by title and agency, of the State and local government agencies within the EPZs. 10 CFR Part 50, Appendix E, Section IV.D.3 requires the licensee to have the capability to notify responsible State and local governmental agencies within 15 minutes after declaring an emergency. The licensee shall demonstrate that appropriate governmental authorities have the capability to make a public alerting and notification decision promptly on being informed by the licensee of an emergency condition, and that administrative and physical means have been established for alerting and providing prompt instructions to the public within the plume exposure pathway EPZ. The alerting and notification capability shall include a backup method. Finally, 10 CFR 50.72(a)(3) requires NRC notification no later than 1 hour after declaring an emergency.

In COL Plan Section II.E, "Notification Methods and Procedures," the applicant described the specific methods and sequencing of notifications that will be covered in the appropriate implementing procedures for North Anna 3 in an emergency. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard E, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(5).

In COL Plan Section II.E, the applicant incorporated by reference Sections 13.3.2.2.2.e and 13.3.2.2.2.g of the ESP Plan, with regard to the descriptions of notification methods and procedures, including the processes used for providing written messages to the public. In Sections 13.3.3.6 and 13.3.3.8 of NUREG–1835, respectively, the staff found this information acceptable. (Public education and information is discussed further in SER Section 13.3.4.7, below.) The applicant provided additional information in COL Plan Section II.E, which states that Dominion maintains procedures for notifying Commonwealth of Virginia and risk jurisdiction response organizations and licensee emergency responders. These procedures include, or make reference to, the pre-planned content of messages to Commonwealth of Virginia and risk jurisdiction organizations. Dominion also makes arrangements to provide prompt notification to members of the public within the plume exposure pathway EPZ. COL Plan Appendix 5 lists an EPIP entitled “Notifications Associated with Emergency Conditions.” ITAAC 2.3 states that a means exists to notify and provide instructions to the public in accordance with the emergency plan requirements.

In COL Plan Section II.E.1, “Notification of Commonwealth and Risk Jurisdiction Authorities,” the applicant stated that Dominion maintains systems and procedures needed to provide prompt notification of affected Commonwealth of Virginia, risk jurisdiction, and Federal authorities following the declaration of any emergency condition, consistent with the emergency classification and action level scheme described in implementing procedures. The emergency classification system is discussed above in SER Section 13.3.4.4. ITAAC 2.1 states that a means to notify responsible organizations, within 15 minutes after the licensee declares an emergency, has been established via the Operational Hot Line among the control room, the Commonwealth of Virginia, and the five risk jurisdictions. The 15-minute notification capability is also addressed in ITAAC 8.1.1.B.2.a.

The Emergency Coordinator initiates notification of affected Commonwealth of Virginia and risk jurisdiction authorities (within 15 minutes after declaration of an emergency), including the escalation or de-escalation of any emergency condition. The primary notification method is the Insta-phone system, which is accessible from the control room, TSC, and EOF. Back-up notification capability is maintained through the use of commercial telephone systems. Message content and verification methods are established in the implementing procedures. Implementing procedures are addressed in ITAAC 9.1, which states that each of the detailed implementing procedures for the North Anna 3 Emergency Plan, as defined in Appendix 5 of the emergency plan, are submitted to the NRC no less than 180 days prior to fuel load. The submission of implementing procedures is also included as an implementation milestone, which is addressed below in SER Section 13.3.4.19. The adequacy of the procedures will be demonstrated through a review of their use during an exercise pursuant to ITAAC 8.1.1 and ITAAC 8.1.2. Exercises and drills are addressed below in SER Section 13.3.4.14.

Dominion maintains the systems and procedures needed to provide prompt notification of the NRC Operations Center following the declaration of any emergency condition. The NRC will be notified as soon as practical following notification of the Commonwealth of Virginia and risk jurisdiction authorities, and within 1 hour of the emergency declaration, including the escalation or de-escalation of any emergency declaration. The primary notification method is the

Emergency Notification System, with back-up notification capability maintained through the use of commercial telephone systems. Emergency notification and communication systems are discussed further in SER Section 9.5.2.

NRC notifications are further addressed in BL 2005-02, which requested in part that all holders of operating licenses provide information regarding the implementation of an NRC notification time period of approximately 15 minutes from discovery of a security-based event. DCD COL Item 1C.1-2-A requires the COL applicant to address the security-related requirements of BL 2005-02, and is addressed below in SER Section 13.3.4.18. With regard to NRC notifications, in RAI 13.03-2.16 dated July 18, 2008 (ADAMS Accession No. ML082000593), the staff asked the applicant to discuss how the North Anna 3 Emergency Plan addresses the latest applicable requirements associated with notifications and responses that are related to an imminent or actual safeguard threat against the facility (or other safeguards event). In an October 6, 2008, response to RAI 13.03-2.16 (ADAMS Accession No. ML082830168), the applicant stated that Dominion plans to include immediate notification of the NRC in the Operations Abnormal Procedures, similar to Units 1 and 2. In addition, for North Anna 3, security-related events are addressed in COLA Part 8, Security Plan, Appendix C, Responsibility Matrix. COLA Part 8, Security Plan was submitted to the NRC under separate letter (Dominion Serial No. NA3-07-002). Demonstration of facility response capabilities in response to hostile actions will be integrated into Force-on-Force and emergency exercises when required. Emergency exercises are addressed below in SER Section 13.3.4.14.

As described by Dominion, the Emergency Coordinator directs the notification and mobilization of the licensee ERO following the declaration of an alert or higher level emergency. The Emergency Coordinator has the discretion to mobilize all or part of the ERO at the notification of unusual event level. ITAAC 2.2 states that a means exists to notify the North Anna 3 ERO. When staffing of the ERO is required, or desired by the Emergency Coordinator, affected personnel may be notified by a multifaceted process, including alarms, announcements, pagers, telephones, on-line messages, etc. Notification and mobilization of the ERO is initiated in accordance with implementing procedures.

The content of initial emergency notification messages from the plant to affected Commonwealth of Virginia and risk jurisdiction authorities includes information addressing the class of the emergency, status of any radioactive releases, locations of any potentially-affected populations, and recommendations regarding protective public actions. Follow-up messages from the plant to affected Commonwealth of Virginia and risk jurisdiction authorities include various detailed information, to the extent that the information is available and appropriate, as mutually agreed upon between Dominion and VDEM.

Dominion further stated that the primary method of alerting the public is by sounding the Alert and Notification System sirens. Other alerting methods may include telephone communications, television and radio communications via the Emergency Alert System (EAS) stations, public address systems, bull horns from patrol cars, and personal contact. The Commonwealth of Virginia and risk jurisdiction governments have ultimate responsibility for warning the public in accordance with their respective RERPs. Affected Commonwealth of Virginia and risk jurisdiction officials bear responsibility for providing emergency messages intended for the public, including instructions regarding specific protective actions. Dominion supports development of these messages by providing supporting information.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that procedures for notification of State and local response organizations and emergency personnel by all organizations have been established, and the licensee has the capability to notify offsite officials and agencies, including State and local governmental agencies within 15 minutes, and NRC no later than 1 hour, after declaring an emergency. The appropriate officials of the State and local government agencies within the EPZs have been identified. The licensee has described the entire spectrum of emergency conditions that involve alerting or activating the emergency organization, including EALs for offsite agency notification and communication steps to be taken under each class of emergency. Message authentication is described in the State and local emergency plans. The applicant has also described how appropriate governmental authorities have the capability to make a public alerting and notification decision promptly following notification of an emergency by the licensee, and administrative and physical means have been established for alerting and providing prompt instruction to the public within the plume exposure pathway EPZ (including a backup method to alert populations), and for public evacuation and other protective measures. In addition, the applicant has described how offsite dose projections will be made and the results transmitted to State and local authorities, the NRC, and other appropriate governmental entities.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard E. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(5), 10 CFR 50.72(a)(3), and 10 CFR Part 50, Appendix E, Sections IV.A.4, IV.C, IV.D.1, and IV.D.3, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.6 Emergency Communications

As stated in NUREG–0654, Planning Standard F, “Emergency Communications,” 10 CFR 50.47(b)(6) requires that provisions exist for prompt communications among principal response organizations, to emergency personnel, and to the public. In addition, 10 CFR Part 50, Appendix E, Section IV.E.9 requires onsite and offsite communication systems with backup power sources, including provisions for communications with State and local governments within the plume exposure EPZ, and Federal emergency response organizations and the NRC. Also required are provisions for communications among the Control Room, TSC, EOF, principal State, and local emergency operations centers (EOC), and field assessment teams. Communication systems shall be tested at designated frequencies.

In COL Plan Section II.F, “Emergency Communications,” the applicant described the communication capabilities between the North Anna site and the Commonwealth of Virginia and risk jurisdiction governments. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard F, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(6).

In COL Plan Section II.F, the applicant incorporated by reference Section 13.3.2.2.2.f of the ESP Plan, with regard to the description of the provisions for prompt communications among principal response organizations to emergency personnel and to the public. In Section 13.3.3.7 of NUREG–1835, the staff found this information acceptable. The applicant provided additional information in Section II.F, which states that Dominion maintains systems and procedures that provide prompt communications between its ERFs and between the site and offsite ERFs. COL Plan Appendix 5 lists an EPIP entitled “Emergency Communications.” ERF communication capabilities are further described below in SER Section 13.3.4.8.

In COL Plan Section II.F.1, “Description of Communication Links,” the applicant stated that Dominion maintains reliable communications links both within the plant and between the plant and external EROs. In addition, Dominion maintains capabilities for 24-hour-per-day emergency notification to the Commonwealth of Virginia and risk jurisdiction emergency response network. Commonwealth of Virginia and risk jurisdiction warning points are staffed 24 hours per day. This communications link consists of an Insta-phone loop, which can be activated from the control room, TSC, or EOF, with links to the Commonwealth of Virginia and risk jurisdictions. The Insta-phone loop has been installed to permit simultaneous telephone-speaker communications for the station to the risk jurisdictions and the Virginia EOC on a 24-hour per day basis. If the Insta-phone is out of service, regular commercial telephone will be used to make the notifications. The offsite agencies have a system to call back to the power station and verify the notification message. Dominion also provides communications capabilities between the control room or TSC and radiological field personnel. Communications systems are described further in DCD Tier 2 Section 9.5.2 and FSAR Section 9.5.2, and addressed in SER Section 9.5.2.

Procedures for notifying, alerting, and activating emergency response personnel in the TSC, OSC, and EOF are described in Section II.E.2, and are discussed in SER Section 13.3.4.5. ITAAC 3.1 and ITAAC 3.2 address the establishment of various communications capabilities. The staff reviewed other application sections that deal with the availability of 24-hour emergency communications and response, and discusses those reviews in SER Sections 13.3.4.1, 13.3.4.2, 13.3.4.5, 13.3.4.8, and 13.3.4.12.

Dominion provides for communications between the control room/TSC/EOF and the NRC Operations Center via dedicated telephone lines. In addition to the ENS, Health Physics Network, Reactor Safety Counterpart Link, and Protective Measures Counterpart Link, separate dedicated telephone lines for communications with the NRC include the Management Counterpart Link (MCL) and Local Area Network (LAN). The MCL lines are located in the TSC and EOF and provide for internal discussions between the NRC Executive Team and the NRC Director of Site Operations or licensee management. The LAN has jacks in the TSC and EOF, and provides access to the NRC LAN. Finally, Dominion will activate the Emergency Response Data System (ERDS) within 1 hour of the declaration of an alert or higher emergency classification in accordance with the applicable facility procedure(s). ITAAC 3.2 states that an access port for ERDS is provided. SER Section 13.3.4.3 discusses the assistance available from Federal agencies, including coordination and communications among those agencies with the North Anna site and State and local agencies.

In COL Plan Sections II.F.2 and II.F.3, the applicant stated that Dominion maintains communications systems that allow for communications between the North Anna site and fixed and mobile medical support facilities. The communications systems include both commercial telephone communications with fixed facilities and radio communications to the ambulance. Communications associated with transporting personnel from the site to the hospital is addressed below in SER Section 13.3.4.12. Dominion conducts tests of its emergency communications system consisting of monthly testing of communications with the facility, EOF, and Commonwealth of Virginia and risk jurisdiction warning points. Dominion also conducts annual testing of communications between the Virginia/risk jurisdiction EOCs and field assessment teams. COL Plan Appendix 5 lists a supporting procedure entitled "Testing of Emergency Communications Systems."

Fukushima Dai-ichi – NTTF Recommendation 9.3

As discussed above in SER Section 13.3.4.2, on March 12, 2012, the NRC requested additional information from all power reactor licensees and holders of construction permits, associated with the NRC NTTF review of the accident at the Fukushima Dai-ichi nuclear facility. In Recommendation 9.3, the NTTF addressed staffing and communications provisions for enhancing emergency preparedness. With regard to communications, the accident at Fukushima highlighted the need to ensure that the communications equipment relied upon to coordinate the event response during a prolonged station blackout can be powered. Specifically, NTTF Recommendation 9.3 requests that all power reactor licensees and holders of construction permits (in active or deferred status) assess their current communications systems and equipment used during an emergency event, including consideration of any enhancements that may be appropriate for the emergency plan with respect to communications requirements of 10 CFR 50.47, Appendix E to 10 CFR Part 50, and NUREG–0696, "Functional Criteria for Emergency Response Facilities." In addition, the means necessary to power the new and existing communications equipment during a prolonged station blackout should be considered. (Onsite emergency organization and staffing is addressed above in SER Section 13.3.4.2.)

In COLA Part 10, the applicant proposed License Condition 3.8.1, which addresses both enhanced staffing and communications capabilities. The resolution of NTTF Recommendation 9.3, including the staff's identified License Condition 2, associated with emergency communications, is addressed above in Section 13.3.4.2 of this report.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

Subject to License Condition 2, the staff finds that provisions exist for prompt communications among principal response organizations, to emergency personnel, and to the public. Specifically, the applicant established a reliable primary and backup means of communications for alerting and activating the response organizations and personnel, including 24-hour manning of communications links. Provisions also exist for communications among the Control Room, TSC, EOF, State, and local governments within the EPZs, and field assessment teams. In addition, the applicant provided a coordinated communication link for fixed and mobile medical support facilities. Onsite and offsite communication systems have backup power sources and are tested at designated frequencies.

Conclusion

Subject to License Condition 2, the staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard F. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(6) and 10 CFR Part 50, Appendix E, Section IV.E.9, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.7 Public Education and Information

As stated in NUREG–0654, Planning Standard G, "Public Education and Information," 10 CFR 50.47(b)(7) requires that information be made available periodically to the public concerning notification methods and initial actions the public should take in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) be established in advance, and procedures for coordinating dissemination of information to the public be established. In addition, 10 CFR Part 50, Appendix E, Section IV.D.2 requires a description of provisions for yearly dissemination to the public within the plume exposure EPZ of basic emergency planning information, such as methods for public notifications and protective actions planned if an accident occurs, general information as to the nature and effects of radiation, and a listing of local broadcast stations that will be used for dissemination of information during an emergency. Signs or other measures shall also be used to disseminate information to any transient population within the plume exposure pathway (16-km (10-mi)) EPZ.

In COL Plan Section II.G, "Public Education and Information," the applicant described the public education and information program for the North Anna site, including the process for keeping the public in the 16-km (10-mi) EPZ informed in the event of an emergency. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard G, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(7).

In COL Plan Section II.G, the applicant incorporated by reference Section 13.3.2.2.2.g of the ESP Plan, with regard to the description of the emergency information program for the public and the news media. In Section 13.3.3.8 of NUREG–1835, the staff found this information acceptable. The applicant provided additional information in Section II.G, which addresses the dissemination of information to the public and the news media, and states that Dominion maintains a coordinated program to educate affected members of the public regarding emergency notification methods and actions.

In COL Plan Section II.G.1, “Public Information Program,” the applicant stated that Dominion coordinates with affected Commonwealth of Virginia and risk jurisdiction authorities to disseminate pertinent emergency response information to members of the public in the plume exposure pathway EPZ on a yearly basis. Information may be provided via a number of methods, including providing informational publications such as brochures or calendars through mailings to individual households in the plume exposure pathway EPZ. Emergency public information may also be distributed in telephone directories and utility bills, through public information postings, and via local media outlets. Distributed information includes educational information on radiation, notification methods and immediate actions, protective measures, special needs of the handicapped, and point of contact for additional information. In addition, COL Plan Section II.G.2, “Distribution and Maintenance of Public Information,” states that information intended for transients (i.e., individuals on vacation in, camping in, or traveling through the plume exposure pathway EPZ) may include public postings, publications provided to hotels, motels, and campgrounds, and information published in telephone directories. These sources of information provide transients with sources for local emergency information, such as local radio and television stations.

The COL Plan Section II.G.3, “News Media Coordination,” states that the outlet for emergency information is the Joint Information Center (JIC), which is an element of the Corporate Emergency Response Center that is located at Dominion’s Innsbrook Technical Center in Glen Allen, Virginia. Members of the news media respond to the JIC. Dominion’s Chief Technical Spokesperson serves in the JIC as the primary licensee spokesperson and news media contact, gathers information from the ERO for dissemination to the news media, and updates the news media on a periodic basis throughout any emergency situation. COL Plan Appendix 5 lists an EPIP entitled “Emergency Media Relations.” COL Plan Section II.G.5, “News Media Training,” states that news media training is accomplished through briefings for the news media offered on a yearly basis. These annual briefings acquaint members of the media organizations with emergency plans, information about radiation hazards, and points of contact for the release of public information during an emergency. COL Plan Appendix 5 lists a supporting procedure entitled “Emergency Plan Training.”

The COL Plan Section II.G.4, “Information Exchange,” states that the Dominion public affairs liaison has access to required public information, primarily through communications with the Chief Technical Spokesperson and designated members of the EOF staff. The Dominion public affairs liaison coordinates continuity and consistency of information with designated members of the Commonwealth of Virginia and risk jurisdiction EROs on a periodic basis. Rumor control is accomplished through ongoing contact with the Chief Technical Spokesperson and by the activities of a Dominion public affairs liaison in the JIC, who monitors communications, identifies rumors, and makes appropriate contacts to obtain and disseminate accurate information through the representatives in the JIC. The rumor control telephone number is announced by the VDEM Public Affairs Office at media briefings and in press releases.

The staff reviewed the various emergency information communication publications, including the brochure entitled “North Anna Power Station Emergency Public Information for Residents and Visitors in the Communities of: [Louisa, Spotsylvania, Orange, Caroline, and Hanover Counties],” Revision September 2007 (ADAMS Accession No. ML081210740), and the

NAPS 2008 Nuclear Emergency Planning Information Calendar (ADAMS Accession No. ML081210741).

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has provided for a coordinated and periodic dissemination of information to the public, including the permanent and transient adult population within the plume exposure (16-km (10-mi)) EPZ, regarding how they will be notified and what their actions should be in an emergency. The applicant has also established the principal points of contact with the news media for dissemination of information during an emergency, and procedures for coordinated dissemination of information to the public. In addition, the applicant has described the provisions for yearly dissemination to the public within the plume exposure EPZ of basic emergency planning information, including the use of signs or other measures to disseminate information to any transient population within the plume exposure EPZ.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard G. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(7) and 10 CFR Part 50, Appendix E, Section IV.D.2, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.8 Emergency Facilities and Equipment

As stated in NUREG–0654, Planning Standard H, “Emergency Facilities and Equipment,” 10 CFR 50.47(b)(8) requires that adequate emergency facilities and equipment to support the emergency response be provided and maintained. In addition, 10 CFR Part 50, Appendix E, Section IV.E.8 requires that adequate provision be made and described for emergency facilities and equipment, including a licensee’s onsite OSC and TSC, as well as an EOF from which effective direction can be given and effective control can be exercised during an emergency. 10 CFR Part 50, Appendix E, Section IV.E.8.b addresses various requirements associated with EOF locations and required provisions, which are not applicable to an existing EOF pursuant to 10 CFR Part 50, Appendix E, Section IV.E.8.e. 10 CFR Part 50, Appendix E, Section IV.E.8.c requires various EOF capabilities, which include supporting response to multiple reactors/sites and simultaneous events, as applicable. 10 CFR Part 50, Appendix E, Section IV.E.8.d requires an alternative facility (for use when onsite emergency facilities cannot be safely accessed during hostile actions) that would be accessible and could function as a staging area for augmentation of emergency response staff. 10 CFR Part 50, Appendix E, Section IV.G requires a description of provisions to be employed to ensure that the emergency plan, its implementing procedures, and emergency equipment and supplies are maintained up to date. 10 CFR Part 50, Appendix E, Section VI.1 requires an ERDS data link between the licensee’s onsite computer system and the NRC Operations Center, through which a limited data set of selected parameters can be automatically transmitted.

In COL Plan Section II.H, “Emergency Facilities and Equipment,” the applicant described the ERFs and the equipment that will be used to assess an accident and monitor functions following the declaration of an emergency. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard H, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(8).

In COL Plan Section II.H, the applicant incorporated by reference Section 13.3.2.2.2.h of the ESP Plan, with regard to the descriptions of ERFs. As described in Section 13.3.3.9 of NUREG–1835, on March 3, 2005, the ESP applicant withdrew its request for the NRC to evaluate major feature H, “Emergency Facilities and Equipment,” as part of the North Anna ESP application. Since the ESP applicant withdrew its request that major feature H (of the ESP SSAR) be evaluated, the staff reached no conclusion regarding the acceptability of ESP major feature H. As part of its COLA review, the staff reviewed the description of the emergency facilities and equipment in Section II.H, which includes the information in Section 13.3.2.2.2.h of the ESP plan.

In COL Plan Section II.H, the applicant stated that the TSC and OSC are provided to support emergency operations consistent with the guidance in Supplement 1 to NUREG–0737, “Clarification of [Three Mile Island] TMI Action Plan Requirements – Requirements for Emergency Response Capability (Generic Letter No. 82-33).” Consistent with SRP Section 13.3, the staff determined compliance with the applicable regulations using the guidance in NUREG–0654, and through it NUREG–0696. Supplement 1 to NUREG–0737 provides additional related guidance that primarily summarizes and supplements the information in NUREG–0696.

Dominion staffs and activates the designated ERFs (i.e., TSC, OSC, and EOF), consistent with the emergency classification and in accordance with EPIPs. ERFs and ERO augmentation is also addressed in BL 2005-02, which states in part that all holders of operating licenses provide information regarding how alternative locations for onsite ERFs support EP functions during a security-based event. In COL Plan Section II.H.4, “Activation and Staffing of Emergency Response Facilities,” the applicant stated that in the event the site is under threat of, or experiencing hostile action, the Louisa Fire Training Center functions as a staging area for augmentation of emergency response staff. This location has the capability to communicate with the EOF, control room, and plant security. The descriptions of ERF notification and staffing are provided in ESP Plan Sections 13.3.2.2.2.e.2 and 13.3.2.2.2.f.4. See also, COL Plan Sections II.E and II.F, which are addressed in SER Sections 13.3.4.5 and 13.3.4.6, respectively. The Commonwealth of Virginia and risk jurisdiction emergency response personnel also staff their ERFs consistent with the provisions in their respective plans.

Emergency Systems and Equipment

Dominion maintains and operates onsite monitoring systems needed to provide data that is essential for initiating emergency measures and for performing accident assessments. This includes monitoring systems for geophysical phenomena, radiological conditions, plant processes, and fire hazards. Dominion also provides offsite radiological monitoring equipment, suitable for assessing the offsite radiological consequences of facility incidents, for use by its offsite monitoring field teams.

Offsite environmental radiological monitoring equipment includes a series of continuous air samplers and environmental monitoring dosimeters surrounding the facility. The facility's Offsite Dose Calculation Manual (ODCM) describes the monitoring systems. In addition to the monitoring systems, equipment, and radiological laboratory facilities provided at the plant, Dominion maintains arrangements to obtain back-up radiological monitoring and analysis support from offsite organizations. COL Plan Section II.C.3 describes the available laboratory facilities, which are discussed above in SER Section 13.3.4.3, and COL Plan Appendix 7 provides a certification letter from these offsite organizations.

Dominion acquires meteorological data from the National Weather Service during periods when the primary system is unavailable. Back-up seismic data are available from the U.S. Geological Survey (National Earthquake Information Center) and the Virginia Polytechnic Institute and State University (Virginia Tech) Seismological Observatory. Streamflow data is available from the U.S. Geological Survey. Flooding data is available from the National Oceanographic and Atmospheric Administration's Hydro-Meteorological Reports. Other data sources, such as commercial media outlets, may also be used.

The station's Meteorological Monitoring System can provide data that is used to predict atmospheric effluent transport and diffusion. The system consists of a primary and a back-up tower, the locations of which were chosen so as to be representative of regional conditions. The North Anna 3 primary meteorological monitoring site consists of a 48.4 meters (m) (159 feet (ft)) tower located approximately 579 m (1900 ft) east of the Unit 1 reactor containment building. The primary meteorological tower records wind speed, wind direction, horizontal wind direction fluctuation, ambient temperature, and dew point temperature. The North Anna 3 back-up meteorological monitoring site consists of instrumentation on a freestanding 10 m (33 ft) tower located approximately 396 m (1300 ft) northeast of the Unit 1 containment building. The tower serves as the back-up meteorological monitoring site. A sensor at the top of the mast monitors wind speed, wind direction, and horizontal wind direction fluctuation. The Meteorological Monitoring System is described further in COL Plan Appendix 2, and addressed below in SER Section 13.3.4.9. In addition, ESP application SSAR Section 2.3, "Meteorology," provides a detailed description of the Meteorological Monitoring System, which is addressed in Section 2.3.3, "Onsite Meteorological Measurements Program," of NUREG–1835.

Dominion performs inspection, inventory, and appropriate operational tests of dedicated emergency equipment and instruments on a quarterly basis, consistent with COL Plan Section II.P. The responsibility for maintaining facilities and equipment is described in COL Plan Section II.P, and addressed below in SER Section 13.3.4.16. Plant procedures establish requirements for performing inventories and operational tests. COL Plan Appendix 5 lists a supporting procedure entitled "Emergency Equipment Inventory and Operational Tests." Dominion maintains sufficient reserves of equipment and instruments to replace any items that are removed from the emergency kits for calibration or repair. COL Plan Appendix 6 describes the emergency equipment and supplies that are typically used by emergency response personnel, including field teams.

The staff finds that the applicant has adequately identified onsite monitoring systems that will be used to initiate emergency measures in addition to the provisions for acquiring data from, or gaining emergency access to, offsite monitoring and analysis equipment. The staff finds that the applicant has provided for adequate offsite meteorological instrumentation and radiological monitoring equipment in the vicinity of the nuclear facility, including sufficient reserves of instruments and equipment to replace those that are removed for calibration or repair. In addition, the applicant has identified emergency kits by general category (e.g., protective equipment, communications equipment, radiological monitoring equipment, and emergency supplies).

Technical Support Center

In COL Plan Section II.H.1, "On-Site Emergency Response Facilities," the applicant stated that the function of the TSC is to provide an area and resources for use by personnel providing plant management and technical support to the plant operating staff during emergency evolutions. The TSC relieves the reactor operators of peripheral duties and communications not directly related to reactor system manipulations and prevents congestion in the control room.

The TSC is located in the electrical building and its size is sufficient to support a staff of 25 people. The TSC is environmentally controlled to provide room air temperature, humidity, and cleanliness appropriate for personnel and equipment. The room is provided with radiological protection and monitoring equipment necessary to monitor personnel radiation exposure and to maintain personnel doses less the 0.05 Sv (5 rem) total effective dose equivalent (TEDE), as defined in 10 CFR 50.2, for the duration of the accident. The level of protection is similar to the main control room. In the event that offsite and onsite AC power are unavailable, the TSC could be evacuated and the TSC management function transferred to a location unaffected by the radiation release. ITAAC 5.1 addresses various TSC features, including location, size, habitability, back-up power, and information and communications capabilities.

The TSC is provided with reliable voice and data communication with the main control room and EOF, and reliable voice communications with the OSC, NRC Operations Center, and Virginia and risk jurisdiction EOCs. COL Part Section II.F describes the communications capabilities provided in the TSC, which is addressed above in SER Section 13.3.4.6. The TSC is also provided control room communication of ERDS data with the NRC Operations Center, Safety Parameter Display System (SPDS) parameters, and key reference materials via LAN connection from the Nuclear Electronic Document Library. Information systems associated with the ERFs and the accident monitoring and display systems are discussed in ESBWR DCD Tier 2, Section 7.5, "Safety-Related and Nonsafety-Related Information Systems," and NUREG–1966, Section 7.5, "Information Systems Important to Safety," and addressed in SER Section 7.5, "Safety-Related Display Information."

Emergency Operations Facility

In COL Plan Section II.H.2, "Emergency Operations Facility," the applicant stated that the function of the EOF is to provide a location for Dominion management to direct and coordinate emergency response activities, with an emphasis on providing support to the plant staff and coordinating emergency response activities with offsite response agencies. Health physics personnel located in the EOF are designated as the point of contact for the receipt of offsite monitoring data results and sample media analysis results collected by Dominion personnel.

Dominion provides both a Local EOF and Central EOF to support the North Anna site. The Local EOF is the primary EOF used to support emergency response activities at the North Anna site. The Central EOF may be activated in lieu of the Local EOF to support emergency response activities for emergencies, such as severe storms, that affect both the North Anna and Surry sites. The Central EOF may also be activated if the Local EOF is unavailable. Except for the radiation protection functions of the Local EOF (discussed below), the minimum capacities, capabilities, and plant parameter displays of the Local EOF and Central EOF are similar.

The Local EOF and Central EOF are the same as those used for North Anna Units 1 and 2. The Local EOF is located within the owner controlled area, adjacent to the NAPS Units 1 and 2 Training Facility, and the Central EOF is located at Dominion's Innsbrook Technical Center in Glen Allen, Virginia, approximately 30 miles from North Anna 3. COL Plan Section II.H.2 further states that the size of the EOF is sufficient to support 35 people. ITAAC 5.2.1 states that the EOF has at least 243 square meters (2625 square feet). Provisions are made for staffing of the EOF by Dominion, Commonwealth of Virginia, and NRC personnel. Dominion also makes provisions for accommodating a limited number of media personnel in the EOF. Contact with the news media in the JIC is described in COL Plan Section II.G, and addressed above in SER Section 13.3.4.7. The Local EOF was designed to provide a specified protection factor from gamma radiation, and has a specially designed ventilation system to limit the exposure of its occupants and further assure its availability during an emergency. Provisions exist for dedicated radiation monitoring equipment to measure airborne particulate and direct radiation. The location of the Central EOF precludes the necessity of providing radiation monitoring systems.

The Local EOF and Central EOF draw power from commercial power sources, and there is electrical generator backup power to the Central EOF. A loss of commercial power should not impact any of the voice or data communications equipment located in the Central EOF. Common Dominion telecommunications infrastructure that supports EOF functions include fiber optic transmission equipment, telephone switching equipment, and data network routers. The telecommunication infrastructure is configured to operate from at least one, and usually multiple, backup power sources in the event of a loss of commercial power. These backup sources include generator, direct current battery, and uninterruptible power supply (UPS) systems. Emergency communications capabilities are described in COL Plan Section II.F, and addressed above in SER Section 13.3.4.6. ITAAC 5.2.2 states that voice transmission and reception have been accomplished between the EOF and TSC. ITAAC 5.2.3 addresses the establishment of EOF communications via the Operational Hot Line. In addition, ITAAC 5.2.4 addresses the availability of various data in the EOF that is pertinent to determine offsite protective measures.

Display capability of the technical data system in the EOF includes a workstation that is capable of displaying the parameters that are required of an SPDS. The SPDS function, as well as human-system interface design for the EOF and TSC, is described in ESBWR DCD Tier 2 Chapter 18, "Human Factors Engineering," and addressed in SER Section 18.8, "Human-System Interface Design." Key reference materials will be available to the EOF staff via LAN connection from the Nuclear Electronic Document Library.

Operational Support Center

In COL Plan Section II.H.9, "Operational Support Center," the applicant stated that the function of the OSC is to provide a common area and the necessary supporting resources for the assembly of designated operations support personnel during emergency conditions. Designated plant support personnel, as indicated in COL Plan Section II.B, assemble in the OSC to provide support to both the control room and the TSC. Personnel reporting to the OSC can be assigned duties in support of emergency operations. Assessment, corrective action, and rescue personnel are dispatched by the OSC to locations in the plant, as directed by the TSC and control room. The OSC is not designed to remain habitable under all projected emergency conditions; however, implementing procedures make provisions for relocating the OSC as needed, based on ongoing assessments of plant conditions and facility habitability.

The OSC is located within the protected area in the service building. ITAAC 5.1.6 states that the OSC is in a location separate from the control room. The OSC provides dedicated telephone extensions for communicating with the control room and TSC, which permits personnel reporting to the OSC to be assigned to duties in support of emergency operations. The OSC is also equipped with a separate telephone line to provide for communications with onsite and offsite locations, as needed. COL Plan Section II.F describes the communications capabilities provided in the OSC (see also, SER Section 13.3.4.6). ITAAC 5.1.7 lists the various communications equipment that is provided in the OSC.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has described, provided, and maintains adequate emergency facilities and equipment to support the emergency response, including a licensee onsite OSC and TSC, and an EOF from which effective direction can be given and effective control can be exercised during an emergency. This includes onsite and offsite radiological and meteorological monitoring systems. The applicant also described provisions to be employed to ensure that the emergency plan, its implementing procedures, and emergency equipment and supplies are kept up-to-date. In addition, the applicant provided for an ERDS data link between the onsite computer system and the NRC Operations Center.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard H. Therefore, staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(8) and 10 CFR Part 50, Appendix E, Sections IV.E.8, IV.G, and VI.1, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.9 Accident Assessment

As stated in NUREG–0654, Planning Standard I, "Accident Assessment," 10 CFR 50.47(b)(9) requires the use of adequate methods, systems, and equipment for assessing and monitoring the actual or potential offsite consequences of a radiological emergency condition. In addition, 10 CFR Part 50, Appendix E, Section IV.A.4 requires the identification of persons within the licensee organization who will be responsible for making offsite dose projections, and a description of how these projections will be made and the results transmitted to State and local authorities, the NRC, and other appropriate governmental entities. 10 CFR Part 50, Appendix E, Section IV.B requires a description of the means to be used for determining the magnitude of, and for continually assessing the impact of, the release of radioactive materials. 10 CFR Part 50, Appendix E, Section IV.E.2 requires that adequate provisions shall be made and described for emergency facilities and equipment, including equipment for determining the magnitude of, and for continuously assessing the impact of, the release of radioactive materials to the environment.

In COL Plan Section II.I, "Accident Assessment," the applicant described the methods, systems, and equipment available for assessing and monitoring actual or potential consequences of a radiological emergency. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard I, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(9).

In COL Plan Section II.I, the applicant incorporated by reference Section 13.3.2.2.2.i of the ESP Plan, with regard to the description of provisions for accident assessment. In Section 13.3.3.10 of NUREG–1835, the staff found this information acceptable. The applicant provided additional information in Section II.I. In COL Plan Section II.I.1, "Parameters Indicative of Emergency Conditions," the applicant stated that implementing procedures describe plant system and effluent parameter values that are indicative of off-normal conditions and the various indications that correspond to the emergency initiating conditions. Plant procedures specify the types and capabilities of the instruments used to indicate emergency conditions.

Tier 2, Section 7.5.1, "Post-Accident Monitoring Instrumentation," of the ESBWR DCD describes the post-accident monitoring systems, and is incorporated into the emergency plan by reference. Tier 2, Section 7.5.2, "Containment Monitoring System," of the ESBWR DCD describes instrumentation parameters that are monitored during both normal reactor operations and post-accident conditions to evaluate the integrity and safe condition of the containment. In addition, FSAR Section 9.3.2, "Process Sampling System," incorporates by reference DCD Tier 2, Section 9.3.2, "Process Sampling System," which describes the post-accident monitoring systems and program. Systems for post-accident sampling, including associated provisions and procedures, are addressed in SER Section 9.3, "Process Auxiliaries."

The COL Plan Section II.I.3, "Determination of Source Term and Radiological Conditions," states that COL Plan Appendix 2 and plant procedures provide the means for relating various measured parameters, including containment radiation monitor readings, to the source term available for release within plant systems, and effluent monitor readings to the magnitude of the release of radioactive materials. COL Plan Appendix 5 lists EPIPs entitled "Core Damage Assessment" and "Obtaining and Analyzing High Activity Samples Under Emergency Conditions." ITAAC 6.1 states that an exercise or drill has been accomplished, including use of selected monitoring parameters identified in the EAL thresholds listed in the EPIPs, to assess simulated degraded plant conditions and initiate protective actions in accordance with the various listed criteria relating to accident assessment and classification, and radiological assessment and control. (The emergency classification and EAL scheme are discussed above in SER Section 13.3.4.4) ITAAC 6.2 states that the EPIPs and ODCM correctly calculate source terms and magnitudes of postulated releases.

In addition, COL Plan Section II.I states that dose assessment procedures include the relationship between effluent monitoring readings and onsite and offsite exposures and contamination for various meteorological conditions. Plant procedures establish processes for estimating release rates and projected doses if the associated instrumentation is inoperable or off-scale, and consider estimated releases based on field monitoring data and surrogate instrumentation and methods to estimate the extent of fuel damage. COL Plan Appendix 2 provides a description of the emergency dose assessment program used at North Anna 3. Information includes dose and dose rate determinations based on plant effluent monitors, and contamination estimates based on deposition assumptions and meteorological conditions. ITAAC 6.3 states that the EPIPs and ODCM calculate the relationship between effluent monitor readings and offsite exposure and contamination for various meteorological conditions.

In COL Plan Section II.H.8, Appendix 2, and ESP SSAR Section 2.3.3, “Onsite Meteorological Measurements Program,” the applicant provided a description of the meteorological monitoring systems that are used to provide initial values and continuing assessments of meteorological conditions under emergency conditions. ITAAC 6.4 states that various meteorological data (i.e., wind speed, wind direction, and ambient and differential air temperature) is available in the control room, TSC, and EOF. Additional details about meteorological instrumentation and methods are discussed in NUREG–1835, Section 2.3.3, “Onsite Meteorological Measurements Program,” and SER Section 2.3.3, “Onsite Meteorological Measurement Programs.”

The COL Plan Section II.I.7, “Field Monitoring Capability,” states that Dominion provides emergency response field teams composed of one or more radiation protection technicians trained in accordance with the emergency preparedness training requirements established in COL Plan Section II.O. The field teams perform a sampling of offsite media as needed to assess the actual or potential magnitude and locations of radiological hazards. ITAAC 6.5 addresses demonstration of the capability for making rapid assessment of the actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways. Dominion notifies and activates field team personnel consistent with COL Plan Section II.E. Mobilization times are consistent with COL Plan Section II.B. (COL Plan Sections II.O, II.E, and II.B are addressed in SER Sections 13.3.4.15, 13.3.4.5, and 13.3.4.2, respectively.)

The COL Plan Appendix 6 provides a description of instrumentation that is available for performance of field monitoring in the plume exposure pathway EPZ. Dominion equips field teams with portable air samplers, appropriate filters or other sampling media (e.g., silver zeolite or other media capable of collecting airborne radioiodine samples), and analysis equipment capable of detecting radioiodine concentrations at or below 10^{-7} µCi/ml (microcuries per milliliter) under field conditions, taking into consideration potential interference from noble gas activity and background radiation. ITAAC 6.6 states that instrumentation used for monitoring I-131 to detect airborne concentrations as low as 1E-07 microcuries per cubic centimeter (µCi/cc) has been provided.

In addition to the required field monitoring instrumentation, Dominion provides protective equipment (including respiratory protection and radioprotective drugs), communications equipment, and supplies to facilitate the performance of radiation, surface contamination, and airborne radioactivity monitoring. Implementing procedures provide guidance for field monitoring teams' performance of monitoring activities. COL Plan Appendix 5 lists an EPIP entitled "Plume Tracking and Assessment of Offsite Radiological Conditions." Field monitoring teams act under the direction of health physics personnel in the TSC prior to activation of the EOF. Following activation of the EOF, the teams act under the direction of EOF health physics personnel.

The COL Plan Section II.I.10, "Relating Measured Parameters to Dose Rates," states that plant implementing procedures establish the means for relating measured parameters, such as surface, airborne, or waterborne activity levels to dose rates for those key isotopes listed in NUREG–0654, Section I, Table 3, "Radionuclides with Significant Contribution to Dominant Exposure Modes." Implementing procedures also establish provisions for estimating the projected dose based on projected and actual dose rates. ITAAC 6.7 states that a methodology has been established for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the various listed isotopes, and for comparing the dose estimates with the Environmental Protection Agency (EPA) protective action guides (PAG).

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has described and provided adequate facilities, systems, equipment, and means for assessing and monitoring the actual or potential offsite consequences of a radiological emergency condition, including determining the magnitude of, and continually assessing the impact of, the release of radioactive materials. The applicant also described the capability and resources for field monitoring within the 16-km (10-mi) plume exposure pathway EPZ, and has the methods, equipment, and expertise to rapidly assess actual or potential radiological hazards. This includes the capability to detect and measure radioiodine airborne concentrations within the plume exposure pathway EPZ as low as 1×10^{7} µCi/cc under field conditions, and to relate the various measured parameters to dose rates for key isotopes and gross radioactivity measurements. In addition, the applicant identified, by position and function to be performed, persons within the licensee organization who will be responsible for making offsite dose projections, and has described how these projections will be made and the results transmitted to State and local authorities, the NRC, and other appropriate governmental entities.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard I. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(9) and 10 CFR Part 50, Appendix E, Sections IV.A.4, IV.B, and IV.E.2, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.10 Protective Response

As stated in NUREG–0654, Planning Standard J, "Protective Response," 10 CFR 50.47(b)(10) requires that a range of protective actions have been developed for the plume exposure pathway EPZ for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and as a supplement to these, the prophylactic use of potassium iodide (KI). ETEs have been developed by applicants and licensees, and licensees shall update the ETEs on a periodic basis. Guidelines for the choice of protective actions during an emergency are developed and in place, and protective actions for the ingestion exposure pathway EPZ appropriate to the locale have been developed. In addition, 10 CFR 50.47(c)(2) and 10 CFR Part 50, Appendix E, Section I require that the size and configuration of the EPZs be determined in relation to local emergency response needs and capabilities, as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. 10 CFR Part 50, Appendix E, Section IV.I requires the development of a range of protective actions to protect onsite personnel during hostile action to ensure the continued ability of the licensee to safely shut down the reactor and perform the functions of the emergency plan.

In COL Plan Section II.J, "Protective Response," the applicant described the protective response measures that have been developed to limit radiation exposure of plant personnel and the public following an accident at the North Anna 3 site. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard J, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(10).

In COL Plan Section II.J, the applicant incorporated by reference Section 13.3.2.2.2.j of the ESP Plan, with regard to the description of protective response measures associated with the plume exposure pathway (10-mi) EPZ and the ingestion exposure pathway (50-mi) EPZ. The two EPZ were also addressed in ESP SSAR Section 13.3.2.2.1, "Emergency Planning Zones," which consist of the same EPZs that currently support North Anna Units 1 and 2. Consistent with 10 CFR 50.47(c)(2), the EPZs meet the required size and were determined in relation to local emergency response needs and capabilities, as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. In Section 13.3.3.1 of NUREG–1835, the staff found this information acceptable. In addition, as discussed above, the staff conducted three site visits, which included driving the roads within and beyond the 10-mi EPZ.

The applicant provided additional information in Section II.J, stating that Dominion establishes and implements methods to inform personnel within the protected area (within the Security fence) and exclusion area (within 5,000 ft of the North Anna 3 containment) of an emergency condition requiring individual action. Dominion maintains the ability to notify individuals within the protected area within about 15 minutes of the declaration of an emergency requiring individual response actions, such as accountability or evacuation, and to account for individuals within the protected area and identify any missing individuals within 30 minutes following initiation of assembly and accountability measures. Dominion also provides a capability to account for individuals within the protected area continuously after the initial accountability. Dominion maintains these capabilities consistent with the requirements of the facility Security Plan. The notification methods include plant public announcement system and audible warning systems. In high noise areas or other areas where these systems may not be audible, other measures, such as visible warning signals or personal notifications, may be used.

Dominion informs individuals located within the exclusion area, but outside of the protected area, via audible warnings provided by warning systems and the activities of the Security force (e.g., vehicle-mounted public address systems) and activities of the Virginia Department of Game and Inland Fisheries. Dominion provides information regarding the meaning of the various warning systems, and the appropriate response actions, via plant training programs, visitor orientation, escort instructions, posted instructions, or within the content of the audible messages. COL Plan Appendix 5 lists an EPIP entitled “Site Assembly, Accountability, and Evacuation.” ITAAC 7.1.1 states that during a drill or exercise, notification and instructions were provided to onsite workers and visitors, within the protected area, over the plant public announcement system. ITAAC 7.1.2 states that during a drill or exercise, audible warnings were provided to individuals outside the protected area, but within the owner controlled area.

Dominion has established evacuation routes to primary and secondary assembly areas, which are shown in Figure II-4, “Map to North Anna Remote Assembly Areas.” Affected individuals evacuate the site via personal vehicles and will be directed to a designated assembly area. The assembly areas provide a location for contamination monitoring of personnel, vehicles, and personal property. If the evacuation routes are rendered impassable or inadvisable due to adverse conditions (e.g., weather-related, radiological, or traffic density conditions), Dominion will direct affected individuals to a safe onsite area for accountability and, if necessary, contamination monitoring and decontamination. Appropriate equipment and supplies are provided from the facility to the assembly areas to facilitate contamination monitoring. Monitoring and decontamination are further discussed below in SER Section 13.3.4.11.

The COL Plan Section II.J.6, “Protective Measures,” states that Dominion provides equipment and supplies to provide adequate protection for individuals remaining or arriving onsite during an emergency. The equipment and supplies include respiratory protection equipment, protective clothing, and radioprotective drugs. COL Plan Appendix 5 lists an EPIP entitled “Respiratory Protection and Distribution of Radioprotective Drugs.” Onsite supplies of protective clothing and respiratory protection equipment may be augmented by that provided by offsite responders, such as firefighters responding to the site. Dominion maintains inventories of emergency equipment and supplies, described in COLA Plan Appendix 6, for use by emergency response personnel in the ERFs and by Dominion’s offsite field monitoring teams. COL Plan Figure II-5, “Radiological Monitoring Locations,” indicates the offsite radiological monitoring locations associated with the plume exposure pathway EPZ.

In the event of a hostile action against the site, conditions may dictate the initiation of protective measures other than personnel assembly, accountability, and evacuation. The Emergency Coordinator makes decisions regarding appropriate protective measures based on the evaluation of site conditions, including input from the Security force. If the Emergency Coordinator feels that personnel assembly, accountability, and evacuation may result in undue hazards to site personnel, the Emergency Coordinator may direct other protective measures, including:

- Evacuation of personnel from areas and buildings perceived as high-value targets
- Site evacuation by opening, while continuing to defend, security gates
- Dispersal of key personnel
- On-site sheltering
- Staging of ERO personnel in alternate locations pending restoration of safe conditions
- Implementation of accountability measures following restoration of safe conditions

Onsite protective measures for security-based events is also addressed in BL 2005-02, which requested in part that all holders of operating licenses provide information regarding onsite protective actions that may be appropriate for a terrorist attack, particularly an aircraft attack. The staff reviewed the description of onsite protective measures identified in BL 2005-02, and find that it is consistent with the applicant's description above of protective measures that may be initiated for hostile actions against the North Anna 3 site. As stated in the applicant's response to RAI 13.03-2.16, demonstration of facility response capabilities in response to hostile actions will be integrated into Force-on-Force and emergency exercises when required. Emergency exercises are addressed below in SER Section 13.3.4.14.

COL Plan Section II.J.7, "Protective Action Recommendations and Bases," states that public PARs are based on plant conditions, estimated offsite doses, or some combination of both. EALs correspond to the projected dose to the population at risk, and are determined consistent with the methodology described in implementing procedures. (EALs are addressed above in SER Section 13.3.4.4). If the Emergency Coordinator declares a general emergency, then Dominion will communicate to the Virginia EOC a PAR to evacuate at least a 2-mile radius around the facility, unless impediments to evacuation exist. The PAR may call for other areas within the plume exposure pathway EPZ to evacuate, shelter-in-place, or monitor and prepare to take protective actions as directed. Notification methods and procedures are described in COL Plan Section II.E, and discussed above in SER Section 13.3.4.5.

In addition to the EAL-based PAR, Dominion provides PARs based on offsite dose projections. The Health Physics staff is responsible for conducting offsite dose projections periodically throughout any emergency during which there is an actual or potential release of an amount of radioactive material that is likely to result in offsite consequences. Implementing procedures will establish requirements for performing calculations and projections. Projected doses are compared to the PAGs shown in COL Plan Table II-3, "Protective Action Guides" (as derived from EPA 400-R-92-001, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," dated May 1992[6]), and PARs are developed based on the results of these comparisons, as discussed in COLA Plan Section II.J.10.m. Consideration will be given to evacuation, sheltering, and as a supplement to these, the prophylactic use of KI, as appropriate. An implementing procedure includes specific PARs, which are based on NUREG–0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents," and plant and meteorological conditions. COL Plan Appendix 5 lists an EPIP entitled "Protective Action Recommendations." Prior to activation of the EOF, the Emergency Coordinator is responsible for determining PARs and communicating them to the Virginia EOC, which is

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[6] In March 2013, the EPA updated EPA 400-R-92-001 with "PAG Manual – Protective Action Guides and Planning Guidance for Radiological Incidents," Draft for Interim Use and Public Comment.

responsible for implementing the protective actions. Following activation of the EOF, the EOF Director assumes these responsibilities, and the Emergency Coordinator or EOF Director provides PARs to the Virginia EOC.

The COL Plan Section II.J.8, “Evacuation Time Estimates,” states that Dominion conducted an ETE that updated the ETE information provided in ESP SSAR Section 13.3.2.1, “Identification of Physical Characteristics,” and which is consistent with the guidance in Appendix 4 of NUREG–0654, NUREG/CR-6863, and NUREG/CR-7002. The ETE Report is included in the COLA as supplemental information to the COL Plan, and the updated population distribution and ETEs are summarized in COL Plan Appendix 4, which includes the updated ETE’s Executive Summary. ETEs are a factor considered in the development of off-site PARs, and are provided to Commonwealth and local governmental authorities for use in developing off-site protective action strategies. The ETE Report provides maps of the plume exposure pathway EPZ, which illustrate the population distribution around the North Anna 3, evacuation areas and routes, and locations of assembly areas. A summary of the staff’s detailed review of the ETE Report is included below in SER Section 13.3.4.17.

The COL Plan Section II.J.10, “Protective Measures Implementation,” states that warnings to the public within the plume exposure pathway EPZ are the responsibility of Commonwealth of Virginia and risk jurisdiction officials, and the primary method of warning the public is by the use of the Early Warning System sirens. Other warning methods may include telephone communications, television and radio EAS stations, public address systems, bull horns from patrol cars and personal contact. There are currently no hospitals, prisons, or nursing homes within the plume exposure pathway EPZ. Offsite notifications and communications are discussed in COL Plan Sections II.E and II.F, and are addressed above in SER Sections 13.3.4.5 and 13.3.4.6, respectively.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant developed a range of protective actions for the (16-km (10-mi)) plume exposure pathway EPZ for emergency workers and the public, including consideration of evacuation, sheltering, and the prophylactic use of KI. The staff finds that the applicant has developed guidelines for the choice of protective actions during an emergency that are consistent with Federal guidance, including protective actions for the (80-km (50-mi)) ingestion exposure pathway EPZ that are appropriate to the locale. The size and configuration of the EPZs have been determined in relation to local emergency response needs and capabilities, as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. In addition, the staff finds that the applicant has developed a range of protective actions to protect onsite personnel during hostile action. Development of ETEs is addressed in Section 13.3.4.17 of this report.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard J. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(10), 10 CFR 50.47(c)(2), and 10 CFR Part 50, Appendix E, Sections I and IV.I, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.11 Radiological Exposure Control

As stated in NUREG–0654, Planning Standard K, "Radiological Exposure Control," 10 CFR 50.47(b)(11) requires that the means for controlling radiological exposures in an emergency be established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA 400-R-92-001, May 1992. In addition, 10 CFR Part 50, Appendix E, Section IV.E.3 requires that adequate provisions shall be made and described for emergency facilities and equipment, including facilities and supplies at the site for decontamination of onsite individuals.

In COL Plan Section II.K, "Radiological Exposure Control," the applicant described the emergency exposure limits for emergency workers, including decisions and efforts made to minimize exposures. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard K, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(11).

In COL Plan Section II.K, the applicant incorporated by reference Section 13.3.2.2.2.k of the ESP Plan, with regard to the description of radiological exposure control measures. In Section 13.3.3.12 of NUREG–1835, the staff found this information acceptable. The applicant provided additional information in Section II.K. In COL Plan Section II.K.1, "On-Site Exposure Guidelines and Authorizations," the applicant stated that Dominion implements onsite exposure guidelines for emergency response consist with EPA 400-R-92-001, Table 2-2, "Guidance on Dose Limits for Workers Performing Emergency Services," which are reflected in COL Plan Table II-4, "Emergency Worker Exposure Guidelines."

Prior to EOF activation, the Emergency Coordinator, in consultation with facility health physics personnel, is responsible for authorizing any emergency exposure exceeding 10 CFR Part 20 limits. Following EOF activation, the EOF Director, in consultation with health physics personnel and the Emergency Coordinator, has this responsibility. If exposures in excess of 10 CFR Part 20 limits are required, these exposures will be limited to individuals who are properly trained and knowledgeable of the tasks to be completed and the risks associated with the exposures. Selection criteria for volunteer emergency workers include consideration of those who are in good physical health, are familiar with the consequences of emergency exposure, and are not a declared pregnant worker. It is preferable, though not mandatory, that volunteers be older than 45 years of age and not be a female capable of reproduction. Efforts are made to maintain personnel doses as low as reasonably achievable (ALARA).

Dominion further stated that Chapter 12, "Radiation Protection," of the FSAR (i.e., COLA Part 2) describes a radiation protection program (RPP) that is consistent with the requirements of 10 CFR Part 20. The RPP, in concert with the EPIPs, includes provisions for implementing emergency exposure guidelines. Implementing procedures establish procedures for allowing onsite volunteers to receive radiation doses in the course of carrying out life-saving and other emergency response activities, including provisions for expeditious decision-making and consideration of the relative risks. COL Plan Appendix 5 lists EPIPs entitled “Radiation Protection Under Emergency Conditions,” and “Personnel Monitoring.” The radiation protection and health physics programs are further described in SER Section 12.0, “Radiation Protection.”

COLA Plan Section II.K.3, “Dosimetry and Dose Assessment,” states that Dominion maintains a site personnel radiation dosimetry program that includes the capability to determine both external and internal doses consistent with the requirements of 10 CFR Part 20. The external dosimetry program includes provisions and requirements for use of both permanent record and self-reading dosimeters (e.g., pocket or electronic dosimeters). Dosimeter ranges are sufficient to measure both planned routine and foreseeable accident photon doses. Plant procedures establish requirements for distributing dosimeters to emergency responders, including those individuals responding to the site from offsite locations. Internal doses are typically estimated through the use of whole body counting and/or in-vitro sampling and analysis routines. Dominion maintains individual Dose records in accordance with the requirements of 10 CFR Part 20 and the RPP and its supporting procedures.

Dominion implements requirements for personnel and area decontamination, including decontamination actions levels and criteria for returning areas and items to normal use, in procedures supporting the RPP. Procedures also address decontamination of onsite personnel wounds, supplies, instruments and equipment, and for waste disposal. COL Plan Appendix 5 lists an EPIP entitled “Decontamination.” COL Plan Appendix 6 describes the emergency equipment and supplies, including decontamination supplies with emergency kits. In addition, Dominion makes provisions for protective clothing, contamination monitoring, and decontamination (including decontamination for radioiodine contamination on the skin) at the offsite assembly area or other location as directed.

In COL Plan Section II.K.6, “Contamination Control Measures,” the applicant stated that the FSAR and Security Plan establish requirements for site access control from offsite locations. Following a site evacuation, law enforcement agencies control access to the owner controlled area, consistent with the requirements of the supporting Commonwealth of Virginia and risk jurisdiction plans. The site Security Force controls entry to the restricted area by individuals, including emergency responders, who must enter the site during an emergency. The RPP and its supporting procedures establish requirements for limiting access to areas having significant radiological hazards, consistent with the requirements of 10 CFR Part 20 and FSAR Chapter 12.

Should the potential exist for contamination of onsite food or drinking water supplies that renders these supplies non-consumable, arrangements will be made for transport of non-contaminated offsite supplies to the North Anna site. Dominion permits areas and items to be returned to normal (i.e., non-contaminated) use following surveys and verification that contamination levels meet the criteria provided in the RPP or its supporting procedures.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has established the means to control radiological exposures for emergency workers in a way consistent with the exposure guidelines in EPA 400-R-92-001. In addition, the applicant made and described adequate provisions for emergency facilities and equipment, including facilities and supplies for monitoring and decontamination of onsite and relocated personnel, vehicles, and other affected materials, and has established appropriate contamination control measures.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard K. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(11) and 10 CFR Part 50, Appendix E, Section IV.E.3, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.12 Medical and Public Health Support

As stated in NUREG–0654, Planning Standard L, "Medical and Public Health Support," 10 CFR 50.47(b)(12) requires that arrangements be made for medical services for contaminated injured individuals. In addition, 10 CFR Part 50, Appendix E, Section IV.E requires facilities and medical supplies at the site for appropriate emergency first aid treatment, and arrangements for medical service providers qualified to handle radiation emergencies onsite. Arrangements are also required for transportation of contaminated injured individuals from the site to specifically identified treatment facilities outside the site boundary.

In COL Plan Section II.L, "Medical and Public Health Support," the applicant described the arrangements for medical services for contaminated injured personnel at the North Anna site. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff's primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard L, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(12).

In COL Plan Section II.L, the applicant incorporated by reference Section 13.3.2.2.2.l of the ESP Plan, with regard to descriptions of plans for medical and public health support. These descriptions included contacts and arrangements for medical services for contaminated injured individuals and were supported by a letter of agreement with the Medical College of Virginia Hospitals (MCVH) in Richmond, Virginia, which describes arrangements that have been made to provide emergency services to North Anna. These arrangements would apply to the ESP site. In Section 13.3.3.13 of NUREG–1835, the staff found this information acceptable.

The applicant provided additional information in COL Plan Section II.L, including a certification letter in COL Plan Appendix 7 that is signed by the Chief Executive Officer of MCVH, which addresses the facility's continued availability in support of a new unit at the North Anna site. COL Plan Section II.L refers to MCVH as the Virginia Commonwealth University Medical Center (VCUMC). (The certification letter in support of North Anna 3 is also discussed above in SER Section 13.3.4.1.) In addition, Section II.L.1 states that the hospital has established and maintains the capability to evaluate the radiation exposure and/or uptake of accident victims and to handle contaminated victims. These capabilities are established and maintained through training courses that are consistent with COL Plan Section II.O, periodic drills and exercises that are consistent with COL Plan Section II.N, and services provided that are consistent with agreements between Dominion and the medical support providers. In the event that a contaminated injured person is transported from North Anna 3 to an offsite medical facility, Dominion may provide to the facility one or more technicians qualified to perform radiological monitoring if requested by the facility to support the radiological aspects of the medical treatment and post-treatment efforts.

Dominion maintains a trained first aid team at the site to provide 24-hour-per-day first aid support consistent with COL Plan Section II.B, and maintains first aid team readiness through training consistent with COL Plan Section II.O and drills and exercises consistent with COL Plan Section II.N. In addition, Dominion has made arrangements with local volunteer rescue squads to transport injured contaminated personnel to the hospital, and response team members have received training concerning transportation of contaminated injured individuals. A health physics technician, with appropriate instrumentation, would normally accompany the person to the hospital. Contaminated injured personnel will be suitably clothed or prepared to prevent the spread of contamination in the transporting vehicle, if practical, considering the medical condition of the injured person. The station can communicate with VCUMC and the site ambulance (if used), and the ambulance can communicate with VCUMC. COL Plan Appendix 5 lists an EPIP entitled “Notifications Associated with Emergency Conditions.”

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff reviewed the certification letter for the medical service providers described above and the additional information provided in COL Plan Section II.L. The staff finds that the applicant has made arrangements for hospital and medical service providers that have the capability to evaluate radiation exposure and uptake, and persons providing these services are adequately prepared to handle contaminated individuals. In addition, the applicant provided for appropriate emergency first aid treatment at the site, including qualified medical personnel to handle radiation emergencies, and arrangements for transporting victims of radiological accidents (i.e., contaminated injured individuals) to offsite medical support facilities.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard L. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(12) and 10 CFR Part 50, Appendix E, Section IV.E, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.13 Recovery and Reentry Planning and Post-Accident Operations

As stated in NUREG–0654, Planning Standard M, “Recovery and Reentry Planning and Post-Accident Operations,” 10 CFR 50.47(b)(13) requires that general plans for recovery and reentry be developed. In addition, 10 CFR Part 50, Appendix E, Section IV.H requires a description of criteria to be used to determine when, following an accident, reentry of the facility would be appropriate or when operation could be resumed.

In COL Plan Section II.M, “Recovery and Re-Entry,” the applicant described the steps that it will take, once the emergency situation has ended, to mitigate the consequences of the event and to minimize any effects on the health and safety of the public and emergency workers. The staff reviewed this section, as well as other relevant portions, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard M, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(13).

In COL Plan Section II.M.1, “Recovery Plans and Procedures,” the applicant stated that Dominion implements recovery plans and procedures that provide guidance for a range of recovery and re-entry activities, including organization, decision making, informing members of the ERO that recovery operations are to be initiated, and estimating the total population exposure. The recovery process is further outlined in the EPIP specifically designed for administration of the recovery program. COL Plan Appendix 5 lists an EPIP entitled “Recovery and Reentry.”

In COL Plan Section II.M.2, “Recovery Organization,” states that prior to entering the recovery/re-entry phase of operations following an emergency Dominion establishes a recovery organization that is consistent with the existing conditions and continuing organizational needs. The EOF Director assumes control and direction of the recovery operation, with the authority and responsibilities set forth in the EPIPs. Depending on plant conditions and the scope of activities, the recovery organization may discharge its activities from one or more designated ERFs or from other locations specified by the recovery organization managers.

COL Plan Section II.M further states that the recovery process is implemented when the facility’s ERO managers, with concurrence of Commonwealth of Virginia and Federal agencies, have determined the station to be in a stable and controlled condition. Upon the determination, Dominion notifies the NRC Operations Center, Virginia EOC, and risk jurisdiction EOCs that the emergency has been terminated and any required recovery has commenced. The recovery organization develops plans and procedures that are designed to address both immediate and long-term actions. Specific recovery procedures may need to be written to address special requirements. The necessity to maintain protective measures implemented during the emergency will be evaluated and, if deemed appropriate, the recovery organization will recommend the relaxation of existing protective measures. Total population doses are periodically estimated in the affected areas utilizing population distribution data. Health Physics personnel determine the TEDE and the thyroid committed dose equivalent (CDE) using a methodology that is consistent with EPA 400-R-92-001.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has developed general plans for recovery and reentry, including describing criteria to be used to determine when, following an accident, reentry of the facility is appropriate or operation can be resumed. In addition, the applicant designated the individuals who will fill key positions in the facility recovery organization. The staff finds that the plans adequately specify the means for informing members of the response organizations that a recovery operation is to be initiated, describe how decisions to relax protective measures are made, and include a method for periodically estimating total population exposure.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard M. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(13) and 10 CFR Part 50, Appendix E, Section IV.H, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.14 Exercises and Drills

As stated in NUREG–0654, Planning Standard N, “Exercises and Drills,” 10 CFR 50.47(b)(14) requires that periodic exercises be conducted to evaluate major portions of emergency response capabilities, periodic drills be conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills be corrected. In addition, 10 CFR Part 50, Appendix E, Section IV.F requires a description of the program that provides for training of employees, exercising by periodic drills, and participation by other assisting persons. The exercises – including hostile action exercises of the onsite and offsite emergency plans – shall test the adequacy of timing and content of implementing procedures and methods, test emergency equipment and communications networks, test the public alert and notification system, and ensure that emergency organization personnel are familiar with their duties. 10 CFR Part 50, Appendix E, Section IV.F further describes the full participation exercise (including timing), participation by each offsite authority having a role under the radiological response plan, deficiencies identified during the exercise, remedial exercises, exercise scenarios, and 8-year exercise cycle.

In COL Plan Section II.N, “Exercises and Drills,” the applicant described the conduct and frequency of emergency exercises and drills, including coordination between the North Anna 3 site and offsite EROs. The staff reviewed this section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard N, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(14).

The COL Plan Section II.N states that Dominion implements a program of periodic drills and exercises to test and evaluate major portions of emergency response capabilities, including emergency plans, procedures and organizations, and to develop and maintain key emergency response skills. Exercises allow demonstration of the key skills specific to emergency response duties in the control room, TSC, OSC, EOF, and JIC. The exercises test the adequacy of timing and content of implementing procedures and methods, emergency equipment and communications networks, the public notification system, and the familiarity of emergency organization personnel with their duties. COL Plan Appendix 5 lists supporting procedures entitled “Conduct of Emergency Drills and Exercises,” and “Testing of Emergency Communications Systems.” Exercise scenarios are varied so major elements of the plans and preparedness organizations are tested, including, at least once during the 8-year exercise cycle, the following:

- Hostile action directed at the plant site.
- No radiological release or an unplanned minimal radiological release that does not require public protective actions.
- An initial classification of, or rapid escalation to, a site area emergency or general emergency.
- Implementation of strategies, procedures, and guidance developed under §50.54(hh)(2) (i.e., for loss of large areas of the plant due to explosion or fire).
- Integration of offsite resources with onsite response.

The drill and exercise program is also addressed in BL 2005-02, which requested in part that all holders of operating licenses provide information regarding how current emergency preparedness drill and exercise programs prepare or evaluate responders for security-based events commensurate with established emergency preparedness standards. DCD COL Item1C.1-2-A requires the COL applicant to address the security-related requirements of BL 2005-02, and is addressed below in SER Section 13.3.4.18. With regard to the drill and exercise program, the applicant stated in response to RAI 13.03-2-16 that demonstration of facility response capabilities in response to hostile actions will be integrated into Force-on-Force and emergency exercises when required.

Dominion conducts an exercise of its onsite emergency plan every 2 years, which may be included in the biennial full participation exercise. Dominion also conducts exercises involving full participation by offsite authorities at least biennially, and at least once every 8-year exercise cycle provisions will be made to start a drill or exercise during off-hours. Unannounced exercises will also be conducted on a periodic basis. Dominion will conduct a full participation exercise within 2 years before initiation of scheduled initial fuel loading, which will include participation by the Commonwealth of Virginia, State of Maryland, and affected local governments within the plume exposure pathway EPZ and the ingestion exposure pathway EPZ. If the full participation exercise is conducted more than 1 year before the scheduled date for initial fuel loading, Dominion will conduct an exercise that tests the onsite emergency plans within 1 year before the scheduled date for initial fuel loading.

The ITAAC 8.1.1 states that the exercise is completed within the specified time periods of 10 CFR Part 50, Appendix E, and the listed onsite exercise objectives have been met with no uncorrected onsite exercise deficiencies. (SER Section 13.3.4.19 addresses implementation milestones associated with this exercise.) In addition, ITAAC 8.1.2 addresses successful performance of assigned responsibilities by onsite emergency response personnel.

ITAAC 8.1.3 addresses offsite exercise objectives and the absence of uncorrected offsite exercise deficiencies prior to reactor operation above 5 percent of rated power.

The COLA Plan Section II.N.2, “Drills,” states that Dominion maintains adequate emergency response capabilities between biennial exercises by conducting drills, including at least one drill involving a combination of some of the principal functional areas of onsite emergency response capabilities. Upon request, Dominion allows affected Commonwealth of Virginia and risk jurisdiction governments to participate in the drills. A response to an actual declared emergency may be used to satisfy emergency drill requirements if the response demonstrates adequate execution of the specified activities. The drill program includes the following (at the indicated frequencies):

Communication Drills:

Dominion conducts monthly tests of communications with Commonwealth of Virginia and risk jurisdiction governments. In addition, Dominion conducts quarterly tests of communications with Federal emergency response organizations, and annual tests of communications between the facility, the Virginia and risk jurisdiction EOCs, and field assessment teams. Communication drills evaluate both the operability of the communications systems and the ability of the participants to understand message content.

Fire Drills:

Dominion conducts fire drills as required by Section 9.5.1 [“Fire Protection System”] of the North Anna 3 FSAR.

Medical Emergency Drills:

Dominion conducts yearly medical emergency drills that include a simulated contaminated injured individual and participation by the local support services agencies (i.e., medical transportation and offsite medical treatment facility).

Radiological Monitoring Drills:

Dominion conducts yearly radiological monitoring drills involving both onsite and offsite radiological monitoring activities, which include collection and analysis of sample media, communications with monitoring teams, and recordkeeping activities. Dominion may coordinate radiological monitoring drills with those drills conducted by Commonwealth of Virginia and risk jurisdiction government entities, or may conduct these drills independently.

Health Physics Drills:

On a semi-annual basis, Dominion conducts onsite health physics drills that include a response to, and analysis of, simulated elevated airborne and liquid samples, direct radiation measurements in the environment, and an analysis of in-plant liquid samples with simulated or actual elevated radiation levels.

Dominion develops drill and exercise scenarios and related materials that establish basic objectives and evaluation criteria; date, time period, location, and participating organizations; simulated events; a narrative summary describing the conduct of the exercise or drill; and arrangements for official observers. One or more qualified instructors/evaluators supervise and evaluate drills and exercises. A qualified instructor/evaluator is an individual whose knowledge, skills, and abilities have been evaluated and determined to be sufficient for observing and evaluating the planned activities against the established criteria. Exercises may be critiqued by Federal and Commonwealth of Virginia observers/evaluators.

Dominion conducts a critique following conduct of the exercise. Participants may include selected Dominion, NRC, Commonwealth of Virginia, risk jurisdiction, and other participants and observers/evaluators. Input from the critique is evaluated to determine the need for changes to the plan, procedures, equipment, facilities, and other components of the emergency preparedness and response program. Dominion identifies deficiencies and tracks corrective actions to completion using the facility's corrective action program.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654. In addition, FEMA stated that the adequacy of the North Anna 3 COLA Emergency Plan review is also dependent on satisfactory demonstration of plan implementation during a joint exercise with the licensee and State and local governments, and utilizing North Anna 3 facilities. ITAAC 8.1.3 addresses offsite exercise objectives and the absence of uncorrected offsite exercise deficiencies prior to (reactor) operation above 5 percent of rated thermal power.

The staff finds that the applicant has described provisions for conducting periodic exercises and drills to evaluate major portions of emergency response capabilities and to develop and maintain key skills. The exercises will test the adequacy of implementing procedures, emergency equipment and communications networks, and the public notification system, and will ensure that the ERO personnel are familiar with their duties. In addition, the applicant described the full participation exercise, participation by offsite authorities, and how exercise and drill deficiencies will be identified and corrected.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard N. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(14) and 10 CFR Part 50, Appendix E, Section IV.F, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.15 Radiological Emergency Response Training

As stated in NUREG–0654, Planning Standard O, "Radiological Emergency Response Training," 10 CFR 50.47(b)(15) requires that radiological emergency response training be provided to those who may be called on to assist in an emergency. In addition, 10 CFR Part 50,

Appendix E, Section IV.F.1 requires a description of the program that provides for training of employees, exercising by periodic drills, and participation by other assisting persons.

In COL Plan Section II.O, “Radiological Emergency Response Training,” the applicant described the training that will be conducted for both onsite and offsite response organizations in support of an emergency at the North Anna site. The staff reviewed this Section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan against NUREG–0654, Planning Standard O, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(15).

In COL Plan Section II.O, the applicant incorporated by reference Section 13.3.2.2.2.o of the ESP Plan, with regard to the description of the emergency preparedness training program. In Section 13.3.3.14 of NUREG–1835, the staff found that this information was acceptable. The applicant provided additional information in Section II.O, which states that Dominion implements a training program that provides for initial training and retraining for individuals who have been assigned emergency response duties, including both onsite staff and offsite individuals who may be called on to provide assistance in the event of an emergency. This includes emergency responders employed by agencies identified in COL Plan Section II.A. Dominion offers training for affected hospital, ambulance/rescue, police, and firefighting personnel. For these and any other offsite emergency responders who may be required to enter the site under emergency conditions, Dominion offers training that addresses site access procedures and identifies (by position) the individual who will control their activities onsite.

In COL Plan Section II.O.2, “Onsite Emergency Response Training,” the applicant stated that the training program includes practical drills (consistent with COL Plan Section II.N) for on-site Dominion personnel who may be called upon to respond to an emergency, during which individuals demonstrate the ability to discharge the assigned emergency response function. The instructor/evaluator corrects any erroneous performance noted during these practical drills and, as appropriate, demonstrates proper performance that is consistent with approved procedures and accepted standards. COL Plan Appendix 5 lists a supporting procedure entitled “Emergency Plan Training,” which supports the ongoing maintenance of emergency preparedness.

COL Plan Section II.O further states that Dominion conducts a program for instructing and qualifying personnel who implement the emergency plan. Individuals complete the required training prior to assignment to a position in the ERO. The training program establishes the scope, nature, and frequency of the required training and qualification measures (e.g., individuals assigned to render treatment during an emergency receive first aid training equivalent to the Red Cross Multi-Media Training). Dominion implements a program to provide position-specific emergency response training for designated members of the ERO, which includes annual retraining. The content of the training program is appropriate for the duties and responsibilities of the assigned position. Failure of Dominion ERO members to successfully complete this training in a timely manner, as specified in plant training program requirements, results in the individual’s removal from the ERO pending completion of the required training.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

The staff finds that the applicant has provided for radiological emergency response training to those who may be called on to assist in an emergency. In addition, the applicant described the program that trains employees to ensure they are familiar with their specific emergency response duties, including exercising with periodic drills. The applicant also described the participation in training and drills by other persons whose assistance might be needed, including specialized initial training and periodic retraining.

Conclusion

The staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard O. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(15) and 10 CFR Part 50, Appendix E, Section IV.F.1, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.16 Responsibility for the Planning Effort – Development, Periodic Review, and Distribution of Emergency Plans

As stated in NUREG–0654, Planning Standard P, “Responsibility for the Planning Effort: Development, Periodic Review and Distribution of Emergency Plans,” 10 CFR 50.47(b)(16) requires that responsibilities for plan development and review and for distribution of emergency plans are established and that planners are properly trained. In addition, 10 CFR Part 50, Appendix E, Section IV.G requires a description of provisions to be employed to ensure that the emergency plan, its implementing procedures, and emergency equipment and supplies are maintained up to date.

In COL Plan Section II.P, “Responsibility for the Planning Effort,” the applicant described the responsibilities and authorities associated with developing and maintaining emergency preparedness for the North Anna site. The staff reviewed this Section, as well as other relevant portions of the application, to determine whether the application conforms to the applicable guidance and complies with the pertinent regulatory requirements. The staff’s primary focus was to evaluate the emergency plan compared to NUREG–0654, Planning Standard P, which provides the detailed evaluation criteria that the staff should consider to determine whether the emergency plan meets the applicable regulatory requirements in 10 CFR 50.47(b)(16).

In COL Plan Section II.P, the applicant incorporated by reference Section 13.3.2.2.2.p of the ESP Plan, with regard to the description of plans for maintaining emergency preparedness. In Section 13.3.3.15 of NUREG–1835, the staff found this information acceptable. The applicant provided additional information in Section II.P, which states that Dominion implements an organizational structure and processes to periodically review, update, distribute, and control the emergency plan (i.e., COL Plan), consistent with facility quality assurance and document control requirements. The facility’s document control organization distributes the updated emergency plan to organizations and individuals with responsibility for implementing the plans. Dominion also implements a program to provide training to personnel responsible for the emergency planning effort appropriate to their duties and responsibilities.

The COL Plan Section II.P further states that the Site Vice President holds the overall authority and responsibility for ensuring that an adequate level of emergency preparedness is maintained. In addition, Dominion establishes a Manager Emergency Preparedness position, which is responsible for developing and updating site emergency plans (including the ETE and emergency personnel notification list), coordinating these plans with other response organizations, and conducting or coordinating an annual review of the emergency plan to verify the plan and its supporting agreements are current. The Manager Emergency Preparedness also reviews and updates the plan and agreements, as needed, to verify they remain current. Dominion develops and implements a process to provide training to the Manager Emergency Preparedness and support staff, which may include formal education, professional seminars, plant-specific training, industry meetings, and other activities and forums that provide for an exchange of pertinent information.

In COLA Part 10, the applicant proposed License Condition 3.1 (Letters of Agreement), which states that prior to loading fuel, the licensee shall update its Units 1 and 2 letters of agreement with the 16 listed entities (i.e., State and county agencies and organizations) or their successors. These updated letters of agreement will identify the specific nature of arrangements in support of emergency preparedness for the North Anna site, including North Anna 3. (Arrangements for support from the various offsite agencies and organizations are discussed above in SER Section 13.3.4.3.) In addition, the emergency plan shall be revised to include these updated letters of agreement after they have been executed. The complete License Condition 3.1 is included above in SER Section 13.3.2 and reflected below, with some staff revisions, as staff-proposed License Condition 5.

In ESP Plan Section 13.3.2, "Major Features Emergency Plan," the applicant stated that "[t]he Major Features Emergency Plan [i.e., ESP Plan] takes advantage of the emergency planning resources, capabilities, and organization that Virginia Power has already established and currently maintains at the NAPS site." In addition, ESP Plan Section 13.3.2.2.2.a.6, "Contacts and Arrangements," states that the existing licensed facilities (i.e., Units 1 and 2) maintain within the NAEP letters of agreement with the listed State and county agencies and organizations. The staff's evaluation of these NAEP letters of agreement is reflected in NUREG–1835, Section 13.3.2, "Contacts and Arrangements with Local, State, and Federal Agencies," and Section 13.3.3.4, "Emergency Response Support and Resources (Supplement 2, Major Feature C)," where the staff found that the letters of agreement were acceptable.

In COL Plan Appendix 7, the applicant provided a June 11, 2010, certification letter, which provided up-to-date information associated with submission of the COLA, and is signed by the 16 agencies and organizations that will support the proposed new nuclear unit (i.e., North Anna 3). When initially submitted to the NRC, as part of the June 28, 2010, revised COLA, the certification letter provided up-to-date information because it reflected recent agreement by the signatories (i.e., all parties signed the certification letter between June 11 and June 16, 2010). The applicant did not update the certification letter in subsequent COLA revisions because there is no requirement to do so. The agencies and organizations represented in the certification letter are the same agencies and organizations represented in the Units 1 and 2 letters of agreement listed in the applicant's proposed License Condition 3.1. (The certification letter and letters of agreement are discussed further in SER Sections 13.3.4.1 and 13.3.4.3.) The staff reviewed the certification letter, and finds it acceptable because it meets the requirements in 10 CFR 52.79(a)(22)(i), and guidance in SRP Acceptance Criterion II.18.

The applicant's proposed License Condition 3.1 would require the COL licensee to update the Units 1 and 2 letters of agreement to reflect North Anna 3 prior to loading fuel, and revise the emergency plan to include these updated letters of agreement after they have been executed. There is no requirement or guidance that precludes Dominion, as a new 10 CFR Part 52 licensee on the existing North Anna site, from waiting to update the emergency plan and letters of agreement until prior to initial North Anna 3 fuel load.

As required by 10 CFR Part 50, Appendix E, Section IV.G, Dominion has maintained the Units 1 and 2 letters of agreement up-to-date following, and independent of, their submission in the ESP application. Since all three reactor units are located on a common site (i.e., the North Anna site), the nature of offsite support reflected in the existing Units 1 and 2 letters of agreement would be generally applicable to North Anna 3 after the COL is issued, during construction, and up to fuel load.

As required by 10 CFR Part 50, Appendix E, Section IV.G, Dominion must maintain the Units 1 and 2 letters of agreement up-to-date.

In addition, as discussed above in SER Section 13.3.4.3, the general nature of the existing letters of agreement is such that the scope of expected support could include expected assistance associated with hostile action at the site, which is required by 10 CFR Part 50, Appendix E, Section IV.A.7 to be identified and described in the COL Plan. However, this requirement is not effective until June 23, 2014, which occurred after COLA submission. The Units 1 and 2 letters of agreement supporting the COLA did not specifically address hostile actions, and were not required to, when the COLA was initially submitted on November 26, 2007. In order to clarify that the expected assistance from offsite agencies includes hostile action, the staff has included in License Condition 5 (below) the requirement for the updated letters of agreement to reflect expected assistance associated with hostile actions at the North Anna site, as required by 10 CFR Part 50, Appendix E, Section IV.A.7.

For the reasons discussed above, the staff finds that delaying the updating of the letters of agreement, and revising the North Anna 3 Emergency Plan to include them after they are executed, until prior to North Anna 3 fuel load is consistent with the requirements in 10 CFR Part 50, Appendix E, Section IV.G, and guidance in NUREG–0654 Evaluation Criterion II.P.4. The staff reviewed License Condition 3.1, and with the exception of the timeframe for submission of the updated letters of agreement, finds that it is acceptable for the reasons discussed above. The staff proposes a timeframe for updating the letters of agreement, which is based on the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a). In addition, the license condition provides the staff with the necessary control over post-licensing updates to the letters of agreement, and ensures that they will be in effect prior to fuel load. Therefore, consistent with the applicant's proposed License Condition 3.1, the staff identified the following License Condition 5.

License Condition 5

5. No later than one hundred eighty (180) days before the date schedule for initial fuel load set forth in the notification submitted in accordance with 10 CFR § 52.103(a), the licensee shall update its North Anna Units 1 and 2 Letters of Agreement with the following entities, or their successors, and revise the North Anna 3 Emergency Plan to include these updated Letters of Agreement after they have been executed. These updated Letters of Agreement shall identify the specific nature of arrangements in support of emergency preparedness for the North Anna site, including North Anna 3, and reflect expected assistance associated with hostile action at the North Anna site, as defined in 10 CFR Part 50, Appendix E, Section IV.A.7.

    a. Commonwealth of Virginia Department of Emergency Management
    b. Commonwealth of Virginia Department of Health
    c. Commonwealth of Virginia Department of State Police
    d. Commonwealth of Virginia Department of Game and Inland Fisheries
    e. Virginia Commonwealth University Medical Center
    f. Louisa County Administrator
    g. Louisa County Sheriff
    h. Louisa County Department of Fire and Emergency Medical Services
    i. Spotsylvania County Sheriff
    j. Spotsylvania Department of Fire, Rescue, and Emergency Management
    k. Orange County Administrator
    l. Orange County Sheriff
    m. Caroline County Sheriff
    n. Caroline County Department of Fire, Rescue, and Emergency Management
    o. Hanover County Administrator
    p. Hanover County Sheriff

In COL Plan Section II.P.9, "Emergency Plan Reviews," the applicant stated that Dominion's independent assessment organization performs, or oversees the performance of, periodic independent reviews of the emergency preparedness program, consistent with the requirements of 10 CFR 50.54(t). The reviews include, at a minimum, the following:

- Emergency plan
- EPIPs and practices
- Emergency preparedness training program
- Readiness testing (e.g., drills and exercises)
- ERFs, equipment, and supplies
- Interfaces with Commonwealth of Virginia and risk jurisdiction government agencies

Dominion's independent assessment organization documents review results and improvement recommendations and reports these results to Dominion management. Review findings are subject to management controls, consistent with the facility's corrective action program. Dominion makes those portions of the reviews that address the adequacy of interfaces with Commonwealth of Virginia and risk jurisdiction governments available to the affected governments. Dominion retains review records for a period of at least 5 years, in accordance with facility document control requirements. COL Plan Section II.P.6, “Supporting Plans,” identifies the following supporting plans and their sources:

- Commonwealth of Virginia Plan (Virginia Emergency Operations Plan, Radiological Emergency Response Basis Plan)

- RERPs for the Counties of Louisa, Spotsylvania, Orange, Caroline, and Hanover

- VCUMC Radiation Emergency Plan

- DOE FRMAC Operations Plan

The FRMAC assistance is discussed above in SER Section 13.3.4.3. COL Plan Appendix 5 lists supporting procedures entitled “Emergency Plan Training” and “Maintaining Emergency Preparedness.” The format for the COL Plan directly follows the format of NUREG–0654, as outlined in the Table of Contents, and Appendix 8 provides a cross-reference of the plan to the evaluation criteria in NUREG–0654.

In its Interim Finding Report for Reasonable Assurance, FEMA found that the offsite emergency plans are adequate for this planning standard and the associated evaluation criteria in NUREG–0654.

Subject to License Condition 5, the staff finds that the applicant has established the responsibilities for plan development and review, including distribution of the emergency plans to all appropriate organizations. In addition, the applicant established provisions to properly train the planners (i.e., the individuals responsible for the emergency planning effort) and described the provisions to be employed to ensure that the emergency plan, its implementing procedures, and emergency equipment and supplies are maintained up-to-date.

Conclusion

Subject to License Condition 5, the staff concludes that the information provided in the COLA is consistent with the guidelines in NUREG–0654, Planning Standard P. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(16) and 10 CFR Part 50, Appendix E, Section IV.G, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.17 Evacuation Time Estimate Analysis

The 10 CFR 50.47(b)(10) requires, in part, that ETEs have been developed by applicants and licensees, and that licensees shall update the ETEs on a periodic basis. In addition, 10 CFR Part 50, Appendix E, Section IV requires that the applicant provide an analysis of the time required to evacuate various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations, using the most recent U.S. Census Bureau data as of the application submission date. NUREG–0654, Appendix 4, “Evacuation Time Estimates within the Plume Exposure Pathway Emergency Planning Zone,” contains the detailed guidance to be used by the staff to determine whether the ETE Report meets the applicable regulatory requirements in 10 CFR Part 50, Appendix E. Additional guidance is contained in NUREG/CR-6863 and NUREG/CR-7002. ETEs are part of the required EP basis and provide Dominion and State and local governments with site-specific information needed for protective action decision making.

The North Anna site is located approximately 64 km (40 mi) northwest of Richmond, Virginia. The North Anna site plume exposure pathway EPZ and the surrounding communities, along with major highways and geographic features, are shown on mapping in the ETE. The protective action zones (PAZ) are illustrated in Figure 6-1, “NAPS EPZ PAZ,” and the physical boundaries of each PAZ are described in Appendix L, “Protective Action Zone (PAZ) Boundaries.” These areas are typically bounded by local roadways and Lake Anna. Evacuation time estimates were determined for 41 evacuation regions (i.e., Regions R01 through R41), which encompass the entire area within the plume exposure pathway EPZ. The evacuation regions are listed in Tables 6-1 and H-1, and are shown in Figures H-1 through H-41.

COL Plan Section J.8 states that an ETE was conducted consistent with the guidance provided in Appendix 4 of NUREG–0654, NUREG/CR-6863, and NUREG/CR-7002. The population distribution and ETEs are summarized in Appendix 4 of COL Plan Part 5 (i.e., the COL Plan), which contains the Executive Summary of the full ETE Report. The North Anna 3 COLA includes, as supplemental information to the COL Plan, ETE Final Report (KLD TR-503), Revision 1, November 2012 (i.e., ETE Report), entitled, “North Anna Power Station – Development of Evacuation Time Estimates” (ADAMS Accession No. ML13221A389), which was prepared by KLD Engineering, P.C., in coordination with Dominion personnel and emergency management personnel representing State and local governments.

The ETE study (i.e., ETE Report) is based on local information, a telephone survey, and 2010 U.S. Census Bureau data, which was the most recent census data available when the ETE Report was revised in November 2012, and submitted to the NRC as part of the December 18, 2013, COLA update. The ETE Report provides a complete review of the evacuation road network, and the PAZ areas were used to define evacuation regions, which approximated keyhole sections within the plume exposure pathway EPZ. The ETE Report consists of these 13 sections and includes detailed supporting information in Appendices A-H and J-N.

Section 1 – Introduction (basic description of the analysis process)

Section 2 – Study Estimates and Assumptions (methodology used)

Section 3 – Demand Estimation (population and vehicles)

Section 4 – Estimation of Highway Capacity (ability of road network to service demand)

Section 5 – Estimation of Trip Generation Time (activity/event time distributions)

Section 6 – Demand Estimation for Evacuation Scenarios (region and scenario evacuation cases)

Section 7	–	General Population Evacuation Time Estimates (ETE) (results of computer analyses)
Section 8	–	Transit-Dependent and Special Facility Evacuation Time Estimates (analyses applied and results obtained)
Section 9	–	Traffic Management Strategy (traffic control designed to expedite movement of evacuating traffic)
Section 10	–	Evacuation Routes (major evacuation routes for the five counties within the plume exposure pathway EPZ)
Section 11	–	Surveillance of Evacuation Operations (concurrent surveillance procedures)
Section 12	–	Confirmation Time (suggested approach of stratified random sample and telephone survey to confirm that the evacuation process is effective)
Section 13	–	Recommendations (suggestions to improve/facilitate the evacuation process)

The Executive Summary of the ETE Report includes a summary of the conclusions reached in the report. Specifically, general population (i.e., permanent residents and transients) ETEs were computed for 574 unique cases, consisting of a combination of 41 unique evacuation regions and 14 unique evacuation scenarios. The 14 scenarios address different times of day, days of the week, weather conditions, a special event (i.e., Triathlon at Lake Anna State Park), and roadway impact. For each scenario, an analysis was included of the scenario applicable population segments including permanent residents and transient populations, transit-dependent permanent residents, special facility residents, and schools. In addition, the ETEs considered a shadow evacuation in each analysis to reflect evacuation of residents from outside of the official evacuation area; the estimated shadow population is presented in Figure 3-4.

The ETEs for the general population range from 1:45 (hr: min) to 3:45 for the 90th percentile. The maximum ETE for the 100th percentile is 6:40. The ETE statistics provide the elapsed times for 90 percent and 100 percent of the population to evacuate from within the impacted region. The 90th percentile ETEs have been identified as the values that should be considered when making protective action decision. This is because the 100th percentile ETEs are prolonged by those relatively few people who take longer to mobilize; referred to as the "evacuation tail." There is very little congestion experienced during evacuation of the EPZ. The ETEs are most influenced by the trip generation time, which is the time residents take to prepare to evacuate. Section M of the ETE study shows the ETEs are sensitive to the trip generation time.

Separate ETEs were computed for schools, the medical facility, transit-dependent persons, and homebound special needs persons. The average single-wave ETEs are comparable to the general population ETEs at the 90th percentile for these population segments, except for the transit-dependent where the average ETE was comparable to the general population ETEs at the 100th percentile. The ETE for the full EPZ (Region R03) is insensitive to changes in population growth and increased shadow evacuation.

The one special event, identified as the Kinetic Triathlon at Lake Anna State Park, and roadway impact scenarios have no material effect on the 100th percentile ETEs. The computation of ETEs considers staged evacuation, wherein people within the 2-mile region from the plant evacuate immediately, and those beyond 2 mi (i.e., downwind to the EPZ boundary) initially shelter-in-place and then evacuate. Federal guidance in Appendix 4 to NUREG–0654 suggests evacuation of the 0-2 mi regions and sectors downwind to 5 mi, and Federal guidance in Supplement 3 to NUREG–0654 and NUREG/CR-7002 suggests staged evacuation be considered where the 0-2 mi area evacuates while the 2-5 mi area shelters. The results of the study show there is no benefit in applying a staged evacuation approach for this EPZ. The current county traffic management plans for the North Anna site EPZ are sufficient, and the ETE study has not identified any necessary changes to the plans.

The staff evaluated the ETE Report against the criteria set forth in Appendix 4 to NUREG–0654, NUREG/CR-6863, and NUREG/CR-7002. The evaluation included checking the ETE Report for internal consistency, consistency with other parts of the emergency plan, and consistency with other parts of the COLA, including the FSAR. Citations in the ETE Report were verified by comparison to the cited document text. General descriptions of the North Anna site region, population, and highways were verified using internet searches, aerial photographs, and field survey observations. Demographic information was gathered, a field survey of the EPZ performed, trip generation times estimated, evacuation regions defined, the procedures specified in the 2010 Highway Capacity Manual applied, the site was modeled using the DYNEV II System traffic simulation model,[7] and ETEs were generated.

Section 3.3 of the ETE study describes a total of 2,298 transients and 899 vehicles assigned to campgrounds in the EPZ. These values correspond to values in Table E-5, "Campgrounds within the EPZ," which show 2,000 transients and 800 vehicles for the Christopher Run Campground and 298 transients and 99 vehicles for the Lake Anna State Park. Section 3.3 further states that data gathered from Lake Anna State Park include 1,920 transients and 480 vehicles, which correspond to values in Table E-6, "State Parks within the EPZ." In RAI Letter No. 118, May 5, 2014 (email, ADAMS Accession No. ML14125A460), the staff requested additional information from the applicant in RAI 13.03-9, regarding why there are two separate (and different) sets of transient data for Lake Anna State Park.

In a May 19, 2014, response to RAI 13.03-9 (ADAMS Accession No. ML14141A016), the applicant stated that the number of transients and vehicles was calculated separately for the campground/cabin facilities and for the day use facilities. Table E-5 presents the number of transients and vehicles for the Lake Anna State Park campground/cabin facilities. Table E-6 presents the number of transients and vehicles for the Lake Anna State Park day use facilities. The number of transients and vehicles presented in Tables E-5 and E-6 for Lake Anna State Park are exclusive of each other (i.e., the number of transients and vehicles are not double-counted). This clarification does not impact the calculated evacuation time estimates. The staff

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[7] The DYNEV traffic simulation model is a macroscopic model that describes the operations of traffic flow in terms of aggregate variables: vehicles, flow rate, mean speed, volume, density, queue length, on each link, for each turn movement, during each Time Interval (i.e., simulation time step).

finds this response acceptable because the applicant's clarification that the values identified in the ETE study represent two different types of transient visitors to Lake Anna State Park (i.e., those that stay for the day, and those that stay overnight) demonstrates that all transients for this facility were included in the analysis. Therefore RAI 13.03-9 is resolved and closed.

In ETE Table 1-1, "Stakeholder Interaction," the applicant identified various interactions among the State and local government agencies, and stated that final review meetings had been conducted.

The staff finds that the applicant has developed adequate ETEs for the plume exposure pathway EPZ for transient and permanent populations using the most recent U.S. Census Bureau data as of the application (update) submission date. In addition, the ETEs are consistent with Appendix 4 to NUREG–0654, NUREG/CR-6863, and NUREG/CR-7002. (SER Section 13.3.4.10 addresses the ETE Report, with regard to protective action decision making for the plume exposure pathway EPZ).

Conclusion

The staff concludes that Revision 1 of the ETE Final Report (KLD TR-503, November 2012) is consistent with the guidelines in Appendix 4 to NUREG–0654, NUREG/CR-6863, and NUREG/CR-7002. Therefore, the staff finds that the information is acceptable and meets the relevant requirements of 10 CFR 50.47(b)(10) and 10 CFR Part 50, Appendix E, Section IV, insofar as the information describes the essential elements of advanced planning and the provisions made to cope with emergency situations.

13.3.4.18 COL Items, Supplemental Information, and ITAAC

As addressed above in SER Section 13.3.2, FSAR Section 13.3 identifies three emergency planning Standard COL Items from the ESBWR DCD (i.e., STD COL Items 13.3-1-A, 13.3-2-A, and 13.3-3-A). Three additional Standard COL Items from the ESBWR DCD, relating to EP, are identified in FSAR Section 13.4, "Operational Program Implementation," FSAR Section 14.3, and FSAR Appendix 1C "Industry Operating Experience," (i.e., STD COL Items 13.4-2-A, 14.3-1-A, and 1C.1-2-A, respectively). FSAR Table 1.10-201 lists the FSAR location(s) where the individual COL items from the DCD are addressed. In addition, FSAR Section 13.5.2.2 identifies one Standard Supplemental Information item (i.e., STD SUP 13.5-28). The following addresses the applicant's resolution of the six Standard COL Items and the Standard Supplemental Information item.

- STD COL 13.3-1-A

DCD COL Item 13.3-1-A states that the COL applicant is responsible for identifying the OSC and the communication interfaces for inclusion in the detailed design of the control room and TSC. In FSAR Section 13.3, the applicant identified this as STD COL 13.3-1-A, and stated that this COL item is addressed in COL Plan Sections II.F and II.H. The staff reviewed Sections II.F and II.H, and determined that the applicant identified the OSC and described the communication interfaces with the main control room and TSC. The staff's evaluation of the descriptions of OSC and communication interfaces is addressed above in SER Sections 13.3.4.6 and 13.3.4.8.

Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 13.3-1-A.

- STD COL 13.3-2-A

DCD COL Item 13.3-2-A states that the COL applicant is responsible for the design of the communication system(s) located in the EOF, in accordance with NUREG–0696. In FSAR Section 13.3, the applicant identified this as STD COL 13.3-2-A, and stated that this COL item is addressed in COL Plan Sections II.F and II.H. The staff reviewed Sections II.F and II.H, and determined that the applicant described the EOF communication systems, in accordance with NUREG–0696. In addition, the applicant addressed EOF communication systems in COL Plan Section II.E and FSAR Section 9.5.2. The staff's evaluation of the EOF and its communication systems is addressed above in SER Sections 13.3.4.5, 13.3.4.6, and 13.3.4.8, and in SER Section 9.5.2. Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 13.3-2-A.

- STD COL 13.3-3-A

DCD COL Item 13.3-3-A states that the COL applicant will provide supplies at the site for decontamination of onsite individuals in the service building, adjacent to the main change rooms. In FSAR Section 13.3, the applicant identified this as STD COL 13.3-3-A, and stated that this COL item is addressed in COL Plan Section II.J. The staff reviewed Section II.J, and determined that the applicant described supplies at the site for decontamination of onsite individuals in the service building, adjacent to the main change rooms. The staff's evaluation of decontamination of onsite individuals is addressed above in SER Section 13.3.4.10. Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 13.3-3-A.

- STD COL 13.4-2-A

DCD COL Item 13.4-2-A states that the COL applicant will provide implementation milestones for operational programs that are required by NRC regulation. In FSAR Section 13.4, the applicant identified this as STD COL 13.4-2-A, and stated that FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations," lists each operational program, the regulatory source for the program, the associated implementation milestone(s), and the Section of the FSAR in which the operational program is fully described. Table 13.4-201 lists the Emergency Planning program (Item) No. 14, and includes the associated implementation milestones. The staff reviewed FSAR Section 13.4 and Table 13.4-201, and determined that the applicant provided implementation milestones for the EP operational program that are required by NRC regulation. The staff's evaluation of these implementation milestones is addressed below in SER Section 13.3.4.19, and in SER Section 13.4, "Operational Programs." Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 13.4-2-A.

- STD COL 14.3-1-A

DCD COL Item 14.3-1-A states that the COL applicant shall provide EP ITAAC based on industry guidance. In FSAR Section 14.3, the applicant identified this as STD COL 14.3-1-A, and stated that the set of generic EP ITAAC in SECY-05-0197, "Review of Operational

Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005 (ADAMS Accession No. ML052770225), was considered in the development of the plant-specific EP ITAAC, which are tailored to the ESBWR design, and included in a separate part of the COLA (i.e., Part 10, Table 2.3-1, which is reflected below in SER Table 13.3-1). The ESBWR DCD does not include any EP ITAAC. The staff reviewed the EP ITAAC in Table 2.3-1 against the generic EP ITAAC in Table 14.3.10-1 of SRP, Section 14.3.10, and determined that the applicant provided EP ITAAC based on guidance in the SRP, because the EP ITAAC in SECY-05-0197 is a subset of, and consistent with, the EP ITAAC in Table 14.3.10-1. The staff's evaluations of individual EP ITAAC in Table 2.3-1 are addressed above in SER Section 13.3.4, as they relate to the various planning standards. Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 14.3-1-A.

- STD COL 1C.1-2-A

DCD COL Item 1C.1-2-A states that the COL applicant will address the requirements of IE BL 2005-02 regarding emergency preparedness and response actions for security-based events. In FSAR Appendix 1C, the applicant identified this as STD COL 1C.1-2-A. Part 2 Table 1C-202 identifies COLA Part 5, Emergency Plan (i.e., COL Plan), as the location where BL 2005-02 is discussed. BL 2005-02 addresses five areas associated with emergency preparedness and response actions for security-based events. These areas, including the COL Plan Section(s) where each is addressed, are as follows:

(1) Emergency classification scheme for security events (COL Plan Section II.D)

(2) NRC notifications (COL Plan Section II.E)

(3) Onsite protective measures (COL Plan Sections II.H and II.J)

(4) ERO augmentation, including alternative emergency response facilities (COL Plan Sections II.B, II.H, and II.J)

(5) Security-related drill and exercise program (COL Plan Section II.N)

The staff reviewed the COLA against BL 2005-02 to identify actions taken or planned to be taken for areas (1) through (5), identified above, and determined that the applicant addressed all of the requirements of BL 2005-02, with regard to emergency preparedness and response actions for security-based events. The staff's evaluation, associated with the applicable areas (1) through (5) of BL 2005-02, is addressed above in SER Sections 13.3.4.2 (4), 13.3.4.4 (1), 13.3.4.5 (2), 13.3.4.8 (3) and (4), 13.3.4.10 (3) and (4), and 13.3.4.14 (5). Therefore, the staff finds that the COL applicant has adequately addressed DCD COL Item 1C.1-2-A.

- STD SUP 13.5-28

STD SUP 13.5-28 states that a discussion of emergency preparedness procedures can be found in the emergency plan, and a list of implementing procedures is maintained in the emergency plan. COL Plan Appendix 5 lists the EPIPs by topic, and states that EPIPs address a range of actions needed to implement the contents of the emergency plan. Specific topical

EPIPs are identified above in SER Section 13.3.4, in relation to their applicability to the various planning standards that are addressed in the emergency plan. Submission of EPIPs to the NRC is discussed below in SER Section 13.3.4.19, and addressed in ITAAC 9.1 of SER Table 13.3-1. Administrative, plant operating, and emergency procedures are addressed in DCD Tier 2, Section 13.5, "Plant Procedures," and discussed in SER Section 13.5, "Plant Procedures."

13.3.4.19 Implementation Milestones

Activities that the COL licensee shall perform after the COL is issued, that are applicable to EP, include the implementation milestones and license conditions listed below. In Table 13.4-201 of FSAR Section 13.4, the applicant listed operational programs required by NRC regulations. The EP program is identified as operational program (Item) No. 14, and includes the associated implementation milestones. The staff reviewed Table 13.4-201, and finds that the proposed implementation milestones associated with the EP program are acceptable because they are consistent with the relevant guidance and acceptance criteria in the SRP, and therefore meet the requirements in Appendix E of 10 CFR Part 50. The implementation milestone associated with EALs is subject to the staff-identified changes reflected in proposed License Condition 4 (see SER Sections 13.3.4.4 and 13.3.5). See also, STD SUP 13.5-28 in SER Section 13.3.4.18, ITAAC 9.1 in SER Table 13.3-1, and SER Sections 13.4 and 13.5, with regard to EPIPs.

Implementation Milestones

- Full participation exercise conducted within 2 years prior to scheduled date for initial loading of fuel, as required by 10 CFR Part 50, Appendix E, Section IV.F.2(a)(ii).

- Onsite exercise conducted within 1 year prior to the scheduled date for initial loading of fuel, as required by 10 CFR Part 50, Appendix E, Section IV.F.2(a)(ii).

- Licensee's detailed implementing procedures for its emergency plan submitted at least 180 days prior to the scheduled date for initial loading of fuel, as required by 10 CFR Part 50, Appendix E, Section V.

- The licensee shall submit a fully developed set of site-specific EAL to the NRC in accordance with the NRC-endorsed version of NEI 07-01, Revision. 0, with no deviations. The fully developed site-specific EAL scheme shall be submitted to the NRC for confirmation at least 180 days prior to initial fuel load.

13.3.5 Post-Combined License Activities

For the reasons discussed in the technical evaluation Section above, the staff proposes to include the following license conditions:

License Conditions 1 through 5

1. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in

the ITAAC, the licensee shall have performed an assessment of on-site and augmented staffing capability for responding to a multi-unit event. The staffing assessment shall be performed in accordance with NEI 12-01, “Guidance for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.” At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall complete implementation of corrective actions identified in the staffing assessment described above, and identify how the augmented staff will be notified given degraded communications capabilities, including any related emergency plan and implementing procedure changes and associated training. [See Section 13.3.4.2 of this report.]

2. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, the licensee shall have performed an assessment of on-site and off-site communications systems and equipment relied upon during an emergency event to ensure communications capabilities can be maintained during an extended loss of ac power. The communication capability assessment shall be performed in accordance with NEI 12-01, “Guidance for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities.” At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall complete implementation of corrective actions identified in the communications capability assessment described above, including any related emergency plan and implementing procedure changes and associated training. [See Sections 13.3.4.2 and 13.3.4.6 of this report.]

3. No later than 2 years before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, the licensee shall have performed an assessment of on-shift staffing in accordance with NEI 10-05, “Assessment of On-Shift Emergency Response Organization Staffing and Capabilities.” At least one hundred eighty (180) days before the date scheduled for initial fuel loading, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall incorporate any changes to the emergency plan needed to bring staffing to the required levels. [See Section 13.3.4.2 of this report.]

4. No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR § 52.103(a), the licensee shall submit to the Director of NRO, or the Director’s designee, in writing, a fully developed set of plant-specific emergency action levels (EALs) for North Anna 3, in accordance with NEI 07-01, “Methodology for Development of Emergency Action Levels – Advanced Passive Light Water Reactors,” Revision 0, with no deviations. The EALs shall have been discussed and agreed upon with State and local officials. [See Section 13.3.4.4 of this staff FSER.]

5. No later than one hundred eighty (180) days before the date schedule for initial fuel load set forth in the notification submitted in accordance with 10 CFR § 52.103(a), the licensee shall update North Anna Units 1 and 2 Letters of Agreement with the following entities, or their successors, and revise the Unit 3 Emergency Plan to include these

updated Letters of Agreement after they have been executed. These updated Letters of Agreement shall identify the specific nature of arrangements in support of emergency preparedness for the North Anna site, including North Anna 3, and reflect expected assistance associated with hostile action at the North Anna site, as defined in 10 CFR Part 50, Appendix E, Section IV.A.7.

a. Commonwealth of Virginia Department of Emergency Management
b. Commonwealth of Virginia Department of Health
c. Commonwealth of Virginia Department of State Police
d. Commonwealth of Virginia Department of Game and Inland Fisheries
e. Virginia Commonwealth University Medical Center
f. Louisa County Administrator
g. Louisa County Sheriff
h. Louisa County Department of Fire and Emergency Medical Services
i. Spotsylvania County Sheriff
j. Spotsylvania Department of Fire, Rescue, and Emergency Management
k. Orange County Administrator
l. Orange County Sheriff
m. Caroline County Sheriff
n. Caroline County Department of Fire, Rescue, and Emergency Management
o. Hanover County Administrator
p. Hanover County Sheriff

[See Section 13.3.4.16 of this report.]

For the reasons discussed in the technical evaluation Section above, the staff proposes to include the following EP ITAAC:

- The licensee shall perform and satisfy the acceptance criteria of the EP ITAAC set forth in SER Table 13.3-1.

13.3.6 Conclusions

The staff reviewed the application, including applicable portions of the referenced North Anna site ESP SSAR and ESBWR DCD. The staff confirmed that the applicant addressed the required information relating to EP, and that there is no additional information needed to support the North Anna 3 COL application. The results of the staff's technical evaluation of the information incorporated by reference in the application are documented in NUREG–1835 for the ESP, and NUREG–1966 for the ESBWR standard design.

The EP ITAAC that are applicable to North Anna 3 are provided below in SER Table 13.3-1. The staff concludes that, pursuant to 10 CFR 52.80(a), the applicant included in the North Anna 3 COL application the proposed inspections, tests, and analyses that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the license, the provisions of the Atomic Energy Act, and the NRC's rules and regulations.

The FEMA provided its findings and determinations concerning the adequacy of offsite EP and preparedness, which are based on its review of State and local emergency plans. FEMA concluded that the offsite State and local emergency plans are adequate to cope with an incident at the North Anna site, and there is reasonable assurance that these plans can be implemented. On the basis of its review of these FEMA findings and determinations, the staff concludes that the State and local emergency plans are adequate, and there is reasonable assurance that they can be implemented.

Based on its evaluation, the staff concludes that the onsite emergency plan establishes an adequate planning basis for an acceptable state of onsite emergency preparedness, and there is reasonable assurance that the plan can be implemented.

Base on FEMA's conclusions and the staff's evaluation, the staff concludes that the emergency plans provide an adequate expression of the overall concept of operation and describe the essential elements of advanced planning and the provisions made to cope with emergency situations. Therefore, the staff concludes that the overall state of onsite and offsite emergency preparedness, when fully implemented, will meet the requirements of 10 CFR 50.33(g), 10 CFR 50.47, Appendix E to 10 CFR Part 50, 10 CFR 52.77, 10 CFR 52.79(a)(21), 10 CFR 52.79(a)(22)(i), 10 CFR 52.79(b)(4), 10 CFR 52.80, 10 CFR 52.83, and 10 CFR 100.21.

Further, in accordance with 10 CFR 50.47(a), the staff concludes that, subject to the required conditions and limitations of the full-power license, including the license conditions listed in Section 13.3.5 of this SER, there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the North Anna site, and that emergency preparedness at North Anna 3 is adequate to support full-power operations.

Table 13.3-1 North Anna 3 ITAAC

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
1.0 Emergency Classification System			
10 CFR 50.47(b)(4) – A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee, and State and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures.	1.1 A standard emergency classification and emergency action level (EAL) scheme exists, and identifies facility system and effluent parameters constituting the bases for the classification scheme. [D.1**] [**D.1 corresponds to NUREG-0654/FEMA-REP-1 evaluation criteria.] ITAAC element addressed in: Combined license (COL) Emergency Plan (EP) II.D.1	1.1 An inspection of the control room, technical support center (TSC), and emergency operations facility (EOF) will be performed to verify that they have displays for retrieving facility system and effluent parameters that constitute the bases for the classification scheme identified in the Emergency Plan Implementing Procedures (EPIPs).	1.1.1 The specific parameters identified in the EAL thresholds listed in the EPIPs have been retrieved and displayed in the control room, TSC, and EOF. 1.1.2 The ranges available in the control room, TSC, and EOF encompass the values for the specific parameters identified in the EAL thresholds listed in the EPIPs.
2.0 Notification Methods and Procedures			
10 CFR 50.47(b)(5) – Procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations and the public has been established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone (EPZ) have been established.	2.1 The means exist to notify responsible State and local organizations within 15 minutes after the licensee declares an emergency. [E.1] ITAAC element addressed in: COL EP II.E.1	2.1 A test will be performed of the capabilities.	2.1 A means to notify responsible organizations, within 15 minutes after the licensee declares an emergency, has been established via the Operational Hot Line among the control room, the Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange County, and Spotsylvania County.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	2.2 The means exist to notify emergency response personnel. [E.2] ITAAC element addressed in: COL EP II.E.2	2.2 A test will be performed of the capabilities.	2.2 A means exists to notify the North Anna 3 emergency response organization.
	2.3 The means exist to notify and provide instructions to the populace within the plume exposure EPZ. [E.6] ITAAC element addressed in: COL EP II.E.6	2.3 The full test of notification capabilities will be conducted.	2.3 A means exists to notify and provide instructions to the public in accordance with the emergency plan requirements.
3.0 Emergency Communications			
10 CFR 50.47(b)(6) – Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public.	3.1 The means exist for communications among the control room, TSC, EOF, principal State and local emergency operations centers (EOCs), and radiological field assessment teams. [F.1.d] ITAAC element addressed in: COL EP II.F.1.d	3.1 A test will be performed of the capabilities.	3.1.1 Communications have been established between the control room and TSC. 3.1.2 Communications have been established among the control room, TSC, and EOF. 3.1.3 Communications via the Operational Hot Line have been established among the TSC and EOCs, which include the Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange County, and Spotsylvania County. 3.1.4 Communications have been established between the TSC and radiological monitoring teams. 3.1.5 Communications have been established between the EOF and radiological monitoring teams.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	3.2 The means exist for communications from the control room, TSC, and EOF to the Nuclear Regulatory Commission (NRC) headquarters and regional office EOCs (including establishment of the Emergency Response Data System (ERDS) between the onsite computer system and the NRC Operations Center). [F.1.f] ITAAC element addressed in: COL EP II.F.1.f	3.2 A test will be performed of the capabilities.	3.2 Communications have been established from the control room, TSC, and EOF to the NRC headquarters and Region II EOCs and an access port for ERDS is provided.
4.0 Public Education and Information			
[Deleted]	[Deleted]	[Deleted]	[Deleted]
5.0 Emergency Facilities and Equipment			
10 CFR 50.47(b)(8) – Adequate emergency facilities and equipment to support the emergency response are provided and maintained.	5.1 The licensee has established a TSC and onsite operational support center (OSC). [H.1] ITAAC element addressed in: COL EP II.H.1	5.1 An inspection of the as-built TSC and OSC will be performed.	5.1.1 The TSC has at least 1950 square feet of floor space. 5.1.2 The following communications equipment have been provided in the TSC and voice transmission and reception have been accomplished: a. NRC systems: Emergency Notification System (ENS), Health Physics Network (HPN), Reactor Safety Counterpart Link (RSCL), Protective Measures Counterpart Link (PMCL),

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Management Counterpart Link (MCL) b. Dedicated telephone to EOF c. Dedicated telephone to control room d. Dedicated telephone to OSC 5.1.3 The TSC has been located in the Electrical Building. 5.1.4 The TSC includes radiation monitors and a ventilation system with a high efficiency particulate air (HEPA) and charcoal filter. 5.1.5 A back-up electrical power supply is available for the TSC.
			5.1.6 The OSC is in a location separate from the control room. 5.1.7 The following communications equipment have been provided in the OSC and voice transmission and reception have been accomplished: a. Dedicated telephone to control room b. Dedicated telephone to TSC c. Plant page system (voice transmission only)
	5.2 The licensee has established an EOF. [H.2] ITAAC element addressed in: COL EP II.H.2	5.2 An inspection of the EOF will be performed.	5.2.1 A report exists that confirms the EOF has at least 243 square meters (2625 square feet). 5.2.2 Voice transmission and reception have been accomplished between the EOF and TSC. 5.2.3 A report exists that confirms voice transmission and reception have been accomplished via the Operational Hot Line among the EOF,

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange County, and Spotsylvania County. 5.2.4 The EOF has the means to acquire, display and evaluate radiological, meteorological, and plant system data pertinent to determining offsite protective measures.
6.0 Accident Assessment			
10 CFR 50.47(b)(9) – Adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition are in use.	6.1 The means exist to provide initial and continuing radiological assessment throughout the course of an accident. [I.2] ITAAC element addressed in: COL EP II.I.2, Appendix 2	6.1 A test of the emergency plan will be conducted by performing an exercise or drill to verify the capability to perform accident assessment.	6.1 An exercise or drill has been accomplished, including use of selected monitoring parameters identified in the EAL thresholds listed in the EPIPs, to assess simulated degraded plant conditions and initiate protective actions in accordance with the following criteria: A. *Accident Assessment and Classification* 1. Initiating conditions identified, EAL parameters determined, and the emergency correctly classified throughout the drill. 2. Protective action recommendations developed and communicated to appropriate authorities. B. *Radiological Assessment and Control* 1. Onsite radiological surveys performed and samples collected. 2. Radiation exposure of emergency workers monitored and controlled. 3. Field monitoring teams assembled and deployed.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			4. Field team data collected and disseminated. 5. Dose projections developed. 6. The decision whether to issue radioprotective drugs to NAPS emergency workers made.
	6.2 The means exist to determine the source term of releases of radioactive material within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors. [I.3] ITAAC element addressed in: COL EP II.I.3, Appendix 2	6.2 An analysis of EPIPs and the Offsite Dose Calculation Manual (ODCM) will be completed to verify the ability to determine the source term and magnitude of release.	6.2 The EPIPs and ODCM correctly calculate source terms and magnitudes of postulated releases.
	6.3 The means exist to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions. [I.4] ITAAC element addressed in: COL EP II.I.4, Appendix 2	6.3 An analysis of EPIPs and the ODCM will be completed to verify the relationship between effluent monitor readings and offsite exposures and contamination for various meteorological conditions has been established.	6.3 The EPIPs and ODCM calculate the relationship between effluent monitor readings and offsite exposures and contamination for various meteorological conditions.
	6.4 The means exist to acquire and evaluate meteorological information. [I.5]	6.4 An inspection of the control room, TSC, and EOF will be performed to verify the availability of the	6.4 The following meteorological data is available in the control room, TSC, and EOF:

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	ITAAC element addressed in: COL EP II.I.5	following meteorological data: • Wind speed (at 10 meters (m) and 48.4 m) • Wind direction (at 10 m and 48.4 m) • Ambient air temperature (at 10 m) • Differential air temperature (between 10 m and 48.4 m)	• Wind speed (at 10 m and 48.4 m) • Wind direction (at 10 m and 48.4 m) • Ambient air temperature (at 10 m) • Differential air temperature (between 10 m and 48.4 m)
	6.5 The means exist to make rapid assessments of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways, including activation, notification means, field team composition, transportation, communication, monitoring equipment, and estimated deployment times. [I.8] ITAAC element addressed in: COL EP II.I.8	6.5 A test will be performed of the capabilities.	6.5 Demonstrate the capability for making rapid assessment of the actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways.
	6.6 The capability exists to detect and measure radioiodine concentrations in air in the plume exposure EPZ, as low as 10^{-7} µCi/cc (microcuries per cubic centimeter) under field conditions. [I.9] ITAAC element addressed in: COL EP II.I.9	6.6 A test of NAPS field survey instrumentation will be performed to verify the capability to detect airborne concentrations as low as 1E-07 µCi/cc.	6.6 Instrumentation used for monitoring I-131 to detect airborne concentrations as low as 1E-07 µCi/cc has been provided.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	6.7 The means exist to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the Environmental Protection Agency (EPA) protective action guides (PAGs). [I.10] ITAAC element addressed in: COL EP II.I.10, Appendix 2	6.7 An analysis of EPIPs will be performed to verify that a methodology is provided to establish means for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the following isotopes: Kr-88, Ru-106, I-131, I-132, I-133, I-134, I-135, Te-132, Xe-133, Xe-135, Cs-134, Cs-137, Ce-144	6.7 A report exists and concludes a methodology has been established for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the specified isotopes (Kr-88, Ru-106, I-131, I-132, I-133, I-134, I-135, Te-132, Xe-133, Xe-135, Cs-134, Cs-137, Ce-144), and for comparing the dose estimates with the EPA PAGs.
7.0 Protective Response			
10 CFR 50.47(b)(10) – A range of protective actions has been developed for the plume exposure EPZ for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place, and protective actions for the ingestion exposure EPZ appropriate to the locale have been developed.	7.1 The means exist to warn and advise onsite individuals of an emergency, including those in areas controlled by the operator, including: [J.1] a. employees not having emergency assignments; b. visitors; c. contractor and construction personnel; and d. other persons who may be in the public access areas, on or passing through the site, or within the owner controlled area. ITAAC element addressed in: COL EP II.J.1	7.1 A test of the onsite warning and communications capability will be performed during a drill or exercise.	7.1.1 During a drill or exercise, notification and instructions were provided to onsite workers and visitors, within the Protected Area, over the plant public announcement system. 7.1.2 During a drill or exercise, audible warnings were provided to individuals outside the Protected Area, but within the Owner Controlled Area.
8.0 Exercises and Drills			

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
10 CFR 50.47(b)(14) – Periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills are (will be) corrected.	8.1 Licensee conducts a full-participation exercise to evaluate major portions of emergency response capabilities, which includes participation by each State and local agency within the plume exposure EPZ, and each State within the ingestion control EPZ. [N.1] ITAAC element addressed in: COL EP II.N.1	8.1 A full-participation exercise (test) will be conducted within the specified time periods of Appendix E to 10 CFR Part 50.	8.1.1 The exercise is completed within the specified time periods of 10 CFR Part 50, Appendix E, and a report exists that confirms onsite exercise objectives listed below have been met and there are no uncorrected onsite exercise deficiencies. A. *Accident Assessment and Classification* 1. Demonstrate the ability to identify initiating conditions, determine EAL parameters, and correctly classify the emergency throughout the exercise. Standard Criteria: a. Determine the correct highest emergency classification level based on events which were in progress, considering past events and their impact on the current conditions, within 15 minutes from the time the initiating condition(s) or EAL(s) is (are) identified. B. *Notifications* 1. Demonstrate the ability to alert, notify, and mobilize site emergency response personnel. Standard Criteria: a. Initiate activation of the emergency recall system following initial event classification for an Alert or higher. 2. Demonstrate the ability to notify responsible State and local government agencies within 15 minutes and the NRC within 60 minutes after declaring an emergency.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			a. Initiate transmittal of initial information to the Commonwealth of Virginia and risk jurisdictions using the designated EPIP within 15 minutes of event classification. b. Initiate transmittal of follow-up information to the Commonwealth of Virginia and risk jurisdictions using the designated EPIP within appropriate interval. c. Initiate transmittal of initial information to the NRC using the designated EPIP within 60 minutes of event classification. 3. Demonstrate the ability to warn or advise onsite individuals of emergency conditions. Standard Criteria: a. Initiate notification of onsite individuals (via plant page or telephone), using the designated EPIP within 15 minutes of notification. 4. Demonstrate the capability of the Alert and Notification System (ANS) sirens to operate properly when required. Standard Criteria: a. 90 percent of the sirens operate properly. C. *Emergency Response* 1. Demonstrate the capability to direct and control emergency operations. Standard Criteria: a. Command and control is demonstrated by the control room in the early phase of the emergency

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			and the TSC, after its activation. 2. Demonstrate the ability to transfer emergency direction from the control room (simulator) to the TSC. Standard Criteria: a. Briefings were conducted prior to turnover responsibility. Personnel document transfer of duties. 3. Demonstrate the ability to prepare for around-the-clock staffing requirements. Standard Criteria: a. Complete 24-hour staff assignments. 4. Demonstrate the ability to perform assembly and accountability for all onsite individuals during an emergency requiring Protected Area assembly and accountability. Standard Criteria: a. Protected Area personnel assembly and accountability completed within 30 minutes following initiation of assembly and accountability measures. D. *Emergency Response Facilities* 1. Demonstrate activation of the OSC, and full functional operation of the TSC and EOF. Standard Criteria: a. The TSC, OSC, and EOF are activated within about 60 minutes of the initial notification. 2. Demonstrate the adequacy of equipment, security provisions, and habitability precautions for the TSC, OSC, EOF, and

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Joint Information Center (JIC), as appropriate. Standard Criteria: a. Demonstrate the adequacy of the emergency equipment in the emergency response facilities. b. The Security Team Leader implements and follows applicable EPIPs. c. The Health Physics (HP) personnel implement the designated EPIP provisions if an onsite or offsite release has occurred. 3. Demonstrate the adequacy of communications for all emergency support resources. Standard Criteria: a. Emergency response facility personnel are able to operate all specified communication systems. b. Clear primary or backup communications links are established and maintained for the duration of the exercise. E. *Radiological Assessment and Control* 1. Demonstrate the ability to obtain onsite radiological surveys and samples. Standard Criteria: a. HP personnel demonstrate the ability to obtain appropriate instruments (range and type) and take surveys. b. Airborne samples are taken when the conditions indicate the need for the information. 2. Demonstrate the ability to continuously monitor

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			and control radiation exposure to emergency workers. Standard Criteria: a. Emergency workers are issued self-reading dosimeters when radiation levels require, and exposures are controlled to 10 CFR Part 20 occupational dose limits (unless the Emergency Coordinator/EOF Director authorizes emergency limits). b. Exposure records are available. c. Emergency workers include Security and personnel within all emergency facilities. 3. Demonstrate the ability to assemble and deploy field monitoring teams. Standard Criteria: a. One field monitoring team is ready to be deployed within 60 minutes of being requested, and no later than 90 minutes from the declaration of an Alert or higher emergency. 4. Demonstrate the ability to satisfactorily collect and disseminate field team data. Standard Criteria: a. Field team data to be collected is dose rate or counts per minute (cpm) from the plume, both open and closed window, and air sample (gross/net cpm) for particulate and iodine, if applicable. b. Satisfactory data dissemination is from the field team to HP (Plume

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Tracking/Dose Assessment) personnel. 5. Demonstrate the ability to develop dose projections. Standard Criteria: a. Timely and accurate dose projections are performed in accordance with EPIPs. 6. Demonstrate the ability to make the decision whether to issue radioprotective drugs to emergency workers. Standard Criteria: a. Radioprotective drugs are taken (simulated) if the estimated dose to the thyroid will exceed 25 rem committed dose equivalent (CDE). 7. Demonstrate the ability to develop appropriate protective action recommendation(s) (PAR(s)) and notify appropriate authorities within 15 minutes of development. Standard Criteria: a. Total effective dose equivalent (TEDE) and CDE dose projections from the dose assessment computer code are compared to criteria in EPIPs. b. PAR(s) is (are) developed within 15 minutes of data availability, as appropriate. c. PAR(s) is (are) transmitted to responsible State and local government agencies within 15 minutes of development. F. *Public Information*

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			1. Demonstrate the capability to develop and disseminate clear, accurate, and timely information to the news media. Standard Criteria: a. Media information (e.g., press releases, press briefings, electronic media) is made available following notification of Dominion External Affairs personnel. 2. Demonstrate the capability to establish and effectively operate rumor control in a coordinated fashion. Standard Criteria: a. Calls are answered in a timely manner with the correct information. b. Rumors are identified and addressed. G. *Evaluation* 1. Demonstrate the ability to conduct a post-exercise critique, to determine areas requiring improvement and corrective action. Standard Criteria: a. An exercise time-line is developed, followed by an evaluation of the objectives. b. Significant problems in achieving the objectives are discussed to ensure understanding of why objectives were not fully achieved. c. Recommendations for improvement in non-objective areas are discussed.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			8.1.2 Onsite emergency response personnel are mobilized in sufficient number to fill the emergency positions identified in COL EP II.B, Onsite Emergency Organization, and a report exists that confirms they successfully perform their assigned responsibilities as outlined in Acceptance Criterion 8.1.1.D, Emergency Response Facilities.
			8.1.3 The exercise is completed within the specified time periods of 10 CFR Part 50, Appendix E, a report exists that confirms offsite exercise objectives have been met and there are no uncorrected offsite deficiencies, or a license condition requires offsite deficiencies to be corrected prior to operation above 5 percent of rated power.
9.0 Implementing Procedures			
10 CFR Part 50, Appendix E.V – No less than 180 days prior to the scheduled issuance of an operating license for a nuclear power reactor or a license to possess nuclear material, the applicant's detailed implementing procedures for its emergency plan shall be submitted to the Commission.	9.1 The licensee has submitted detailed implementing procedures for its emergency plan no less than 180 days prior to fuel load.	9.1 An inspection will be performed to confirm that the detailed implementing procedures for the North Anna 3 Emergency Plan were submitted to the NRC.	9.1 Each of the detailed implementing procedures for the North Anna 3 Emergency Plan, as defined in Appendix 5 of the Emergency Plan, are submitted to the NRC no less than 180 day prior to fuel load.

13.4 <u>Operational Program Implementation</u>

13.4.1 Introduction

This Section of the FSAR addresses the operational programs described in NRC guidance SECY-05-0197. The Section includes a description of the programs and the proposed implementation milestones for each program.

This Section describes the proposed implementation milestones for each operational program in compliance with the guidance of RG 1.206, Regulatory Position C.I.13.4. The applicant provides this information in FSAR Table 13.4-201 "Operational Programs Required by NRC Regulations," which lists each operational program, the regulatory requirement for the program, the associated implementation milestone(s), and the Section of the FSAR that describes the operational program.

13.4.2 Summary of Application

Section 13.4.1 of North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 13.4.1 of the certified ESBWR DCD, Revision 10. In addition, in FSAR Section 13.4.1, Revision 8, the applicant provides the following:

<u>COL Items</u>

- STD COL 13.4-1-A Operational Programs

Table 13.4-201 lists each operational program, the regulatory source for the program, the associated implementation milestone(s), and the Section of the FSAR that fully describes the operational program, as required by RG 1.206.

- STD COL 13.4-2-A Implementation Milestones

The applicant provided the information in FSAR Table 13.4-201, which lists each operational program, the regulatory requirement for each program, the associated implementation milestone(s), and the Section of the FSAR that fully describes the operational program consistent with the guidance in RG 1.206.

13.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, in the Staff Requirements Memorandum on SECY-05-0197, the Commission provided the following directions regarding operational programs:

- Include license conditions for operational programs in the COL, where implementation requirements are not specified in the regulations.

- Identify the list of operational programs required to be included in a COL application.

- Use the proposed generic EP-ITAAC as a model for EP-ITAAC to be included in COL applications.

- The SRP Section 13.4.1 provides guidance for staff review. For a COL application, the staff reviews the applicable table in FSAR Section 13.4.1, Revision 8, to ensure that all required operational programs are included. The staff's review of the operational program description and the proposed implementation milestones is performed within the identified SRP Section reviews.

13.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.4 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.4 of North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this Section.

The staff reviewed the information in North Anna 3 COL FSAR as follows:

COL Items

- STD COL 13.4-1-A Operational Programs
- STD COL 13.4-2-A Implementation Milestones

The staff reviewed FSAR Table 13.4-201 and determined that the applicant had identified the operational programs required by NRC regulations and had provided a description of the proposed implementation milestones for each program in North Anna 3 COL Part 10, "Tier 1/ITAAC/Proposed License Conditions." The technical evaluation of the operational programs to ensure that the applicant has fully described the programs and their associated implementation milestones is provided in the respective Section of this SER.

Operational Program Implementation Schedule License Condition:

> No later than 12 months after issuance of the COL, Dominion shall submit to the Director of NRO, or the Director's designee, a schedule for implementation of the operational programs listed in FSAR Table 13.4-201, including the associated estimated date for initial loading of fuel.
>
> The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until all the operational programs listed in FSAR Table 13.4-201 have been fully implemented.

13.4.5 Post Combined License Activities

License Condition Section 3.6 of North Anna COLA Part 10 references North Anna 3 FSAR Table 13.4-201, for the implementation milestones for each operational program. These implementation milestones, the schedule for which is required to be submitted and updated in accordance with the license condition described above, specify activities to be completed following issuance of the COL. Implementation of each operational program will be evaluated by the staff according to the respective implementation milestone.

13.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the COL application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this Section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this Section that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 13.4.1, and other NRC RGs. The staff's review concludes that the applicant has presented adequate information on COL Items STD COL 13.4-1-A and 13.4-2-A in Table 13.4-201 of the COL FSAR.

13.5 <u>Plant Procedures</u>

This Section of the FSAR addresses the administrative and operating procedures that the operating organization (plant staff) uses to ensure that routine operating, off-normal, and emergency activities are conducted in a safe manner. This Section is divided into two Sections that are described below—Administrative Procedures and Operating and Emergency Operating Procedures. The inspection of the procedures will occur as part of the construction inspection program.

13.5.1 Administrative Procedures

13.5.1.1 Introduction

The administrative procedures the applicant uses to ensure that routine operating, off-normal, and emergency activities are conducted in a safe manner are provided. In plant procedures, the applicant provides a brief description of the nature and content of the procedures and a schedule for the preparation of appropriate written administrative and operating procedures. The applicant delineates in the description of the procedures the functional position for procedural revisions and approval before implementation.

13.5.1.2 Summary of Application

Section 13.5.1 of North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 13.5.1 of the certified ESBWR DCD Revision 10. In addition, in FSAR Section 13.5.1, the applicant provides the following information:

COL Item

- STD COL 13.5-1-A Administrative Procedures

Industry guidance for the appropriate format, content, and typical activities delineated in written procedures is implemented, as appropriate. Guidance is based on ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications."

Administrative procedures are developed in accordance with the nominal schedule presented in Table 13.5-202.

Supplemental Information

- STD SUP 13.5-1

In FSAR Section 13.5, the applicant states that this Section describes the administrative and operating procedures that the operating organization (plant staff) uses to conduct routine operating, abnormal, and emergency activities in a safe manner.

- STD SUP 13.5-2

The quality assurance program description (QAPD) describes procedural document control, record retention, adherence, assignment of responsibilities, and changes.

- STD SUP 13.5-3

Procedures are identified in this section by topic, type, or classification in lieu of the specific title and represent general areas of procedural coverage.

- STD SUP 13.5-4

The applicant states that procedures are developed before fuel loading to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations.

- CWR COL 13.5-4-A

Industry guidance for the appropriate format, content, and typical activities delineated in written procedures is implemented, as appropriate. Guidance is based on ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications" (Reference 13.5-02).

- STD SUP 13.5-5

The format and content of procedures are controlled by administrative procedure(s). Procedures are organized to include the following components, as necessary:

    - Title Page
    - Table of Contents
    - Scope and Applicability

- Responsibilities
- Prerequisites
- Precautions and Limitations
- Main Body
- Acceptance Criteria
- Check-off Lists
- References
- Attachments and Data Sheets

- STD SUP 13.5-6

Each procedure is sufficiently detailed for an individual to perform the required function without direct supervision but does not provide a complete description of the system or plant process. The level of detail in the procedure is commensurate with the qualifications of the individual normally performing the function.

- STD SUP 13.5-7

Procedures are developed to be consistent with the guidance described in DCD Section 18.9, "Procedure Development," and with input from the human factors engineering (HFE) process and evaluations.

The bases for procedure development include:

- Plant design bases

- System-based technical requirements and specifications

- Task analyses results

- Risk-important human actions identified in the human reliability analysis (HRA)/probabilistic risk assessment (PRA)

- Initiating events considered in the Emergency Operating Procedures (EOPs), including those events in the design bases

- Generic Technical Guidelines (GTG) for EOPs

Procedure verification and validation (V&V) includes the following activities, as appropriate:

- A review to verify they are correct and can be carried out.

- A final validation in a simulation of the integrated system as part of the V&V activities as described in DCD Section 18.11, "Human Factors Verification and Validation."

- A verification of modified procedures for adequate content, format, and integration.

- The procedures are assessed through validation if a modification substantially changes personnel tasks that are significant to plant safety. The validation verifies that the procedures correctly reflect the characteristics of the modified plant and can be performed effectively to restore the plant.

- STD SUP 13.5-8

Procedures for shutdown management are developed to be consistent with the guidance in NUMARC 91-06, “Guidelines for Industry Actions to Assess Shutdown Management,” to reduce the potential for the loss of reactor coolant system boundary and inventory during shutdown conditions. (Reference 13.5-203)

- STD SUP 13.5-9

This Section describes administrative procedures that provide administrative controls over activities that are important to safety for the operation of the facility.

- CWR SUP 13.5-10

Procedures outline the essential elements of the administrative programs and controls as described in ASME NQA-1 and Section 17.5. These procedures are organized such that the program elements are prescribed in documents normally referred to as administrative procedures. Administrative procedures contain adequate programmatic controls to provide effective interface between organizational elements. This includes contractor and owner organizations providing support to the station operating organization.

- CWR SUP 13.5-11

Procedure control is discussed in the QAPD. Type and content of procedures are discussed throughout Section 13.5.

- STD SUP 13.5-12

The applicant defines the procedure writer’s guide.

- STD SUP 13.5-13

The applicant states that updates to maintenance and control procedures are performed according to the QAPD.

- STD SUP 13.5-14

The applicant states that the administrative programs and associated procedures developed in the pre-COL phase are described in Table 13.5-201.

- STD SUP 13.5-15

This Section describes those procedures that provide administrative controls with respect to procedures, including those that define and provide controls for operational activities of the plant staff.

- STD SUP 13.5-16

The applicant provides a list of plant administrative procedures.

13.5.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the administrative and plant procedures, and the associated acceptance criteria, are in Section 13.5.1 and SRP Section 13.5.2.1.

In particular, the relevant provisions for reviewing plant procedures are based on (1) meeting the methods and criteria described in 10 CFR 52.79(a)(14), (26), (29)(i), (29)(ii), (33), and (34), and in TMI Action Plan Items I.C.1 and I.C.9; and (2) meeting the guidance of SRP, Sections 13.5.1.1 and 13.5.2.1. The review of FSAR information related to the development of emergency procedures is based on meeting the requirements of 10 CFR 52.79(a)(14), (26), (29)(i), (29)(ii), (33), and (34); and the guidance of SRP, Section 13.5.2.1.

The provisions for reviewing COL Item STD COL 13.5-1-A related to the implementation of the plan are based on the following:

- Meeting the requirements of 10 CFR 52.79(a)(14), (26), (29)(i), (29)(ii), (33), and (34).
- Meeting the TMI Action Plan requirements described in NUREG–0737 and Supplement 1 to NUREG–0737.
- The plant procedures in accordance with the provisions of TMI Action Plan Item I.C.5.
- The guidance of SRP, Sections 13.5.1.1 and 13.5.2.1.

The relevant provisions for reviewing FSAR information related to the procedures included in the scope of the plan are based on (1) meeting the requirements of the procedures in Sections A3, A5, and A10 of ANSI/ANS-3.2; and (2) meeting the guidance of SRP, Sections 13.5.1.1 and 13.5.2.1.

13.5.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.5.1 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.5.1 of North Anna 3 COL FSAR, Revision 8 and checked the referenced ESBWR DCD, Revision 10 to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to administrative procedures.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 13.5-1-A

The applicant states that industry guidance ASME NQA-1 for the appropriate format, content, and typical activities delineated in written procedures is implemented, as appropriate. Administrative procedures are developed in accordance with the nominal schedule presented in Table 13.5-202.

The ESBWR DCD Tier 2, Section 13.5.1 states that the applicant shall develop the administrative procedures, therefore in North Anna 3 COL FSAR, the applicant in Section 13.5.1 states, "This section describes administrative procedures that provide administrative control over activities that are important to safety for the operation of the facility."

The staff reviewed FSAR Section 13.5.1 and Table 13.5-202 and determined that they address the development of the administrative procedures within the timeline specified in SRP, Section 13.5.1.1. The staff concluded that the new paragraph meets the criteria in SRP, Section 13.5.1.1.

Supplemental Information

In addition to the supplemental items listed in Sections 13.5.1 and 13.5.2 of the FSAR, STD SUP Items 13.5.3 through13.5.9 described in FSAR Section 13.5 provide additional detail of the applicant's process for developing all of North Anna 3 procedures.

- STD SUP 13.5-1

The staff reviewed STD SUP 13.5-1, which describes the administrative and operating procedures used to conduct routine operating, abnormal, and emergency operating activities. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-2

The QAPD describes procedural document control, record retention, adherence, assignment of responsibilities, and changes. The QAPD is evaluated in Chapter 17, "Quality Assurance," of this SER.

The staff reviewed STD SUP 13.5-2, which describes procedural document control, record retention, adherence, assignment of responsibilities, and changes. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1, combined with evaluation of the QAPD in Chapter 17 and is therefore acceptable.

- STD SUP 13.5-3

This Section identifies procedures by topic, type, or classification in lieu of the specific title, and represents general areas of procedural coverage.

The staff reviewed STD SUP 13.5-3, which states that plant procedures are identified by topic, type, or classification. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-4

The applicant states that:

> Procedures are developed prior to fuel load to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations.

The staff reviewed STD SUP 13.5-4 to develop plant procedures before initial fuel loading. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- CWR COL 13.5-4-A

The staff reviewed CWR COL 13.5-4-A, which states that industry guidance based on ASME NQA-1 is implemented as appropriate for the format, content, and activities delineated in written procedures. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-5

Administrative procedures control the format and content of procedures, which are organized to include the following components, as necessary:

- Title Page
- Table of Contents
- Scope and Applicability
- Responsibilities
- Prerequisites
- Precautions and Limitations
- Main Body
- Acceptance Criteria
- Check-Off Lists
- References
- Attachments and Data Sheets

The staff reviewed STD SUP 13.5-5, which states that the format and content of plant procedures used to conduct routine operating, abnormal, and emergency operating activities. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-6

The staff reviewed STD SUP 13.5-6, which states that the plant procedures used to conduct routine operations, abnormal, and emergency operating activities should have the level of detail commensurate with the qualifications of the individual performing the required functions. The staff determined that this Section of the applicant's FSAR meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-7

Procedures should be developed consistent with the guidance described in DCD Tier 2, Section 18.9, and with input from the HFE process and evaluations.

The bases for procedural development include:

- Plant design bases;
- System-based technical requirements and specifications;
- Task analyses results;
- Risk-important human actions identified in the HRA/PRA;
- Initiating events considered in the EOPs, including those events in the design bases; and
- GTGs for EOPs.

Procedure V&V includes the following activities, as appropriate:

- A review to verify that they are correct and can be carried out.
- A final validation in a simulation of the integrated system as part of the V&V activities as described in DCD Tier 2, Section 18.11.
- Verification that modified procedures have adequate content, format, and integration.
- The procedures are assessed through validation if a modification substantially changes personnel tasks that are significant to plant safety. The validation verifies that the procedures correctly reflect the characteristics of the modified plant and can be performed effectively to restore the plant.

The staff reviewed STD SUP 13.5-7, which states that plant procedures used to conduct routine operation, abnormal, and emergency operating activities should be consistent with the guidance described in DCD Tier 2, Section 18.9. The staff determined that this Section of the applicant's FSAR is consistent with the guidance in DCD Tier 2, Section 18.9 and meets the criteria in SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-8

The staff reviewed STD SUP 13.5-08, which states that procedures for managing a shutdown should be consistent with the guidance in NUMARC 91-06. The staff determined that this Section of the applicant's FSAR is consistent with the guidance in NUMARC 91-06 and meets the criteria in SRP, Section 13.5.1.1. This information is therefore acceptable.

- STD SUP 13.5-9

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative controls over safety-related activities for the operation of the facility. In FSAR Section 13.5.1.1, the applicant replaces the first sentence of the paragraph to supplement the DCD with the following:

> This section describes administrative procedures that provide administrative control over activities that are important to safety for the operation of the facility.

The staff concluded that the applicant-provided descriptions of plant administrative procedures meet the criteria in SRP, Section 13.5.1.1 and are therefore acceptable.

- CWR SUP 13.5-10

The applicant states that:

> Procedures outline the essential elements of the administrative programs and controls described in ASME NQA-1 and Section 17.5. These procedures are organized to prescribe the programmatic elements in documents normally referred to as administrative procedures.
>
> Administrative procedures contain adequate programmatic controls to provide an effective interface between organizational elements, including contractor and owner organizations that support the station operating organization.

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative controls over safety-related activities for the operation of the facility, but applicants are not required to include detailed written procedures in the FSAR. In FSAR Section 13.5-1-A, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. The staff determined that this information meets the criteria of SRP, Section 13.5.1.1 and is therefore acceptable.

- CWR SUP 13.5-11

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide for administrative controls over safety-related activities for the operation of the facility, but applicants are not required to include detailed written procedures in the FSAR. In FSAR Section 13.5-1-A, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. The Supplemental Information CWR SUP 13.5-11 refers to the QAPD and FSAR Section 13.5. The staff's review of these sections concluded that the applicant has provided an adequate and acceptable description of procedural controls in North Anna 3 COL FSAR that meets the criteria in SRP, Section 13.5.1.1.

- STD SUP 13.5-12

The applicant states that:

> A procedure style (writer's) guide promotes the standardization and application of HFE principles to procedures. The writer's guide establishes the process for developing procedures that are complete, accurate, consistent, and easy to understand and follow. The guide provides objective criteria so that procedures are consistent in organization, style, and content. The writer's guide provides criteria for the content and format of procedures, including written action steps and specific acceptable acronym lists and terms to be used.

In SRP, Section 13.5.1.1, Area of Review Item 1.A, "Category (A) Controls," states that the applicant should describe the procedural review and approval process. Inherent in this discussion is the use of a procedure writer's guide. In FSAR Section 13.5.1.1, the applicant adds a new paragraph under STD SUP 13.5-12 that describes the writer's guide and promotes the standardization of procedures that include human factor applications and consistent organization, style, and content. The staff concluded that the applicant has provided acceptable general operating descriptions of procedures that meet the criteria in SRP, Section 13.5.2.1.

- STD SUP 13.5-13

The applicant states that:

> Procedure maintenance and control of procedure updates are performed in accordance with the QAPD.

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative controls over safety-related activities for the operation of the facility, but the applicant is not required to include detailed written procedures in the FSAR. In FSAR Section 13.5.1.1, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. In STD SUP 13.5-13, the applicant states that the control over the maintenance and updates of procedures is performed in accordance with the QAPD. The staff determined that this information meets the criteria of SRP, Section 13.5.1.1 and is therefore acceptable.

- STD SUP 13.5-14

The applicant states:

> The administrative programs and associated procedures developed in the pre-COL phase are described in Table 13.5-201 (for future designation as historical information).

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative control over safety-related activities for the operation of the facility, but the applicant is not required to include detailed written procedures in the FSAR. In FSAR Section 13.5.1.1, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. In FSAR Section 13.5.1, STD SUP 13.5-14 refers to Table 13.5-201. The staff's review of these Sections concluded that the applicant has provided an adequate description of procedural controls in the FSAR that meets the criteria in SRP, Section 13.5.1.1. This information is therefore acceptable.

- STD SUP 13.5-15

The applicant states:

> Section 13.5.1.1, "Administrative Procedures-General," describes those procedures that provide administrative controls with respect to procedures, including those that define and provide controls for operational activities of the plant staff.

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative control over safety-related activities for the operation of the facility, but the applicant is not required to include detailed written procedures in the FSAR. In FSAR Section 13.5.1.1, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. The staff reviewed these listed procedures, regulatory requirements, and proposed completion times per Table 13.5-202 in the COL FSAR. The staff concluded that the applicant has provided an acceptable and adequate description of procedural controls in the FSAR that meets the criteria in SRP, Section 13.5.1.1.

- STD SUP 13.5-16

The applicant states that, plant administrative procedures provide procedural instructions for the following:

- Procedures review and approval
- Procedure adherence
- Scheduling for surveillance tests and calibration
- Log entries
- Record retention

- Containment access
- Bypass of safety function and jumper control
- Communication systems
- Equipment control procedures—These procedures provide for control of equipment, as necessary, to maintain personnel and reactor safety, and to avoid the unauthorized operation of equipment
- Control of maintenance and modifications
- Fire Protection Program procedures
- Crane Operation Procedures—Crane operators who operate cranes over fuel pools are qualified and conduct themselves in accordance with ANSI/ASME B30.2 (Chapter 2-3), “Overhead and Gantry Cranes” (Reference 13.5-201).
- Temporary changes to procedures
- Temporary procedure issuance and control
- Special orders of a temporary or self-canceling nature
- Standing orders to shift personnel including the authority and responsibility of the shift manager, senior reactor operator in the control room, control room operator, and shift technical advisor
- Manipulation of controls and assignment of shift personnel to duty stations per the requirements of 10 CFR 50.54 (i), (j), (k), (l), and (m), including delineation of the space designated for the “At the Controls” area of the Control Room
- Shift relief and turnover procedures
- Fitness for duty (FFD)
- Control Room access
- Working hour limitations
- Feedback of design, construction, and applicable important industry and operating experience
- Shift Manager administrative duties

- Verification of correct performance of operational activities

- A vendor interface program that provides vendor information for safety-related components is incorporated into plant documentation

The SRP, Section 13.5.1.1 states that the applicant should describe the procedures that provide administrative controls over safety-related activities for the operation of the facility, but the applicant is not required to include detailed written procedures in the FSAR. In FSAR Section 13.5.1.1, the applicant lists the Category (A) Controls and Category (B) Specific Procedures described in SRP, Section 13.5.1.1. The staff's review of these listed procedures, regulatory requirements, and proposed completion times per COL FSAR Table 13.5-202 concluded that the applicant has provided acceptable and adequate descriptions of procedural controls in the COL FSAR that meet the criteria in SRP, Section 13.5.1.1.

13.5.1.5 Post Combined License Activities

The applicant identifies the following commitment under the Supplemental Information STD SUP 13.5-4:

> Procedures are developed prior to fuel load to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations.

13.5.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this Section that were incorporated by reference have been reviewed and are acceptable.

In addition, the staff compared the additional COL items and supplemental information in the application to the relevant NRC regulations, the guidance in SRP Section 13.5.1, SRP Sections 13.5.1.1 and 13.5.2.1; and other NRC RGs. The staff's review concludes that the applicant has presented adequate information in North Anna 3 FSAR to meet the guidance in the applicable Sections of the SRP. Thus, the applicant has adequately addressed COL Item STD COL 13.5-1-A, Supplemental Information Items STD SUP 13.5-1 through 13.5-16, and CWR COL 13.5-4-A relating Plant Operating Procedures Development, and the information in this Section is therefore acceptable.

13.5.2 Operating and Maintenance Procedures

13.5.2.1 Introduction

This Section of the FSAR provides the operating and maintenance procedures that the plant staff uses to ensure that routine operating, off-normal, and emergency activities are conducted in a safe manner. The plant procedures provide a brief description of the nature and content of the procedures and a schedule for preparing appropriate written operating and maintenance procedures. This FSAR Section also delineates in the description of operating and maintenance procedures the functional position for a procedural revision and approval process before implementation.

13.5.2.2 Summary of Application

Section 13.5.2 of North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 13.5.2 of the certified ESBWR DCD, Revision 10. In addition, in COL FSAR Section 13.5.2, the applicant provides the following:

COL Items

- STD COL 13.5-2-A

Operating Procedures are developed in accordance with Section 13.5.2.1, and Maintenance Procedures are developed in accordance with Section 13.5.2.2.6.1.

- STD COL 13.5-3-A

Emergency Procedures are developed in accordance with Section 13.5.2.1.4.

- CWR COL 13.5-4-A

A Plant Operating Procedures Development Plan is established in accordance with Section 13.5.2.1.

- STD COL 13.5-5-A

The scope of procedures in the Plant Operating Procedures Development Plan is addressed in Section 13.5.2.1.

- STD COL 13.5-6-A

The applicant states that procedures for calibration, inspection, and testing are included in the Plant Operating Procedures Development Plan.

Supplemental Information

- STD SUP 13.5-18 Classification of Procedures
- STD SUP 13.5-19 System Operating Procedures
- STD SUP 13.5-20 General Operating Procedures
- STD SUP 13.5-21 Abnormal (Off-Normal) Operating Procedures
- CWR SUP 13.5-22 Emergency Operating Procedures
- STD SUP 13.5-23 Alarm Response Procedures

•	CWR SUP 13.5-24	Temporary Procedures
•	STD SUP 13.5-25	Fuel Handling Procedures
•	STD SUP 13.5-26	Maintenance and Other Operating Procedures
•	STD SUP 13.5-27	Plant Radiation Protection Procedures
•	STD SUP 13.5-28	Emergency Preparedness Procedures
•	STD SUP 13.5-29	Instrument Calibration and Test Procedures
•	STD SUP 13.5-30	Chemistry Procedures
•	STD SUP 13.5-31	Radioactive Waste Management Procedures
•	STD SUP 13.5-32	Maintenance, Inspection, Surveillance, and Modification Procedure
•	STD SUP 13.5-33	Inspection Procedures
•	STD SUP 13.5-34	Modification Procedures
•	STD SUP 13.5-35	Heavy Load Handling Procedures
•	STD SUP 13.5-36	Material Control Procedures
•	STD SUP 13.5-37	Security Procedures
•	STD SUP 13.5-38	Refueling and Outage Planning Procedures
•	STD SUP 13.5-40	Procedure related to Refueling Cavity Integrity
•	STD SUP 13.5-41	Special Nuclear Material (SNM) Material Control and Accounting Procedures

Each standard or site-specific supplement defines the procedure of interest.

13.5.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for the plant operating and maintenance procedures, and the associated acceptance criteria, are in SRP Section 13.5.2.1.

In particular, the relevant provisions for reviewing plant procedures are based on (1) meeting the requirements of methods and criteria described in 10 CFR 52.79(a)(14), (26), (29)(i), (29)(ii), (33), and (34) and TMI Action Plan Items I.C.1 and I.C.9; and (2) meeting the guidance of SRP, Section 13.5.2.1. The review of FSAR information related to the development of emergency procedures is based on meeting the requirements of 10 CFR 52.79(a)(14), (26), (29)(i), (29)(ii), (33), and (34) and the guidance of SRP, Section 13.5.2.1.

13.5.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.5.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.5.2 of North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to operating and maintenance procedures. In addition, the staff reviewed the resolution to the following COL and supplemental information items included under Section 13.5.2 of the COL FSAR. In this review, the staff used the applicable Sections of the SRP as guidance.

<u>*COL Items*</u>

- STD COL 13.5-2-A Plant Operating Procedures Development Plan

The third paragraph of Section 13.5.2 in DCD Tier 2 is replaced with the following:

> Operating Procedures are developed in accordance with Section 13.5.2.1 and Maintenance Procedures are developed in accordance with Section 13.5.2.2.6.1.

The ESBWR DCD Tier 2, Section 13.5.2 states that the development of operating and maintenance procedures is the responsibility of the applicant. The staff reviewed Section 13.5.2.1 and determined that it addresses the development of operating procedures, which will be developed at least 6 months before fuel load. The staff reviewed Section 13.5.2.2.6.1 and determined that it addressed the development of maintenance procedures. The staff concluded that these paragraphs meet the criteria in SRP, Section 13.5.2.1.

- STD COL 13.5-3-A Emergency Procedures Development

The last sentence of Section 13.5.2 in the ESBWR DCD Tier 2 is replaced with the following:

> Emergency Procedures are developed in accordance with Section 13.5.2.1.4.

The ESBWR DCD Tier 2, Section 13.5.2 states that the applicant will develop emergency procedures. In COL FSAR Section 13.5.2, the applicant states that the new Section 13.5.2.1.4 was added to address the development of emergency procedures. The staff reviewed Section 13.5.2.1.4 and determined that it addresses the development of emergency procedures.

The SRP, Section 13.5.2.1, states that the procedures generation package (PGP) should include a description of the process used to develop plant-specific technical guidelines (P-STG) from the GTG, the identification of significant deviations from the generic guidelines, and a description of the process used for identifying operator information and control requirements; a plant-specific writer's guide; a description of the program for V&V of EOPs; and a description of the program for training operators on EOPs. In FSAR Section 13.5.2.1.4, the applicant stated that the PGP would include the identification of significant deviations from the generic guidelines, and a description of the process used for identifying operator information and control requirements; a generic writer's guide; a description of the program for V&V of EOPs; and a description of the program for training operators on EOPs. The applicant also stated that the procedure development program, as described in the PGP for EOPs, is submitted to the NRC at least 3 months prior to the planned date to begin formal operator training on the EOPs. The PGP did not include a description of the process used to develop P-STGs from the GTGs or a plant-specific writer's guide. The staff concluded that the applicant-provided added paragraph did not meet the criteria in SRP, Section 13.5.2.1. The staff issued RAI 13.05.02.01, 13.05.02.01-3 and 13.05.02.01-4 requesting Dominion to address the missing P-STG development process description and plant-specific writer's guide. The applicant responded to RAI 13.05.02.01, 13.05.02.01-3, and 13.05.02.01-4, stating that it will provide a P-SWG, P-STGs, and identify the group within the operating organization responsible for maintaining procedures. The staff determined that these responses are acceptable and has verified that the applicable standards have been incorporated into the North Anna 3 FSAR Revision 8, Section 13.5.2.1.4. The staff concluded that this new Section meets the criteria in SRP, Section 13.5.2.1.

- CWR COL 13.5-4-A Plant Operating Procedures Development Plan

The COL Item CWR COL 13.5-4-A replaces the fifth paragraph of the DCD Tier 2 with the following:

> A Plant Operating Procedures Development Plan is established in accordance with Section 13.5.2.1.

The ESBWR DCD Tier 2, Section 13.5.2 states that the applicant will develop a Plant Operating Procedures Development Plan. In the North Anna 3 COL FSAR Section 13.5.2, the applicant states that the new Section 13.5.2.1 was added to address the establishment of a Plant Operating Procedures Development Plan. The staff reviewed paragraph 13.5.2.1 and determined that it addresses the establishment of a Plant Operating Procedures Development Plan. The staff concluded that this new paragraph meets the criteria in SRP, Section 13.5.2.1.

- STD COL 13.5-5-A Procedures Included in Scope of Plan

The COL Item STD COL 13.5-5-A replaces the second paragraph of the DCD Tier 2 with the heading "Procedures Related to Refueling Cavity Integrity" with the following:

> The scope of procedures in the Plant Operating Procedures Development Plan is addressed in Section 13.5.2.1.

The ESBWR DCD Tier 2, Section 13.5.2 states that the applicant will include procedures for handling heavy loads in the scope of the Plant Operating Procedures Development Plan. In North Anna 3 COL FSAR Section 13.5.2, the applicant states that the Plant Operating Procedures Development Plan is established in accordance with Section 13.5.2.1.

The staff reviewed Section 13.5.2.1 and determined that it included procedures for handling heavy loads within the scope of the Plant Operating Procedures Development Plan. The staff concluded that this new Section meets the criteria in SRP, Section 13.5.2.1.

- STD COL 13.5-6-A Procedures for Calibration, Inspection, and Testing

STD COL 13.5-6-A replaces the second sentence of the Section "Procedures for Calibration, Inspection and Testing" to the DCD Tier 2 with the following:

> Procedures for calibration, inspection, and testing are included in the Plant Operating Procedures Development Plan.

The ESBWR DCD Tier 2, Section 13.5.2.1 states that the applicant will ensure that all portions of the safety-related logic circuitry are adequately covered in surveillance procedures described in GL 96-01, "Testing of Safety Related Logic Circuits." In North Anna 3 COL FSAR Section 13.5.2.1, the applicant has added to the procedures for calibration, inspection, and testing to the Plant Operating Procedures Development Plan to ensure they are appropriately developed and maintained. The staff of the Plant Operating Procedures Development Plan determined that procedures will be developed and maintained and the calibration, inspection, and testing procedures will adequately test all portions of safety-related logic circuitry in a manner that, is as described in GL 96-01. The staff concluded that this meets the criteria in SRP, Section 13.5.2.1.

Supplemental Information

- STD SUP 13.5-18 Classification of Procedures

North Anna 3 STD SUP 13.5-18 states the following:

> The classifications of operating procedures are:
>
> - System Operating Procedures
> - General Operating Procedures
> - Abnormal (Off-Normal) Operating Procedures
> - Emergency Operating Procedures
> - Alarm Response Procedures.

The SRP, Section 13.5.2.1 states that the applicant should identify the different classifications of procedures (e.g., system procedures, general plant procedures, abnormal procedures, emergency operating procedures, and alarm procedures) that the operators will use in the control room (CR) and locally in the plant for plant operations. In FSAR Section 13.5.2, the applicant states that the classifications of operating procedures are system operating procedures, general operating procedures, abnormal (off-normal) operating procedures, emergency operating procedures, and alarm response procedures. The staff concluded that the applicant has provided acceptable procedure classification information that meets the criteria in SRP, Section 13.5.2.1.

- STD SUP 13.5-19

System Operating Procedures in FSAR Section 13.5.2.1.1, STD SUP 13.5-19 states the following:

> Instructions for energizing, filling, venting, draining, starting up, shutting down, changing modes of operation, returning to service following testing or maintenance (if not contained in the applicable procedure), and other instructions appropriate for operation of systems are delineated in system procedures.
>
> System procedures contain check-off lists, where appropriate, which are prepared in sufficient detail to provide an adequate verification of the status of the system.

The SRP, Section 13.5.2.1 states that the applicant should describe the general format and content of the different classifications of procedures. In FSAR Section 13.5.2, Section 13.5.2.1.1 describes system operating procedures and their general format and content. The staff concluded that the applicant has provided descriptions of the system operating procedures that meet the criteria in SRP, Section 13.5.2.1.

- STD SUP 13.5-20

General Operating Procedures FSAR Section 13.5.2.1.2, STD SUP 13.5-20 states the following:

> General operating procedures provide instructions for performing integrated plant operations involving multiple systems, such as plant startup and shutdown.
>
> These procedures provide a coordinated means of integrating procedures together to change the mode of plant operation or to achieve a major plant evolution. Check-off lists are used for the purpose of confirming completion of major steps in proper sequence.
>
> Typical types of general operating procedures are described as follows:
>
> - Startup procedures provide instruction for starting the reactor from cold or hot conditions, establishing power operation, and recovering from reactor trips.
>
> - Shutdown procedures guide operations during and following controlled shutdown or reactor trips, and include instructions for establishing or maintaining hot standby and safe or cold shutdown conditions, as applicable.
>
> - Power operation and load changing procedures provide instruction for steady-state power operation and load changing.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., general plant procedures) and the general format and content of the different classifications of procedures. In FSAR Section 13.5.2, Section 13.5.2.1.2 describes general operating procedures and their general format and content. The staff concluded that the applicant has provided descriptions of general operating procedures that are acceptable and meet the criteria in SRP, Section 13.5.2.1.

- STD SUP 13.5-21 Abnormal Operating Procedures

In FSAR Section 13.5.2.1.3, STD SUP 13.5-21 states the following:

> Abnormal operating procedures for correcting abnormal conditions are developed for those events where system complexity might lead to operator uncertainty. Abnormal operating procedures describe actions to be taken during other than routine operations, which, if continued, could lead to either material failure, personnel harm, or other unsafe conditions.
>
> Abnormal procedures are written so that a trained operator knows in advance the expected course of events or indications that identify an abnormal situation and the immediate action to be taken.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., abnormal operating procedures) and the general format and content of the different classifications of procedures. In FSAR Section 13.5.2, Section 13.5.2.1.3 describes abnormal (off-normal) procedures and their general format and content. The staff concluded that the applicant has provided descriptions of abnormal procedures that are acceptable and meet the criteria in SRP, Section 13.5.2.1.

- CWR SUP 13.5-22

Emergency Operating Procedures in FSAR Section 13.5.2.1.4, CWR SUP 13.5-22 states the following:

> EOPs are procedures that direct actions necessary for the operators to mitigate the consequences of transients and accidents that cause plant parameters to exceed reactor protection system or [Engineered Safety Features] ESF actuation setpoints.
>
> Emergency operating procedures include appropriate guidance for the operation of plant post-72-hour equipment, and are developed as appropriate per the guidance of:
>
> - NUREG–0737, “Clarification of TMI Action Plan Requirements,” Items I.C.1 and I.C.9
>
> - The QAPD

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., emergency operating procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.1.4, the applicant added a new paragraph that described emergency operating procedures and their general format and content. The staff concluded that the applicant has provided descriptions of emergency operating procedures that meet the criteria in SRP, Section 13.5.2.1.

- STD SUP 13.5-23 Alarm Response Procedures

In FSAR Section 13.5.2.1.5, STD SUP 13.5-23 states the following:

> Procedures are provided for annunciators (alarm signals) identifying the proper operator response actions to be taken. Each of these procedures normally contains: a) the meaning of the annunciator or alarm, b) the source of the signal, c) any automatic plant responses, d) any immediate operator action, and e) the long range actions. When corrective actions are very detailed and/or lengthy, the alarm response may refer to another procedure.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., alarm response procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.1.5, the applicant added a new paragraph that described alarm response procedures and their general format and content. The staff concluded that the applicant has provided descriptions of alarm response procedures that are acceptable and meet the criteria in SRP, Section 13.5.2.1.

- CWR SUP 13.5-24 Temporary Procedures

In FSAR Section 13.5.2.1.6, CWR SUP 13.5-24 states the following:

> Temporary procedures are issued during the operational phase only when permanent procedures do not exist for the following activities: to direct operations during testing, refueling, maintenance, and modifications; to provide guidance in unusual situations not within the scope of the normal procedures; and to provide orderly and uniform operations for short periods when the plant, a system, or a component of a system is performing in a manner not covered by existing detailed procedures, or has been modified or extended in such a manner that portions of existing procedures do not apply.
>
> Temporary operating procedures are developed under established administrative guidelines. They include designation of the period of time during which they may be used and adhere to the QAPD and Technical Specifications, as applicable.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., temporary procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.1.6, the applicant added a new paragraph that described temporary procedures and their general format and content. The staff concluded that the applicant has provided descriptions of temporary procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-25 Fuel Handling

Procedures in FSAR Section 13.5.2.1.7, STD SUP 13.5-25 states the following:

> Fuel handling operations, including fuel receipt, identification, movement, storage, and shipment, are performed in accordance with written procedures. Fuel handling procedures address, for example, the status of plant systems required for refueling; inspection of replacement fuel and control rods; designation of proper tools; proper conditions for spent fuel movement and storage; proper conditions to prevent inadvertent criticality; proper conditions for fuel cask loading and movement; and status of interlocks, reactor trip circuits, and mode switches. These procedures provide instructions for use of refueling equipment, actions for core alterations, monitoring core criticality status, accountability of fuel, and partial or complete refueling operations.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., fuel handling procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.1.7, the applicant added a new paragraph that described fuel handling procedures and their general format and content. The staff concluded that the applicant has provided descriptions of fuel handling procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-26 Maintenance and Other Operating Procedures

FSAR Section 13.5.2.2, STD SUP 13.5-26 states the following:

The QAPD provides guidance for procedural adherence. The technical review for elements of the QAPD for Dominion which addresses this STD SUP 13.5-26 is evaluated in Section 17.5 of this SER.

- STD SUP 13.5-27 Plant Radiation Protection

Procedures in FSAR Section 13.5.2.2.1, STD SUP 13.5-27 states the following:

> The plant radiation protection program is contained in procedures. Procedures are developed and implemented for such things as: maintaining personnel exposures, plant contamination levels, and plant effluents ALARA; monitoring both external and internal exposures of workers, considering industry-accepted techniques; performing routine radiation surveys; performing environmental monitoring in the vicinity of the plant; monitoring radiation levels during maintenance and special work activities; evaluating radiation protection implications of proposed modifications; management of radioactive wastes for offsite shipment, disposal, and treatment; and maintaining radiation exposure records of workers and others.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., plant radiation protection procedures) and the general format and content of the different classifications of procedures. In FSAR Section 13.5.2, the applicant adds new Section 13.5.2.2.1 that describes plant radiation protection procedures and their general format and content. The staff concluded that the applicant has provided plant radiation protection procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-28 Emergency Preparedness

Procedures in FSAR Section 13.5.2.2.2, STD SUP 13.5-28 states the following:

> A discussion of emergency preparedness procedures can be found in the Emergency Plan. A list of implementing procedures is maintained in the Emergency Plan.

The technical review for STD SUP 13.5-28 is in Section 13.3 of this SER.

- STD SUP 13.5-29 Instrument Calibration and Test

Procedures In FSAR Section 13.5.2.2.3, STD SUP 13.5-29 states the following:

> The QAPD provides a description of procedural requirements for instrumentation calibration and testing.

The technical review for elements of the QAPD for Dominion which address this STD SUP 13.5-29 is in Section 17.5 of this SER.

- STD SUP 13.5-30 Chemistry Procedures

In FSAR Section 13.5.2.2.4, STD SUP 13.5-30 states the following:

> Procedures provided for chemical and radiochemical control activities include the nature and frequency of sampling and analyses; instructions for maintaining fluid quality within prescribed limits; the use of control and diagnostic parameters; and limitations on concentrations of agents that could cause corrosive attack, foul heat transfer surfaces or become sources of radiation hazards due to activation.
>
> Procedures are also provided for the control, treatment, and management of radioactive wastes and control of radioactive calibration sources.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., chemistry procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.2.4, the applicant added a new paragraph that described chemical and radiochemical control activities procedures and their general format and content. The staff concluded that the applicant has provided chemistry procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-31 Radioactive Waste Management

Procedures In FSAR Section 13.5.2.2.5, STD SUP 13.5-31 states the following:

> Procedures for the operation of the radwaste processing systems provide for the control, treatment, and management of onsite radioactive wastes. These procedures are addressed in Section 13.5.2.1.1, System Operating Procedures.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., radioactive waste management procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.2.5, the applicant added a new paragraph that described radioactive waste management procedures and their general format and content. The staff concluded that the applicant has provided radioactive waste management procedures that meet the criteria in SRP Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-32 Maintenance, Inspection, Surveillance, and Modification Procedures

In FSAR Section 13.5.2.2.6.1, STD SUP 13.5-32 states the following:

> Maintenance procedures describe maintenance planning and preparation activities. Maintenance procedures are developed considering the potential impact on the safety of the plant, license limits, availability of equipment required to be operable and possible safety consequences of concurrent or sequential maintenance, testing, or operating activities.

In SRP, Section 13.5.2.1, the staff stated that the application should describe the different classifications of procedures, e.g., maintenance, inspection, surveillance, and modification procedures, and the general format and content of the different classifications of procedures should be described, though maintenance, inspection, surveillance, and modification procedures are not specifically required to be described. In FSAR, Section 13.5.2.2.6 and Section 13.5.2.2.6.1, the applicant added a new Section that described maintenance, inspection, surveillance, and modification procedures and their general format and content. The staff concluded that the applicant-provided maintenance, inspection, surveillance, and modification procedures meet the criteria found in SRP, Section 13.5.2.1. The staff determined that this is acceptable, as the requirements of SRP, Section 13.5.2.1 are met.

- STD SUP 13.5-33 Inspection Procedures

In FSAR Section 13.5.2.2.6.2, STD SUP 13.5-33 states the following:

> The QAPD provides a description of procedural requirements for inspections.

In FSAR Section 13.5.2.2.6.3, STD SUP 13.5-33 states the following:

> The QAPD provides a description of procedural requirements for surveillance testing. Surveillance testing procedures are written in a manner that adequately tests all portions of safety-related logic circuitry as described in Generic Letter 96-01, "Testing of Safety Related Logic Circuits."

The technical review for elements of the QAPD for Dominion which address this STD SUP 13.5-33 is in Section 17.5 of this SER.

- STD SUP 13.5-34 Modification Procedures

In FSAR Section 13.5.2.2.6.4, STD SUP 13.5-34 states the following:

> Plant modifications and changes to setpoints are developed in accordance with approved procedures. These procedures control necessary activities associated with the modifications such that they are carried out in a planned, controlled, and orderly manner. For each modification, design documents such as drawings, equipment and material specifications, and appropriate design analyses are developed, or the as-built design documents are utilized. Separate reviews are conducted by individuals knowledgeable in both technical and QA requirements to verify the adequacy of the design effort.
>
> Proposed modifications that involve a license amendment or a change to Technical Specifications are processed as proposed license amendment request.
>
> Plant procedures impacted by modifications are changed to reflect revised plant conditions prior to declaring the system operable and cognizant personnel who are responsible for operating and maintaining the modified equipment are adequately trained.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., modification procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.2.6.4, the applicant added a new Section that described modification procedures and their general format and content. The staff concluded that the applicant has provided modification procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-35 Heavy Load Handling Procedures

In FSAR Section 13.5.2.2.6.5, STD SUP 13.5-35 states the following:

> This topic is discussed in Section 9.1.5.8 of this SER.

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., heavy-load handling procedures) and the general format and content of the different classifications of procedures. In FSAR Section 13.5.2, the applicant refers to the revised Section 9.1.5.8 that describes heavy-load handling procedures and their general format and content. The staff concluded that the applicant has provided heavy-load handling procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-36 Material Control Procedures

In FSAR Section 13.5.2.2.7, STD SUP 13.5-36 states the following:

> The QAPD provides a description of procedural requirements for material control.

The technical review for elements of the QAPD for Dominion which address this STD SUP 13.5-36 is in Section 17.5 of this SER.

- STD SUP 13.5-37 Security Procedures

In FSAR Section 13.5.2.2.8, STD SUP 13.5-37 states the following:

> A discussion of security procedures is provided in the Security Plan.

The technical review for STD SUP 13.5-37 is in Section 13.6 of this SER.

- STD SUP 13.5-38 Refueling and Outage Planning Procedures

In FSAR Section 13.5.2.2.9, STD SUP 13.5-38 states the following:

> Procedures provide guidance for the development of refueling and outage plans, and as a minimum address the following elements:
>
> - An outage philosophy which includes safety as a primary consideration in outage planning and implementation.
> - Separate organizations responsible for scheduling and overseeing the outage and provisions for an independent safety review team that would be assigned to perform final review and grant approval for outage activities.
> - Control procedures, which address both the initial outage plan and safety-significant changes to schedule.
> - Provisions that activities receive adequate resources.
> - Provisions that defense-in-depth during shutdown and margins are not reduced or provisions that an alternate or backup system must be available if a safety system or a defense-in-depth system is removed from service
> - Provisions that personnel involved in outage activities are adequately trained including operator simulator training to the extent practicable, and training of other plant personnel, including temporary personnel, commensurate with the outage tasks they are to perform.

- The guidance described in NUMARC 91-06, “Guidelines for Industry Actions to Assess Shutdown Management,” to reduce the potential for loss of reactor coolant system boundary and inventory during shutdown conditions (Reference 13.5-203).

The SRP, Section 13.5.2.1 states that the applicant should describe the different classifications of procedures (e.g., refueling and outage planning procedures) and the general format and content of the different classifications of procedures. In FSAR, Section 13.5.2.2.9, the applicant added a new Section that described refueling and outage planning procedures and their general format and content. The staff concluded that the applicant has provided refueling and outage planning procedures that meet the criteria in SRP, Section 13.5.2.1 and are therefore acceptable.

- STD SUP 13.5-40 Procedure related to Refueling Cavity Integrity

In FSAR Section 13.5.2.2.10, STD SUP 13.5-40 states the following:

Procedures will be established and implemented for:

- Monitoring refueling cavity seal leakage,
- Responding to refueling cavity and buffer pool drain down events, and
- Performing periodic maintenance and inspection of the refueling cavity seal and the Main Steam and Isolation Condenser System plugs in accordance with vendor recommendations.

In SRP, Section 13.5.2.1, the staff stated that the application should describe the different classifications of procedures, e.g., refueling cavity integrity procedures, and the general format and content of the different classifications of procedures should be described, though refueling cavity integrity procedures are not specifically required to be described. In FSAR, Section 13.5.2.2.10, the applicant added a new Section that described refueling cavity integrity procedures and their general format and content. The staff concluded that the applicant-provided described refueling cavity integrity procedures meet the criteria found in SRP, Section 13.5.2.1. The staff determined that this is acceptable, as the requirements of SRP, Section 13.5.2.1 are met.

- STD SUP 13.5-41 Special Nuclear Material (SNM) Material Control and Accounting Procedures

In FSAR Section 13.5.2.2.11, STD SUP 13.5-41 states the following:

A material control and accounting system consisting of special nuclear material accounting procedures is utilized to delineate the requirements, responsibilities, and methods of special nuclear material control from the time special nuclear material is received until it is shipped from the plant. These procedures provide detailed steps for SNM shipping and receiving, inventory, accounting, and preparing records and reports.

The Special Nuclear Material (SNM) Material Control and Accounting (MC&A) Program description is provided in Appendix 13CC.

In SRP, Section 13.5.2.1, the staff stated that the application should describe the different classifications of procedures, e.g., SNM MC&A procedures, and the general format and content of the different classifications of procedures should be described, though SNM MC&A procedures are not specifically required to be described. In FSAR, Section 13.5.2.2.11, the applicant added a new Section that described SNM MC&A procedures and their general format and content. The detailed program description is provided in North Anna 3 FSAR Appendix 13CC. The staff concluded that the applicant-provided SNM material control and accounting procedures meet the criteria found in SRP, Section 13.5.2.1. The staff determined that this is acceptable, as the requirements of SRP, Section 13.5.2.1 are met.

13.5.2.5 Post Combined License Activities

The applicant identified the following post COL activities in development of plant procedures:

- Procedures are developed prior to fuel load to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations (STD SUP 13.5-4).

- Operating procedures are developed at least 6 months prior to fuel load to allow sufficient time for plant staff familiarization and to allow staff adequate time to review the procedures and to develop operator licensing examinations (STD COL 13.5-6-A).

- The procedure development program, as described in the PGP for EOPs, is submitted to the NRC at least 3 months prior to the planned date to begin formal operator training on the EOPs (STD COL 13.5-3-A).

13.5.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, related to this Section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this Section that were incorporated by reference have been reviewed and are acceptable.

In addition, the staff compared the additional COL and supplemental information items in the COL application to the relevant NRC regulations, the guidance in SRP Section 13.5 and other NRC RGs. The staff's review concludes that the applicant has provided the required information to satisfy the requirements of the NRC regulations. The applicant has adequately addressed COL Items STD COL 13.5-2-A, 13.5-3-A, 13.5-5-A, and 13.5-6-A; Supplemental Items STD SUP 13.5-18, 13.5-19, 13.5-20, 13.5-21, 13.5-23, 13.5-25, 13.5-26, 13.5-27, 13.5-28, 13.5-29, 13.5-30, 13.5-31, 13.5-32, 13.5-33, 13.5-34, 13.5-35, 13.5-36, 13.5-37, 13.5-38, 13.5-40 and 13.5.41; and site-specific COL and Supplemental Items CWR COL 13.5-4-A, CWR SUP 13.5-22, and CWR SUP 13.5-24 relating to plant procedures. The staff finds the applicant has provided the required procedure information in its application and therefore it is acceptable.

13.6 Physical Security

13.6.1 Introduction

The North Anna 3 COLA describes the applicant's physical protection program, which is intended to meet the NRC regulations for protection against the design basis threat (DBT) to design safeguards systems to protect against acts of radiological sabotage as required by 10 CFR 73.1, "Purpose and Scope." The overall purpose of the applicant's physical protection program is to provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

The applicant chose to update the site's Part 8 of the COLA concerning the NRC-endorsed security plan template. In this update, the applicant chose to change from NEI 03-12, Revision 6 to Revision 7, in order to maintain consistency with Dominion's fleet operating security plans.

The physical protection program includes the design of a physical protection system that ensures the capabilities to detect, assess, interdict, and neutralize threats of radiological sabotage are maintained at all times. The applicant incorporates by reference the standard ESBWR design, which includes design of physical protection systems within the design of the vital area and vital systems, as described in the ESBWR DCD including topical report, NEDE-33389, "ESBWR Security Enhancements Report," NEDE-33390, "ESBWR Interim Compensatory Measures Assessment Report," and NEDE-33391, "The ESBWR Safeguards Assessment Report." Part 8 of the COL application, consisting of the North Anna Physical Security Plan (PSP), Training and Qualification Plan (T&QP), and Safeguards Contingency Plan (SCP) (collectively, security plan), is referenced in Section 13.6 of the North Anna COL FSAR to describe the physical protection program and physical protection systems that are not addressed within the scope of the standard ESBWR design for meeting NRC performance and prescriptive requirements for physical protection stated in 10 CFR Part 73, "Physical Protection of Plants and Materials." Because of information security requirements, the staff's evaluation of the physical security protection program presented in this publicly-available SER does not include the same level of detail as the safeguards information (SGI) version. Those persons with the correct access authorization and need-to-know may view the SGI version of the North Anna COLA Section 13.6 SER, which is located in the NRC's Secure LAN.

13.6.2 Summary of Application

Section 13.6, "Physical Security," of the North Anna COL FSAR, Revision 8, incorporates by reference Section 13.6 of the certified ESBWR DCD, Revision 10.

Part 8 – Safeguards/Security Plans

In a letter dated November 26, 2007, Dominion submitted a security plan to the NRC as part of the COLA for proposed North Anna 3. In a letter dated March 30, 2009, Dominion submitted Revision 1 to the North Anna security plan. In a letter dated June 28, 2010, Dominion submitted Revision 2 to the security plan. In a letter dated July 18, 2011, Dominion submitted Revision 3 to the security plan. In a letter dated July 31, 2013, Dominion submitted Revision 4 to the security plan. In a letter dated March 30, 2015, Dominion submitted Revision 5 to the security plan.

In a letter dated December 18, 2013, Dominion submitted revisions to the SGI documents in Part 8 of the North Anna 3 COLA for NRC review. Enclosure 1 provides the Evaluation of CAS/SAS Design for No Single Act, Revision 4. Enclosure 2 provides Figure North Anna 3 COL 13.6-16-A, Security Site Arrangement - Fields of Fire drawings. Enclosure 3 provides GE Hitachi Nuclear Energy licensing topical report LTR NEDC - 33844P, Bomb Blast Analysis for North Anna 3.

Additionally, in the North Anna COL FSAR Section 13.6, the applicant stated as follows:

COL Information Items

- STD COL 13.6-6-A

Site key control was addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.5. A key control program will be developed and implemented prior to the milestone for PSP implementation (Table 13.4-201).

- STD COL 13.6-7-A

Redundancy and equivalency of the central alarm station (CAS) and secondary alarm station (SAS) was addressed by the applicant through the North Anna PSP, Section 15.4, and in the "Evaluation of CAS/SAS Design for No Single Act," Revision 3.

- NAPS COL 13.6-8-A

The no single act requirement for the CAS and SAS was addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. A description of the design of the CAS and SAS and analysis of single act security events is contained in the North Anna, "Evaluation of CAS/SAS Design for No Single Act," Revision 3.

- STD COL 13.6-9-A

The requirement for operational alarm response procedures was addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.3. Operating alarm response procedures will be developed and implemented in accordance with milestone defined in Section 13.5.2.1.

- STD COL 13.6-10-A

The requirement for operational surveillance test procedures was addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.8. The establishment of these surveillance test procedures and frequencies will be completed in accordance with the milestone for PSP implementation (Table 13.4-201).

- STD COL 13.6-11-A

Maintenance test procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.8. The establishment of these testing and maintenance milestones will be completed in accordance with the milestone for PSP implementation (Table 13.4-201).

- STD COL 13.6-12-A

Operational response procedures to security events were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. As part of the Security Plan, the applicant will develop an integrated response strategy to a confirmed security event that provides for manual actuation of plant systems by the operators to an evolving scenario necessitating escalating operator response. This action will be completed prior to the milestone for PSP implementation (Table 13.4-201).

- STD COL 13.6-13-A

Operational alarm response procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.3. This action will be completed prior to the milestone for PSP implementation (Table 13.4-201).

- STD COL 13.6-14-A

Administrative controls to sensitive cabinets were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.5. Administrative procedures will be developed prior to the milestone for PSP implementation (Table 13.4-201) to control work being performed in cabinets containing the control circuitry for systems listed in Table 4-1 of NEDE-33391.

- STD COL 13.6-15-A

Administrative controls to sensitive equipment were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.5. Administrative procedures will be developed prior to the milestone for PSP implementation (Table 13.4-201) that will require two persons, each of whom are qualified to perform the intended work, to be present during the performance of any work on systems listed in Table 4-1 of NEDE-33391.

- NAPS COL 13.6-16-A

External bullet resisting enclosures (BRE) were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. The applicant provided site arrangement drawings, which show the location of the external BREs and indicate the fields of fire from these locations. The applicant also described the level of protection provided to security personnel in the BREs from the effects of the equipment available to the adversaries utilizing the DBT toolkit.

- NAPS COL 13.6-17-A

Site-specific locations of security barriers were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. The applicant provided site arrangement drawings showing the site-specific locations of security barriers that are not part of the ESBWR Certified Design, in the PSP. Additionally, prior to the milestone for PSP implementation (Table 13.4-201) the applicant will demonstrate that the security strategy described in the ESBWR Safeguards Assessment Report (NEDE-33391) remains valid.

- STD COL 13.6-18-A

Ammunition for armed responders was addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. Prior to the milestone for PSP implementation (Table 13.4-201), the applicant will update the security plan with an analysis to determine if armed responders require ammunition greater than the amount normally carried to include the development of necessary procedures to assure adequate ammunition is available.

- STD COL 13.6-19-A

Site-specific update of the ESBWR Safeguards Assessment Report was addressed by the applicant through the North Anna COL FSAR, Section 13.6.2. Prior to the milestone for PSP implementation (Table 13.4-201), the applicant will analyze the ESBWR Safeguards Assessment Report to reflect site-specific location of engagement positions including fields of fire, to demonstrate that the security strategy can be implemented as described and the effectiveness of neutralization in the report can be achieved. The PSP will be updated based on this revised analysis.

- STD COL 13.6-20-A

Physical security ITAAC is covered in part by the ESBWR standard ITAAC that addresses the physical plant security systems and those features that are part of the standard design. The ESBWR standard ITAAC were addressed by the applicant through the ESBWR DCD Tier 1, which was incorporated by reference. The plant and site-specific physical security ITAAC not covered by the ESBWR standard design, are contained in the North Anna COL FSAR, Part 10, Section 2.2.1, “Site-Specific Physical Security ITAAC.”

Supplemental Information

- STD SUP 13.6-1

In Section 13.6.2 of the North Anna 3 COL FSAR, the applicant provides supplemental information addressing the security plans which are submitted as separate licensing documents to fulfill the requirements of 10 CFR 52.79(a)(35) and (36). The applicant also states that the security plan meets the requirements of 10 CFR Part 73 and will be maintained in accordance with the requirements of 10 CFR 52.98 and protected in accordance with 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements.". The security plans are categorized as security SGI. The safeguards version of the North Anna COL application Section 13.6 SER, which included the evaluation of STD SUP 13.6-1, is located in the NRC's Secure Local Area Network.

- NAPS ESP COL 13.6-1

In Section 13.6.2 of the North Anna 3 COL FSAR, the applicant provides the design requirements for protected area barriers described in the PSP. The barriers will be designed and located to support the security response strategy timelines. The specific designs for protected area barriers will be completed as part of detailed plant design before the milestone for PSP implementation (Table 13.4-201).

The North Anna 3 ESP COL 13.6-1: A COL or construction permit (CP) applicant should provide specific designs for protected area barriers. Exact locations and the design of barriers are not known at the ESP stage.

- CWR SUP-13.6-2

In Section 13.6.2 of the North Anna 3 COL FSAR, the applicant provides supplemental information addressing a commitment that has been added to administrative procedures to meet the requirements of 10 CFR 73.58 for managing the safety/security interface.

- NAPS SUP 13.6-2 13.6.5 ESP Information

North Anna 3 ESP SSAR Section 13.6 is incorporated by reference.

License Conditions

- Part 10, Section 3.6

The applicant proposed a license condition in Part 10 of the North Anna COLA, which provides milestones for implementing applicable portions of the Physical Security Program.

13.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966 related to the ESBWR DCD, Revision 10. In addition, the relevant requirements of the Commission regulations for the physical security, and the associated acceptance criteria, are summarized in SRP Section 13.6.

The applicable regulatory requirements for physical protection are as follows:

- The provisions of 10 CFR 52.79(a)(35)(i) and (ii) require that information submitted for a COL describe how the applicant will meet the requirements of 10 CFR Part 73 and provide a description of the implementation of the PSP. The provisions of 10 CFR 52.79(a)(36)(i) through (iv) require that the application include an SCP in accordance with the criteria set forth in Appendix C, "Nuclear Power Plant Safeguards Contingency Plans," to 10 CFR Part 73, and a T&QP in accordance with Appendix B of 10 CFR Part 73. The provisions also require that the applicant provide a description of the implementation of the SCP and the T&QP; and that the applicant protect the PSP, T&QP, SCP, and other related SGI in accordance with the requirements of 10 CFR 73.21.

- The provisions of 10 CFR Part 73 include performance-based and prescriptive regulatory requirements that, when adequately met and implemented, provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. A COL applicant must describe how it will meet the regulatory requirements of 10 CFR Part 73 that are applicable to nuclear power plants.

- The provisions of 10 CFR 52.79(a)(41) require an evaluation of the facility against the SRP in effect 6 months before the docket date of the application. The evaluation required by this Section shall include an identification and description of all differences in design features, analytical techniques, and procedural measures proposed for a facility and those corresponding features, techniques, and measures given in the SRP acceptance criteria. Where a difference exists, the evaluation shall discuss how the proposed alternative provides an acceptable method of complying with the Commission's regulations, or portions thereof, that underlie the corresponding SRP acceptance criteria. The SRP is not a substitute for the regulations, and compliance is not a requirement.

The staff used SRP, Section 13.6.1, Revision 1, dated June 15, 2010, to complete the physical security COL review.

Regulatory guidance documents, technical reports (TR), accepted industry codes and standards that an applicant may apply to meet regulatory requirements include, but are not limited to the following:

- RG 5.7, Revision 1, "Entry/Exit Control for Protected Areas, Vital Areas, and Material Access Areas," May 1980.

- RG 5.12, "General Use of Locks in the Protection and Control of Facilities and Special Nuclear Materials," November 1973.

- RG 5.44, Revision 3, "Perimeter Intrusion Alarm Systems," October 1997.

- RG 5.62, Revision 1 "Reporting of Safeguards Events," November 1987.

- RG 5.65, “Vital Area Access Controls, Protection of Physical Protection System Equipment and Key and Lock Controls,” September 1986.

- RG 5.66, Revision 1, “Access Authorization Program for Nuclear Power Plant,” July 2009.

- RG 5.68, “Protection Against Malevolent Use of Vehicles at Nuclear Power Plants,” August 1994.

- RG 5.74, “Managing the Safety/Security Interface,” March 2009.

- RG 5.75, “Training and Qualification of Security Personnel at Nuclear Power Reactor Facilities,” June 2009.

- NRC letter dated November 10, 2011, NRC Staff Review of NEI 03-12 “Template for Security Plan, Training and Qualification, Safeguards Contingency Plan, [and Independent Spent Fuel Storage Installation Security Program],” (Revision 7) (ADAMS Accession No. ML112800379).

- SECY-05-0197.

The following documents include security-related or SGI and are not publically available:

- RG 5.69, “Guidance for the Application of Radiological Sabotage Design Basis Threat in the Design, Development, and Implementation of a Physical Security Protection Program that Meets 10 CFR 73.55 Requirements,” June 2006.

- RG 5.76, “Physical Protection Programs at Nuclear Power Reactors,” July 2009.

- NEI 03-12, Revision 7, “Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan, and Independent Spent Fuel Installation Security Program.”

- NUREG/CR-6190, “Update of NUREG/CR-6190 Material to Reflect Postulated Threat Requirements,” March 27, 2003.

- RG 5.77, “Insider Mitigation Program,” March 2009.

13.6.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 13.6 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 13.6 of North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information contained in the application and the information incorporated by reference address the relevant information related to this Section.

The staff reviewed the information in the COL application:

COL Information Items

- STD COL 13.6-9-A

Operational alarm response procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.3.

> Operating alarm response procedures will be developed and implemented in accordance with milestone defined in Section 13.5.2.1.

The staff reviewed STD COL 13.6-9-A and determined that it adequately references that the operational alarm response procedures were addressed and will be developed and implemented in accordance with the milestone defined in Section 13.5.2.1. The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-10-A

Operational surveillance test procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.8.

> The establishment of these surveillance test procedures and frequencies will be completed in accordance with the milestone for Physical Security Plan implementation (Table 13.4-201).

The staff reviewed STD COL 13.6-10-A and determined that it adequately references that the operational surveillance test procedures and frequencies were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-11-A

Maintenance test procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.8.

> The establishment of these testing and maintenance milestones will be completed in accordance with the milestone for Physical Security Plan implementation (Table 13.4-201).

The staff reviewed STD COL 13.6-11-A and determined that it adequately references that the maintenance test procedures were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-12-A

Operational response procedures to security events were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2.

> As part of the Security Plan, the applicant will develop an integrated response strategy to a confirmed security event that provides for manual actuation of plant systems by the operators to an evolving scenario necessitating escalating operator response. This action will be completed prior to the milestone for PSP implementation (Table 13.4-201).

The staff reviewed STD COL 13.6-12-A and determined that it adequately references that the operational response procedures to security events were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-13-A

Operational alarm response procedures were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.3.

> This action will be completed prior to the milestone for Physical Security Plan implementation (Table 13.4-201).

The staff reviewed STD COL 13.6-13-A and determined that it adequately references that the alarm response procedures were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-14-A

Administrative controls to sensitive cabinets were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.5.

> Administrative procedures will be developed prior to the milestone for Physical Security Plan implementation (Table 13.4-201) to control work being performed in cabinets containing the control circuitry (contact elements) for the systems listed in Table 4-1 of NEDE-33391 (DCD reference 13.6-6).

The staff reviewed STD COL 13.6-14-A and determined that it adequately references that the administrative controls to sensitive cabinets were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-15-A

Administrative controls to sensitive equipment were addressed by the applicant through the North Anna COL FSAR, Section 13.6.1.1.5.

> Administrative procedures will be developed prior to the milestone for Physical Security Plan implementation (Table 13.4-201) that will require two persons, each of whom are qualified to perform the intended work, to be present during the performance of any work on systems listed in Table 4-1 of NEDE-33391.

The staff reviewed STD COL 13.6-15-A and determined that it adequately references that the administrative controls to sensitive equipment procedures were addressed and will be completed in accordance with the milestone for PSP implementation (Table 13.4-201). The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- NAPS COL 13.6-16-A

External BREs were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2.

> A site arrangement drawing that shows the location of the external Bullet Resisting Enclosures and indicates the fields of fire from these locations is provided in COLA Part 8: Security, drawing NA3 COL 13.6-16-A, Security Site Arrangement - Fields of Fire. A description of the level of protection provided to security personnel stationed in Bullet Resisting Enclosures (BREs) from the effects of the equipment available to the adversaries utilizing the Design Basis Threat (DBT) toolkit (defined in DCD Reference 13.6-8) is also provided in COLA Part 8: Security, drawing NA3 COL 13.6-16-A, Security Site Arrangement - Fields of Fire.

In RAI 13.06.01-63 the staff asked the applicant for additional information concerning the Site Arrangement – Fields of Fire drawing that was provided in their December 18, 2013, submittal. The NRC requested additional information to evaluate and assess the proposed defensive strategy and to compare this strategy to the information incorporated by reference from NEDE-33391, Revision 3.

In a response dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant provided information addressing Item 1, an updated fields of fire drawing addressing Item 2, and a Table addressing Items 3 and 4 of this RAI. In RAI 13.06.01-74, the staff asked an additional follow-up question regarding the December 18, 2013 submittal concerning Enclosure number 3's topical report. Since North Anna 3 will share the protected area (PA) perimeter with North Anna 1 and 2, the response to RAI 13.06.01-74, and items regarding unresolved issues (URIs) concerning North Anna's operating site may affect the response to a portion of RAI 13.06.03-63.

In May 2015, the final disposition of the North Anna Units 1 and 2 URI, and disposition of RAIs 13.06.01-63 and 13.06.01-74 was satisfied during the operating site's triennial force-on-force exercise. The final outcome of this URI required North Anna to appropriately identify in the site security plan and implementing procedures the minimum number of armed responders and armed security officers required to implement the site protective strategy. Therefore, RAIs 13.06.01-63 and 13.06.01-74 are resolved and closed.

- NAPS COL 13.6-17-A

Site-specific locations of security barriers were addressed by the applicant through the North Anna COL FSAR, Section 13.6.2.

> A site arrangement drawing that shows the location of the Protected Area (PA) fence, the isolation zone on either side of the PA fence, the Vehicle Barrier System (VBS), any Red Zone or Delay Fences, and any buildings or structures inside the PA that are not part of the Certified Design is provided in Figure 13.6-201, Security Site Arrangement – Physical Layout.
>
> Prior to the milestone for Physical Security Plan implementation (Table 13.4-201), a demonstration that the security strategy described in the ESBWR Safeguards Assessment Report (DCD Reference 13.6-6) remains valid will be conducted.

In RAI 13.06.01-64 dated May 6, 2014 (ADAMS Accession No. ML14126A406), the staff asked the applicant if they would consider relocating the detailed North Anna 3 COL 13.6-17-A drawing, Figure 13.6-201 to the site's PSP. In its response dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant provided a revised figure showing the site-specific locations of security barriers, which will be incorporated into Part 2 of the North Anna COL FSAR. Dominion determined that it was not necessary to provide the detailed information on the site's security plan because the information was significantly in excess of that required by the PSP, and can create an unnecessary configuration management challenge when minor changes to the site are made.

The staff finds the response to RAI 13.06.01-64, in regard to COL Information Item 13.6-17-A, acceptable as it provides a commitment to add a revised site arrangement drawing to the North Anna 3, FSAR Part 2 showing the location of the PA fence, isolation zone on either side of the fence, the VBS, any red zone or delay fences, and any buildings or structures inside the PA that are not part of the design.

In FSAR Part 2, Revision 8, dated June 2014, the applicant provided a revised site arrangement drawing that shows the location of the PA fence, isolation zone on either side of the fence, the VBS, any red zone or delay fences, and any buildings or structures inside the PA that are not part of the design. Therefore, RAI 13.06.01-64 is resolved and closed.

- STD COL 13.6-18-A

Ammunition for armed responders was addressed by the applicant through the North Anna COL FSAR Section 13.6.2.

> Prior to the milestone for Physical Security Plan implementation (Table 13.4-201), the security plan will be updated with an analysis to determine if armed responders require ammunition greater than the amount normally carried to provide reasonable assurance of successful engagement of adversaries from various engagement positions, including the development of necessary procedures to assure adequate ammunition is available.

The staff's evaluation of STD COL 13.6-18-A is contained in Section 13.6.4.1.9 of this SER. The staff reviewed STD COL 13.6-18-A and determined that it adequately references that an analysis to determine if ammunition greater than the amount that is normally carried and the development of necessary procedures will be completed in accordance with the milestone for the PSP implementation table (Table 13.4-201).

The site protective strategy is in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

- STD COL 13.6-19-A

Site-specific update of the ESBWR Safeguards Assessment Report was addressed by the applicant through the North Anna COL FSAR Section 13.6.2.

> Prior to the milestone for Physical Security Plan implementation (Table 13.4-201), the security plan will be updated with an analysis of the ESBWR Safeguards Assessment Report (DCD Reference 13.6-6) reflecting site-specific locations of engagement positions including fields of fire. This applies for the external Bullet Resisting Enclosures as well as any internal positions that have external engagement responsibilities. This will include an implementation analysis of the Security Strategy described in the report, focusing on the effectiveness of neutralization of adversaries before significant radiological sabotage can occur.

In RAI 13.06.01-35, the staff asked the applicant to describe how the specific security features identified in NEDE-33391 will be tracked, incorporated, verified, and demonstrated for the North Anna 3 physical protection program. In its response dated November 19, 2009 (ADAMS Accession No. ML093270043), the applicant stated that Revision 2 of NEDE-33391, ESBWR "Safeguards Assessment Report" will be used to develop a strategy that will be tested and implemented to protect North Anna 3 against the adversary characteristics of the DBT. The assumptions in the report will be analyzed when developing the protective strategy.

During RAI reconciliations, it was noted that significant information in the NEDE-33391, ESBWR "Safeguards Assessment Report" Revision 2 was superseded by information in NEDE-33391, Revision 3. In a letter dated October 8, 2014 (ADAMS Accession No. ML14287A288), the applicant stated that the response to RAI 13.06.01-35 would be revised to reference the latest revision [Revision 3] of the ESBWR Safeguards Assessment report. In addition, it was stated in the North Anna RAI Review letter dated August 30, 2013 (ADAMS Accession No. ML13247A394) that the response to RAI 13.06.01-35 was valid with the exception of the reference to the New Plant Physical Security Program Milestone Implementation Schedule that was proposed by NEI but later deleted.

Development of the site protective strategy is a necessary milestone in the implementation of the North Anna Security Program. The applicant stated that the milestone for the development of the site protective strategy, as well as the major changes (modifications or revisions) resulting from the development of the protective strategy will be communicated to the NRC and tracked in the 14.3-201 Operational Programs Required by NRC Regulations. The applicant stated that it will submit, within 12 months after issuance of a COL, a schedule for implementation of the North Anna Security Program that supports planning for and conduct of NRC inspections. The schedule will be updated every 6 months until 12 months before scheduled fuel load, and every month thereafter until the North Anna Security Program has been fully implemented. This is documented in the SER Section 13.6.5 as License Condition 13.6-1.

The staff found the applicant response to RAI 13.06.01-35 acceptable, as it provides in the FSAR, STD COL 13.6-19-A a commitment to update the PSP with the analysis from the ESBWR Safeguards Assessment Report and the protective strategy to include plant-specific features, as required by 10 CFR 73.55(b). Therefore, RAI 13.03.01-35 is resolved and closed.

- STD COL 13.6-20-A

Physical security ITAAC is covered in part by the ESBWR standard ITAAC that address the physical plant security systems and those features that are part of the standard design. In addition, this COL item was also addressed by the applicant through the North Anna COL FSAR Section 13.6.2.

> Features of the physical security system are covered, in part, by the standard ESBWR design, while other features are plant and site specific. Accordingly, the ESBWR standard ITAAC cover the physical plant security system and address those features that are part of the standard design. NRC guidance provides suggested ITAAC that cover both the standard design and the plant and site specific features. The plant and site-specific Physical Security ITAAC not covered by the ESBWR Tier 1, Section 2.19, are contained in Part 10, ITAAC, Section 2.2.1 Site-Specific Physical Security ITAAC.

The staff reviewed STD COL 13.6-20-A and found that between the information described in the ESBWR Design Certification and the site-specific information described in Part 10, ITAAC, Section 2.2.1, Site-Specific Physical Security ITAAC, the applicant adequately addressed the Physical Security ITAAC.

License Conditions

- Part 10, Section 3.6

In FSAR Part 10, Revision 6, dated December 2013 (ADAMS Accession No. ML14007A426), the applicant proposed a license condition in Part 10 of the North Anna COLA that provides milestones for implementing applicable portions of the Security Program. Specifically, the applicant proposed the following:

The licensee shall submit to the appropriate Director of the NRC, a schedule, no later than 12 months after issuance of the COL, that supports planning for and conduct of NRC inspections of operational programs listed in the operational program FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

The applicant followed the recommendations of the SRM dated February 22, 2006, on SECY-05-0197, in formulating the above license condition. The Staff, however, notes that the Commission, in its 2012 decision in the *Vogtle* proceeding, approved a license containing a different condition governing the same subject

Condition 2. D.(11) of the Southern Nuclear Operating Company's Vogtle Electric Generating Plant, Unit 3, COL (ADAMS Accession No. ML112991110), which governs the Operational Program Implementation Schedule, states:

> No later than 12 months after issuance of the COL, SNC shall submit to the Director of NRO, or the Director's designee, a schedule for implementation of the operational programs listed in FSAR Table 13.4-201, including the associated estimated date for initial loading of fuel. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until all the operational programs listed in FSAR Table 13.4-201 have been fully implemented.

The staff will use Vogtle Condition 2.D.(11) as a template for the corresponding condition in a North Anna COL.

13.6.4.1 Physical Security Plan

The applicant submitted in Part 8 of the COLA the North Anna 3 PSP, T&QP and SCP, to meet the requirements of 10 CFR 52.79(a)(35) and (36). Part 2, FSAR, Chapter 13, Section 13.6 references North Anna 3 PSP, T&QP, and SCP in describing the licensing basis for establishing a physical protection program, design of a physical protection system, and security organization that will have as its objective to provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. The PSP submitted by North Anna 3 makes references to 10 CFR 50.34(c) and (d). Since this is a COLA which includes a common PA for both operating and new reactors, the references also include 10 CFR 52.79(a)(35)(i), (36)(i) and (36)(ii). The staff evaluated the North Anna 3 Security Plans only.

Security plans must describe how the applicant will implement Commission requirements and those site-specific conditions that affect implementation as required by 10 CFR 73.55(c)(1)(i) and 10 CFR 73.55(c)(1)(ii).

The requirements are provided in 10 CFR 73.55(c) and (d) to establish, maintain, and implement a PSP to meet the requirements of 10 CFR 73.55, “Requirements for Physical Protection of Licensed Activities in Nuclear Power Reactors against Radiological Sabotage,” and 10 CFR Part 73, Appendices B and C. The applicant must show establishment and maintenance of a security organization, the use of security equipment and technology, the training and qualification of security personnel, the implementation of predetermined response plans and strategies, and the protection of digital computer and communication systems and networks. The applicant must have a management system for development, implementation, revision, and oversight of security implementing procedures. The approval process for implementing security procedures will be documented.

In the July 18, 2011 cover letter response to RAI questions 13.06-26, 13.06-15, and 13.06-16, “SRP 13.06: Response To Rai Letter 55,” the applicant provided the following statement to clarify the intent for the separation of the COL security plan and the operating site fleet security plan, and how it would be reassembled after receipt of license: “The COLA PSP was created by copying information from the operating fleet PSP applicable to North Anna Units 1 and 2 and then adding information applicable to North Anna Unit 3. The COLA PSP is submitted as part of the license application to provide assurance of physical protection of North Anna Unit 3 in accordance with applicable regulatory requirements. North Anna Units 1 and 2 will continue to operate in accordance with the operating fleet PSP. After receipt of the license, the information in the COLA PSP will be included in the operating fleet PSP, with changes provided to the next submission of the North Anna Unit 3 COLA.”

The staff has reviewed the applicant’s description in PSP Section 1, for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the PSP is consistent with the acceptance criteria in the SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(c) and (d), and therefore is acceptable.

13.6.4.1.1 Introduction and Physical Facility Layout

The provisions of 10 CFR 52.79(a)(35) require that the application include a PSP describing how the applicant will meet the requirements of 10 CFR Part 73 (and 10 CFR Part 11, “Criteria and Procedures for Determining Eligibility for Access to or Control over Special Nuclear Material,” if applicable, including the identification and description of jobs as required by 10 CFR 11.11(a) of this chapter, at the proposed facility). The plan must list tests, inspections, audits, and other means to be used to demonstrate compliance with the requirements of 10 CFR Parts 11 and 73, if applicable; and a description of the implementation of the PSP.

The provisions of 10 CFR 52.79(a)(36) require that the application contain: (i) a SCP in accordance with the criteria set forth in Appendix C to 10 CFR Part 73. The SCP shall include plans for dealing with threats, thefts, and radiological sabotage, as defined in 10 CFR Part 73 of this chapter, relating to the SNM and nuclear facilities licensed under this chapter and in the applicant's possession and control. Each application for this type of license shall include the information contained in the applicant's SCP. (Implementing procedures required for this plan need not be submitted for approval.)

(ii) A training and qualification plan in accordance with the criteria set forth in Appendix B to 10 CFR Part 73.

(iii) A cyber security plan in accordance with the criteria set forth in 10 CFR 73.54, “Protection of Digital Computer and Communication Systems and Networks” of this chapter;

(iv) A description of the implementation of the SCP, training and qualification plan, and cyber security plan; and

(v) Each applicant who prepares a PSP, a SCP, a training and qualification plan, or a cyber security plan, shall protect the plans and other related SGI against unauthorized disclosure in accordance with the requirements of 10 CFR 73.21 of this chapter.

The provisions of 10 CFR 52.79(a)(44) requires a description of the FFD program required by 10 CFR Part 26, “Fitness for Duty Programs,” and its implementation.

Requirements are established in 10 CFR 73.55(c)(2) to ensure protection of SGI against unauthorized disclosure in accordance with 10 CFR 73.21. The applicant’s submittal in Part 8 of the COLA (page 1) acknowledges that the PSP the T&QP, and the SCP discuss specific features of the physical security system or response procedures and are SGI.

Section 1 of the PSP describes the applicant’s commitment to satisfying 10 CFR 50.34(c) and (d) and 10 CFR Part 73 by submitting a PSP, and to controlling the PSP and its appendices as SGI according to 10 CFR 73.21.

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.b, require a description and map of the physical layout of the site.

Section 1.1 of the PSP provides descriptions of location, site layout, and facility configuration. The PSP describes the physical structures and their locations on the site, description of the PA, and a description of the site in relation to nearby towns, roads, and other environmental features important to the coordination of response operations. The plant layout includes identification of main and alternate entry routes for law enforcement assistance forces and the location of control points for marshaling and coordinating response activities.

In addition, Section 1.1 of the North Anna COLA describes general plant descriptions that include details of the 16-to 80-kilometer (10- to 50-mile) radius of the geographical area of the North Anna 3 site, a site area map, and general plant and site descriptions. North Anna COL FSAR, Chapter 2, references the ESBWR design certification for the principal design and operating characteristics for the design and construction of North Anna 3. Part 1, “General Information,” of the North Anna COLA describes the name of the applicant and principal business locations.

In RAI 13.06.01-64, Item number 3, the staff questioned the added information provided in the applicant's PSP, pointing to the FSAR and ESP SSAR for information concerning the site's layout. In its response, the applicant stated that the sentence pointing to the FSAR and ESP SSAR will be removed from PSP Section 1.1. In addition, the applicant stated, in PSP Section 1.1, SCP Section 4.2, and PSP Figure 1, information pertaining to surrounding airports will be added. In a letter dated March 30, 2015, the licensee provided a revised security plan, Revision 5, with the above information. The applicant appropriately updated PSP Section 1.1, SCP Sections 4.2, and Figure 1. Therefore, RAI 13.06.01-64, Item number 3 is resolved and closed.

The staff has reviewed the facility physical layout provided in PSP Section 1.1 and as supplemented by the North Anna COL FSAR. The staff determined that the applicant included site-specific conditions that affect the applicant's capability to satisfy the requirements of a comprehensive PSP. The applicant has adequately described the physical structures and their locations on site and the site in relation to nearby towns, roads, and other environmental features important to the effective coordination of response operations. Also in Section 1.1, the applicant described which figures in the PSP that depicts the main and alternate entry routes for law-enforcement assistance and the location of control points for marshaling and coordinating response activities. The staff concludes that the applicant's security plans have met the requirements for content of a PSP as stated above. Therefore, the staff found the "Facility Layout" described in the PSP and the North Anna COL FSAR is acceptable.

13.6.4.1.2 Performance Objectives

The provisions of 10 CFR 73.55(b)(1) require, in part, that the applicant shall establish and maintain a physical protection program with an objective to provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety. The provisions of 10 CFR 73.55(b)(2) establish, in part, the requirement to protect a nuclear power reactor against the DBT of radiological sabotage as described in 10 CFR 73.1. The provisions of 10 CFR 73.55(b)(3)(i) and 10 CFR 73.55(b)(3)(ii) require the applicant to establish a physical protection program designed to ensure the capabilities to detect, assess, interdict, and neutralize threats up to and including the DBT of radiological sabotage, as stated in 10 CFR 73.1, are maintained at all times, and to provide defense-in-depth, supporting processes, and implementing procedures that will ensure the effectiveness of the physical protection program.

Section 2 of the PSP outlines regulatory requirements for the establishment and maintenance of an onsite physical protection system, security organization, and integrated response capability. As part of the objective, the security program design incorporates supporting processes such as defense-in-depth principles, including diversity and redundancy, to ensure that no single event can disable the security response capability. The physical protection systems and programs described in the PSP are designed to protect against the DBT of radiological sabotage in accordance with the requirements of 10 CFR 73.55(a) through (r) or NRC approved equivalent measures that meet the same high assurance objectives provided by paragraph (a) through (r). The applicant proposes to use the corrective action program to track, trend, correct and prevent recurrence of failures and deficiencies in the physical protection program.

The staff has reviewed the applicant's description in PSP Section 2, for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.55(b), and therefore is acceptable.

13.6.4.1.3 Performance Evaluation Program

Requirements are established in 10 CFR 73.55(b)(4) through (b)(11) for the applicant to analyze and identify site-specific conditions, establish programs, plans, and procedures that address performance evaluations, access authorization, cyber security, insider mitigation, FFD, corrective actions, and operating procedures. Regulations in 10 CFR 73.55(b)(6) prescribe specific requirements to establish, maintain, and implement a performance evaluation program in accordance with 10 CFR Part 73, Appendix B, Section VI for implementation of the plant protective strategy.

Section 3.0 of the PSP describes that drills and exercises, as discussed in the T&QP, will be used to assess the effectiveness of the contingency response plan and the effectiveness of the applicant's response strategy. Other assessment methods include formal and informal exercises or drills, self-assessments, and internal and external audits and evaluations.

The performance evaluation processes and criteria that assess the effectiveness of the security program, including adequate protection against radiological sabotage, will be established in facility procedures and the deficiencies identified will be managed through the corrective action program.

Section 3.0 of the PSP references Section 4.0 of the T&QP, which provides additional details related to the performance evaluation of security personnel in accordance with 10 CFR Part 73 Appendix B Section VI. Section 4.0 of the T&QP includes provisions to conduct security force tactical drills and force-on-force exercises to evaluate the effectiveness of security systems and the response performances of security personnel. In addition, Section 17 of the PSP describes additional detail regarding the applicant's processes for reviews, evaluations, and audits that will complement the performance evaluation program.

The staff has reviewed the applicant's description in PSP Section 3 and the T&QP Section 4 (evaluated separately) for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.55(b)(6), and therefore is acceptable.

13.6.4.1.4 Establishment of Security Organization

The provisions of 10 CFR 73.55(d) establish requirements to describe a security organization, including the management system for oversight of the physical protection program. The security organization must be designed, staffed, trained, qualified, periodically re-qualified, and equipped to implement the physical protection program as required by 10 CFR 73.55(b) and 10 CFR Part 73, Appendices B and C.

As explained below, Section 4.0 of the PSP describes how the applicant meets the requirements of 10 CFR 73.55(d)(1).

Security Organization Management

Section 4.1 of the PSP describes the organization's management structure. The PSP establishes that the security organization is a critical component of the physical protection program and is responsible for the effective application of engineered systems, technologies, programs, equipment, procedures, and personnel that are necessary to detect, assess, interdict, and neutralize threats up to and including the DBT of radiological sabotage. The security organization may be proprietary, contract, or other qualified personnel.

The PSP describes that the organization will be staffed with appropriately trained and equipped personnel, in a command structure with administrative controls and procedures, to provide a comprehensive response. Section 4.1 of the PSP also describes the roles and responsibilities of the security organization. The PSP provides that at least one full time, dedicated security shift supervisor, who has the authority for command and control of all security operations, is on site at all times.

The security force implementing the security functions as described in this section of the plan will either be a proprietary force, or contractor or other qualified personnel. The training and qualification provisions are described in the T&QP.

The staff has reviewed the applicant's description in PSP Sections 4 and 4.1 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(d) and is, therefore, acceptable.

13.6.4.1.5 Qualification for Employment in Security

The requirements of 10 CFR 73.55(d)(3) state, in part, that the applicant may not permit any individual to implement any part of the physical protection program unless the individual has been trained, equipped and qualified to perform assigned duties and responsibilities in accordance with Appendix B to 10 CFR Part 73 and the applicant's T&QP.

Section 5 of the PSP describes that employment qualifications for members of the security force are delineated in the T&QP.

The staff has reviewed the applicant's description in PSP Section 5 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.55(d)(3) and therefore is acceptable.

13.6.4.1.6 Training of Non-Security Personnel

Consistent with requirements in 10 CFR 73.55(d)(3), 10 CFR 73.56, "Personnel Access Authorization Requirements for Nuclear Power Plants," and 10 CFR Part 73, Appendix B, Section VI.C.1, all personnel who are authorized unescorted access to the applicant's PA receive training, in part, to ensure that they understand their role in security and their responsibilities in the event of a security incident. Individuals assigned to perform security-related duties or responsibilities, such as, but not limited to, material searches and vehicle escort are trained, qualified, and re-qualified in accordance with the T&QP to perform these duties and responsibilities and to ensure that each individual has the minimum knowledge, skills, and abilities required for effective performance of assigned duties and responsibilities.

Section 6 of the PSP describes the training provided for all personnel who have been granted unescorted access to the applicant's PA.

The staff has reviewed the applicant's description in PSP Section 6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.56 and 10 CFR Part 73, Appendix B, and therefore is acceptable.

13.6.4.1.7 Security Personnel Training

The provisions of 10 CFR 73.55(d) require that all security personnel are trained and qualified in accordance with 10 CFR Part 73, Appendix B, Section VI prior to performing their duties.

Section 7 of the PSP describes that all security personnel are trained, qualified and perform tasks at levels specific for their assignments in accordance with the applicant's T&QP.

The staff has reviewed the applicant's description in PSP Section 7 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP and the T&QP meets the requirements of 10 CFR 73.55(d) and therefore is acceptable. The staff's review of the applicant's T&QP is located in Section 13.6.4.2 of this SER.

In RAI 13.06.01-70 dated May 6, 2014 (ADAMS Accession No. ML14126A406) , the staff requested information from the applicant regarding a discrepancy in training between the operating site's CTM and North Anna 3's COL CTM for the Remotely Operated Weapon System (ROWS) training for Task number 29, "Demonstrate Proficiency in use of ROWS:" for the column: "ROWS Operator (RO)." The staff also requested the applicant provide pertinent documentation concerning any planned use of ROWS at North Anna 3, and revise Task Number 29 as needed to reflect the planned use of ROWS as it applies to the North Anna 3 COLA T&QP. In the applicant response dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant clarified that the North Anna site does not have or plan to have ROWS. By letter dated March 30, 2015 (ADAMS Accession No. ML15093A050), the applicant revised their COL CTM with a clarified depiction of training regarding ROWS.

Accordingly, the staff finds the response to RAI 13.06.01-70 acceptable, as it provides clarification that the North Anna combined site does not have ROWS. Therefore, RAI 13.06.01-70 is resolved and closed.

13.6.4.1.8 Local Law Enforcement Liaison

The following requirement is stated in 10 CFR 73.55(k)(9), "To the extent practicable, licensees shall document and maintain current agreements with applicable law enforcement agencies to include estimated response times and capabilities." In addition, 10 CFR 73.55(m)(2) requires that the periodic licensee reviews of the physical protection program required by that Section include an audit of the effectiveness of the response commitments by local, State, and Federal law enforcement authorities.

Section 8 of the PSP provides a detailed discussion of the ongoing relationship with local law enforcement agencies (LLEA). The plans addressing response, communication methodologies, and protocols, command and control structures and marshaling locations are located in the operations procedures, emergency plan procedures, and the site-specific law enforcement response plan. The law enforcement response plan is reviewed biennially concurrent with the PSP effectiveness review.

The staff has reviewed the applicant's description in PSP Section 8 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.55(k)(9) and 10 CFR 73.55(m)(2), and therefore is acceptable.

13.6.4.1.9 Security Personnel Equipment

The requirements of 10 CFR 73.55(d)(3) state, in part, that the applicant may not permit any individual to implement any part of the physical protection program unless the individual has been trained, equipped and qualified in accordance with 10 CFR Part 73, Appendix B and the T&QP. Regulations in 10 CFR Part 73, Appendix B, Section VI.G.2(a) state, in part, that the applicant must ensure that each individual is equipped or has ready access to all personal equipment or devices required for the effective implementation of the NRC-approved security plans, the applicant's protective strategy, and implementing procedures. The provisions of 10 CFR Part 73, Appendix B, Sections VI.G.2(b) and VI.G.2(c) delineate the minimum equipment requirements for security personnel and armed response personnel.

The applicant addresses STD COL 13.6-18-A as follows: PSP Section 9 describes the equipment, including armament, ammunition and communications equipment that is provided to security personnel in order to ensure that security personnel are capable of performing the function stated in the Commission-approved security plans, applicant's protective strategy, and implementing procedures.

The staff has reviewed the applicant's description in PSP Section 9 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(d)(3) and Appendix B, Section VI.G.2(a), VI.G.2(b) and VI.G.2(c), and therefore is acceptable.

13.6.4.1.10 Work Hour Controls

The provisions of 10 CFR Part 26, "Fitness for Duty Programs," Subpart I, "Managing Fatigue," establish the requirements for managing fatigue. The provisions of 10 CFR 26.205, "Work Hours," establish requirements for work hours. The provisions of 10 CFR 26.205(a) require that any individual who performs duties identified in 10 CFR 26.4(a)(1) through (a)(5) shall be subject to the requirements of Section 26.205(a).

Section 10 of the PSP describes how the applicant will implement work hour controls in accordance with 10 CFR Part 26, Subpart I, and that site procedures shall describe performance objectives and implementing procedures.

The staff's review of the FFD program is found in Section 13.7 of this SER.

13.6.4.1.11 Physical Barriers

The following requirements are established in 10 CFR 73.55(e): "Each licensee shall identify and analyze site-specific conditions to determine the specific use, type, function, and placement of physical barriers needed to satisfy the physical protection program design requirements of 10 CFR 73.55(b)." (1) The applicant shall: (i) "Design, construct, install and maintain physical barriers as necessary to control access into facility areas for which access must be controlled or denied to satisfy the physical protection program design requirements of paragraph (b) of this Section." 10 CFR 73.55(b)(3) (ii) states that the physical protection program must: "Provide defense-in-depth through the integration of systems, technologies, programs, equipment, supporting processes, and implementing procedures as needed to ensure the effectiveness of the physical protection program."

Section 11 of the PSP provides a general description of how the applicant will implement its program for physical barriers, and that this implementation is in accordance with the performance objectives and requirements of 10 CFR 73.55(b).

Owner Controlled Area (OCA) Barriers

Section 11.1 of the PSP describes the use of OCA barriers at the site.

Vehicle Barriers

The PSP Sections 11.2.1 and 11.2.2 provides for vehicle control measures to protect against the DBT of radiological sabotage. The staff has verified that such measures are in accordance with site-specific analysis. Further, the staff has determined that these measures integrate systems, technologies, programs, supporting processes, and implementing procedures to provide defense-in-depth against the DBT land vehicle bomb assault. The staff has also determined that such measures provide for a VBS at a stand-off distance adequate to protect personnel, equipment, and systems necessary to prevent significant core damage and spent fuel sabotage against the effects of such an assault. Further, the staff confirmed that the applicant's PSP provides that the inspection, monitoring, and maintenance of the VBS are included in facility procedures. In view of the above, the staff concludes that the PSP identifies measures taken to provide high assurance that a land vehicle bomb assault can be defended against.

In RAI 13.06.01-22 (ADAMS Accession No. ML092881296) dated October 1, 2009, the staff asked the applicant to provide a general description of natural terrain features that make up portions of the outer VBS; provide a reference to the criteria used to determine the acceptability of these features, and to provide a reference to the criteria used to determine that the current North Anna outer VBS location and stand-off distance are appropriate given the proximity of the proposed North Anna 3 to the current outer VBS location. In a letter dated August 24, 2009), the applicant responded: "The natural terrain features that make up portions of the outer VBS include water and trees which have been analyzed in accordance with NUREG/CR–4250 for acceptability. A portion of the natural terrain of the current outer VBS will be removed and replaced with temporary man-made barriers during construction of North Anna 3. The location and design of the permanent VBS will be analyzed in accordance with the criteria of NUREG/CR–4250. The staff found the response to RAI 13.06.01-22 unacceptable, as it does not contain enough high assurance criterion that is used to determine applicable construction standards and stand-off distance for the final VBS for North Anna 1, 2, and 3.

In RAI 13.06.01-38 (ADAMS Accession No. ML092881296) dated October 1, 2009, the staff requested additional information concerning the response to RAI 13.06.01-22. In its response dated November 19, 2009 (ADAMS Accession No. ML093270043), the applicant stated that the blast calculations used in the design and layout of the permanent VBS, including determination of stand-off distance, were developed in accordance with the guidance given in NUREG/CR–4250 and NUREG–6190.

The staff found the response to RAI 13.06.01-38 (ADAMS Accession No. ML093270043) dated October 29, 2009, acceptable, as it provides details on how the applicant determined the applicable construction standards and stand-off distance for the final VBS, in accordance with 10 CFR 73.55(b) and 10 CFR 73.55(e)(10). Therefore, RAIs 13.06.01-22 and 13.06.01-38 are resolved and closed.

Accordingly, the staff found that the proposed vehicle control measures are consistent with the physical protection program design requirements of 10 CFR 73.55(b) and 10 CFR 73.55(e)(10).

Waterborne Threat Measures

The provisions of 10 CFR 73.55(e)(10)(ii) require the applicant to "identify areas from which a waterborne vehicle must be restricted, and where possible, in coordination with local, State, and Federal agencies having jurisdiction over waterway approaches, deploy buoys, markers, or other equipment. In accordance with the site-specific analysis, provide periodic surveillance and observation of waterway approaches and adjacent areas."

In a portion of RAI 13.06.01-65 dated May 6, 2014 (ADAMS Accession No. ML14126A406), the staff requested additional information on why certain information was removed from the North Anna COL security plan concerning monitored views of certain Sections of the adjacent waterways. In a letter dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant came to the conclusion that the missing information was inadvertently removed and would be reinstated in the next revision update of their security plan. By letter dated March 30, 2015 (ADAMS Accession No. ML15093A050), the applicant submitted an update to the PSP providing the missing information.

The staff concludes that Section 11.2.3 of the PSP describes protection measures that are adequate to protect the North Anna 3 site against waterborne threats.

Accordingly, the staff finds the response to RAI 13.06.01-65 acceptable, as it provides details on how the applicant meets the regulatory requirements of 10 CFR 73.55(e)(10)(ii). Therefore, this portion of RAI 13.06.01-65 is resolved and closed.

Protected Area Barriers

The provisions of 10 CFR 73.55(e)(8)(i) require that the PA perimeter must be protected by physical barriers that are designed and constructed to: (1) limit access to only those personnel, vehicles, and materials required to perform official duties; (2) channel personnel, vehicles, and materials to designated access control portals; and (3) be separated from any other barrier designated as a vital area physical barrier, unless otherwise identified in the PSP.

The descriptions of the PA barrier are provided in PSP Section 11.3.

Section 11.3 of the PSP describes the extent to which the PA barrier at the perimeter is separated from a vital area. The security plan identifies where the PA barrier is not separated from a vital area barrier, as required by 10 CFR 73.55(e)(8)(i)(c).

Section 11.3 of the PSP describes isolation zones. As required in 10 CFR 73.55(e)(7), the isolation zone is maintained in outdoor areas adjacent to the PA perimeter barrier and is designed to ensure the ability to observe and assess activities on either side of the PA perimeter.

These descriptions meet the definitions of physical barrier and PA in 10 CFR 73.2 and the requirements of 10 CFR 73.55(e)(8).

Vital Area Barriers

The provisions of 10 CFR 73.55(e)(9) require that "Vital equipment must be located only within vital areas, which must be located within a protected area so that access to vital equipment requires passage through at least two physical barriers, except as otherwise approved by the Commission and identified in the security plans." In addition, 10 CFR 73.55(e)(5) requires that the physical barriers to access of certain vital areas shall be bullet resisting.

Section 11.4 of the PSP describes that vital areas are restricted access areas surrounded by physical barriers with the capability to restrict access to only authorized individuals.

Accordingly, the staff found all vital areas are constructed in accordance with established regulatory requirements. Section 11.4 also describes that the reactor CR, CAS, SAS and the location within which the last access control function for access to the PA is performed, must be bullet resisting. Accordingly, the staff finds all vital areas are constructed in accordance with established regulatory requirements.

Target Set Equipment

The provisions of 10 CFR 73.55(f) require the following:

> The licensee shall document and maintain the process used to develop and identify target sets, to include the site-specific analyses and methodologies used to determine and group the target set equipment or elements. The licensee shall consider cyber-attacks in the development and identification of target sets. Target set equipment or elements that are not contained within a protected or vital area must be identified and documented consistent with the requirements in 10 CFR 73.55(f)(1) and be accounted for in the licensee's protective strategy. The licensee shall implement a process for the oversight of target set equipment and systems to ensure that changes to the configuration of the identified equipment and systems are considered in the licensee's protective strategy. Where appropriate, changes must be made to documented target sets.

Section 11.5 of the PSP describes that target set equipment or elements that are not contained within a protected or vital area are identified and accounted for in the site protective strategy.

In connection with the review of the ESBWR physical protection program, the staff identified several RAIs relating to target sets. In light of these RAIs, GEH provided additional design detail to give the applicant insight into the development of site-specific target set analyses. The applicant incorporates by reference the design of physical protection systems within the design of the vital area and vital systems for the ESBWR, as described in the ESBWR DCD including topical reports, NEDE-33389, NEDE-33390, and NEDE-33391.

GEH stated in NEDE-33391 that target sets were created to aid in the development of the ESBWR physical security systems, which are not considered as final or fully comprehensive because of the simplified assumptions that were made, and that a comprehensive target set document must be developed following an approved development process. GEH also stated that the insights from the development of target sets described in the ESBWR Safeguards Assessment Report should be considered and included, as appropriate. However, the simplifying assumptions need to be expanded to include the necessary combinations of Target Set elements. In addition, the Target Set document should include adjustments to reflect site-specific conditions.

The staff has reviewed the applicant's description in Sections 11.5 and 14.5 of the PSP, Section 7 of the SCP, and information in NEDE-33391, for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in Sections 11.5 and 14.5 of the PSP, Section 7 of the SCP, and the information in NEDE-33391, is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in

Sections 11.5 and 14.5 of the PSP and Section 7 of the SCP meets the requirements of 10 CFR 73.55(f)(1), (3) and (4), and is, therefore, acceptable. The target sets, target set analysis and site protective strategy are in facility implementing procedures, which were not subject to staff review as part of this COL application and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii).

Delay Barriers

The provisions of 10 CFR 73.55(e)(3)(ii) require that physical barriers must "provide deterrence, delay, or support access control" to perform the required function of the applicant's physical protection program. The PSP describes the use of delay barriers at North Anna 3.

Section 11.6 of the PSP includes a description of the use of delay barriers to meet the requirements of 10 CFR 73.55(e).

The staff has reviewed the applicant's description in PSP Sections 11, 11.1, 11.2, 11.2.1, 11.2.2, and 11.2.3, and Sections 11.3 through 11.6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(e), and therefore is acceptable.

13.6.4.1.12 Security Posts and Structures

The provisions of 10 CFR 73.55(e)(5) require that the reactor CR, the CAS, and the location within which the last access control function for access to the PA is performed, must be bullet-resisting.

Section 12 of the PSP states that security posts and structures are qualified to a level commensurate with their application within the site protective strategy, and that these positions are constructed of bullet resisting materials. Section 11.4 of the PSP states the reactor CR, the CAS, SAS, and the location within which the last access control function for access to the PA is performed must be bullet resisting.

In a portion of RAI 13.06.01-66 dated May 6, 2014 (ADAMS Accession No. ML14126A406), the staff questioned how many alarm stations North Anna has between the combined site. In addition, the staff requested the applicant to update all appropriate sections and figures to reflect the appropriate amount of alarms stations for this combined site. In a letter dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant responded with the amount of alarm stations between the combined site. In a letter dated March 30, 2015 (ADAMS Accession No. ML15093A050), the applicant revised Figure 7 of the PSP to depict the location of the SAS for the combined site.

Accordingly, the staff finds the response to RAI 13.06.01-66 acceptable, as the applicant provided details on how many alarm stations the combined site has. Therefore, this portion of RAI 13.06.01-66 is resolved and closed.

The staff has reviewed the applicant's description in PSP Section 12 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(e)(5), and therefore is acceptable.

13.6.4.1.13 Access Control Devices

Regulations in 10 CFR 73.55(g)(1) state that, consistent with the function of each barrier or barrier system, the applicant shall control personnel, vehicle, and material access, as applicable, at each access control point in accordance with the physical protection program design requirements of 10 CFR 73.55(b).

The applicant addresses STD COL 13.6-6-A by adhering to the provisions of 10 CFR 73.55(g)(6) which requires control of access control devices as stated in subparagraph (i): "The licensee shall control all keys, locks, combinations, passwords and related access control devices used to control access to PAs, vital areas and security systems to reduce the probability of compromise."

Types of Security-Related Access Control Devices

Section 13.1 of the PSP describes that the applicant uses security-related access control devices to control access to protected and vital areas and security systems.

Control and Accountability of Access Control Devices

Section 13.2 of the PSP describes the control of security-related locks and describes the controls associated with the changes to and replacements of access control devices and the accountability and inventory control process, and the circumstances that require changes in security-related locks. The applicant uses facility procedures to produce, control, and recover keys, locks, and combinations for all areas and equipment which serve to reduce the probability of compromise. The issue of access control devices is limited to individuals who have unescorted access authorization and need access to perform official duties and responsibilities. Keys and locks are accounted for through a key inventory control process as described in facility procedures.

The staff has reviewed the applicant's description in PSP Sections 13, 13.1, and 13.2, for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the descriptions provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(g)(1) and (6), and therefore are acceptable.

13.6.4.1.14 Access Requirements

Access Authorization and Fitness for Duty

The provisions of 10 CFR 73.55(b)(7) require the applicant to establish, maintain, and implement an access authorization program in accordance with 10 CFR 73.56 and to describe the program in the PSP. The provisions of 10 CFR Part 26 require the applicant to establish and maintain an FFD program.

Section 14.1 of the PSP describes that the access authorization program implements regulatory requirements utilizing the provisions in RG 5.66, Revision 1, dated July 2009. RG 5.66 is an acceptable method for meeting the requirements of 10 CFR 73.55(b)(7).

The staff has reviewed the applicant's description in PSP Section 14.1 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(b)(7), 10 CFR 73.56 and 10 CFR Part 26 and therefore is acceptable.

Insider Mitigation Program

The provisions of 10 CFR 73.55(b)(9) require that the applicant establish, maintain, and implement an insider mitigation program and describe the program in the PSP. The insider mitigation program must monitor the initial and continuing trustworthiness and reliability of individuals granted or retaining unescorted access authorization to a protected or vital area, and implement defense-in-depth methodologies to minimize the potential for an insider to adversely affect, either directly or indirectly, the applicant's capability to prevent significant core damage and spent fuel sabotage. The insider mitigation program must include elements from: the access authorization program; the FFD program; the cyber security program; and the physical protection program.

Section 14.2 of the PSP describes how the applicant will establish, maintain, and implement an insider mitigation program utilizing the guidance in RG 5.77. The insider mitigation program requires elements from the access authorization program described in 10 CFR 73.56; the FFD program described in 10 CFR Part 26; the cyber security program described in 10 CFR 73.54, and the physical security program described in 10 CFR 73.55. In addition, Section 14.2 describes the integration of the programs mentioned above to form a cohesive and effective insider mitigation program. The applicant addresses the observations for the detection of tampering. RG 5.77 is an acceptable method for meeting the requirements of 10 CFR 73.55(b)(9).

The staff has reviewed the applicant's description in PSP Section 14.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(b)(9), and therefore is acceptable.

Picture Badge Systems

Requirements for badges are stated in 10 CFR 73.55(g)(6)(ii). "The licensee shall implement a numbered photo identification badge system for all individuals authorized unescorted access to the protected area and vital areas. In addition, identification badges may be removed from the protected area under limited conditions and only by authorized personnel. Records of all badges shall be retained and shall include name and areas to which persons are granted unescorted access."

The provisions of 10 CFR 73.55(g)(7)(ii) require that individuals not employed by the applicant, but who require frequent or extended unescorted access to the PA and/or vital areas to perform duties and responsibilities required by the applicant at irregular or intermittent intervals, shall satisfy the access authorization requirements of 10 CFR 73.56 and 10 CFR Part 26 of this chapter, and shall be issued a non-employee photo identification badge that is easily distinguished from other identification badges before being allowed unescorted access to the protected and vital areas. Non-employee photo identification badges must visually reflect that the individual is a non-employee and that no escort is required.

Section 14.3 of the PSP describes the site picture badge system. Identification badges will be displayed while individuals are inside the PA or vital areas. When not in use, badges may be removed from the PA by authorized holders, provided that a process exists to deactivate the badge upon exit and positively confirm the individual's true identity and authorization for unescorted access prior to entry into the PA. Records are maintained to include the name and areas to which unescorted access is granted of all individuals to whom photo identification badges have been issued.

The staff has reviewed the applicant's description in PSP Section 14.3 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(g)(6)(ii) and (7)(ii), and therefore is acceptable.

Searches

The provisions of 10 CFR 73.55(h) require, in part, that the applicant meet the objective to detect, deter, and prevent the introduction of firearms, explosives, incendiary devices, or other items that could be used to commit radiological sabotage. To accomplish this, the applicant shall search individuals, vehicles, and materials consistent with the physical protection program design requirements in paragraph (b) of this Section, and the function to be performed at each access control point or portal before granting access.

Section 14.4 of the PSP provides an overview description of the search process for vehicle, personnel, and materials. The search process is conducted using security personnel, specifically trained non-security personnel, and technology.

Vehicle Barrier System Access Control Point Searches

The provisions of 10 CFR 73.55(h)(2)(ii) through (v) provide the requirements for the applicant to search vehicles at the OCA and 10 CFR 73.55(h)(3) provides requirements for searches of personnel, vehicles and materials prior to entering the PA.

Section 14.4.1 of the PSP describes the process for the search of personnel, vehicles, and materials at predetermined locations prior to granting access to designated facility areas identified by the applicant as needed to satisfy the physical protection program. The applicant states that it has developed specific implementing procedures to address vehicle and materials searches at these locations.

Protected Area Personnel Search

Section 14.4 of the PSP describes the process for searches of all personnel requesting access into PAs. The PSP describes the search for firearms, explosives, incendiary devices, or other items that could be used to commit radiological sabotage using equipment capable of detecting these items or through visual and physical searches or both to ensure that all items are clearly identified prior to granting access into the PA. All persons except official Federal, State, and LLEA personnel on official duty are subject to these searches upon entry to the PA. Detailed discussions of observation and control measures are found in the implementing procedures.

Protected Area Packages and Materials Search

Section 14.4.3 of the PSP describes the process for conducting searches of packages and materials for firearms, explosives, incendiary devices, or other items that could be used to commit radiological sabotage using equipment capable of detecting these items or through visual and physical searches or both to ensure that all items are clearly identified before these items can enter the North Anna PA. Detailed provisions for conducting these searches are found in the applicant's implementing procedures and include the search and control of bulk materials and products. The applicant's implementing procedures also discuss the control of packages and materials previously searched and tamper sealed by personnel trained in accordance with the T&QP.

Protected Area Vehicle Search

Section 14.4.4 of the PSP describes the process for the search of vehicles for firearms, explosives, incendiary devices, or other items that could be used to commit radiological sabotage using equipment capable of detecting these items or through visual and physical searches or both to ensure that all items are clearly identified at the PA. Detailed provisions for conducting these searches are found in the applicant's implementing procedures. The applicant's implementing procedures also address the search methodologies for vehicles that must enter the PA under emergency conditions.

Protected Area Access Controls

Section 14.4.5 of the PSP describes the process for controlling access at all points where personnel or vehicles could gain access into the applicant's PA. The plan notes that all points of personnel access are through a lockable portal. The entry process is normally monitored by multiple security personnel. Personnel are normally allowed access through means that verify identity and authorization following the search process. Vehicles are controlled through positive control methods described in facility procedures.

Escort and Visitor Requirements

The provisions of 10 CFR 73.55(g)(7) state, in part, that the applicant may permit escorted access to protected and vital areas to individuals who have not been granted unescorted access in accordance with the requirements of 10 CFR 73.56 and 10 CFR Part 26. Provisions in 10 CFR 73.55(g)(8) establish escort requirements. The applicant is required to implement procedures for processing, escorting, and controlling visitors. Procedures will address confirmation of identity of visitors, maintenance of a visitor control register, visitor badging and escort controls including, training, communications, and escort ratios.

Section 14.4.6 of the PSP describes the process for control of visitors. The PSP affirms that procedures address the identification, processing, and escorting of visitors, and the maintenance of a visitor control register. Training provisions for escorting visitors include responsibilities, communications and escort ratios. All escorts are trained to perform escort duties in accordance with site requirements as described in the procedures. All visitors wear a badge that clearly indicates that an escort is required.

The staff has reviewed the applicant's description in PSP Sections 14.4, and 14.4.1 through 14.4.6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(h)(2), (h)(3), (g)(7) and (g)(8), and therefore is acceptable.

Vital Area Access Controls

The provisions of 10 CFR 73.55(g)(4) require that the applicant control access into vital areas consistent with established access authorization lists. In response to a site-specific credible threat or other credible information, the applicant shall implement a two-person (line-of-sight) rule for all personnel in vital areas so that no one individual is permitted access to a vital area.

The provisions of 10 CFR 73.56(j) require the applicant to establish, implement, and maintain a list of individuals who are authorized to have unescorted access to specific nuclear power plant vital areas during non-emergency conditions. The list must include only those individuals who have a continued need for access to those specific vital areas in order to perform their duties and responsibilities. The list must be approved by a cognizant manager or supervisor who is responsible for directing the work activities of the individual who is granted unescorted access to each vital area, and be updated and reapproved no less frequently than every 31 days.

Section 14.5 of the PSP describes vital areas and that the applicant maintains vitals areas locked and protected by an active intrusion alarm system. An access authorization system is established to limit unescorted access that is controlled by an access authorization list that is reassessed and reapproved at least once every 31 days. Additional access control measures are described in the facility procedures.

The staff has reviewed the applicant's description in PSP Section 14.5 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(g)(4), and therefore is acceptable.

13.6.4.1.15 Surveillance Observation and Monitoring

The provisions of 10 CFR 73.55(i)(1) require that the applicant establish and maintain intrusion detection systems that satisfy the design requirements of 10 CFR 73.55(b) and provide, at all times, the capability to detect and assess unauthorized persons and facilitate the effective implementation of the protective strategy.

Illumination

The provisions of 10 CFR 73.55(i)(6) require, in part, that all areas of the facility are provided with illumination necessary to satisfy the design requirements of 10 CFR 73.55(b) and implement the protective strategy. Specific requirements include providing a minimum illumination level of 0.2 foot-candles, measured horizontally at ground level, in the isolation zones and appropriate exterior areas within the PA. Alternatively, the applicant may augment the facility illumination system by means of low-light technology to meet the requirements of this Section or otherwise implement the protective strategy. The applicant shall describe in the security plans how the lighting requirements of this Section are met and, if used, the type(s) and application of low-light technology.

Section 15.1 of the PSP describes that all isolation zones and appropriate exterior areas within the PA have lighting capabilities that provide illumination sufficient for the initiation of an adequate response to an attempted intrusion of the isolation zone, a PA, or a vital area. A discussion of the implementation of technology using fixed and non-fixed low-light level cameras or alternative technological means is provided. The applicant has addressed the potential for loss of lighting and the compensatory actions that would be taken if that event were to occur.

Surveillance Systems

The provisions of 10 CFR 73.55(i)(5) require, in part, that the applicant implement, establish, and maintain intrusion detection and assessment, surveillance, and observation and monitoring systems to satisfy the design requirements of 10 CFR 73.55(b), and to conform to the applicant's OCA.

Section 15.2 of the PSP describes that surveillance is accomplished by human observation and technology. Surveillance systems include a variety of cameras, video display, and annunciation systems designed to assist the security organization in observing, detecting, and assessing alarms or unauthorized activities. Certain systems provide real-time and recorded play back of recorded video images. The specifics of surveillance systems are described in facility implementing procedures.

Intrusion Detection Equipment

Section 15.3 of the PSP describes the perimeter intrusion detection system, and the PA and vital area intrusion detection systems. These systems are capable of detecting attempted and actual unauthorized penetration of the PA perimeter barrier; are monitored with assessment equipment designed to satisfy the requirements of 10 CFR 73.55(i) and provide real-time and play-back/recorded video images of the detected activities before and after each alarm annunciation. The PSP describes how the applicant will meet regulatory requirements for redundancy, tamper indication, and uninterruptable power supply.

Central Alarm Station (CAS) and Secondary Alarm Station (SAS) Operation

The applicant addresses STD COL 13.6-7-A and NAPS COL 13.6-8-A as follows: The provisions of 10 CFR 73.55(i)(4) provides requirements for alarm stations. It is required, in 10 CFR 73.55(i)(4)(i) that both alarm stations must be designed and equipped to ensure that a single act, in accordance with the DBT of radiological sabotage defined in 10 CFR 73.1, cannot disable both alarm stations. The applicant shall ensure the survivability of at least one alarm station to maintain the ability to perform the following functions: 1) detect and assess alarms; 2) initiate and coordinate an adequate response to an alarm; 3) summon offsite assistance; and 4) provide command and control. The provisions of 10 CFR 73.55(i)(4)(iii) require, in part, that the CAS and SAS alarm stations must be equal and redundant.

Section 15.4 of the PSP describes the functional operations of the CAS and the SAS. The PSP provides that the alarm stations are equipped such that no single act will disable both alarm stations. The applicant's PSP provides that each alarm station is properly manned and that no activities are permitted that would interfere with the operator's ability to execute assigned duties and responsibilities.

Security Patrols

Owner Controlled Area Surveillance and Response

The provisions of 10 CFR 73.55(e)(6) require that the applicant establish and maintain physical barriers in the OCA, as needed, to satisfy the physical protection program design requirements of 10 CFR 73.55(b). It is required in 10 CFR 73.55(i)(5)(ii), in part, that the applicant provide continuous surveillance, observation and monitoring of the OCA and that these responsibilities may be performed by security personnel during continuous patrols, through the use of video technology, or by a combination of both.

Section 15.5.1 of the PSP describes the processes used to meet this requirement. The PSP discusses the process to be used and provides that details regarding the implementation of

OCA surveillance techniques are found in facility procedures. The PSP provides a discussion regarding the implementation of manned and video options for patrolling and surveillance of the OCA.

In a portion of RAI 13.06.01-65 dated May 6, 2014 (ADAMS Accession No. ML14126A406), the staff requested additional information to explain inconsistencies in the OCA patrols as described in North Anna 3, Revision 4, PSP Section 11.2.3 and SCP Section 7, with North Anna 1 and 2, Revision 18, same Sections. In a letter dated May 29, 2014 (ADAMS Accession No. ML14155A338), the applicant came to the conclusion that the missing information was mistakenly removed and would be reinstated in the next revision update of their security plan. By letter dated March 30, 2015, (ADAMS Accession No. ML15093A050), the applicant submitted an update to the combined security plan providing the missing information**.**

The staff concludes that PSP Section 15.5.1, and SCP Section 7 describes surveillance and response measures adequate to protect the North Anna 3 against intrusion.

Accordingly, the staff found the response to RAI 13.06.01-65 acceptable, as it provided details on how the applicant meets the regulatory requirements of 10 CFR 73.55(e)(6). Therefore, this portion of RAI 13.06.01-65 is resolved and closed.

Protected and Vital Area

The provisions of 10 CFR 73.55(i)(5)(iii) through (viii) require, in part, that armed patrols check unattended openings that intersect a security boundary, such as an underground pathways, check external areas of the PA and vital area portals, periodically inspect vital areas, conduct random patrols of accessible target set equipment, be trained to recognize obvious tampering and if detected, initiate an appropriate response in accordance with established plans and procedures.

Section 15.5.2 of the PSP describes the process employed by the applicant to meet the above requirements. The PSP describes the areas of the facility that will be patrolled and observed, as well as the frequency of these patrols and observations. The applicant has addressed the observations for the detection of tampering in Section 14.2 of the PSP and in the facility procedures.

The staff has reviewed the applicant’s description in PSP Sections 15, 15.1 through 15.4, 15.5.1, and 15.5.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. The staff verified that the PSP provided for the identification of openings, areas, and equipment that must be checked, inspected, or otherwise observed by armed patrols. Further, the staff has determined that the PSP provides for training of patrols and procedures to recognize obvious tampering and to initiate an appropriate response to recognized tampering. In view of these staff determinations, the applicant’s description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(b) and (i), and therefore are acceptable with respect to surveillance observation and monitoring.

13.6.4.1.16 Communications

The provisions of 10 CFR 73.55(j)(1) through (6) describe the requirements for establishment and maintenance of continuous communication capabilities with both onsite and offsite resources to ensure effective command and control during both normal and emergency situations. An individual assigned to an alarm station must be capable of calling for assistance, on-duty security force personnel must be capable of maintaining continuous communication with each alarm station and vehicle escorts, and personnel escorts must maintain timely communication with security personnel. Continuous communication capabilities must terminate in both alarm stations, including between LLEA and each alarm station and between the CR and each alarm station. Non-portable communications must remain operable from independent power sources. The applicant must identify areas where communications could be interrupted or not maintained.

Notifications (Security Contingency Event Notifications)

Section 16.1 of the PSP states that the applicant has a process to ensure that continuous communications are established and maintained between the onsite security force staff and the offsite support agencies.

System Descriptions

Section 16.2 of the PSP describes the establishment and maintenance of the communications system. Detailed descriptions of security systems are included in the facility procedures, including areas where communications could be interrupted or not maintained. The North Anna site security personnel have access to both hard wired and alternate communications systems. Site security personnel are assigned communications devices to maintain continuous communications with the CAS and SAS. All personnel and vehicles are assigned communications resources with which to maintain continuous communications. Continuous communication protocols are available between the CAS, SAS, and each CR. The applicant maintains a secondary power source, within a vital area, for all non-portable security communications equipment.

The staff has reviewed the applicant’s description in PSP Sections 16, 16.1, and 16.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP meets the requirements of 10 CFR 73.55(j)(1) through (6), and therefore are acceptable.

13.6.4.1.17 Review, Evaluation, and Audit of the Physical Security Program

The provisions of 10 CFR 73.55(m) require, in part that each element of the physical protection program be reviewed at least every 24 months. A review is required within 12 months after initial physical protection program implementation or a change in personnel, procedures, equipment, or facilities that could have a potentially adverse effect on security. A review is also required as necessary based on site-specific analysis assessments, or other performance indicators. Reviews must be conducted by individuals independent of those responsible for security program and those directly responsible for implementation of the onsite physical protection program. Reviews must include an audit of security plans, implementing procedures and local law enforcement commitments. Results of reviews shall be presented to management at least one level above the level responsible for day-to-day plant operations, and findings must be entered in the site corrective action program.

Section 17 of the PSP describes that the physical security program is reviewed 12 months following initial implementation and at least every 24 months by individuals independent of both security program management and personnel who have a direct responsibility for implementation of the security program. The physical security program review includes, but is not limited to, an audit of the effectiveness of the physical security program, cyber security plans, implementing procedures, safety/security interface activities, the testing, maintenance, and calibration program, and response commitments by local, State, and Federal law enforcement authorities.

The PSP also states that a review shall be conducted as necessary based upon site-specific analyses, assessments, or other performance indicators and as soon as reasonably practical, but no longer than 12 months, after changes occur in personnel, procedures, equipment, or facilities that potentially could adversely affect safety/security.

The PSP provides further that the results and recommendations of the physical security program review, management's finding on whether the physical security program is currently effective and any actions taken as a result of recommendations from prior program reviews are documented in a report to plant management and to appropriate corporate management at least one level higher than that having responsibility for the day-to-day plant operation. The PSP provides that these reports are maintained in an auditable form and maintained for inspection.

The PSP states that findings from the onsite physical security program reviews are entered into the facility corrective action program.

The provisions of the PSP described above are virtually identical to the requirements of Section 73.55(m) summarized above, and the PSP satisfies those requirements. The staff, however, raised a question regarding the requirements of 10 CFR 73.58, “Safety/security requirements for nuclear power reactors.”

In RAI 13.06.01-36 (ADAMS Accession No. ML092730215) dated September 30, 2009, the staff requested that the applicant address the requirements of 10 CFR 73.58. “ In its response, dated November 9, 2009 (ADAMS Accession No. ML093270043), the applicant stated that a procedure will be developed and used to review planned and emergent activities on safety and security with guidance from RG 5.74. The procedure will be developed by March 31, 2010, for compliance with 10 CFR 73.58 for Safety/Security Interface. Additionally, a description of the North Anna 3 safety/security interface program will be included in North Anna COL FSAR, Section 13.6.2.

The staff finds that the response to RAI 13.06.01-36 meets the requirements of 10 CFR 73.58 and is acceptable, because it provides a commitment to implement administrative procedures to manage the safety/security interface. Specifically, the North Anna COL FSAR Revision 6, Section 13.6.2, dated July 2013, states in, CWR SUP-13.6-2:

Administrative procedures have been implemented that meet the requirements of 10 CFR 73.58 for managing the safety/security interface.

The staff has verified that CWR SUP-13.6-2 has been included in the North Anna 3 FSAR. Therefore, RAI 13.06.01-36 is resolved and closed.

The North Anna 3 COL applicant responding as the subsequent COL (S-COL) application in the design centered licensing review approach, see Section 1.2.3 of this SER, provided the results of its review of RAIs, including 13.06.01-57 submitted by the Fermi 3 reference COL (R-COL) applicant. The following clarification RAI was submitted to the ESBWR R-COL, Fermi 3:

In RAI 13.06.01-57, the NRC staff requested clarification pertaining to how the applicant, once licensed, will analyze and identify changes in the site specific conditions related to the ESBWR's structures, systems, and components (SSCs) (described in certain technical reports), resulting from changes made to the Fermi 3 COL between issuance of the COL and the security program implementation milestones provided in FSAR Table 13.4-201 to ensure that the security plan continues to meet 10 CFR 73.55(b)(4). Also, clarify how the applicant, once licensed, will ensure that the as-built plant continues to meet all physical protection program design and performance criteria in 10 CFR 73.55 at the time the physical protection program is implemented. During a public telephone call on August 4, 2014 (ML14281A128), the NRC staff provided feedback to the applicant concerning the addition of "NRC endorsed" and the removal of "currently accepted" to the RAI 13.06.01-57 response. In a letter dated August 4, 2014, the applicant submitted to the NRC a revised COLA markup associated with its response to RAI 13.06.01-57.

In its response, the applicant stated that the description of the content of the administrative procedures implementing the 10 CFR 73.58 Fermi 3 COLA FSAR, Section 13.6.2 will be revised as follows:

These procedures are in effect at the time of issuance of the COL and were developed using NRC endorsed industry guidance.

The NRC staff finds that the response to RAI 13.06.01-57 meets the requirements of 10 CFR 73.55(b)(4) and 10 CFR 73.58 and is acceptable, because it provides a commitment to implement administrative procedures to manage the safety/security interface during the construction phase and throughout the operational phase. The incorporation of changes to the Fermi 3 COL FSAR, Section 13.6.2 is being tracked as Confirmatory Item 13.6-1. The staff verified that FSAR Revision 7 incorporated changes provided in response to RAI 13.06.01-57. Therefore, Confirmatory Item 13.6-1 is resolved.

North Anna 3 representatives were also present during the above-stated public telephone call, and agreed to follow Fermi 3's response in a letter dated October 8, 2014 (ADAMS Accession No. ML14287A288).

> Administrative procedures have been implemented that meet the requirements of 10 CFR 73.58 for managing the safety/security interface. These procedures are in effect at the time of issuance of the combined license and were developed using NRC endorsed industry guidance.

The staff has reviewed the applicant's description in PSP Section 17 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. As set forth above, the applicant's description in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(m), and therefore is acceptable

In FSAR Part 2, Revision 9, dated June 2016, the applicant provided an update to STD SUP-13.6-2 confirming the changes to match Fermi 3's response regarding Safety/Security interface. Therefore, confirmatory item 13.06-01 is closed.

13.6.4.1.18 Response Requirements

The provisions of 10 CFR 73.55(k) require, in part, that the applicant establish and maintain a properly trained, qualified and equipped security force required to interdict and neutralize threats up to and including the DBT defined in 10 CFR 73.1, to prevent significant core damage and spent fuel sabotage. To meet this objective, the applicant must ensure that necessary equipment is in supply, working, and readily available for use. The applicant must ensure training has been provided to all armed members of the security organization who will be available on site to implement the applicant's protective strategy as described in the facility procedures and 10 CFR Part 73, Appendix C. The applicant must have facility procedures to reconstitute armed response personnel and have established working agreement(s) with LLEA. The applicant must have implemented a threat warning system to accommodate heightened security threats and coordination with NRC representatives.

Section 18 of the PSP describes an armed response team, as well as its responsibilities, training and equipment, and the number of armed response force personnel required to be immediately available at all times to implement the site's protective strategy. The PSP provides for training in accordance with the requirements of 10 CFR Part 73, Appendix B that will ensure implementation of the site protective strategy in accordance with 10 CFR Part 73, Appendix C. Procedures are in place to reconstitute the armed response personnel as are agreements with LLEA. The PSP also describes procedures to manage the threat warning system.

The staff has reviewed the applicant's description in PSP Section 18 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria.

Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(k), and therefore is acceptable.

13.6.4.1.19 Special Situations Affecting Security

The provisions of 10 CFR 73.58 require that each nuclear power reactor applicant requesting a license under 10 CFR Part 50, or 10 CFR Part 52, comply with the following requirements: the applicant shall assess and manage the potential for adverse effects on safety and security, including the site emergency plan, before implementing changes to plant configurations, facility conditions, or security; the scope of changes to be assessed and managed must include planned and emergent activities (such as, but not limited to, physical modifications, procedural changes, changes to operator actions or security assignments, maintenance activities, system reconfiguration, access modification or restrictions, and changes to the security plan and its implementation); where potential conflicts are identified, the applicant shall communicate them to appropriate personnel and take compensatory and/or mitigative actions to maintain safety and security under applicable Commission regulations, requirements, and license conditions.

The provisions of 10 CFR 73.55(a)(2) require the applicant's security plans to identify, describe, and account for site-specific conditions that affect its capability to satisfy the requirements of that Section.

The provisions of 10 CFR 73.55(n)(8) require, in part, operational and post-maintenance performance testing to ensure operational readiness for security equipment and systems.

Refueling/Major Maintenance

Section 19.1 of the PSP describes that security procedures identify measures for implementation of actions prior to refueling or major maintenance activities. These measures include controls to ensure that a search is conducted prior to revitalizing an area, that protective barriers and alarms are fully operational, and that post-maintenance performance testing is performed to ensure operational readiness of equipment in accordance with 10 CFR 73.55(n)(8).

Construction and Maintenance

Section 19.2 of the PSP states that during periods of construction and maintenance when temporary modifications are necessary, the applicant will implement measures that provide for equivalency in the physical protective measures and features impacted by the activities such that physical protection measures are not degraded. The process for making such changes or modifications is included in the facility procedures.

The staff has reviewed the applicant's description in PSP Sections 19.1 and 19.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(n)(8) and 10 CFR 73.58, and are, therefore, acceptable.

13.6.4.1.20 Maintenance, Testing, and Calibration

In accordance with 10 CFR 73.55(n), the applicant is required to establish, maintain, and implement a maintenance, testing, and calibration program to ensure that security systems and equipment, including secondary and uninterruptible power supplies, are tested for operability and performance at predetermined intervals, maintained in operable condition, and have the capability of performing their intended functions. The regulation requires that the applicant describe its maintenance testing and calibrations program in the PSP, and that the implementing procedures describe the details and intervals for conducting these activities. Applicant procedures must identify criteria for documenting deficiencies in the corrective action program and ensuring data protection in accordance with 10 CFR 73.21. The applicant must conduct periodic operability testing of the intrusion alarm system and must conduct performance testing at the beginning and end of the period for which it is used for security, or if the period of continuous use exceeds 7 days, at least once every 7 days. Communication equipment must be tested not less than daily, and search equipment must also be tested periodically. Procedures must be established for testing equipment located in hazardous areas, and procedures must be established for returning equipment to service after each repair.

Sections 20.1 through 20.7 of the PSP describe the maintenance, testing, and calibration program for security-related equipment. Section 20.1 states that the applicant shall conduct intrusion detection testing in accordance with recommended testing procedures described in RG 5.44, Revision 3, which specifies testing frequency.

The staff has determined that Section 20.7 does not apply to North Anna 3, due to North Anna not having ROWS. North Anna security plan Revision 5, dated March 2015 (ADAMS Accession No. ML15093A050), appropriately identifies that ROWS is not applicable to this site.

Accordingly, the staff has determined that the PSP provides for testing of each operational component credited for the implementation of the security program at a frequency in accordance with 10 CFR 73.55(n), the PSP, and implementing procedures.

The staff has reviewed the applicant’s description in PSP Sections 20 and 20.1 through 20.7 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(n), and therefore is acceptable.

13.6.4.1.21 Compensatory Measures

The provisions of 10 CFR 73.55(o) requires, in part, that the applicant shall identify criteria and measures to compensate for degraded or inoperable equipment, systems, and components to meet the requirements of Section 73.55. Compensatory measures must provide a level of protection that is equivalent to the protection that was provided by the degraded or inoperable, equipment, system, or components. Compensatory measures must be implemented within specific time frames necessary to meet the appropriate portions of 10 CFR 73.55(b) and described in the security plans.

Section 21 of the PSP identifies measures and criteria to compensate for degraded or inoperable equipment, systems, and components in accordance with 10 CFR 73.55(o) to assure that the effectiveness of the physical protection system is not reduced by failure or other contingencies affecting the operation of the security-related equipment or structures. Sections 21.1 through 21.14 of the PSP address PA and vital area barriers, intrusion detection and alarm systems, lighting, fixed and non-fixed closed circuit television, play-back and recorded video systems, computer systems, access control devices, VBS, channeling barrier systems, other security related equipment, and UPS.

In a portion of RAI 13.06.01-66, the staff asked the applicant to explain the discrepancy between the operating site security plan and the combined site security plan concerning the site UPS. By letter dated May 29, 2015, the applicant stated that this discrepancy was made in error, and would be corrected. In Revision 5 of the North Anna COL security plan dated March 30, 2015 (ADAMS Accession No. ML15093A050), the applicant revised PSP Section 14.5 to correct the discrepancy between the operating and combined site security plans.

Accordingly, the staff found the response to this portion of RAI 13.06.01-66 acceptable, as it provides the corrected information in PSP Section 14.5 on how the applicant meets the regulatory requirements of 10 CFR 73.55(c)(1)(i) and 10 CFR 73.55(c)(1)(ii). Therefore, this portion of RAI 13.06.01-66 is resolved and closed.

The staff has reviewed the applicant's description in PSP Sections 21 and 21.1 through 21.14, for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(o), and therefore is acceptable.

13.6.4.1.22 Records

The provisions of 10 CFR 73.55(q) and 10 CFR Part 73, Appendix B, Section VI.H, and Appendix C, Section II.C, require, in part, that the applicant must retain and maintain all records required to be kept by the Commission regulations, orders, or license conditions until the Commission terminates the license for which the records were developed, and shall maintain superseded portions of these records for at least 3 years after the record is superseded, unless otherwise specified by the Commission. The provisions of 10 CFR Part 26, Subpart N, 10 CFR 73.56(o), and 10 CFR 73.70 include requirements for records regarding FFD, access authorization, and certain other security-related matters, respectively. Among other things, the applicant is required to keep records of contracts with any contracted security force that implements any portion of the onsite physical protection program for the duration of the contract. The applicant must make all records, required to be kept by the Commission, available to the Commission and the Commission may inspect, copy, retain and remove all such records, reports and documents whether kept by the applicant or a contractor. Review and audit reports must be maintained and available for inspection for a period of 3 years.

Section 22 of the PSP addresses the requirements to maintain records. Sections 22.1 through 22.13 address each kind of record that the applicant will maintain and the duration of retention for each record. The following types of records are maintained in accordance with the above mentioned regulations: access authorization; suitability, physical, and psychological qualification records for security personnel; PA and vital area access control records; PA visitor access records; PA vehicle access records; vital area access transaction records; vitalization and de-vitalization records; vital area access list reviews; security plans and procedures; security patrols, inspections and tests; maintenance; CAS and SAS alarm annunciation and security response records; LLEA records; records of audits and reviews; access control devices; security training and qualification records; firearms testing and maintenance records; and engineering analysis for the VBS.

In RAI 13.06.01-32 dated October 1, 2009 (ADAMS Accession No. ML092881296), the staff requested the applicant to clarify their commitment to RG 5.66 in the North Anna 3 COLA Part 2: FSAR - NAPS COL 1.9-3-A Table 1.9-202 “Conformance with Regulatory Guides.” In the applicant’s response (ADAMS Accession No. ML093270043) dated November 19, 2009, the applicant stated in part: “When the template [NEI 03-12] is revised and endorsed to include the sentence ["All elements of Regulatory Guide 5.66, Revision 1, have been implemented to satisfy the requirements of 10 CFR 73.56 and 10 CFR part 26 related to unescorted access and unescorted access authorization."], Dominion will include the sentence in the next revision to the Physical Security Plan.”

Accordingly, the staff finds the response to RAI 13.06.01-32 acceptable, as the applicant provides a commitment to update the North Anna PSP with the statement "All elements of Regulatory Guide 5.66, Revision 1, have been implemented to satisfy the requirements of 10 CFR 73.56 and 10 CFR part 26 related to unescorted access and unescorted access authorization.," once the NRC endorsed NEI 03-12, Section 14.1 has been updated with the sentence "All elements of Regulatory Guide 5.66, Revision 1, have been implemented to satisfy the requirements of 10 CFR 73.56 and 10 CFR Part 26 related to unescorted access and unescorted access authorization." Therefore, RAI 13.06.01-32 is resolved and closed.

The staff has reviewed the applicant’s description in PSP Sections 22 and 22.1 through 22.13 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1 the staff found that the descriptions provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 26, 10 CFR 73.55(q), 10 CFR 73.56(o), and 10 CFR 73.70, and are, therefore, acceptable.

13.6.4.1.23 Digital Systems Security

Section 23 of the PSP addresses digital systems security. The applicant stated in its PSP that it has implemented the requirements of 10 CFR 73.54 and maintains a cyber security plan that describes how it has provided high assurance that safety, security, and emergency preparedness (SSEP) functions are protected against the DBT. Once the NRC reviews and approves the plan, it is a condition of the site license and the program is implemented consistent with the approved schedule in the plan.

The staff’s review of the cyber security plan is found in Section 13.8 of this SER.

13.6.4.1.24 Temporary Suspension of Security Measures

The provisions of 10 CFR 73.55(p) allow the applicant to suspend implementation of affected requirements of this Section under the following conditions: (i) In accordance with 10 CFR 50.54(x) and 50.54(y) of this chapter, the licensee may suspend any security measures under this Section in an emergency when this action is immediately needed to protect the public health and safety and no action consistent with license conditions and technical specifications that can provide adequate or equivalent protection is immediately apparent. This suspension of security measures must be approved as a minimum by a licensed senior operator before taking this action. (ii) During severe weather when the suspension of affected security measures is immediately needed to protect the personal health and safety of security force personnel and no other immediately apparent action consistent with the license conditions and technical specifications can provide adequate or equivalent protection. This suspension of security measures must be approved, as a minimum, by a licensed senior operator, with input from the security supervisor or manager, before taking this action.

Suspension of Security Measures in Accordance with 10 CFR 50.54(x) and (y)

Section 24.1 of the PSP addresses suspension of security measures in accordance with 10 CFR 50.54(x) and 10 CFR 50.54(y). Specifically, the plan provides description of the conditions under which suspension is permissible, the level of authority necessary to suspend security measures, and the provisions for reporting such a suspension.

Suspension of Security Measures during Severe Weather or Other Hazardous Conditions

As required in 10 CFR 73.55(p)(3), which states in part, “suspension of security measures are reported and documented in accordance with the provisions of 10 CFR 73.71.” This suspension of security measures must be approved, as a minimum, by a licensed senior operator, with input from the security supervisor or manager, before taking this action. Suspended security measures must be reinstated as soon as conditions permit.

Section 24.2 of the PSP provides that certain security measures may be temporarily suspended during circumstances such as imminent, severe, or hazardous weather conditions, but only when such action is immediately needed to protect the personal health and safety of security force personnel and no other immediately apparent action consistent with the security measures can provide adequate or equivalent protection. Under the PSP, suspended security measures shall be restored as soon as practical.

The staff has reviewed the applicant’s description in PSP Sections 24, 24.1, and 24.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the PSP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the PSP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(p), and therefore is acceptable.

13.6.4.1.25 Appendix A Glossary of Terms and Acronyms

Appendix A, “Glossary of Terms and Acronyms,” was reviewed and found to be consistent with the NRC endorsed NEI 03-12, Revision 7 template.

13.6.4.1.26 Conclusions on the Physical Security Plan

Accordingly, the staff’s review described in Sections 13.6.4.1.1 through 13.6.4.1.25 of this SER, the North Anna 3 PSP meets the requirements of 10 CFR 73.55(a) through (r). The target sets, target set analysis, and site protective strategy are in the facility implementing procedures, which were not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and procedurally correct implementation of the PSP will provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

13.6.4.2 Appendix B Training and Qualification Plan

13.6.4.2.1 Introduction

The provisions of 10 CFR 73.55(c)(4) state that the applicant shall establish, maintain, implement, and follow a T&QP that describes how the criteria set forth in 10 CFR Part 73, Appendix B will be implemented.

The provisions of 10 CFR 73.55(d)(3) state that the applicant may not permit any individual to implement any part of the physical protection program unless the individual has been trained, equipped, and qualified to perform their assigned duties and responsibilities in accordance with 10 CFR Part 73, Appendix B and the T&QP. Non-security personnel may be assigned duties and responsibilities required to implement the physical protection program and shall:

(i) Be trained through established applicant training programs to ensure each individual is trained, qualified, and periodically requalified to perform assigned duties.

(ii) Be properly equipped to perform assigned duties.

(iii) Possess the knowledge, skills, and abilities, to include physical attributes such as sight and hearing, required to perform their assigned duties and responsibilities.

In addition, 10 CFR Part 73, Appendix B, Section VI.D.2(a) states armed and unarmed individuals shall be requalified at least annually in accordance with the requirements of the Commission-approved T&QP.

The T&QP describes that it is written to address the requirements found in 10 CFR Part 73, Appendix B, Section VI. The applicant indicates that the objective of the plan is to provide a mechanism to ensure that members of the security organization, and all others who have duties and responsibilities in implementing the security requirements and protective strategy, are properly trained, equipped, and qualified. The T&QP describes, deficiencies identified during the administration of the T&QP requirements are documented in the site corrective action program. The staff has reviewed the introduction Section in the T&QP and has determined that it includes all of the programmatic elements necessary to satisfy the requirements of 10 CFR 73.55 and 10 CFR Part 73, Appendix B, Section VI applicable to the T&QP. Additional section-by-section evaluations and discussions are found in the following paragraphs.

13.6.4.2.2 Employment Suitability and Qualification

Provisions for mental qualifications, documentation, and physical requalification for security personnel (applicant employee and contractor) are described in the following T&QP Sections.

Suitability

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.1(a) require, in part, that before employment, or assignment to the security organization, an individual shall: (1) possess a high school diploma or pass an equivalent performance examination designed to measure basic mathematical, language, and reasoning skills, abilities, and knowledge required to perform security duties and responsibilities; (2) have attained the age of 21 for an armed capacity or the age of 18 for an unarmed capacity; (3) not have any felony convictions that reflect on the individual's reliability; and (4) not be disqualified from possessing or using firearms or ammunition in accordance with applicable State or Federal law, including 18 U.S.C. 922, for individuals in an armed capacity. Applicants shall use information that has been obtained during the completion of the individual's background investigation for unescorted access to determine suitability. Satisfactory completion of a firearms background check for the individual under 10 CFR 73.19 of this part will also fulfill this requirement. The provisions of 10 CFR Part 73, Appendix B, Section VI.B.1(b) requires that the qualification of each individual to perform assigned duties and responsibilities must be documented by a qualified training instructor and attested to by a security supervisor.

Section 2.1 of the T&QP details the requirements of qualifications for employment in the security organization that follows the regulation in 10 CFR Part 73, Appendix B, Section VI.B.1(a).

Physical Qualifications

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.2 require, in part, that individuals whose duties and responsibilities are directly associated with the effective implementation of the Commission-approved security plans, applicant protective strategy, and implementing procedures, may not have any physical conditions that would adversely affect their performance of assigned security duties and responsibilities.

Section 2.2 of the T&QP details that those individuals who are directly associated with implementation of the security plans, protective strategy and procedures, may not have any physical conditions that would adversely affect their performance of assigned security duties and responsibilities. All individuals that are found on the critical task matrix shall demonstrate the necessary physical qualifications prior to duty.

Physical Examination

It is stated in 10 CFR Part 73, Appendix B, Section VI.B.2(a)(2), that armed and unarmed individuals assigned security duties and responsibilities shall be subject to a physical examination designed to measure the individual's physical ability to perform assigned duties and responsibilities as identified in the Commission-approved security plans, applicant protective strategy, and implementing procedures.

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.2(a)(3) state, in part, that the physical examination must be administered by a licensed health professional with the final determination being made by a licensed physician to verify the individual's physical capability to perform assigned duties and responsibilities.

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.2(b) through (e) provide the minimum requirements that individuals must meet, and include requirements for vision, hearing, review of existing medical conditions, and examination for potential addictions.

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.2(f) address medical examinations before returning to assigned duties following any incapacitation.

Section 2.3 of the T&QP describes the physical examinations for armed and unarmed individuals assigned security duties, as well as other individuals that implement parts of the physical protection program. Minimum requirements exist for physical examinations of vision, hearing, existing medical conditions, addiction, or other physical requirements.

The staff has reviewed the applicant's description in T&QP Sections 2.1, 2.2, and 2.3 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73 Appendix B, Sections VI.B.1 and VI.B.2, and are, therefore, acceptable.

Medical Examinations and Physical Fitness Qualifications

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.4(a), require, in part, that armed members of the security organization shall be subject to a medical examination by a licensed physician, to determine the individual's fitness to participate in physical fitness tests, and that the applicant shall obtain and retain a written certification from the licensed physician that no medical conditions were disclosed by the medical examination that would preclude the individual's ability to participate in the physical fitness tests or meet the physical fitness attributes or objectives associated with assigned duties.

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.4(b), require, in part, that before assignment, armed members of the security organization shall demonstrate physical fitness for assigned duties and responsibilities by performing a practical physical fitness test. The physical fitness test must consider physical conditions such as strenuous activity, physical exertion, levels of stress, and exposure to the elements as they pertain to each individual's assigned security duties. The physical fitness qualification of each armed member of the security organization must be documented by a qualified training instructor and attested to by a security supervisor.

Section 2.4 of the T&QP is explicit in its requirements for medical examinations and physical qualifications.

The staff has reviewed the applicant's description in T&QP Section 2.4 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.B.4(a) and 10 CFR Part 73, Appendix B, Section VI.B.4(b), and therefore is acceptable.

Psychological Qualifications

General Psychological Qualifications

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.3(a), require, in part, that armed and unarmed individuals shall demonstrate the ability to apply good judgment, mental alertness, the capability to implement instructions and assigned tasks, and possess the acuity of senses and ability of expression sufficient to permit accurate communication by written, spoken, audible, visible, or other signals required by assigned duties and responsibilities.

Section 2.5.1 of the T&QP details that individuals whose security tasks and jobs are directly associated with the effective implementation of the security plan and protective strategy shall demonstrate the qualities in 10 CFR Part 73, Appendix B, Section VI.B.3(a).

Professional Psychological Examination

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.3(b), require, in part, that a licensed psychologist, psychiatrist, or physician trained in part to identify emotional instability shall determine whether armed members of the security organization and alarm station operators in addition to meeting the requirement stated in Appendix B, Section VI.B.3(a), have no emotional instability that would interfere with the effective performance of assigned duties and responsibilities.

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.3(c), require that a person professionally trained to identify emotional instability shall determine whether unarmed individuals, in addition to meeting the requirement stated in Appendix B, Section VI.B.3(a), have no emotional instability that would interfere with the effective performance of assigned duties and responsibilities.

Section 2.5.2 of the T&QP provides for the administration of psychological and emotional determination that will be conducted by appropriately licensed and trained individuals.

The staff has reviewed the applicant's description in T&QP Sections 2.5.1 and 2.5.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Sections VI.B.3(a), (b) and (c), and therefore are acceptable.

Documentation

The provisions of 10 CFR Part 73, Appendix B, Section VI.H.1 require, in part, the retention of all reports, records, or other documentation required by Appendix B in accordance with 10 CFR 75.55(q).

Section 2.6 of the T&QP describes that qualified training instructors create the documentation of training activities and that security supervisors attest to these records, as required. Records are retained in accordance with Section 22 of the PSP as described in Section 13.6.4.1.22 of this SER.

The staff has reviewed the applicant's description in T&QP Section 2.6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP meets the requirements of 10 CFR Part 73, Appendix B, Section VI.H.1 and therefore is acceptable.

Physical Requalification

The provisions of 10 CFR Part 73, Appendix B, Section VI.B.5 require that: (a) at least annually, armed and unarmed individuals shall be required to demonstrate the capability to meet the physical requirements of this appendix and the applicant's T&QP; and (b) the physical requalification of each armed and unarmed individual must be documented by a qualified training instructor and attested to by a security supervisor.

Section 2.7 of the T&QP describes that physical requalification is conducted at least annually, and documented as described in the PSP and as has otherwise been described in 10 CFR Part 73, Appendix B, Section VI.B.5.

The staff has reviewed the applicant's description in T&QP Section 2.7 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.B.5 and therefore is acceptable.

13.6.4.2.3 Individual Training and Qualification

Duty Training

The provisions of 10 CFR Part 73, Appendix B, Section VI.C.1 provide for duty training and qualification requirements. The regulation states, in part, that all personnel who are assigned to perform any security-related duty or responsibility shall be trained and qualified to perform assigned duties and responsibilities to ensure that each individual possesses the minimum knowledge, skills, and abilities required to effectively carry out those assigned duties and responsibilities. Each individual who is assigned duties and responsibilities identified in the Commission-approved security plans shall be trained before assignment in accordance with the requirements of 10 CFR Part 73, Appendix B, the T&QP, and the PSP. Such personnel must be trained and qualified in the use of all equipment or devices required to effectively perform all assigned duties and responsibilities.

Section 3.1 of the T&QP details the requirements that individuals assigned duties must be trained and qualified in their duties, meet minimum qualifications or re-qualification requirements, and be trained and qualified in all equipment or devices required prior to performing their duties.

The staff has reviewed the applicant's description in T&QP Sections 3.0 and 3.1 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.C.1 and therefore are acceptable.

On-The-Job Training

The provisions of 10 CFR Part 73, Appendix B, Section VI.C.2(a) through (c) provides requirements for on-the-job training. On-the-job training performance standards and criteria must ensure that each individual demonstrates the requisite knowledge, skills, and abilities needed to effectively carry out assigned security duties and responsibilities. Individuals assigned contingency duties must complete a minimum of 40 hours of on-the-job training.

On-the-job training for contingency activities and drills must include, but is not limited to, hands-on application of knowledge, skills, and abilities related to: (1) response team duties; (2) use of force; (3) tactical movement; (4) cover and concealment; (5) defensive positions; (6) fields of fire; (7) redeployment; (8) communications (primary and alternate); (9) use of assigned equipment; (10) target sets; (11) table top drills; (12) command and control duties; and (13) applicant protective strategy.

The T&QP provides a comprehensive discussion of the applicant's approach to meeting the requirements for on-the-job training as identified above and covers each of the elements.

The staff has reviewed the applicant's description in T&QP Section 3.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Sections VI.C.2(a) through (c), and therefore is acceptable.

Critical Task Matrix

The provisions of 10 CFR Part 73, Appendix B, Section VI.C.1(b) require, in part, that each individual who is assigned duties and responsibilities identified in the Commission-approved security plans, applicant protective strategy, and implementing procedures shall, before assignment, demonstrate proficiencies in implementing the knowledge, skills and abilities to perform assigned duties.

The T&QP includes a critical task matrix as Table 1 of the T&QP. This matrix addresses the means through which each individual will demonstrate the required proficiencies. Tasks that individuals must perform are listed in RG 5.75.

The staff has reviewed the applicant's description in T&QP Section 3.3 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.C.1(b) and therefore is acceptable.

Initial Training and Qualification Requirements

The provisions of 10 CFR Part 73, Appendix B, Section VI.C.1(a) through (b), provide the requirements for duty training.

The provisions of 10 CFR Part 73, Appendix B, Section VI.D.1(a), provide requirements for demonstration of qualification.

Section 3.4 of the T&QP describes that the individuals must be trained and qualified prior to performing security-related duties within the security organization, and must meet the minimum qualifying standards in Sections 3.4.1 and 3.4.2.

Written Examination

The provisions of 10 CFR Part 73, Appendix B, Section VI.D.1(b)(1), provide that written exams must include those elements listed in the Commission-approved T&QP to demonstrate an acceptable understanding of assigned duties and responsibilities, to include the recognition of potential tampering involving both safety and security equipment and systems.

Section 3.4.1 of the T&QP describes the measures that are implemented by the applicant to meet the requirements in 10 CFR Part 73, Appendix B, Section VI.D.1(b)(1).

Hands on Performance Demonstration

The provisions of 10 CFR Part 73, Appendix B, Section VI.D.1(b)(2), require that armed and unarmed individuals shall demonstrate hands-on performance for assigned duties and responsibilities by performing a practical hands-on demonstration for required tasks. The hands-on demonstration must ensure that theory and associated learning objectives for each required task are considered and that each individual demonstrates the knowledge, skills, and abilities required to effectively perform the task.

Section 3.4.2 of the T&QP describes the measures that are implemented by the applicant that meet the requirements and as has otherwise been described in 10 CFR Part 73, Appendix B, Section VI.D.1(b)(2).

The staff has reviewed the applicant's description in T&QP Sections 3.4, 3.4.1, and 3.4.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Sections VI.C.1(b)(1) and VI.D.1(b)(2), and therefore are acceptable.

Continuing Training and Qualification

The provisions of 10 CFR Part 73, Appendix B, Section VI.D.2 state, in part, that armed and unarmed individuals shall be requalified at least annually in accordance with the requirements of this appendix and the Commission-approved T&QP. The results of requalification must be documented by a qualified training instructor and attested to by a security supervisor.

Section 3.5 of the T&QP provides a discussion regarding the management of the requalification program to ensure that each individual is trained and qualified. In part, the applicant's plan provides that annual requalification may be completed up to 3 months before or 3 months after the scheduled date. However, the next annual training must be scheduled 12 months from the previously scheduled date rather than the date the training was actually completed.

The staff has reviewed the applicant's description in T&QP Section 3.5 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.D.2, and therefore is acceptable.

Annual Written Examination

The provisions of 10 CFR Part 73, Appendix B, Section VI.D.1.(b)(3), provide that armed individuals shall be administered an annual written exam that demonstrates the required knowledge, skills, and abilities to carry out assigned duties and responsibilities as an armed member of the security organization. The annual written exam must include those elements listed in the Commission-approved T&QP to demonstrate an acceptable understanding of assigned duties and responsibilities.

Section 3.5.1 of the T&QP provides that each individual will be tested, in part, with an annual written exam that at a minimum covers: the role of security personnel; use of deadly force; the requirements in 10 CFR 73.21; authority of private security personnel; power of arrest; search and seizure; offsite law enforcement response; tactics; and tactical deployment and engagement.

The staff has reviewed the applicant's description in T&QP Section 3.5.1 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.D.1.(b)(3) and is, therefore, acceptable.

Demonstration of Knowledge, Skills, and Abilities

The provisions of 10 CFR Part 73, Appendix B, Sections VI.A., B., C., and D. (A.4, C.3(d), D.1(a), D.1(b)(2)) state, in part, that an individual must demonstrate required knowledge, skills and abilities, to carry out assigned duties and responsibilities.

Section 3.5.2 of the T&QP provides that all knowledge, skills, and abilities will be demonstrated in accordance with a SAT program, similar to what is described in RG 5.75.

The staff has reviewed the applicant's description in T&QP Section 3.5.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Sections VI.A., B., C., and D. and therefore is acceptable.

Weapons Training and Qualification

General Firearms Training

The provisions of 10 CFR Part 73, Appendix B, Section VI.E require that armed members of the security organization shall be trained and qualified in accordance with the requirements of this appendix and the Commission-approved T&QP. Training must be conducted by certified firearms instructors who shall be recertified at least every 3 years. Applicants shall conduct annual firearms familiarization and armed members of the security organization must participate in weapons range activities on a nominal 4-month periodicity.

Section 3.6.1 of the T&QP addresses the requirements in 10 CFR Part 73, Appendix B, Sections VI.E.1(d)(1) through (11), and includes provisions for training in the use of deadly force and participation in weapons range activities on a nominal 4-month periodicity. Each armed member of the security organization is trained and qualified by a certified firearms instructor for the use and maintenance of each assigned weapon to include, but not limited to, marksmanship, assembly, disassembly, cleaning, storage, handling, clearing, loading, unloading, and reloading, for each assigned weapon.

The staff has reviewed the applicant's description in T&QP Section 3.6.1 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.E.1 and therefore is acceptable.

General Weapons Qualification

The provisions of 10 CFR Part 73, Appendix B, Section VI.F.1, "Weapons Qualification and Requalification Program," require that qualification firing must be accomplished in accordance with Commission requirements and the Commission-approved T&QP for assigned weapons. The results of weapons qualification and requalification must be documented and retained as a record.

Section 3.6.2 of the T&QP provides that all armed personnel are qualified and requalified with assigned weapons. All weapons qualification and requalification must be documented and retained as a record.

The staff has reviewed the applicant's description in T&QP Section 3.6.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.F.1 and therefore is acceptable.

Tactical Weapons Qualification

The provisions of 10 CFR Part 73, Appendix B, Section VI.F.2 require that the applicant conduct tactical weapons qualification. The applicant's T&QP must describe the firearms used, the firearms qualification program, and other tactical training required to implement the Commission-approved security plans, applicant protective strategy, and implementing procedures. Applicant developed tactical qualification and requalification courses must describe the performance criteria needed to include the site-specific conditions (such as lighting, elevation, fields of fire) under which assigned personnel shall be required to carry out their assigned duties.

Section 3.6.3 of the T&QP provides that a tactical qualification course of fire is used to assess armed security force personnel in tactical situations to ensure they are able to demonstrate that their required tactical knowledge, skills, and abilities remain proficient.

The staff has reviewed the applicant's description in T&QP Section 3.6.3 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.F.2 and therefore is acceptable.

Firearms Qualification Courses

The provisions of 10 CFR Part 73, Appendix B, Section VI.F.3, state, in part, that the applicant shall conduct the following qualification courses for each weapon used: (a) an annual daylight fire qualification course; and (b) an annual night fire qualification course.

Courses of Fire

The provisions of 10 CFR Part 73, Appendix B, Section VI.F.4 describe required courses of fire.

Section 3.6.4 of the T&QP provides a description of the firearms qualification scores for each of the courses of fire used to ensure armed members of the security organization are properly trained and qualified. Courses of fire are used individually for handguns, semiautomatic rifles, and enhanced weapons.

The staff has reviewed the applicant's description in T&QP Section 3.6.4 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.F.3, and 10 CFR Part 73, Appendix B, Section VI.F.4 and therefore is acceptable.

Firearms Requalification

The provisions of 10 CFR Part 73, Appendix B, Section VI.F.5 provide that armed members of the security organization shall be requalified for each assigned weapon at least annually in accordance with Commission requirements and the Commission-approved T&QP, and the results documented and retained as a record. Firearms requalification must be conducted using the courses of fire outlined in 10 CFR Part 73, Appendix B, Sections VI.F.2, VI.F.3, and VI.F.4. Section 3.6.5 of the T&QP states that armed members of the security organization will requalify at least annually with each weapon assigned, using the courses of fire provided in the T&QP.

The staff has reviewed the applicant's description in T&QP Section 3.6.5 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.F.5 and therefore is acceptable.

Weapons, Personal Equipment and Maintenance

The provisions of 10 CFR Part 73, Appendix B, Section VI.G provide the requirements for weapons, personal equipment, and maintenance. These requirements provide that the applicant shall provide armed personnel with weapons that are capable of performing the function stated in the Commission-approved security plans, applicant protective strategy, and implementing procedures. In addition, the applicant shall ensure that each individual is equipped or has ready access to all personal equipment or devices required for the effective implementation of the Commission-approved security plans, applicant protective strategy, and implementing procedures.

Section 3.7 of the T&QP describes that personnel are provided with weapons and personnel equipment necessary to meet the plans and the protective strategy. The equipment provided is described in Section 9 of the PSP, and maintenance is performed as described in Section 20 of the PSP. The staff's review of Section 9.0, "Security Personnel Equipment," and Section 20, "Maintenance, Testing, and Calibration," of the PSP is in Sections 13.6.4.1.9 and 13.6.4.1.20 of this SER.

The staff has reviewed the applicant's description in T&QP Section 3.7 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.G, and therefore is acceptable.

Documentation

The provisions of 10 CFR Part 73, Appendix B, Section VI.H require that the applicant retain all reports, records, or other documentation required by this appendix in accordance with the requirements of 10 CFR 73.55(q). The applicant shall retain each individual's initial qualification record for 3 years after termination of the individual's employment and shall retain each requalification record for 3 years after it is superseded. The applicant shall document data and test results from each individual's suitability, physical, and psychological qualification and shall retain this documentation as a record for 3 years from the date of obtaining and recording these results.

Section 3.8 of the T&QP provides that records are retained in accordance with Section 22, "Records," of the PSP. The PSP Section 22.11 describes how the applicant will retain each individual's initial qualification record for 3 years after termination of the individual's employment and shall retain each re-qualification record for 3 years after it is superseded.

The staff has reviewed the applicant's description in T&QP Section 3.8 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.H and therefore is acceptable.

13.6.4.2.4 Performance Evaluation Program

The provisions in 10 CFR Part 73, Appendix B, Section VI.C.3, "Performance Evaluation Program," state, in part, that:

> (a) [Applicants] shall develop, implement, and maintain a Performance Evaluation Program that is documented in procedures [and] which describes how the [applicant] will demonstrate and assess the effectiveness of their onsite physical protection program and protective strategy, including the capability of the armed response team to carry out their assigned duties and responsibilities during safeguards contingency events. The Performance Evaluation Program and procedures shall be referenced in the [applicant's T&QP].
>
> (b) The Performance Evaluation Program shall include procedures for the conduct of tactical response drills and force-on-force exercises designed to demonstrate and assess the effectiveness of the [applicant's] physical protection program, protective strategy and contingency event response by all individuals with responsibilities for implementing the [SCP].
>
> (l) The Performance Evaluation Program must be designed to ensure that:
>
> (1) Each member of each shift who is assigned duties and responsibilities required to implement the SCP and applicant protective strategy participates in at least one (1) tactical response drill on a quarterly basis and one (1) force-on-force exercise on an annual basis[.]

Section 4 of the T&QP details the performance evaluation program consistent with the requirements of 10 CFR Part 73, Appendix B, Section VI.C.3(a) through (m). Additional details of the performance evaluation program are described in the facility procedures.

The staff has reviewed the applicant's description in T&QP Section 4 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, Section VI.C.3 and therefore is acceptable.

13.6.4.2.5 Definitions

The provisions of 10 CFR Part 73, Appendix B, Section VI.J, state, in part, that terms defined in 10 CFR Part 50, 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," and 10 CFR Part 73 have the same meaning when used in this appendix. Definitions are found in the PSP, Appendix A, "Glossary of Terms and Acronyms." Included in this Section of the T&QP is the Critical Task Matrix, which is considered SGI and has not been included in this SER.

The staff has reviewed the applicant's description in the T&QP of the Critical Task Matrix tasks for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the T&QP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the T&QP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix B, and therefore is acceptable.

13.6.4.2.6 Conclusion on the Training and Qualification Plan

Accordingly, the staff's review described in Sections 13.6.4.2.1 through 13.6.4.2.5 of this SER, the North Anna 3 T&QP meets the requirements of 10 CFR Part 73, Appendix B. The target sets, target set analysis, and site protective strategy will be in the facility implementing procedures, which are not subject to staff review as part of this COL application and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii). The staff concludes that complete and procedurally correct implementation will provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

13.6.4.3 Appendix C Safeguards Contingency Plan

13.6.4.3.1 Background Information

This category of information identifies the perceived dangers and incidents that the plan addresses and a general description of how the response is organized.

Purpose of the Safeguards Contingency Plan

The provisions of 10 CFR Part 73, Appendix C, Section II.B.1.b, indicate that the applicant should discuss general goals, objectives, and operational concepts underlying the implementation of the SCP.

Section 1.1 of the SCP describes the purpose and goals of the SCP, including guidance to security and management for contingency events.

Scope of the Safeguards Contingency Plan

The provisions of 10 CFR Part 73, Appendix C, Section II.B.1.c, delineate the types of incidents that should be covered by the applicant in the SCP, how the onsite response effort is organized and coordinated to effectively respond to a safeguards contingency event, and how the onsite response for safeguards contingency events has been integrated into other site emergency response procedures.

Section 1.2 of the SCP states the scope of the SCP to analyze and define decisions and actions of security force personnel, as well as facility operations personnel, for achieving and maintaining safe shutdown.

Perceived Danger

The provisions of 10 CFR Part 73, Appendix C, Section II.B.1.a, require that, consistent with the DBT specified in 10 CFR 73.1(a)(1), the applicant shall identify and describe the perceived dangers, threats, and incidents against which the SCP is designed to protect.

Section 1.3 of the SCP outlines the threats used to design the physical protection systems.

The applicant adequately addresses perceived danger, provides a purpose of the plan, and describes the scope of the plan.

Definitions

Section 1.4 of the SCP describes that a list of terms and their definitions used in describing operational and technical aspects of the approved SCP as required by 10 CFR Part 73, Appendix C, Section II.B.1.d is found in Appendix A of the PSP.

The staff has reviewed the applicant’s description in SCP Sections 1, 1.1, 1.2, 1.3, and 1.4 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant’s description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix C, Section II.B.1 and therefore is acceptable.

13.6.4.3.2 Generic Planning Base

As required in 10 CFR Part 73, Appendix C, Section II.B.2., this Section of the plan defines the criteria for initiation and termination of responses to security events to include the specific decisions, actions, and supporting information needed to respond to each type of incident covered by the approved SCP.

Situations Not Covered by the Contingency Plan

Section 2.1 of the SCP details the general types of conditions that are not covered in the plan.

<u>Situations Covered by the Contingency Plan</u>

The provisions of 10 CFR Part 73, Appendix C, Section II.B.2.a, require, in part, that the plan identify those events that will be used for signaling the beginning or aggravation of a safeguards contingency according to how they are perceived initially by the applicant's personnel. Applicants shall ensure detection of unauthorized activities and shall respond to all alarms or other indications signaling a security event, such as penetration of a PA, vital area, or unauthorized barrier penetration (vehicle or personnel); tampering, bomb threats, or other threat warnings—either verbal, such as telephoned threats, or implied, such as escalating civil disturbances.

The provisions of 10 CFR Part 73, Appendix C, Section II.B.2.b, require, in part, that the plan define the specific objective to be accomplished relative to each identified safeguards contingency event. The objective may be to obtain a level of awareness about the nature and severity of the safeguards contingency to prepare for further responses; to establish a level of response preparedness; or to successfully nullify or reduce any adverse safeguards consequences arising from the contingency.

The provisions of 10 CFR Part 73, Appendix C, Section II.B.2.c require, in part, that the applicant identify the data, criteria, procedures, mechanisms and logistical support necessary to achieve the objectives identified.

Section 2.2 of the SCP describes in detail the specific situations covered by and provides a list of objectives for each event and also provides objectives and data required for each event.

The staff has reviewed the applicant's description in SCP Sections 2, 2.1 and 2.2 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix C Section II.B.2 and therefore are acceptable.

13.6.4.3.3 Responsibility Matrix

The provisions of 10 CFR Part 73, Appendix C, Section II.B.4 state that this category of information consists of the detailed identification of responsibilities and specific actions to be taken by the applicant's organizations and/or personnel in response to safeguards contingency events. To achieve this result the applicant must address the following:

- The provisions of 10 CFR Part 73, Appendix C, Section II.B.4.a require, in part, that the applicant develop site procedures that consist of matrixes detailing the organization and/or personnel responsible for decisions and actions associated with specific responses to safeguards contingency events. The responsibility matrix and procedures must be referenced in the applicant's SCP.

- The provisions of 10 CFR Part 73, Appendix C, Section II.B.4.b require, in part, that the responsibility matrix procedures shall be based on the events outlined in the applicant's generic planning base and must include specific objectives to be accomplished, descriptions of responsibilities for decisions and actions for each event, and overall description of response actions each responding entity.

- The provisions of 10 CFR Part 73, Appendix C, Section II.B.4.c require in part, that responsibilities are to be assigned in a manner that precludes conflict of duties and responsibilities that would prevent the execution of the SCP and emergency response plans.

- The provisions of 10 CFR Part 73, Appendix C, Section II.B.4.d require, in part, that the applicant ensure that predetermined actions can be completed under the postulated conditions.

Section 3 of the SCP includes a responsibility matrix, as required by Appendix C, Section II.B.4.a. The responsibility matrix integrates the response capabilities of the security organization (described in Section 4 of the SCP) with the background information relating to decision/actions and organizational structure (described in Section 1 of the SCP), as required by Appendix C, Section II.B.4.a. The responsibility matrix provides an overall description of the response actions and their interrelationships, as required by Appendix C, Section II.B.4.b. Responsibilities and actions have been predetermined to the maximum extent possible and assigned to specific entities to preclude conflicts that would interfere with or prevent the implementation of the SCP or the ability to protect against the DBT of radiological sabotage, as required by Appendix C, Section II.B.4.c. In part, the applicant shall ensure that predetermined actions can be completed under the postulated conditions as required by Appendix C, Section II.B.4.d.

The staff has reviewed the applicant's description in SCP Section 3 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix C, Section II.B.4 and therefore is acceptable.

13.6.4.3.4 Licensee Planning Base

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3 require, in part, that the applicant's planning base include factors affecting the SCP that are specific for each facility.

Licensee Organization

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.a require, in part, that the SCP describe the organization's chain of command and delegation of authority during safeguards contingency events, to include a general description of how command and control functions will be coordinated and maintained.

Duties/Communication Protocols

Section 4.1.1 of the SCP details the duties and communications protocols of each member of the security organization responsible for implementing any portion of the applicant's protective strategy, which will allow for coordination and maintenance of command and control functions as required by Appendix C, Section II.B.3.a.

Security Chain of Command/Delegation of Authority

Section 4.1.2 of the SCP describes in detail the chain of command and delegation of authority during contingency events, and this is also described in the responsibility matrix portions of the SCP. The chain of command and delegation of authority during normal operations is discussed in the PSP. Accordingly, the staff concludes that the applicant has described the chain of command and delegation of authority during contingency events as required by Appendix C, Section II.B.3.a.

Physical Layout

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.b, require, in part, that the SCP include a site map depicting the physical structures located on the site, including onsite ISFSI, and a description of the structures depicted on the map. Plans must also include a description and map of the site in relation to nearby towns, transportation routes (e.g., rail, water, and roads), pipelines, airports, hazardous material facilities, and pertinent environmental features that may have an effect upon coordination of response activities. Descriptions and maps must indicate main and alternate entry routes for law enforcement or other offsite response and support agencies and the location for marshaling and coordinating response activities.

Section 4.2 of the SCP references Sections 1.1 and 14.5 of the PSP for layouts of the OCA, PA, vital areas, site maps, and descriptions of site features. The staff confirmed that these layouts, maps, and descriptions include the detailed information required by Appendix C, Section II.B.3.b and described above.

Safeguards Systems

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.c require, in part, that the SCP include a description of the physical security systems that support and influence how the applicant will respond to an event in accordance with the DBT described in 10 CFR 73.1(a). The description must begin with onsite physical protection measures implemented at the outermost facility perimeter, and must move inward through those measures implemented to protect target set equipment.

Section 4.3 of the SCP describes that safeguards systems are described in PSP Sections 9, 11, 12, 13, 15 and 16, and in the facility implementing procedures/documents. Section 8 of the SCP describes how physical security systems will be used to respond to a threat at the site, as required by Appendix C, Section II.B.3.c. As further required by Appendix C, Section II.B.3.c, the SCP description begins with physical protection measures proposed at the outermost facility perimeter, and moves inward through those measures proposed protect target set equipment.

Law Enforcement Assistance

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.d require, in part, that the applicant provide a listing of available law enforcement agencies, a general description of their response capabilities, their criteria for response, and a discussion of working agreements or arrangements for communicating with these agencies.

Section 4.4 of the SCP states in detail the role of LLEA in the site protective strategy. In accordance with Appendix C, Section II.B.3.d, these details include LLEA response capabilities, LLEA criteria for response, and the working agreements or arrangements for communicating with these LLEAs. Additional details regarding LLEA are included in Section 8 of the PSP and Section 5.6 of the SCP.

Policy Constraints and Assumptions

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.e require, in part, that the SCP include a discussion of State laws, local ordinances, and company policies and practices that govern the applicant's response to incidents. These must include, but are not limited to, the following: 1) use of deadly force; 2) recall of off-duty employees; 3) site jurisdictional boundaries, and 4) use of enhanced weapons, if applicable.

Section 4.5 of the SCP details the site security policies, including the use of deadly force, provisions for the recall of off-duty employees, site jurisdictional boundaries, and authority to request offsite assistance, as required by Appendix C, Section II.B.3.e.

Administrative and Logistical Considerations

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.f require, in part, that the applicant provide descriptions of practices which influence how the security organization responds to a safeguards contingency event to include, but not limited to, a description of the procedures that will be used for ensuring that equipment needed to facilitate responses will be readily accessible, in good working order, and in sufficient supply.

Section 4.6 of the SCP outlines administrative duties of the Manager-Nuclear Security and the Security Shift Supervisor, and the use of facility procedures and administrative forms.

The staff has reviewed the applicant's description in SCP Sections 4, 4.1, 4.1.1, 4.1.2, and 4.2 through 4.6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR Part 73, Appendix C, Section II.B.3 and therefore is acceptable.

13.6.4.3.5 Response Capabilities

This Section outlines the response by the applicant to threats to the facility. As set forth below, the applicant describes in detail how they protect against the DBT with onsite and offsite organizations, in accordance with the regulations in 10 CFR 50.54(p)(1) and (hh)(1), 10 CFR 73.55(k), 10 CFR Part 73, Appendix B, Section VI and 10 CFR Part 73, Appendix C, Section II.B.3. In addition, Appendix C, "Introduction," states, in part, that it is important to note that an applicant's SCP is intended to be complementary to any emergency plans developed pursuant to Appendix E of 10 CFR Part 50 and 10 CFR 52.79, "Contents of Applications; Technical Information and FSAR."

Response to Threats

Section 5.1 of the SCP describes the protective strategy design to defend the facility against all aspects of the DBT. Each organization has defined roles and responsibilities.

Armed Response Team

Section 5.2 of the SCP notes the individuals included in the responsibility matrix and their role in the site protective strategy. This Section also notes the minimum number of individuals and their contingency equipment for implementation of the protective strategy. The applicant described the armed response team consistent with 10 CFR 73.55(k)(4), (5), (6) and (7), 10 CFR Part 73, Appendix B, Section VI, and 10 CFR Part 73, Appendix C, Section II.B.3.

Supplemental Security Officer

Section 5.3 of the SCP describes in detail the use of supplemental security officers in the site protective strategy. The applicant described the use of supplemental security officers, consistent with the requirements in 10 CFR 73.55(k)(4).

Facility Operations Response

Section 5.4 of the SCP describes the role of operations personnel in the site protective strategy, including responsibilities, strategies and conditions for operator actions as discussed in 10 CFR 50.54(hh).

Emergency Plan Response

Section 5.5 of the SCP notes the integration of the Emergency Plan (EP) with the applicant's protective strategy, and it gives some examples of how the EP can influence the protective strategy as discussed in 10 CFR 73.55(b)(11).

Local Law Enforcement Agencies (LLEA)

SCP Section 5.6 documents the current agreements with applicable LLEA, and therefore meets the requirements of 10 CFR 73.55(k)(9) and 10 CFR Part 73, Appendix C, Section II.B.3.d and lists the LLEAs that will respond to the site as a part of the protective strategy. Details on the LLEA response are located in Section 8 of the PSP. Further SCP Section 5.6 provides a general description of the LLEA response capability and meets the corresponding portions of 10 CFR 73.55(k)(9).

State Response Agencies

Section 5.7 of the SCP documents the current agreements with applicable LLEA, and therefore meets the requirements of 10 CFR 73.55(k)(9) and 10 CFR Part 73, Appendix C, Section II.B.3.d and lists the State response agencies that support the site as a part of the protective strategy. Further Section 5.7 provides a general description of the LLEA response capability and meets the corresponding portions of 10 CFR 73.55(k)(9).

Federal Response Agencies

Section 5.8 of the SCP documents the current agreements with applicable LLEA, and therefore meets the requirements of 10 CFR 73.55(k)(9) and 10 CFR Part 73, Appendix C, Section II.B.3.d and lists the Federal response agencies that support the site as a part of the protective strategy. Further Section 5.7 provides a general description of the LLEA response capability and meets the corresponding portions of 10 CFR 73.55(k)(9).

Response to Independent Spent Fuel Storage Installation (ISFSI) Events

Section 5.9 of the SCP meets the requirements of 10 CFR 73.55(k)(9) and 10 CFR Part 73, Appendix C, Section II.B.3.d, and describes the Response Requirements for ISFSI as a part of the protective strategy.

The staff has reviewed the applicant's description in SCP Sections 5.0 through 5.9 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP meet the requirements of 10 CFR 50.54(p)(1) and (hh), 10 CFR 73.55(k), 10 CFR Part 73, Appendix B, Section VI and 10 CFR Part 73, Appendix C, Section II.B.3 and therefore are acceptable. In addition, Appendix C, "Introduction" states, in part, that it is important to note that an applicant's SCP is intended to be complementary to any EPs developed pursuant to Appendix E to 10 CFR Part 50 and 10 CFR 52.17.

13.6.4.3.6 Defense-In-Depth

Section 6 of the SCP lists site physical security characteristics, programs, and strategy elements that illustrate the defense-in-depth nature of the site protective strategy, as required in 10 CFR 73.55(b)(3).

The staff has reviewed the applicant's description in SCP Section 6 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(b)(3) and therefore are acceptable.

13.6.4.3.7 Protective Strategy

The provisions of 10 CFR Part 73, Appendix C, Section II.B.3.c(v) require that applicants develop, implement, and maintain a written protective strategy that shall: 1) be designed to meet the performance objectives of 10 CFR 73.55 (a) through (r); 2) identify predetermined actions, areas of responsibilities, and timelines for the deployment of armed personnel; 3) include measures that limit the exposure of security personnel to possible attack; 4) include a description of the physical security systems and measures that provide defense in depth; 5) describe the specific structure and responsibilities of the armed response organization; and 6) provide a command and control structure.

Section 8 of the SCP describes the site protective strategy.

The staff has reviewed the applicant's description in SCP Section 8 for the implementation of the site-specific physical protection program in accordance with Commission regulations and the SRP acceptance criteria. Because the applicant's description in the SCP is consistent with the acceptance criteria in SRP, Section 13.6.1, the staff found that the description provided in the SCP provides reasonable assurance that the licensee will meet the requirements of 10 CFR 73.55(a) through (r) and 10 CFR Part 73, Appendix C and therefore is acceptable.

13.6.4.3.8 Conclusions on the Safeguards Contingency Plan

Accordingly, the staff's review described in Sections 13.6.4.3.1 through 13.6.4.3.8 of this SER, the SCP meets the requirements of 10 CFR Part 73, Appendix C, in accordance with the DBT of radiological sabotage as stated in 10 CFR 73.1. The target sets, target set analysis, and site protective strategy will be in facility implementing procedures, which are not subject to staff review as part of this COLA and are, therefore, subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii). The staff concludes that complete and procedurally correct implementation of the SCP will provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

13.6.5 Post Combined License Activities

For the reasons discussed in the technical evaluation Section above, the staff found the following license condition to track implementation of the Physical Security Program, the Safeguards Contingency Program, and the Training and Qualification Program, acceptable.

> License Condition (COLA Part 10 Section 3.6)
>
> Operational Program Readiness
>
> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

This schedule shall also address:

- The implementation of site-specific Severe Accident Management Guidelines
- The spent fuel rack coupon monitoring program implementation

13.6.6 Conclusions

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to physical security, and there is no outstanding information that needs to be addressed in the North Anna COL FSAR related to this Section. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna COL application are documented in NUREG–1966.

The staff concludes that the relevant information presented in the North Anna COL FSAR is acceptable based on the applicable regulations specified in Section 13.6.4 of this SER. The staff based its conclusion on the following:

The staff's review of the PSP, T&QP and SCP has focused on ensuring the necessary programmatic elements are included in these plans in order to provide high assurance that activities involving SNM are not inimical to the common defense and security and do not constitute an unreasonable risk to the public health and safety.

As described in this Section, the staff has determined that these plans include the necessary programmatic elements that, when effectively implemented, will provide the required high assurance. The burden to effectively implement these plans remains with the applicant. Effective implementation is dependent on the procedures and practices the applicant develops to satisfy the programmatic elements of its PSP, T&QP, and SCP. The target sets, target set analysis and site protective strategy are in the facility implementing procedures, which were not subject to staff review as part of this COLA, and are therefore subject to future NRC inspection in accordance with 10 CFR 73.55(c)(7)(iv) and 10 CFR Part 73, Appendix C, Section II.B.5(iii). As provided by Section 3 of the applicant's PSP, a performance evaluation program will be implemented that periodically tests and evaluates the effectiveness of the overall protective strategy. This program provides that deficiencies be corrected. In addition, NRC inspectors will conduct periodic force-on-force exercises that will test the effectiveness of the applicant's protective strategy. Based on the results of the applicant's own testing and evaluation, the NRC's baseline inspections and force-on-force exercises, enhancements to the applicant's PSP, T&QP, and SCP may be necessary to ensure that the overall protective strategy can be effectively implemented. As such, the staff approval of the applicant's PSP, T&QP, and SCP is limited to the programmatic elements necessary to provide the required high assurance as stated above. Should deficiencies be identified with the programmatic elements of these plans as a result of the periodic applicant or NRC conducted drills or exercises that test the effectiveness of the overall protective strategy, the plans shall be corrected to address these deficiencies in a timely manner and the applicant should notify the NRC of these plan changes in accordance with the requirements of 10 CFR 50.54(p) or 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit."

The COL applicant's security plan information is withheld from public disclosure in accordance with the provisions of 10 CFR 73.21.

13.6A Site-Specific Inspection, Test, Analysis, and Acceptance Criteria for Physical Security

13.6A.1 Introduction

The North Anna 3 COLA describes in Part 10, "Proposed License Conditions (Including ITAAC)" "Inspection, Test, Analysis, and Acceptance Criteria" of the license conditions for the plant's physical protection systems or features to provide physical protection of the site-specific protective strategy and elements of a site security program. The COLA incorporates by reference the standard ESBWR design including physical protection systems within the design of the vital area and vital systems. The COLA incorporates by reference the ESBWR plant layout and configurations of barriers, and listed ITAAC related to the site-specific design for achieving detection, assessment, communications, delay, and response for physical protection against potential acts of radiological sabotage and theft of SNM.

The design bases or supporting security analyses and assumptions related to the design descriptions of security-related features incorporated as reference from the ESBWR DCD is Tier 2 information, including NEDE-33391, NEDE-33390, and NEDE-33389. Descriptions of site-specific security structures, programs and contingency measures are located in the North Anna 3 PSP, which includes the site PSP, training and qualification plan, and the SCP.

13.6A.2 Summary of Application

Section 14.3 of the North Anna 3 COL FSAR, Revision 7 incorporates by reference the Table 2.19-1 of the ESBWR DCD Revision 10 and TRs. Part 10, Revision 5, Section 2.2, of the North Anna 3 COLA incorporates by reference the Physical Security ITAAC (PS-ITAAC) for systems within the scope of the DCD Tier 1. Part 10, Revision 5, Section 2.2.1 also listed the Site-Specific Physical Security ITAAC and Design Description.

In addition, in Dominion COL FSAR Section 14.3, the applicant provided the following:

Supplemental Information

- CWR COL 14.3-2-A Site-Specific ITAAC

The selection criteria and methodology provided in this Section of the referenced DCD were utilized as the site-specific selection criteria and methodology for ITAAC. These criteria and methodology were applied to those site-specific (SS) systems that were not evaluated in the referenced DCD. The entire set of ITAAC for the facility, including DC-ITAAC, EP-ITAAC, PS-ITAAC, and SS-ITAAC, is included in a separate part of the COLA [COL Part 10].

License Condition

- Part 10, License Condition

  License Condition (COLA Part 10 Section 3.6)

  Operational Program Readiness

  The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented.

  This schedule shall also address:

  - The implementation of site-specific Severe Accident Management Guidelines
  - The spent fuel rack coupon monitoring program implementation

13.6A.3 Regulatory Basis

The regulatory basis on the information incorporated by reference is addressed in NUREG–1966, the FSER related to the ESBWR DCD. In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations are given in 10 CFR Part 73. 10 CFR Part 73 includes specific security and performance requirements that, when adequately implemented, are designed to protect nuclear power reactors against acts of radiological sabotage, prevent the theft or diversion of SNM, and protect SGI against unauthorized release.

Regulation in 10 CFR 52.80(a) requires that information submitted in a COLA include the proposed ITAAC that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the ITAAC are met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Atomic Energy Act, and the NRC's regulations.

The North Anna 3 design descriptions, commitments, and acceptance criteria for the security features, including the plant's layout and determination of vital equipment and areas, for a certified design that are based on physical protection systems or hardware provided for meeting requirements including the following Commission regulations:

- 10 CFR Part 50
- 10 CFR Part 52
- 10 CFR 73.1(a)(1), "Radiological sabotage"
- 10 CFR 73.55
- 10 CFR Part 73, Appendix B, "General Criteria for Security Personnel"

- 10 CFR Part 73, Appendix C, “Nuclear Power Plant Safeguards Contingency Plans”

- 10 CFR Part 73, Appendix G, “Reportable Safeguards Events”

- 10 CFR Part 73, Appendix H, “Weapons Qualification Criteria”

- 10 CFR Part 74, “Material Control and Accounting of Special Nuclear Material”

- 10 CFR 100.21(f), “Non-Seismic Siting Criteria”

- Regulatory requirements and acceptance criteria related to physical protection systems or hardware are identified in SRP Section 14.3.12.

Regulatory guidance documents that are applicable to this evaluation are:

- RG 1.91, “Evaluations of Explosions Postulated to Occur at Transportation Routes Near Nuclear Power Plants,” Revision 1

- RG 1.206

- RG 4.7, “General Site Suitability Criteria for Nuclear Power Stations,” Revision 2

- RG 5.7, Revision 1

- RG 5.12

- RG 5.29, “Material Control and Accounting for Nuclear Power Reactors”

- RG 5.44, Revision 3

- RG 5.62, Revision 1

- RG 5.65

- RG 5.66

- Information Notice 86-83, “Underground Pathways into Protected Areas, Vital Areas, and Controlled Access Areas,” September 19, 1986.

- Regulatory Information Summary 2005-04, “Guidance on the Protection of Unattended Openings that Intersect a Security Boundary or Area,” April 14, 2005 (Exempt from public disclosure in accordance with 10 CFR 2.390)

- SECY-05-0197.

The COL applicant is required to describe commitments for establishing and maintaining a physical protection system (engineered and administrative controls), organization, programs, and procedures for implementing a site-specific strategy that demonstrate, if adequately implemented, high assurance of protection of the plant against the DBT. The site-specific physical protection system described must be reliable and available, and implement the concept of defense-in-depth protection in order to provide a high assurance of protection. The security operational programs and the physical protection system are required to meet specific and performance requirements of 10 CFR Part 26, 10 CFR 73.54, 10 CFR 73.55, 10 CFR 73.56, 10 CFR 73.57, "Requirements for criminal history records checks of individuals granted unescorted access to a nuclear power facility, a non-power reactor, or access to Safeguards Information." and 10 CFR 73.58. Within this context, the DC applicant is required only to address those elements or portion of physical protection system or features that are considered within the scope of design. The technical basis for physical protection hardware within the scope of the design provides the basis for ITAAC verification and closure.

13.6A.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed Section 14.3 of the ESBWR DCD, Revision 10, and checked to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic. The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to ITAAC for physical security. The results of the staff's evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966 and its supplements.

The staff reviewed the information in the North Anna 3 COL FSAR:

Supplemental Information

- CWR COL 14.3-2-A Site-Specific ITAAC

The CWR COL 14.3-2-A adds the following after DCD Section 14.3.9.

> The selection criteria and methodology provided in this Section of the referenced DCD were utilized as the site-specific selection criteria and methodology for ITAAC. These criteria and methodology were applied to those site-specific (SS) systems that were not evaluated in the referenced DCD. The entire set of ITAAC for the facility, including DC-ITAAC, EP-ITAAC, PS-ITAAC, and SS-ITAAC, is included in a separate part of the COLA [COL Part 10].

In Part 10, of the North Anna 3 COLA, Dominion describes the PS-ITAAC for the plant's physical protection systems or features to provide physical protection of the site-specific protective strategy and elements of a site security program. The COLA incorporates by reference Tier 1, Table 2.19-1 of the ESBWR DCD, including plant layout and configurations of barriers, and listed ITAAC related to the site-specific design for achieving detection, assessment, communications, delay, and response for physical protection against potential acts of radiological sabotage and theft of SNM. DCD Tier 1, Table 2.19-1 includes the PS-ITAACs that are in the scope of the ESBWR standard design. Site-specific PS-ITAAC that are outside the scope of the ESBWR DCD Tier 1, Table 2.19-1 are provided in Table 2.2.1-1 of Part 10 of the North Anna 3 COLA.

The staff's evaluation of the PS-ITAAC (CWR COL 14.3-2-A) is documented in the Sections 13.6A.4.1 through 13.6A.4.3 of this SER.

13.6A.4.1 Detection and Assessment Hardware

The applicant submitted PS-ITAAC, in Revision 5 of the North Anna 3 COLA, Part 10, Table 2.2.1-1, "ITAAC for the Site-Specific Security System." The North Anna 3 COL application incorporates by reference the ESBWR DCD Tier 1, Table 2.19-1, Revision 10, design commitments and ITAAC for the physical security system to be used at North Anna 3.

The physical security system provides physical features to detect, delay, assist in response to, and defend against the DBT for radiological sabotage. The physical security system consists of physical barriers and an intrusion detection system. The details of the physical security system are categorized as SGI. The physical security system provides protection for vital equipment and plant personnel.

The PS-ITAAC reference numbers listed below are from SRP Section 14.3.12, "Physical Security Hardware - Appendix "A"," and are used to provide clarification of the ITAAC related to "Detection and Assessment Hardware."

PS-ITAAC 2 Protected Area Barrier:

a. Physical barriers for the protected area perimeter will not be part of vital area barriers.

b. Penetrations through the protected area barrier will be secured and monitored.

c. Unattended openings that intersect a security boundary, such as underground pathways, will be protected by a physical barrier and monitored by intrusion detection equipment or provided surveillance at a frequency sufficient to detect exploitation.

PS-ITAAC 3 Isolation Zone:

a. Isolation zones will exist in outdoor areas adjacent to the physical barrier at the perimeter of the protected area and will be designed of sufficient size to permit observation and assessment on either side of the barrier.

b. Isolation zones will be monitored with intrusion detection and assessment equipment that is designed to provide detection and assessment of activities within the isolation zone.

c. Areas where permanent buildings do not allow sufficient observation distance between the intrusion detection system and the protected area barrier (e.g., the building walls are immediately adjacent to, or are an integral part of the protected area barrier) will be monitored with intrusion detection and assessment equipment that is designed to detect the attempted or actual penetration of the protected area perimeter barrier before completed penetration of the barrier and assessment of detected activities.

PS-ITAAC 4 Protected Area Perimeter Intrusion Detection and Assessment Systems:

a. The perimeter intrusion detection system will be designed to detect penetration or attempted penetration of the protected area perimeter barrier before completed penetration of the barrier, and for subsequent alarms to annunciate concurrently in at least two continuously manned onsite alarm stations (central and secondary alarm stations).

b. The perimeter assessment equipment will be designed to provide video image recording with real-time and playback capability that can provide assessment of detected activities before and after each alarm annunciation at the protected area perimeter barrier.

c. The intrusion detection and assessment equipment at the protected area perimeter will be designed to remain operable from an uninterruptible power supply in the event of the loss of normal power.

PS-ITAAC 6 Bullet-Resisting Barriers Requirements:

The external walls, doors, ceiling, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area will be bullet resistant, to at least Underwriters Laboratories Ballistic Standard 752, “The Standard of Safety for Bullet-Resisting Equipment,” Level 4, or National Institute of Justice Standard 0108.01, “Ballistic Resistant Protective Materials,” Type III.

PS-ITAAC 9 Picture Badge Identification System Requirements:

An access control system with a numbered photo identification badge system will be installed and designed for use by individuals who are authorized access to protected areas and vital areas without escort.

Accordingly, the staff determined that the North Anna 3 COLA, Part 10, Table 2.2.1-1 has adequately addressed PS-ITAAC for Detection and Assessment Hardware Items 2(a), 2(b), 2(c), 3(a), 3(b), 3(c), 4(a), 4(B), 4(c), 6 partially, and 9 identified in Appendix A to SRP Section 14.3.12.

The North Anna 3 COLA, Part 10, Table 2.2.1-1 partially addressed PS-ITAAC 6. The application references the ESBWR DCD, Revision 10, which also partially addressed PS-ITAAC 6. The staff determined the between both the North Anna 3 COL and the ESBWR DCD all elements of the PS-ITAAC 6 PS-ITAAC 6 are adequately addressed as identified in Appendix A to SRP Section 14.3.12.

The staff has determined that the Detection and Assessment Hardware PS-ITAAC, described in SRP, Section 14.3.12 has been fully addressed between the North Anna 3 submission in FSAR, Revision 8 and the ESBWR DCD, Revision 10.

13.6A.4.2 Delay or Barrier Design

The applicant submitted PS-ITAAC, in Revision 5 of the North Anna 3 COLA, Part 10, Table 2.2.1-1, "ITAAC for the Site-Specific Security System." The Dominion, North Anna 3 COLA incorporates by reference the ESBWR DCD Tier 1, Table 2.19-1, Revision 10, design commitments and ITAAC for the physical security system to be used at North Anna 3.

The PS-ITAAC listed below reference numbers are from SRP Section 14.3.12 Physical Security Hardware - Appendix "A" and are used to provide clarification of the ITAAC related to "Delay or Barrier Design."

PS-ITAAC 1. Vital Area and Vital Area Barrier:

a. Vital equipment will be located only within a vital area.

b. Access to vital equipment will require passage through at least two physical barriers.

PS-ITAAC 8. Personnel, Vehicle, and Material Access Control Portals and Search Equipment:

a. Access control points will be established and designed to control personnel and vehicle access into the protected area.

b. Access control points will be established and designed with equipment for the detection of firearms, explosives, and incendiary devices at the protected area personnel access points.

Accordingly, the staff determined that the North Anna 3 COLA, Part 10, Table 2.2.1-1 has adequately addressed, PS-ITAAC for Delay or Barrier Design Items 8(a), 8(b), identified in Appendix A to SRP Section 14.3.12.

The North Anna 3 COLA, Part 10, Table 2.2.1-1 partially addressed PS-ITAAC 1(a) and 1(b). The application references the ESBWR DCD, Revision 10, which also partially addressed PS-ITAAC 1(a) and 1(b). The staff determined that between both the North Anna 3 COL and the ESBWR DCD all elements of the PS-ITAAC 1(a) and 1(b) are adequately addressed as identified in Appendix A to SRP Section 14.3.12.

The staff has determined that PS-ITAAC described in SRP, Section 14.3.12 has been fully addressed between the North Anna 3 submission in FSAR, Revision 8 and the ESBWR DCD, Revision 10.

13.6A.4.3 Systems, Hardware, or Features Facilitating Security Response and Neutralization

The applicant submitted PS-ITAAC, in Revision 5 of the North Anna 3 COLA, Part 10, Table 2.2.1-1, "ITAAC for the Site-Specific Security System." The Dominion, North Anna 3 COLA incorporates by reference the ESBWR DCD Tier 1, Table 2.19-1, Revision 10, design commitments and ITAAC for the physical security system to be used as the North Anna 3.

The below listed PS-ITAAC reference numbers are from SRP Section 14.3.12 Physical Security Hardware - Appendix "A" and are used to provide clarification of the ITAAC related to "Systems, Hardware, or Features Facilitating Security Response and Neutralization."

PS-ITAAC 5 Illumination Requirements:

Isolation zones and exterior areas within the protected area will be provided with illumination to permit assessment in the isolation zones and observation of activities within exterior areas of the protected area.

PS-ITAAC 7 Vehicle Control Measures Requirements:

The vehicle barrier system will be designed, installed, and located at the necessary standoff distance to protect against the design-basis threat vehicle bombs.

PS-ITAAC 10 Vital Areas Access Control Requirements:

Unoccupied vital areas will be designed with locking devices and intrusion detection devices that annunciate in the Secondary Alarm Station.

PS-ITAAC 11 Alarm Station:

a. Intrusion detection equipment and video assessment equipment will annunciate and be displayed concurrently in at least two continuously manned onsite alarm stations (Central and Secondary Alarm Stations).

b. The Secondary Alarm Station will be located inside the protected area and will be designed so that the interior of the alarm station is not visible from the perimeter of the protected area.

c. Central and Secondary Alarm Stations will be designed, equipped and constructed such that no single act, in accordance with the design-basis threat of radiological sabotage, can simultaneously remove the ability of both the central and secondary alarm stations to (1) detect and assess alarms, (2) initiate and coordinate an adequate response to alarms, (3) summon offsite assistance, and (4) provide effective command and control.

d. Both the Central and Secondary Alarm Stations will be constructed, located, protected, and equipped to the standards for the Central Alarm Station (alarm stations need not be identical in design but shall be equal and redundant, capable of performing all functions required of alarm stations).

e. ITAAC 11(new) In May 2010, Standard Review Plan (SRP) Section 14.3.12 was revised during the review of this application; an additional PS-ITAAC task was added to this Section. This new task is addressed by the applicant in Section 15 of the North Anna 3 PSP. The ITAAC SRP dated January 2010, that was used for review is published in the *Federal Register*. The initial (2007) SRP on date of application meets the requirements under 10 CFR 50.34(H)

PS-ITAAC 12 Secondary Power Supplies for Alarm Annunciation and Communication Equipment Requirements:

The secondary security power supply system for alarm annunciator equipment contained in the Secondary Alarm Station and non-portable communications equipment contained in the Secondary Alarm Station is located within a vital area.

PS-ITAAC 13 Intrusion Detection Systems Console Display:

a. Security alarm devices, including transmission lines to annunciators, will be tamper indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm (e.g., intrusion alarms, emergency exit alarm) and location.

b. Intrusion detection and assessment systems will be designed to provide visual display and audible annunciation of alarms in the Secondary Alarm Station.

PS-ITAAC 14 Intrusion Detection Systems Recording Requirements:

Intrusion detection systems recording equipment will record onsite security alarm annunciation including the location of the alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, and time.

PS-ITAAC 15 Vital Area Emergency Exits Requirements:

Emergency exits through the protected area perimeter and vital area boundaries will be alarmed with intrusion detection devices and secured by locking devices that allow prompt egress during an emergency.

PS-ITAAC 16 Communication:

a. The Secondary Alarm Station will have conventional (land line) telephone service with the Main Control Room and local law enforcement authorities.

b. The Secondary Alarm Station will be capable of continuous communication with on-duty security force personnel.

c. Non-portable communications equipment in the Secondary Alarm Station will remain operable from an independent power source in the event of loss of normal power.

Accordingly, the staff determined that the North Anna 3 COLA, Part 10, Table 2.2.1-1 has adequately addressed, PS-ITAAC for Systems, Hardware, or Features Facilitating Security Response and Neutralization Items 5, 7, 10 11(a), 11(b), 11(c), 11(d), (Note: 10 CFR 50.34(h), SRP Section 14.3.12 was revised during the review of this application, and an additional PS-ITAAC task was added to this Section. This new task is addressed by the applicant in Section 15 of the North Anna 3 PSP), 12, 13(a), 13(b), 15, 16(a)16(b), 16(c), identified in Appendix A to SRP Section 14.3.12.

The North Anna 3 COLA, Part 10, Table 2.2.1-1 partially addressed PS-ITAAC Items 10, 11(b), 12, 13(a), 13(b) 14, 15, 16(a), 16(b), 16(c). The application references the ESBWR DCD, Revision 10, which also partially addressed PS-ITAAC Items 10, 11(b), 12, 13(a), 13(b) 14, 15, 16(a), 16(b), 16(c). The staff determined the between both the North Anna 3 COL and the ESBWR DCD all elements of the PS-ITAAC Items 10, 11(b), 12, 13(a), 13(b) 14, 15, 16(a), 16(b), 16(c) are adequately addressed as identified in Appendix A to SRP Section 14.3.12.

The staff has determined that Systems, Hardware, or Features Facilitating Security Response and Neutralization PS-ITAAC described in SRP, Section 14.3.12 has been fully addressed between the North Anna 3 submission in FSAR Revision 8 and the ESBWR DCD, Revision 10.

License Condition

- Part 10, License Condition

The staff has reviewed the license condition below against the recommendations in SECY-05-0197 as endorsed by the related SRM dated February 22, 2006. The staff concluded that the proposed license condition conforms to the guidance in SECY-05-0197. In December 2013, Dominion submitted a revised FSAR Table 13.4-201 and Part 10, of their COLA, which confirms the addition of the Operational Program Readiness milestone requirements for Physical Security.

In addition, the staff proposes the following License Condition for ITAAC for Physical Security:

> License Condition (COLA Part 10 Section 3.6)
>
> Operational Program Readiness
>
> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site specific Severe Accident Management Guidance.
> - The spent fuel rack coupon monitoring program implementation.

The licensee shall perform and satisfy the ITAAC defined in FSAR Table 2.2.1-1, "ITAAC for the Site-Specific Physical Security."

13.6A.5 Post-Combined License Activities

North Anna 3 COLA Part 10 Section 3.6 Operational Program Readiness

> The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:
>
> - The implementation of site specific Severe Accident Management Guidance.
> - The spent fuel rack coupon monitoring program implementation.

License Condition 13.6.1: The licensee shall perform and satisfy the ITAAC defined in FSAR Table 2.2.1-1, "ITAAC for the Site-Specific Physical Security" and as shown in Attachment 1 of this SER.

13.6A.6 Conclusions

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to PS-ITAAC, and there is no outstanding information expected to be addressed in the Dominion's COL FSAR related to this Section. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

The staff concludes that the relevant information presented in the North Anna 3 COL FSAR, is acceptable based on the applicable regulations specified in Section 13.6A.3 of this SER. The staff based its conclusion on the following:

CWR COL 14.3-2-A, as related to PS-ITAAC is acceptable due to the staff finding that the applicant adequately describes the physical security systems and provided the implementation of the site-specific protective strategy and security programs as documented in Section 13.6 of this SER. The applicant adequately describes the site-specific PS-ITAAC for meeting the requirements of 10 CFR 73.55 and provides the technical bases for establishing a PS-ITAAC for the protection against acts of radiological sabotage and theft of SNM. The applicant includes systems and features as stated in North Anna 3 COL FSAR, Chapter 13 and referenced TRs. The applicant has provided adequate descriptions of objectives, prerequisites, test methods, data required, and acceptance criteria for security-related ITAAC for the approval of the North Anna 3 COL.

Attachment 1: FSAR Table 2.2.1-1, "ITAAC for the Site-Specific Physical Security"

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1(a). Vital equipment will be located only within a vital area.	1(a). All vital equipment locations will be inspected.	1(a). Vital equipment is located only within a vital area.
1(b). Access to vital equipment will require passage through at least two physical barriers.	1(b). All vital equipment physical barriers will be inspected.	1(b). Vital equipment is located within a protected area such that access to the vital equipment requires passage through at least two physical barriers.
2(a). Physical barriers for the protected area perimeter will not be part of vital area barriers.	2(a). The protected area perimeter barriers will be inspected.	2(a). Physical barriers at the perimeter of the protected area are separated from any other barrier designated as a vital area barrier.
2(b). Penetrations through the protected area barrier will be secured and monitored.	2(b). All penetrations through the protected area barrier will be inspected.	2(b). All penetrations and openings through the protected area barrier are secured and monitored by intrusion detection equipment.
2(c). Unattended openings that intersect a security boundary, such as underground pathways, will be protected by a physical barrier and monitored by intrusion detection equipment or provided surveillance at a frequency sufficient to detect exploitation.	2(c). All unattended openings within the protected area barriers will be inspected.	2(c). All unattended openings (such as underground pathways) that intersect a security boundary (such as the protected area barrier), are protected by a physical barrier and monitored by intrusion detection equipment or provided surveillance at a frequency sufficient to detect exploitation.
3(a). Isolation zones will exist in outdoor areas adjacent to the physical barrier at the perimeter of the protected area and will be designed of sufficient size to permit observation and assessment on either side of the barrier.	3(a). The isolation zones in outdoor areas adjacent to the protected area perimeter barrier will be inspected.	3(a). The isolation zones exist in outdoor areas adjacent to the physical barrier at the perimeter of the protected area and are of sufficient size to permit observation and assessment of activities on either side of the barrier in the event of its penetration or attempted penetration.
3(b). Isolation zones will be monitored with intrusion detection and assessment equipment that is designed to provide detection and assessment of activities within the isolation zone.	3(b). The intrusion detection equipment within the isolation zones will be inspected.	3(b). Isolation zones are equipped with intrusion detection and assessment equipment capable of providing detection and assessment of activities within the isolation zone.

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
3(c). Areas where permanent buildings do not allow sufficient observation distance between the intrusion detection system and the protected area barrier (e.g., the building walls are immediately adjacent to, or are an integral part of the protected area barrier) will be monitored with intrusion detection and assessment equipment that is designed to detect the attempted or actual penetration of the protected area perimeter barrier before completed penetration of the barrier and assessment of detected activities.	3(c). Inspections of areas of the protected area perimeter barrier that do not have isolation zones will be performed.	3(c). Areas where permanent buildings do not allow sufficient observation distance between the intrusion detection system and the protected area barrier (e.g., the building walls are immediately adjacent to, or an integral part of, the protected area barrier) are monitored with intrusion detection and assessment equipment that detects attempted or actual penetration of the protected area perimeter barrier before completed penetration of the barrier and assessment of detected activities.
4(a). The perimeter intrusion detection system will be designed to detect penetration or attempted penetration of the protected area perimeter barrier before completed penetration of the barrier, and for subsequent alarms to annunciate concurrently in at least two continuously manned onsite alarm stations (central and secondary alarm stations).	4(a). Tests, inspections, or a combination of tests and inspections of the intrusion detection system will be performed.	4(a). The intrusion detection system can detect penetration or attempted penetration of the protected area perimeter barrier before completed penetration of the barrier, and subsequent alarms annunciate concurrently in at least two continuously manned on site alarms stations (central and secondary alarm stations).
4(b). The perimeter assessment equipment will be designed to provide video image recording with real-time and playback capability that can provide assessment of detected activities before and after each alarm annunciation at the protected area perimeter barrier.	4(b). Tests, inspections, or a combination of tests and inspections of the video assessment equipment will be performed.	4(b). The perimeter assessment equipment is capable of real-time and playback video image recording that provides assessment of detected activities before and after each alarm at the protected area perimeter barrier.
4(c). The intrusion detection and assessment equipment at the protected area perimeter will be designed to remain operable from an uninterruptible power supply in the event of the loss of normal power.	4(c). Tests, inspections, or a combination of tests and inspections of the uninterruptible power supply will be performed.	4(c). All Intrusion detection and assessment equipment at the protected area perimeter remains operable from an uninterruptible power supply in the event of the loss of normal power.

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
5. Isolation zones and exterior areas within the protected area will be provided with illumination to permit assessment in the isolation zones and observation of activities within exterior areas of the protected area.	5. The illumination in isolation zones and exterior areas within the protected area will be inspected.	5. Illumination in isolation zones and exterior areas within the protected area is 0.2 foot candles measured horizontally at ground level or alternatively augmented, sufficient to permit assessment and observation.
6. The external walls, doors, ceiling, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area will be bullet resistant, to at least Underwriters Laboratories Ballistic Standard 752, "The Standard of Safety for Bullet-Resisting Equipment," Level 4, or National Institute of Justice Standard 0108.01, "Ballistic Resistant Protective Materials," Type III.	6. Type test, analysis, or a combination of type test and analysis of the external walls, doors, ceiling, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area will be performed.	6. A report exists and concludes that the walls, doors, ceilings, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area are bullet resistant to at least Underwriters Laboratories Ballistic Standard 752, Level 4, or National Institute of Justice Standard 0108.01, Type III.
7. The vehicle barrier system will be designed, installed, and located at the necessary standoff distance to protect against the design-basis threat vehicle bombs.	7. Type test, inspections, analysis or a combination of type tests, inspections, and analysis will be performed for the vehicle barrier system	7. A report exists and concludes that the vehicle barrier system will protect against the threat vehicle bombs based on the standoff distance for the system.
8(a). Access control points will be established and designed to control personnel and vehicle access into the protected area.	8(a). Tests, inspections, or a combination of tests and inspections of installed systems and equipment will be performed.	8(a). Access control points exist for the protected area and are configured to control access.
8(b). Access control points will be established and designed with equipment for the detection of firearms, explosives, and incendiary devices at the protected area personnel access points.	8(b). Tests, inspections, or a combination of tests and inspections of installed systems and equipment will be performed.	8(b). Detection equipment exists and is capable of detecting firearms, explosives, and incendiary devices at the protected area personnel access control points.
9. An access control system with a numbered photo identification badge system will be installed and designed for use by individuals who are authorized access to protected areas and vital areas without escort.	9. The access control system and the numbered photo identification badge system will be tested.	9. The access authorization system with a numbered photo identification badge system is installed and provides authorized access to protected and vital areas only to those individuals with unescorted access authorization.

Table 2.2.1-1
ITAAC for the Site-Specific Security System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10. Unoccupied vital areas will be designed with locking devices and intrusion detection devices that annunciate in the Secondary Alarm Station.	10. Tests, inspections, or a combination of tests and inspections of unoccupied vital area intrusion detection equipment and locking devices will be performed.	10. Unoccupied vital areas are locked, and intrusion is detected and annunciated in the Secondary Alarm Station.
11(a). Intrusion detection equipment and video assessment equipment will annunciate and be displayed concurrently in at least two continuously manned onsite alarm stations (Central and Secondary Alarm Stations).	11(a). Tests, inspections, or a combination of tests and inspections of intrusion detection equipment and video assessment equipment will be performed.	11(a). Intrusion detection equipment and video assessment equipment annunciate and display concurrently in at least two continuously manned onsite alarm stations (Central and Secondary Alarm Stations).
11(b). The Secondary Alarm Station will be located inside the protected area and will be designed so that the interior of the alarm station is not visible from the perimeter of the protected area.	11(b). The Secondary Alarm Station location will be inspected.	11(b). The Secondary Alarm Station is located inside the protected area, and the interior of the alarm station is not visible from the perimeter of the protected area.
11(c). The alarm system will not allow the status of a detection point, locking mechanism or access control device to be changed without the knowledge and concurrence of the alarm station operator in the other alarm station.	11(c).Tests, inspections, or a combination of tests and inspections of intrusion detection equipment and access control equipment will be performed.	11(c). The alarm system will not allow the status of a detection point, locking mechanism or access control device to be changed without the knowledge and concurrence of the alarm station operator in the other alarm station.
11(d). Central and Secondary Alarm Stations will be designed, equipped and constructed such that no single act, in accordance with the design-basis threat of radiological sabotage, can simultaneously remove the ability of both the central and secondary alarm stations to (1) detect and assess alarms, (2) initiate and coordinate an adequate response to alarms, (3) summon offsite assistance, and (4) provide effective command and control.	11(d). Tests, inspections, or a combination of tests and inspections of the Central and Secondary Alarm Stations will be performed.	11(d). Central and Secondary Alarm Stations are designed, equipped, and constructed such that no single act, in accordance with the design-basis threat of radiological sabotage, can simultaneously remove the ability of both the central and secondary alarm stations to (1) detect and assess alarms, (2) initiate and coordinate an adequate response to alarms, (3) summon offsite assistance, and (4) provide effective command and control.

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
11(e). Both the Central and Secondary Alarm Stations will be constructed, located, protected, and equipped to the standards for the Central Alarm Station (alarm stations need not be identical in design but shall be equal and redundant, capable of performing all functions required of alarm stations).	11(e). Tests, inspections, or a combination of tests and inspections of the Central and Secondary Alarm Stations will be performed.	11(e). The Central and Secondary Alarm Stations are located, constructed, protected, and equipped to the standards of the Central Alarm Station and are functionally redundant (stations need not be identical in design).
12. The secondary security power supply system for alarm annunciator equipment contained in the Secondary Alarm Station and non-portable communications equipment contained in the Secondary Alarm Station is located within a vital area.	12. The secondary security power supply system will be inspected.	12. The secondary security power supply system for alarm annunciator equipment contained in the Secondary Alarm Station and non-portable communications equipment contained in the Secondary Alarm Station is located within a vital area.
13(a). Security alarm devices, including transmission lines to annunciators, will be tamper-indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm (e.g., intrusion alarms, emergency exit alarm) and location.	13(a). All security alarm devices and transmission lines will be tested.	13(a). Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs, or when the system is on standby power), and the alarm annunciation indicates the type of alarm (e.g., intrusion alarm, emergency exit alarm) and location.
13(b). Intrusion detection and assessment systems will be designed to provide visual display and audible annunciation of alarms in the Secondary Alarm Station.	13(b). Intrusion detection and assessment systems will be tested.	13(b). The intrusion detection and assessment systems provide a visual display and audible annunciation of alarms in the Secondary Alarm Station (concurrently with the display and annunciation in the Central Alarm Station).
14. No Site-Specific ITAAC specified.	14. No Site-Specific ITAAC specified.	14. No Site-Specific ITAAC specified.

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
15. Emergency exits through the protected area perimeter and vital area boundaries will be alarmed with intrusion detection devices and secured by locking devices that allow prompt egress during an emergency.	15. Tests, inspections, or a combination of tests and inspections of emergency exits through the protected area perimeter and vital area boundaries will be performed.	15. Emergency exits through the protected area perimeter and vital area boundaries are alarmed with intrusion detection devices and secured by locking devices that allow prompt egress during an emergency.
16(a). The Secondary Alarm Station will have conventional (land line) telephone service with the Main Control Room and local law enforcement authorities.	16(a). Tests, inspections, or a combination of tests and inspections of the Secondary Alarm Stations' conventional (land line) telephone service will be performed.	16(a). The Secondary Alarm Station is equipped with conventional (land line) telephone service with the Main Control Room and local law enforcement authorities.
16(b).The Secondary Alarm Station will be capable of continuous communication with on-duty security force personnel.	16(b). Tests, inspections, or a combination of tests and inspections of the Secondary Alarm Stations' continuous communication capabilities will be performed.	16(b). The Secondary Alarm Station is capable of continuous communication with on-duty watchmen, armed security officers, armed responders, or other security personnel who have responsibilities within the physical protection program and during contingency response events.
16(c). Non-portable communications equipment in the Secondary Alarm Station will remain operable from an independent power source in the event of loss of normal power.	16(c). Tests, inspections, or a combination of tests and inspections of the non-portable communications equipment will be performed.	l6(c). All non-portable communication devices (including conventional telephone systems) in the Secondary Alarm Station are wired to an independent power supply that enables those systems to remain operable (without disruption) during the loss of normal power.

13.7 Fitness for Duty

13.7.1 Introduction

Pursuant to 10 CFR 52.79(a)(44), COLA must include a description of the FFD program required by 10 CFR Part 26, and its implementation. The FFD program is designed to provide reasonable assurance that: (1) individuals are trustworthy and reliable as demonstrated by the avoidance of substance abuse; (2) individuals are not under the influence of any substance, legal or illegal, or mentally or physically impaired from any cause, which in any way adversely affects their ability to safely and competently perform their duties; (3) measures are established and implemented for the early detection of individuals who are not fit to perform their duties; (4) the construction site is free from the presence and effects of illegal drugs and alcohol; (5) the work places are free from the presence and effects of illegal drugs and alcohol; and, (6) the effects of fatigue and degraded alertness on an individual's ability to safely and competently perform their duties are managed commensurate with maintaining public health and safety.

13.7.2 Summary of Application

The COL applicant has provided Section 13.7 of the North Anna 3 COLA FSAR, Revision 5, for staff review. The COL applicant submitted the draft text of Revision 5 of COL FSAR Section 13.7 and Section 13.4-201 in March 16, 2012, NRC Docket No. 52-017 Dominion Virginia Power, North Anna 3 COL, SRP Section 13.07: Response to RAI Letter 52. In these documents, Dominion described conditions of the operations and construction FFD programs for North Anna 3. The staff review is based on the applicant's COL, Revision 5, dated March 2012.

Supplemental Information

The staff needed to obtain further clarity on the COL applicant's description of the FFD program. Information initially provided by the COL applicant was insufficient to perform a technical evaluation – additional site-specific information was needed from the COL applicant about the North Anna 3 FFD program. To accomplish this, the staff issued RAI 13.07-1, dated December 3, 2010 (ADAMS Accession No. ML103560107), Revisions to NEI 06-06 and question13.07-2, dated December 3, 2010 (ADAMS Accession No. ML103560107), site-specific FFD information) to the COL applicant. The COL applicant provided responses to the staff RAIs in a letter dated January 18, 2011 (ADAMS Accession No. ML103560139). The RAI responses described the FFD program for both the construction phase and the operations phase of North Anna 3. The FFD Program is implemented and maintained in two phases; the construction phase program and the operations phase program. The construction and operations phase programs are implemented as identified in North Anna COL FSAR Table 13.4-201. The construction phase program is consistent with the NRC-accepted NEI, "Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites," NEI 06-06, Revision 5. The NRC FFD technical staff and managerial oversight staff has determined the North Anna operations phase program complies with 10 CFR Part 26.

License Conditions

There are no FFD license conditions for North Anna 3.

13.7.3 Regulatory Basis

The applicable regulatory requirements for COL FSAR Section13.7-1 and Section 13.4-201 are as follows:

- 10 CFR Part 26
- 10 CFR 52.79(a)(44

Pending the issuance of an NRC regulatory guide for NEI 06-06, applicants may cite NEI 06-06, Revision 5 as a reference in the development of site-specific applications.

13.7.4 Technical Evaluation

The staff reviewed COLA application Part 2, FSAR Sections 13.7, and 13.4-201 and found that the required information relating to the FFD program and the complete scope of information relating to this review topic are met.

The staff reviewed the following information in the COL applicant FSAR:

Supplemental Information

The COL applicant provided a new COL FSAR Section 13.7, and has revised COL FSAR 13.4-201 as a change to the COL FSAR Revision 5.

The staff review of COL FSAR Section 13.7-1 included the following: (1) The adequacy of the FFD program for the construction phase; (2) the adequacy of the FFD program for the operations phase; and (3) the program implementation milestones proposed by the COL applicant for both the construction phase and operations phase.

In RAI 13.07-1, dated December 3, 2010 (ADAMS Accession No. ML103560107), the staff asked the applicant the following:

> Under 10 CFR 52.79(a)(44), the Applicant's FSAR must contain a description of the fitness for duty (FFD) program required by 10 CFR Part 26 and its implementation. The Applicant intends to update its FFD program for the construction phase to comply with NEI 06-06. If future revisions to NEI 06-06 are endorsed by the NRC, does the Applicant intend to update its FFD program for the construction phase to comply with certain clarifications, additions, and exceptions in these future, endorsed revisions, as necessary?

In the January 18, 2011, response to RAI 13.07-1 (ADAMS Accession No. ML110270303), the COL applicant states the following:

> Dominion intends to update the construction phase FFD program to conform to the NRC-endorsed version of NEI 06-06, or provide justified alternative methods of conformance to regulations. After the COL is issued, Dominion will continue to meet the applicable FFD regulations.

In the January 18, 2011, response to RAI 13.07-1, the applicant committed to implement a construction phase (FFD) program to reflect the changes identified in response to RAI13.07-1. The staff verified that the applicant has included the proposed changes in FSAR, Revision 8. Therefore, RAI 13.07-01 is resolved and closed.

In RAI 13.07-2, dated December 3, 2010 (ADAMS Accession No. ML103560107), the staff asked the applicant the following:

> Under 10 CFR 52.79(a)(44), the Applicant's FSAR must contain a description of the fitness for duty (FFD) program required by 10 CFR Part 26 and its implementation. Describe how the COL Application, FSAR, Part 2, Table 13.4-201, item 20, (Sheet 13-58), comports with 10 CFR 26, Sections 26.3 and 26.4, and guidance in NRC's letter to the Nuclear Energy Institute dated December 2, 2009, entitled "Status of U. S. Nuclear Regulatory Commission Review and Endorsement of NEI 06-06, "Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites" In particular, provide site-specific information to clearly and sufficiently describe your operational FFD program, in terms of the scope and level of detail to allow as reasonable assurance of finding of acceptability. For example, will North Anna base its Section 26.4(a) and (b) FFD program for Behavioral Observation Program and drug and alcohol testing on an operational unit program or develop its own specific program? Please describe substantial differences, if any.

In the January 18, 2011, response to RAI 13.07-2 (ADAMS Accession No. ML110270303), the COL applicant states the following:

> The COL Application, FSAR, Part 2, Table 13.4-201, item 20 references 10 CFR 26, Sections 26.3 and 26.4, as applicable, as requirements for implementation of the FFD Program for operation and for construction. Dominion will use both the current operational FFD program and a North Anna Unit 3 specific construction FFD program based on the individuals and the type of work being performed. In-particular, the 10 CFR Part 26.4(a) and (b) FFD program, which is the operational FFD program, will cover Dominion's employees and Dominion's subcontractors. Dominion's Engineering, Procurement, and Construction (EPC) contractor personnel and the EPC's subcontractors will be covered by a Dominion-approved contractor FFD program. The North Anna Unit 3 specific construction FFD program, 10 CFR Part 26.4(f), will cover the construction workers and first line supervisors. There are no substantial differences between the FFD programs, which are consistent with 10 CFR Part 26 and NEI 06-06, Revision 5. FSAR Table 13.4-201 and FSAR Section 13.7 will be revised to reflect the guidance provided in NRC's letter to the Nuclear Energy Institute dated December 2, 2009, entitled "Status of U. S. Nuclear Regulatory Commission Review and Endorsement of NEI 06-06,

“Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites”. Also, site-specific information, including the applicable 10 CFR Part 26 element subparts, will be added to clearly describe the FFD programs.

FSAR, Part 2, Table 13.4-201 and Section 13.7 will be revised […].

In FSAR Part 2, Revision 6, the applicant revised COL FSAR Table 13.4-201(Operations Programs Required by NRC Regulations and Program Implementation) as follows:

COL FSAR Table 13.4-201 Operations Programs Required by NRC Regulations and Program Implementation

Program Title	Program Source	FSAR Section	Milestone	Requirement
FFD Program (Construction-Workers & First Line Supervisors)	10 CFR Part 26.4(f)	13.7	Prior to initiating 10 CFR 26 construction activities	10 CFR 26, Subpart K
FFD Program (Construction-Management & Oversight Personnel)	10 CFR Part 26.4(e)	13.7	Prior to initiating 10 CFR 26 construction activities	10 CFR 26, Subparts A through H, N and O
FFD Program for security personnel	10 CFR 26.4(e)(1)	13.7	Prior to initiating 10 CFR 26 construction activities	10 CFR 26, Subparts A through H, N and O
FFD Program for security personnel cont.	10 CFR 26.4(a)(5)	13.7	Prior to the earlier of: a. Receipt of SNM in the form of fuel assemblies, b. Establishment of a PA, or c. 10 CFR 52.103(g) finding	10 CFR 26, Subparts A through I, N and O

Program Title	Program Source	FSAR Section	Milestone	Requirement
FFD Program for FFD Program personnel	10 CFR Part 26.4(g)	13.7	Prior to initiating 10 CFR 26 construction activities	10 CFR 26, Subparts A, B, D through H, N, O and C per licensee's discretion
FFD Program for persons required to physically report to the Technical Support Center (TSC) or Emergency Operations Facility (EOF)	10 CFR Part 26.4(c)	13.7	Prior to the conduct of the first full participation emergency preparedness exercise under 10 CFR 50, Appendix E, Section F.2.a	10 CFR 26, Subparts A through I, N and O, except for 10 CFR 26.205 through 10 CFR 26.209
FFD Program for Operation	10 CFR 26.4(a) and 10 CFR 26.4(b)	13.7	Prior to the earlier of: a. Receipt of SNM in the form of fuel assemblies b. Establishment of a PA, or c. 10 CFR 52.103(g) finding	10 CFR 26, Subparts A through I, N and O, except for individuals listed in 10 CFR 26.4(b), who are not subject to 10 CFR 26.205 through 10 CFR 26.209

The COL applicant stated that their FFD program is implemented and maintained in two phases, the construction and operations phases, which are dependent on the activities, duties, or access afforded to certain individuals at the construction site.

The COL applicant stated that their construction FFD program conforms to the guidance in the NRC-accepted NEI 06-06, Revision 5, which applies to persons constructing or directing the construction of safety- and security-related SSCs performed onsite where the new reactor will be installed and operated. Other on-site key personnel will be subject to the operations FFD program that complies with the requirements of 10 CFR Part 26, Subparts A through H, N, and O. At the establishment of a protected area, all persons who are granted unescorted access will meet the requirements of an operations FFD program.

The COL applicant stated that their workforce population is subject to a random testing program and that the numbers are derived from weekly averages of active badges over a 7-day period and that persons to be tested are identified by a computerized testing generator.

The COL applicant stated their site-specific information at the construction site is provided:

- Dominion's Engineering, Procurement, and Construction (EPC) contractor personnel and the EPC's subcontractors working in the following areas are covered by a Dominion-approved contractor FFD Program (10 CFR Part 26, elements Subparts A-H, N and O):

    - FFD program personnel
    - Security personnel
    - Construction management and oversight personnel

- Dominion's EPC contractor personnel and the EPC's subcontractors working in the following area are covered by a Dominion-approved contractor FFD Program (10 CFR Part 26, elements Subpart K):

    - Construction workers and first-line supervisors

- Dominion's employees and Dominion's subcontractors working in the following areas are covered by the Dominion North Anna Units 1 and 2 Operations FFD Program (10 CFR Part 26, elements Subparts A-I, N and 0):

    - FFD program personnel

    - Security personnel protecting fuel assemblies

    - Personnel required to physically report to the Technical Support Center (TSC) or Emergency Operations Facility (EOF) by Emergency Plans and procedures (except for 10 CFR Part 26, Sections 26.205-209 and Subpart K, which do not apply)

- All other Dominion employees and Dominion subcontractors working at the construction site are covered by the Dominion North Anna Units 1 and 2 Operations FFD Program (10 CFR Part 26, elements Subparts A-H, N and O)

In the January 18, 2011 response to RAI 13.07-2, the applicant committed to modify the FSAR to indicate a replacement to Section 13.7, Fitness for Duty. They also agreed to provide site-specific information, and to provide explanation of their construction FFD program to comply with certain clarification, additions, and exceptions in these future, endorsed revisions as necessary. The staff has determined that this response, which includes site-specific information and milestones is acceptable. The staff verified that the applicant had included the proposed changes in COL FSAR revision 6. Therefore, this RAI is resolved and closed.

License Conditions

There are no license conditions applicable to the North Anna COLA.

13.7.5 Post Combined License Activities

There are no post license activities associated with the North Anna 3 COLA.

13.7.6 Conclusion

The staff reviewed FSAR Section 13.7 and the applicant's proposed revision to this Section. The staff's review confirmed that the applicant has addressed the required information relating to the FFD Program, and no outstanding information is expected to be addressed in the COL FSAR related to this Section.

The staff compared the information in the proposed FSAR markup changes to the relevant NRC regulations and the guidance in NEI 06-06. The staff concludes that the information in the North Anna 3 COL FSAR is acceptable because it meets the regulatory requirements in 10 CFR Part 26 and 10 CFR 52.79(a)(44). The staff based this conclusion on the following:

STD SUP 13.7-1, which relates to the FFD Program, is acceptable because it conforms to 10 CFR Part 26 and 10 CFR 52.79(a)(44), as clarified in the NRC letter to NEI dated December 2, 2009 (ADAMS Accession No. ML092881085).

13.8 Cyber Security

13.8.1 Introduction

This Section provides information relating to the preparations and plans for the Cyber Security program for North Anna 3. The purpose of this Section is to demonstrate that the COL applicant will establish and maintain a Cyber Security Program to provide high assurance that digital systems, networks, and communication systems are protected from cyber-attacks.

13.8.2 Summary of Application

On December 5, 2011, Dominion submitted a Revision 2 of the Cyber Security Plan (CSP) for North Anna 3. The CSP applies to all critical digital assets (CDA) required for North Anna 3 operation. In the submittal, Dominion describes how it establishes, implements, and maintains a Cyber Security program that protects digital computer and communication systems and networks associated with safety-related and important-to-safety functions; security functions; emergency preparedness functions, including offsite communications; and support systems and equipment which, if compromised, would adversely impact safety, security, or emergency preparedness functions.

13.8.3 Regulatory Basis

The following NRC regulations include the relevant requirements and guidance for the CSP:

- 10 CFR 73.54
- 10 CFR 73.55(a)(1), 10 CFR 73.55(b)(8), and 10 CFR 73.55(m)
- 10 CFR 73, Appendix G

The 10 CFR 73.54 requires each applicant to build and operate a nuclear power plant under 10 CFR Part 52, to submit, a CSP that satisfies the requirements of 10 CFR 73.54 for Commission review and approval.

The staff stated in a letter (Subject: Nuclear Energy Institute [NEI] 08-09, "Cyber Security Plan Template, Rev. 6), dated May 5, 2010 (ADAMS Accession No.: ML101190371), that an applicant may use the template in NEI 08-09, Revision 6, to prepare an acceptable CSP. Dominion submitted a CSP for North Anna 3 that was based on the template provided in NEI 08-09, Revision 6. The submitted CSP was reviewed against the template in NEI 08-09, Revision 6, which has been found acceptable for use by staff. NEI 08-09, Revision 6 is comparable to RG 5.71, "Cyber Security Programs For Nuclear Facilities," which is approved NRC guidance.

13.8.4 Technical Evaluation

The staff performed a technical evaluation of the applicant's CSP. The staff's review finds that the applicant's CSP conforms to the guidance in NEI 08-09, Revision 6, which is comparable to RG 5.71, to satisfy the requirements in 10 CFR 73.54. The staff also reviewed the applicant's CSP against the requirements of 10 CFR 73.54 in accordance with the guidance in RG 5.71. The staff's evaluation of each Section of the applicant's CSP is discussed below.

13.8.4.1 Scope and Purpose

The North Anna 3 CSP establishes a means to achieve high assurance that digital computer and communication systems and networks associated with the following functions are adequately protected against cyber-attacks up to and including the DBT:

- Safety-related and important-to-safety functions;
- Security functions;
- Emergency preparedness functions, including offsite communications; and
- Support systems and equipment which, if compromised, would adversely impact safety, security, or emergency preparedness functions.

The submitted CSP describes achievement of high assurance of adequate protection of systems associated with the above functions from cyber-attacks by:

- Implementing and documenting the "baseline" security controls as described in Section 3.1.6 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3 described in RG 5.71; and

- Implementing and documenting a CSP to maintain the established cyber security controls through a comprehensive life cycle approach as described in Section 4 of NEI 08-09, Revision 6, which is comparable to Appendix A, Section A.2.1 of RG 5.71.

The applicants CSP states:

> Within the scope of NRC's cyber security rule at Title 10 of the *Code of Federal Regulations* structures, systems, and components (SSCs) in the balance of plant (BOP) that could directly or indirectly affect reactivity at a nuclear power plant and could result in an unplanned reactor shutdown or transient. Additionally, these SSCs are under the licensee's control and include electrical distribution equipment out to the first inter-tie with the offsite distribution system.

The staff reviewed the above information and found no substantive deviation from Regulatory Position C.3.3 in RG 5.71 and Appendix A, Section A.2.1 of RG 5.71. The staff finds that the applicant established adequate measures to implement and document the Cyber Security Program, including baseline security controls. Based on the review, the staff finds that the CSP adequately establishes the Cyber Security Program, including baseline security controls.

13.8.4.2 Analyzing Digital Computer Systems and Networks and Applying Cyber Security Controls

The Dominion North Anna 3 CSP describes that the Cyber Security Program is established, implemented, and maintained as described in Section 3.1 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3 described in RG 5.71 to:

- analyze digital computer and communications systems and networks; and

- identify those assets that must be protected against cyber-attacks to satisfy 10 CFR 73.54(a)

The submitted CSP states that the cyber security controls in Appendices D and E of NEI 08-09, Revision 6, which are comparable to Appendices B and C in RG 5.71, are implemented to protect CDAs from cyber-attacks.

Based on the above, the staff finds that the CSP adequately addresses security controls.

13.8.4.3 Cyber Security Assessment and Authorization

The CSP provided information addressing the creation of a formal, documented, cyber security assessment and authorization policy. This included a description concerning the creation of a formal, documented procedure comparable to Section 3.1.1 of NEI 08-09, Revision 6.

The staff finds that the applicant established adequate measures to define and address the purpose, scope, roles, responsibilities, management commitment, and coordination, and facilitates the implementation of the cyber security assessment and authorization policy.

Based on the review, the staff finds that the CSP adequately established controls to develop disseminate and periodically update the cyber security assessment and authorization policy and implementing procedure.

13.8.4.4 Cyber Security Assessment Team

The Cyber Security Assessment Team (CSAT) responsibilities include conducting the cyber security assessment, documenting key findings during the assessment, and evaluating assumptions and conclusions about cyber security threats. The submitted CSP outlines the requirements, roles and responsibilities of the CSAT that are comparable to Section 3.1.2 of NEI 08-09, Revision 6. It also states that that the CSAT has the authority to conduct an independent assessment.

The submitted CSP describes that the CSAT will consist of individuals with knowledge about information and digital systems technology; nuclear power plant operations, engineering, and plant technical specifications; and physical security and emergency preparedness systems and programs. The CSAT description in the CSP is comparable to Regulatory Position C.3.1.2 in RG 5.71.

The submitted CSP lists the roles and responsibilities for the CSAT which included performing and overseeing the cyber security assessment process; documenting key observations; evaluating information about cyber security threats and vulnerabilities; confirming information obtained during tabletop reviews, walk-downs, or electronic validation of CDAs; and identifying potential new cyber security controls.

Based on the above, the staff finds that the CSP adequately establishes the requirements, roles, and responsibilities of the CSAT.

13.8.4.5 Identification of Critical Digital Assets

The submitted CSP states that the applicant will identify and document CDA and critical systems, including a general description, the overall function, the overall consequences if a compromise were to occur, and the security functional requirements or specifications as described in Section 3.1.3 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.1.3 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes the process to identify CDAs.

13.8.4.6 Examination of Cyber Security Practices

The submitted CSP describes how the CSAT will examine and document the existing cyber security procedures, and practices; existing cyber security controls; detailed descriptions of network and communication architectures (or network/communication architecture drawings); information on security devices; and any other information that may be helpful during the cyber security assessment process as described in Section 3.1.4 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.1.2 of RG 5.71. The examinations will include an analysis of the effectiveness of the existing Cyber Security program and cyber security controls. The CSAT will document the collected cyber security information and the results of their examination of the collected information.

Based on the above, the staff finds that the CSP adequately describes the examination of cyber security practices.

13.8.4.7 Reviews and Validation Testing

The submitted CSP describes tabletop reviews and validation testing, which confirm the direct and indirect connectivity of each CDA and identify direct and indirect pathways to CDAs. The CSP states that validation testing will be performed electronically or by physical walkdowns. The applicant’s plan for tabletop reviews and validation testing is comparable to Section 3.1.5 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.1.4 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes tabletop reviews and validation testing.

13.8.4.8 Mitigation of Vulnerabilities and Application of Cyber Security Controls

In accordance with Section 3.1.6 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3 and Appendix A.3.1.6 to RG 5.71, the submitted CSP describes the use of information collected from Section 3.1.4 of the CSP to address cyber security controls.

The submitted CSP notes that before Dominion North Anna 3 can implement security controls on a CDA, it must assess the potential for adverse impact as per Section 3.1.6 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes mitigation of vulnerabilities and application of security controls.

13.8.4.9 Incorporating the Cyber Security Program into the Physical Protection Program

The submitted CSP states that the Cyber Security program will be reviewed as a component of the Physical Security Program in accordance with the requirements of 10 CFR 73.55(m). This information is comparable to Section 4.1 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.4 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes review of the CSP as a component of the physical security program.

13.8.4.10 Cyber Security Controls

The submitted CSP describes how the technical, operational and management cyber security controls contained in Appendices D and E of NEI 08-09, Revision 6, that are comparable to Appendices B and C in RG 5.71, are evaluated and dispositioned based on site-specific conditions during all phases of the cyber security program. The CSP describes that many security controls have actions that are required to be performed on specific frequencies and that the frequency of a security control is satisfied if the action is performed within 1.25 times the frequency specified in the control, as applied, and as measured from the previous performance of the action as described in Section 4.2 of NEI 08-09, Revision 6.

Based on the above, the staff finds that the CSP adequately describes implementation of cyber security controls.

13.8.4.11 Defense-in-Depth Protective Strategies

The submitted CSP describes the implementation of defensive strategies that ensure the capability to detect, respond to, and recover from a cyber-attack. The CSP specifies that the defensive strategies consist of security controls, defense-in-depth measures, and the defensive architecture. The submitted CSP notes that the defensive architecture establishes the logical and physical boundaries to control the data transfer between these boundaries.

The applicant established defense-in-depth strategies by: implementing and documenting a defensive architecture as described in Section 4.3 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.2 in RG 5.71; a Physical Security Program, including physical barriers; the operational and management controls described in Appendix E of NEI 08-09, Revision 6, which is comparable to Appendix C to RG 5.71; and the technical controls described in Appendix D of NEI 08-09, Revision 6, which is comparable to Appendix B to RG 5.71.

Based on the above review, the staff finds that the “Defense-in-Depth Protective Strategies” described in Section 4.3 of North Anna 3 CSP are acceptable.

13.8.4.12 Ongoing Monitoring and Assessment

The submitted CSP describes how ongoing monitoring of cyber security controls to support CDAs is implemented comparable to Appendix E of NEI 08-09, Revision 6, which is comparable to Regulatory Positions C.4.1 and C.4.2 of RG 5.71. The ongoing monitoring program includes configuration management and change control; cyber security impact analysis of changes and changed environments; ongoing assessments of cyber security controls; effectiveness analysis (to monitor and confirm that the cyber security controls are implemented correctly, operating as intended, and achieving the desired outcome) and vulnerability scans to identify new vulnerabilities that could affect the security posture of CDAs.

Based on the above, the staff finds that the CSP adequately describes ongoing monitoring and assessment.

13.8.4.13 Modification of Digital Assets

The submitted CSP describes how cyber security controls are established, implemented, and maintained to protect CDAs. These security controls ensure that modifications to CDAs are evaluated before implementation that the cyber security performance objectives are maintained, and that acquired CDAs have cyber security requirements in place to achieve the site's CSP objectives. This information is comparable to Section 4.5 of NEI 08-09, Revision 6, which is comparable to Appendices A.4.2.5 and A.4.2.6 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes modification of digital assets.

13.8.4.14 Attack Mitigation and Incident Response

The submitted CSP describes the process to ensure that SSEP functions are not adversely impacted due to cyber-attacks in accordance with Section 4.6 of NEI 08-09, Revision. 6, which is comparable to Appendix C, Section C.8 of RG 5.71. The CSP includes a discussion about creating incident response policy and procedures, and addresses training, testing and drills, incident handling, incident monitoring, and incident response assistance. It also describes identification, detection, response, containment, eradication, and recovery activities comparable to Section 4.6 of NEI 08-09, Revision 6.

Based on the above, the staff finds that the CSP adequately describes attack mitigation and incident response.

13.8.4.15 Cyber Security Contingency Plan

The submitted CSP describes creation of a Cyber Security Contingency Plan and policy that protects CDAs from the adverse impacts of a cyber-attack described in Section 4.7 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3.2.7, and Appendix C.9 of RG 5.71. The applicant describes the Cyber Security Contingency Plan that would include the response to events. The plan includes procedures for operating CDAs in a contingency, roles and responsibilities of responders, processes and procedures for backup and storage of information, logical diagrams of network connectivity, current configuration information, and personnel lists for authorized access to CDAs.

Based on the above, the staff finds that the CSP adequately describes the cyber security contingency plan.

13.8.4.16 Cyber Security Training

The submitted CSP describes a program that establishes the training requirements necessary for the applicant's personnel and contractors to perform their assigned duties and responsibilities in implementing the Program in accordance with Section 4.8 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3.2.8 of RG 5.71.

The CSP states that individuals will be trained with a level of cyber security knowledge commensurate with their assigned responsibilities in order to provide high assurance that individuals are able to perform their job functions in accordance with Appendix E of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.3.2.8 of RG 5.71 and describes three levels of training: awareness training, technical training, and specialized cyber security training.

Based on the above, the staff finds that the CSP adequately describes the cyber security training and awareness.

13.8.4.17 Evaluate and Manage Cyber Risk

The submitted CSP describes how cyber risk is evaluated and managed utilizing site programs and procedures comparable to Section 4.9 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.4 and Appendix C, Section C.13 of RG 5.71. The CSP describes the Threat and Vulnerability Management Program; Risk Mitigation; Operational Experience Program; and the Corrective Action Program. The applicants CSP will describe how each CSP program will be used to evaluate and manage risk.

Based on the above, the staff finds that the CSP adequately describes evaluation and management of cyber risk.

13.8.4.18 Policies and Procedures

The CSP describes development and implementation of policies and procedures to meet security control objectives in accordance with Section 4.10 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.5 and Appendix A, Section A.3.3 of RG 5.71. This includes the process to document, review, approve, issue, use, and revise policies and procedures.

The CSP also describes the applicant’s procedures to establish specific responsibilities for positions described in Section 4.11 of NEI 08-09, Revision 6, which is comparable to Appendix C, Section C.10.10 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes cyber security policies and implementing procedures.

13.8.4.19 Roles and Responsibilities

The submitted CSP describes the roles and responsibilities for the qualified and experienced personnel, including the CSP Sponsor, the Cyber Security Program Manager, Cyber Security Specialists, the Cyber Security Incident Response Team (CSIRT), and other positions as needed. The CSIRT initiates in accordance with the Incident Response Plan and initiates emergency action when required to safeguard CDAs from cyber security compromise and to assist with the eventual recovery of compromised systems. Implementing procedures establish roles and responsibilities for each of the cyber security roles in accordance with Section 4.11 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.3.1.2, Appendix A, Section A.3.1.2, and Appendix C, Section C.10.10 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes cyber security roles and responsibilities.

13.8.4.20 Cyber Security Program Review

The submitted CSP describes how the Cyber Security program establishes the necessary procedures to implement reviews of applicable program elements in accordance with Section 4.12 of NEI 08-09, Revision 6, which is comparable to Regulatory Position C.4.3 and Appendix A, Section A.4.3 of RG 5.71.

Based on the above, the staff finds that the CSP adequately describes Cyber Security program review.

13.8.4.21 Document Control and Records Retention and Handling

The submitted CSP states that the applicant has established the necessary measures and procedures to ensure that sufficient records of items and activities affecting cyber security are developed, reviewed, approved, issued, used, and revised to reflect completed work.

The staff confirmed that the North Anna 3 discussion of records retention complies with 10 CFR 73.54(h).

Based on the above, the staff finds that the CSP adequately describes cyber security document control and records retention and handling.

13.8.4.22 Implementation Milestone

The FSAR Table 13.4-201 contains the implementation milestone for the cyber security program. The milestone is “prior to receipt of fuel on-site.” The staff’s review of the implementation milestone finds that it is satisfactory since it complies with 10 CFR 73.55(a)(4).

Based on the above review, the staff finds that the “Implementation Milestone” described in Table 13.4-201 of North Anna 3 FSAR is acceptable.

13.8.5 Post Combined License Activities

There are no post license activities associated with the North Anna 3 COLA.

13.8.6 Conclusion

The staff compared the Dominion North Anna 3 CSP and FSAR table 13.4-201 to the relevant NRC regulations and the criteria in RG 5.71 via NEI 08-09, Revision 6.

The staff concluded that Dominion North Anna 3 is in compliance with the NRC regulations. The staff finds that the information in the Dominion North Anna 3 CSP adequately addresses the relevant requirements and guidance of 10 CFR 73.54 and RG 5.71, respectively. Therefore, the staff finds the information contained in this Section acceptable.

The staff's review confirmed that the applicant addressed the relevant information necessary to satisfy the requirements of 10 CFR 73.54, 10 CFR 73.55(a)(1), 10 CFR 73.55(b)(8), 10 CFR 73.55(m), and Appendix G to 10 CFR Part 73, as applicable. Thus, the staff finds that the North Anna 3 CSP meets applicable NRC requirements and guidance and therefore is acceptable.

References

1. 10 CFR 100.21(f), "Non-Seismic Siting Criteria"

2. 10 CFR 11.11, "General requirements."

3. 10 CFR 2.390, "Public inspections, exemptions, and request for withholding."

4. 10 CFR 26.205, "Work hours."

5. 10 CFR 26.4, "FFD program applicability to categories of individuals."

6. 10 CFR 50.120, "Training and Qualification of Nuclear Power Plant Personnel."

7. 10 CFR 50.2, "Definitions."

8. 10 CFR 50.33. "Contents of applications; general information."

9. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

10. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

11. 10 CFR 50.34f, "Additional TMI-related requirements."

12. 10 CFR 50.40(b), "Common standards."

13. 10 CFR 50.47, "Emergency plans."

14. 10 CFR 50.54(hh)(2), "…loss of large areas of the plant due to explosions or fire…"

15. 10 CFR 50.54, "Conditions of licenses."

16. 10 CFR 50.71, "Maintenance of records, and making of reports."

17. 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors."

18. 10 CFR 50.80, "Transfer of licenses."

19. 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit."

20. 10 CFR 52.103(a), "…scheduled date for initial loading of fuel...."

21. 10 CFR 52.103(g), "…the Commission finding on operation of facility..."

22. 10 CFR 52.103, "Operation under a combined license."

23. 10 CFR 52.17, "Contents of applications; technical information."

24. 10 CFR 52.24, "Issuance of early site permit."

25. 10 CFR 52.63, "Finality of standard design certification."

26. 10 CFR 52.63, "Finality of standard design certification."

27. 10 CFR 52.77, "Contents of applications; general information."

28. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

29. 10 CFR 52.80, "Contents of applications; additional technical information.

30. 10 CFR 52.83, "Finality of referenced NRC approvals; partial initial decision on site suitability."

31. 10 CFR 52.98, "Finality of combined licenses; information requests."

32. 10 CFR 52.99, "Inspection during construction."

33. 10 CFR 55.13 "General exemption."

34. 10 CFR 55.31 "How to apply."

35. 10 CFR 55.4, "Definitions."

36. 10 CFR 55.41 "Written examinations: Operators."

37. 10 CFR 55.43 "Written examinations: Senior operators."

38. 10 CFR 55.45 "Operating tests."

39. 10 CFR 55.46 "Simulation facilities."

40. 10 CFR 55.59, "Requalification."

41. 10 CFR 73.1,"Purpose and scope."

42. 10 CFR 73.2, "Definitions."

43. 10 CFR 73.21, "Protection of safeguards information: performance requirements."

44. 10 CFR 73.54, "Protection of digital computer and communication systems and networks."

45. 10 CFR 73.55, "Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage."

46. 10 CFR 73.56, "Personnel access authorization requirements for nuclear power plants."

47. 10 CFR 73.57, "Requirements for criminal history records checks of individuals granted unescorted access to a nuclear power facility, a non-power reactor, or access to Safeguards Information."

48. 10 CFR 73.58, "Safety/security interface requirements for nuclear power reactors."

49. 10 CFR 73.70, "Records."

50. 10 CFR 73.71, "Reporting of safeguards events."

51. 10 CFR Part 11, "Criteria and Procedures for Determining Eligibility for Access to or Control over Special Nuclear Material."

52. 10 CFR Part 11, "Criteria and Procedures for Determining Eligibility for Access to or Control over Special Nuclear Material."

53. 10 CFR Part 19, "Notices, Instructions and Reports to Workers: Inspection and Investigation."

54. 10 CFR Part 20, "Standards for Protection against Radiation."

55. 10 CFR Part 26, "Fitness for Duty Programs."

56. 10 CFR Part 26, Subpart I, "Managing Fatigue."

57. 10 CFR Part 40, "Domestic Licensing of Source Material."

58. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

59. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

60. 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements."

61. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

62. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

63. 10 CFR Part 55, "Operator's Licenses."

64. 10 CFR Part 73, "Physical Protection of Plants and Materials."

65. 10 CFR Part 73, Appendix A, "U.S. Nuclear Regulatory Commission Offices and Classified Mailing Addresses."

66. 10 CFR Part 73, Appendix B, "General Criteria for Security Personnel"

67. 10 CFR Part 73, Appendix C, "Nuclear Power Plant Safeguards Contingency Plans"

68. 10 CFR Part 73, Appendix G, "Reportable Safeguards Events"

69. 10 CFR Part 73, Appendix H, "Weapons Qualification Criteria"

70. 10 CFR Part 74, "Material Control and Accounting of Special Nuclear Material"

71. 44 CFR Part 352, "Commercial Nuclear Power Plants: Emergency Preparedness Planning."

72. 44 CFR Part 353, "Fee for Services in Support, Review, and Approval of State and Local Government or Licensee Radiological Emergency Plans and Preparedness," Appendix A, "Memorandum of Understanding Between NRC and FEMA Relating to Radiological Emergency Planning and Preparedness." (58 FR 47996, September 14, 1993)

73. ANSI/ANS-3.1-1993, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants."

74. ANSI/ANS-3.2-2012. "Managerial, Administrative, and Quality Assurance Controls for the Operational Phase of Nuclear Power Plants."

75. ANSI/ASME B30.2 2011, "Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)."

76. ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear Facility Applications."

77. Dominion North Anna, "North Anna Power Station Emergency Public Information for Residents and Visitors in the Communities of: [Louisa, Spotsylvania, Orange, Caroline, and Hanover Counties]," Revision September 2007 (ADAMS Accession No. ML081210740).

78. Dominion North Anna-NAPS 2008 Nuclear Emergency Planning Information Calendar EPA 400-R-92-001, "The Manual of Protective Action Guides and

79. EPA 400-R-92-001, "The Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," May 1992.

80. *Federal Register*, 58 FR 47996, "Memorandum of Understanding between Federal Emergency Management Agency and Nuclear Regulatory Commission," September 14, 1993.

81. *Federal Register*, 76 FR 72560, "Enhancements to Emergency Preparedness Regulations, "November 23, 2011.

82. Federal Register, 79 FR 61944, "Final Rule: Economic Simplified Boiling-Water Reactor Design Certification," October 15, 2014.

83. FEMA CFR Title 44, Emergency Management and Assistance, Part 350, "Review and Approval of State and Local Radiological Emergency Plans and Preparedness."

84. FEMA Interim Finding Report on North Anna 3, for Reasonable Assurance, dated December 1, 2009 (ADAMS Accession No. ML093441481).

85. FEMA Title 44, Emergency Management and Assistance, 350.9, "Exercises."

86. FEMA Title 44, Emergency Management and Assistance, Part 353, Appendix A, "Memorandum of Understanding (MOU) Between Federal Emergency Management Agency and Nuclear Regulatory Commission Relating to Radiological Emergency Planning and Preparedness."

87. FEMA-REP-10, "Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants," November 1985.

88. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

89. IN 1986-83, "Underground Pathways into Protected Areas, Vital Areas, and Controlled Access Areas," September 19, 1986 (ADAMS Accession Nos. ML031250244, ML031250275).

90. NEDC-33844P, GE Hitachi Nuclear Energy licensing topical report, "Bomb Blast Analysis for North Anna 3."

91. NEDE-33389, Revision 1, "ESBWR Security Enhancements Report," July 2009 (ADAMS Accession No. ML091940127).

92. NEDE-33390, Revision 1, "ESBWR Interim Compensatory Measures Assessment Report," November 2008 (ADAMS Accession No. ML083300549).

93. NEDE-33391, Revision 2, "ESBWR Safeguards Assessment Report," March 2010 (ADAMS Accession No. ML100770378).

94. NEI 03-12, Revision 7, "Template for the Security Plan, Training and Qualification Plan, Safeguards Contingency Plan, and Independent Spent Fuel Installation Security Program," February 23, 2009. (ADAMS Accession No. ML11301A066).

95. NEI 06-014A, Revision 7, "Quality Assurance Program Description," August 2010. (ADAMS Accession No. ML102370305.)

96. NEI 06-06, Revision 5, "Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites," August 2009. (ADAMS Accession No. ML092430016).

97. NEI 06-13A, Revision 2, "Template for an Industry Training Program Description," March 2009. (ADAMS Accession No. ML090910554).

98. NEI 07-01, Revision 0, "Methodology for Development of Emergency Action Levels Advanced Passive Light Water Reactors" September 30, 2007 (ADAMS Accession No. ML072710311).

99. NEI 08-09, Revision 6, "Cyber Security Plan Template," April 28, 2010 (ADAMS Accession No. ML101180434).

100. NEI 10-05, Revision 0, "Assessment of On-Shift EP ITAAC Emergency Response Organization Staffing and Capabilities," June 2011. (ADAMS Accession No. ML111751698).

101. NEI 12-01, Revision 0, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," May 2012. (ADAMS Accession No. ML12125A412).

102. NRC BL 2005-02, "Emergency Preparedness and Response Actions for Security-Based Events," July 18, 2005 (ADAMS Accession No. ML051740058).

103. NRC GL 96-01, "Testing of Safety Related Logic Circuits." (ADAMS Accession No. ML031200626).

104. NRC IN 86-83, "Underground Pathways into Protected Areas, Vital Areas, and Controlled Access Areas," September 19, 1986.

105. NRC ISG DC/COL-ISG-1, "Interim Staff Guidance on Seismic Issues of High Frequency Ground Motion," May 19, 2008 (ADAMS Accession No. ML081400293).

106. NRC ISG NSIR/DPR-ISG-01, Revision 0, "Emergency Planning for Nuclear Power Plants," November 2011. (ADAMS Accession No. ML113010523.)

107. NRC RG 1.149, Revision 4, "Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations," April 2011 (ADAMS Accession No. ML110420119).

108. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

109. NRC RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)."

110. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

111. NRC RG 1.91, Revision 1, "Evaluations of Explosions Postulated to Occur at Transportation Routes Near Nuclear Power Plants," February 1978 (ADAMS Accession No. ML003740286).

112. NRC RG 4.7, Revision 2, "General Site Suitability Criteria for Nuclear Power Stations," April 1998 (ADAMS Accession No. ML003739894).

113. NRC RG 5.12, "General Use of Locks in the Protection and Control of Facilities and Special Nuclear Materials," November 1973 (ADAMS Accession No. ML003740035).

114. NRC RG 5.29, Revision 2, "Nuclear Material Control and Accounting for Nuclear Power Reactors," June 2013 (ADAMS Accession No. ML13051A421).

115. NRC RG 5.44, Revision 3, "Perimeter Intrusion Alarm Systems," October 1997 (ADAMS Accession No. ML003739217).

116. NRC RG 5.62, Revision 1, "Reporting of Safeguards Events," November 1987 (ADAMS Accession No. ML003739271).

117. NRC RG 5.65, "Vital Area Access Controls, Protection of Physical Security Equipment and Key and Lock Controls," September 1986. (ADAMS Accession No. ML003739336).

118. NRC RG 5.66, "Access Authorization Program for Nuclear Power Plants," October 2011 (ADAMS Accession No. ML112060028).

119. NRC RG 5.68, "Protection against Malevolent Use of Vehicles at Nuclear Power Plants," August 1994 (ADAMS Accession No. ML003739379).

120. NRC RG 5.69, "Guidance for the Application of Radiological Sabotage Design-Basis Threat in the Design, Development, and Implementation of a Physical Security Protection Program that Meets 10 CFR 73.55 Requirements," September 2007 (Revised May 2010: ADAMS Accession No. ML101410631).

121. NRC RG 5.7, Revision 1, "Entry/Exit Control for Protected Areas, Vital Areas, and Material Access Areas," May 1980 (ADAMS Accession No. ML003739976).

122. NRC RG 5.71, "Cyber Security Programs for Nuclear Facilities," January 2010 (ADAMS Accession No. ML090340159).

123. NRC RG 5.74, "Managing the Safety/Security Interface," June 2009 (ADAMS Accession No.ML091690036).

124. NRC RG 5.75, "Training and Qualification of Security Personnel at Nuclear Power Reactor Facilities," July 2009 (ADAMS Accession No. ML091690037).

125. NRC RG 5.76, "Physical Protection Programs at Nuclear Power Reactors," July 2009.

126. NRC RG 5.77, "Insider Mitigation Program," March 2009.

127. NRC RIS 2005-04, "Guidance on the Protection of Unattended Openings that Intersect a Security Boundary or Area," April 14, 2005.

128. NRC SECY-05-0197, "Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," October 28, 2005, (ADAMS Accession Nos. ML052770225, ML052770257), and the related SRM, dated February 22, 2006 (ADAMS Accession No. ML060530316).

129. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

130. NRC Staff NUREG/CR 6190, "Update of NUREG/CR 6190 Material to Reflect Postulated Threat Requirements," March 27, 2003. (ADAMS Accession No. ML031560022; original NUREG/CR 6190 available at: http://www.osti.gov/scitech/biblio/10181515).

131. NRC Staff NUREG/CR-6863, "Development of Evacuation Time Estimate Studies for Nuclear Power Plants," January 2005 (ADAMS Accession No. ML050250240).

132. NRC Staff NUREG/CR-7002, "Criteria for Development of Evacuation Time Estimate Studies," November 2011 (ADAMS Accession No. ML113010515).

133. NRC Staff NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML 040420012).

134. NRC Staff NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980. (ADAMS Accession No. ML040420012.)

135. NRC Staff NUREG-0696, "Functional Criteria for Emergency Response facilities," February 28, 1981 (ADAMS Accession No. ML051390358).

136. NRC Staff NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980 (ADAMS Accession No. ML051400209).

137. NRC Staff NUREG-0737, Supplement 1, "Clarification of TMI Action Plan Requirements," January 1983 (ADAMS Accession No. ML051390367).

138. NRC Staff NUREG-1021, "Operator Licensing Examination Standards for Power Reactors," July 2004 (ADAMS Accession No. ML042320438).

139. NRC Staff NUREG-1220, "Training Review Criteria and Procedures." January 1993 (ADAMS Accession No. ML102571869).

140. NRC Staff NUREG-1835 2006b, "Supplement to the Final Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site, September 2006 (ADAMS Accession No. ML063170371).

141. NRC Staff NUREG-1835 NRC 2005b, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site, September 2005 (ADAMS Accession No. ML052710305). Available at http://pbadupws.nrc.gov/docs/ML0527/ML052710305.pdf

142. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

143. NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management," December 1991 (ADAMS Accession No. ML11125A011).

144. SANDIA 85-0935 (NUREG/CR-4250),"Vehicle Barriers: Emphasis on Natural Features," July 1985.

145. U.S. Code 18 U.S.C. 922, "Unlawful Acts."

14.0 INITIAL TEST PROGRAM

14.0 INITIAL TEST PROGRAM

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 test programs, including preoperational tests, initial fuel loading and initial criticality, low-power tests, and power-ascension tests. In the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR) the applicant addressed information concerning the initial test program (ITP) for structures, systems, and components (SSCs) and design features for both the nuclear portion of the North Anna 3 site, and the balance of plant. The COL applicant thus describes the scope of the ITP, as well as the general plans for accomplishing the ITP in sufficient detail to demonstrate that there is due consideration given to matters that normally require advance planning.

In accordance with Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Regulatory Position C.I.14, "Verification Programs," dated June 2007, the COL applicant describes the technical aspects of the ITP in sufficient detail to show that (1) the test program adequately verifies the functional requirements of plant SSCs, and (2) the sequence of testing is such that the safety of the plant does not depend on untested SSCs. The COL applicant also describes measures to ensure that (1) the ITP will be accomplished with adequate numbers of qualified personnel; (2) there will be adequate administrative controls established to govern the ITP; (3) the ITP will be used, to the extent practicable, to train and familiarize the plant's operating and technical staff in the operation of the facility; and (4) the adequacy of plant operating and emergency procedures will be verified, to the extent practicable, during the period of the ITP. This chapter also provides information on the inspections, tests, analyses, and acceptance criteria (ITAAC) that are intended to demonstrate that, when the inspections, tests, and analyses are performed and the associated acceptance criteria met, the facility will have been constructed and will operate in conformity with (1) the COL; (2) the Atomic Energy Act of 1954, as amended; and (3) the U.S. Nuclear Regulatory Commission (NRC) regulations.

14.1. Initial Test Program for Preliminary Safety Analysis Reports

Section 14.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference with no departures or supplements Section 14.1, "Initial Test Program For Preliminary Safety Analysis Reports," of Revision 10 of the Design Control Document (DCD) for the Economic Simplified Boiling-Water Reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.[1] The staff's review confirmed that there is no outstanding issue related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52, Appendix E, "Design Certification Rule for ESBWR Design," Section VI.B.1, all nuclear safety issues have been resolved relating to ITP for Preliminary Safety Analysis Reports that the applicant has incorporated by reference.

[1] See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

14.2 Initial Plant Test Program for Final Safety Analysis Reports

14.2.1 Introduction

This FSAR section presents an overview of the North Anna 3 ITP.

14.2.2 Summary of Application

Section 14.2, “Initial Plant Test Program for Final Safety Analysis Reports,” of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 14.2, of the ESBWR DCD, Revision 10.

In addition, the North Anna 3 FSAR Section 14.2, provides the following:

COL Items

- STD COL 14.2-1-A Description – Initial Test Program Administration

The applicant developed and provided a description of the ITP administration in Appendix 14AA of the North Anna 3 COL FSAR, Revision 8.

- NAPS COL 14.2-1-A Description – Initial Test Program Administration

The applicant provided the site-specific administrative controls to be included in the Startup Administrative Manual (SAM) related to the ITP as Appendix 14AA, “Description of Initial Test Program Administration,” to address STD COL 14.2-1-A.

- STD COL 14.2-2-A Startup Administrative Manual

The applicant provided a milestone for completing the SAM.

- CWR COL 14.2-3-A Test Procedures

In the North Anna 3 COL FSAR, the applicant addressed the STD COL-14.2-3-A as consistent with reference (CWR) COL 14.2-3-A indicating the information is consistent with the reference COL. The applicant provided milestones for making approved test procedures satisfying the requirements of the ITP. The applicant addressed this COL information as information consistent with the Reference COL applicant, Fermi Unit 3 Station (COL 14.2-3-A), in its COL FSAR, Revision 8 for North Anna 3.

- STD COL 14.2-4-A Test Program Schedule and Sequence

The applicant provided a license condition to develop and make detailed testing schedules available for NRC review prior to actual implementation. The implementation milestones for the ITP are provided in the North Anna 3 COL FSAR, Revision 8, Section 13.4, “Operational Program Implementation.”

- NAPS COL 14.2-5-A		Site Specific Tests

The applicant described the site-specific preoperational and initial startup tests not addressed in DCD Section 14.2.8.

- NAPS COL 14.2-6-A		Site Specific Test Procedures

The applicant specified that site-specific testing will be performed and acceptance criteria for each preoperational and startup test are documented in test procedures available 60 days prior to their intended use.

Supplemental Information

- STD SUP 14.2-2		Test Records

The applicant specified that startup test reports are prepared in accordance with RG 1.16, "Reporting of Operating Information – Appendix A Technical Specifications."

- STD SUP 14.2-4		AC [Alternating Current] Power Distribution System Preoperational Test General Test Methods and Acceptance Criteria

The applicant specified proper operation of the automatic transfer capability of the normal preferred power source to the alternate preferred power source.

- NAPS SUP 14.2-1		Organization and Staffing

The applicant provided additional information regarding responsibilities, qualifications, and organization for the preoperational and startup testing program.

- NAPS SUP 14.2-2		Site-Specific Performance Test

The applicant specified that the objective of this test is to demonstrate acceptable performance of the waste heat rejection portion of the circulating water system (CWS or CIRC); (i.e., the dry cooling array and the hybrid cooling tower and basin).

- NAPS SUP 14.2-3		Site-Specific Pre-Operational Tests

The applicant specified site-specific preoperational tests for the station water system (SWS) and the Cooling Tower.

- NAPS SUP 14.2-4		Plant Service Water System (PSWS) Preoperational Test Purpose

The applicant specified the verification of proper operation of the PSWS.

- NAPS SUP 14.2-5 Plant Service Water System Performance Test Purpose

The applicant specified the verification of performance of the PSWS under expected reactor power operation load conditions.

14.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor."

The regulatory basis for acceptance of supplemental information related to operational programs is addressed in the following documents:

- Section 14.2 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," the Standard Review Plan (SRP);

- Regulatory Position C.I.14, of RG 1.206; and

- RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants."

The regulatory basis for applicant development of administrative controls that will be used to govern the ITP is addressed in SRP Sections 14.2.3.B.ii and iii, and in RG 1.206, Regulatory Position C.I.14. The applicable regulatory requirements for the information being reviewed in this section are 10 CFR 52.79(a)(28) and Criterion XI of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

14.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 14.2 of the certified ESBWR DCD. The staff reviewed Section 14.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the North Anna 3 COL FSAR, Revision 8 and the information in the ESBWR DCD, appropriately represent the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information contained in the application and the information incorporated by reference addresses the relevant information related to this section.

The North Anna 3 ITP includes a test program that will verify the functional requirements of plant SSCs. The ITP also includes the applicant's plans for the sequence of testing. The staff noted that the sequence of testing is organized in such a manner that the safety of the plant does not depend on any untested SSCs. In addition, the staff noted the following:

- The ITP is to be conducted with an adequate number of qualified personnel.

- Appropriate administrative controls have been established to govern the ITP.

- The test program will be used to train and familiarize the plant's operating and technical staff with general operation of the facility.

- The adequacy of plant operating and emergency procedures will be verified, to the extent practicable, during the ITP performance period.

The staff's technical evaluation of the FSAR sections affected by COL Items STD COL 14.2-1-A, NAPS COL 14.2-1-A, STD COL 14.2-2-A, STD COL 14.2-3-A, STD COL 14.2-4-A, NAPS COL 14.2-5-A, NAPS COL 14.2-6-A and supplemental information items STD SUP 14.2-2, STD SUP 14.2-4, NAPS SUP 14.2-1, NAPS SUP 14.2-2, NAPS SUP 14.2-3, NAPS SUP 14.2-4, and NAPS SUP 14.2-5 is discussed in Sections 14.2.4.1 through 14.2.4.8. The staff's evaluation of the North Anna 3 COL FSAR includes changes from Revision 2 to Revision 8.

14.2.4.1 Organization and Staffing

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

Supplemental Information

- NAPS SUP 14.2-1

In FSAR Section 14.2.1.4, "Organization and Staffing," the applicant added the following:

> Section 13.1 provides additional information regarding responsibilities, qualifications, and organization for implementing the preoperational and startup testing program.

The staff found the administrative addition of a pointer to Section 13.1 of the FSAR, regarding organization and staffing, acceptable.

14.2.4.2 Startup Administrative Manual

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

COL Items

- STD COL 14.2-1-A Description – Initial Test Program Administration

The applicant developed and provided a description of the ITP administration in Appendix 14AA of the North Anna 3 FSAR, Revision 8.

Section 14.2.2.1, "Startup Administrative Manual," of the DCD states in part that:

> A description of the initial test program administration is developed and made available to the NRC by the COL Applicant. This includes a discussion and description of the process and organizational controls and requirements that are included in the Startup Administrative Manual. See Section 14.2.10, COL Information Item 14.2-1-A.

The staff reviewed STD COL 14.2-1-A related to COL Information Item 14.2-1 and noted that in Revision 0 of North Anna 3 COL FSAR, the applicant did not include such administrative controls.

At public meetings on May 13 and May 22, 2008, the applicant and other design-centered working group (DCWG) representatives proposed a test program administrative document (proposed FSAR Appendix 14AA, "Description of Initial Test Program Administration," dated May 22, 2008). On June 23, 2008, the staff issued a request for additional information (RAI) 14.02-3 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML082060489), requesting the applicant to formally submit this DCWG Appendix on the docket. In a response letter dated August 7, 2008, to RAI 14.02-3 (ADAMS Accession No. ML082240413), the applicant stated that it will include the referenced test program administrative document as Appendix 14AA of the FSAR in the next revision of the North Anna 3 COL FSAR. The staff subsequently reviewed North Anna 3 COL FSAR, Revision 8, and verified that the applicant has incorporated Appendix 14AA in Chapter 14. The staff confirmed that it provides an adequate discussion and description of the process and organizational controls and requirements that are to be included in the SAM consistent with the guidance provided in SRP Section 14.2. Therefore, RAI 14.2-03 is resolved and closed.

In North Anna 3 COL FSAR, Appendix 14AA, the applicant replaced STD COL 14.2-1-A as North Anna COL 14.2-1-A, indicating that the organization information is site-specific. The applicant revised Section 14AA.2, "Organization and Staffing," to include site-specific organizational description of the principal management positions (including any augmenting organizations) responsible for planning, executing, and documenting preoperational and startup testing activities, as well as revised Section 14AA.2.2, "Responsibilities," to include responsibilities and interfaces, and the degree of participation of each identified organizational unit that will be responsible for the administration and technical direction of the ITP in order to be aligned with that of Engineering, Procurement Construction contract and Chapter 13.

In addition, the applicant revised Table 13.1-201, "Generic Position/Site Specific Position Cross Reference," of Section 13.1, "Organizational Structure of Applicant," referenced in FSAR Section 14AA.2, to include the qualification and experience requirements for the preoperational and startup test engineer positions to meet the qualification requirements of inspection and test personnel defined in American Society of Mechanical Engineers (ASME) NQA-1-1994," Quality Assurance Requirements for Nuclear Facility Applications," and also added the preoperational and startup test managers positions including their associated education and experience. Table 13.1-201 was updated to align the startup and preoperational test personnel information consistent with North Anna 3 COL FSAR, Appendix 17AA, "North Anna Power Station Unit 3 Quality Assurance Program Description," and Dominion's current organization and resource estimates.

The staff reviewed the changes made in Table 13.1-201 and FSAR Section 14AA.2 of North Anna 3 COL FSAR and determined that the administrative control changes adequately define the organizations that will carry out the ITP; describe the authorities, responsibilities, and interfaces; and delineate training and qualification requirements for organizations participating in the implementation of the ITP, consistent with the guidance in RG 1.68. Additionally, the staff found that the applicant's commitment to RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," which provides training and qualification guidance for nuclear power plant personnel, including personnel participating in ITP activities, found in Table 1.9-202 of the North Anna 3 COL, is adequate.

The staff reviewed the proposed North Anna 3 COL FSAR, Appendix 14AA and noted that in Section 14AA.3.4, "Test Procedure Changes," that the COL applicant provided a description of changes to test procedures; however, Section 14AA.3.4 did not include a description of the 10 CFR 50.59, "Changes, tests and experiments," for evaluating major test procedure changes for test abstracts in the ITP. In accordance with 10 CFR 50.59(c)(1)—

> A licensee may make changes to test procedures as described in the FSAR without obtaining a license amendment, only if:
>
> (i) a change to the technical specifications (TS) incorporated in the license is not required, and
>
> (ii) the change, test or experiment does not meet any of the criteria in (10 CFR 50.59(c)(2)).

On July 28, 2008, the staff initiated RAI 14.02-7 (ADAMS Accession No. ML082110133), requesting the COL applicant to include in Section 14AA.3.4, "Test Procedure Changes," the requirements to evaluate and obtain a license amendment, if it is revealed that a major test procedure change could result in a TS amendment in accordance with 10 CFR 50.59(c)(1) or it meets one of the eight criteria in 10 CFR 50.59(c)(2)(i) through (viii).

In a response letter dated September 11, 2008 to RAI 14.02-7 (ADAMS Accession No. ML082610417), the applicant proposed to revise FSAR Section 14AA.3.4, "Test Procedure Changes," with the following additional information:

> Review and approval requirements for procedure changes that do not change the intent are established in administrative procedures in the SAM.
>
> All test procedure intent changes will be revised against the following criteria (consistent with 10 CFR 50.59 and the design certification rule):
>
> - Departure from Tier 1 information
> - Departure from Tier 2 information that significantly decreases the level of safety in accordance with 10 CFR 50.59(c)(1) and meets any one of eight criteria in 10 CFR 50.59(c)(2)(i) through (viii) or 10 CFR [Part] 52, Design Certification Appendix, Section VIII.B.5.b.
> - Departure from Tier 2* information
> - Departure from Technical Specifications.
>
> Preoperational test procedure intent changes involving Tier 1, Tier 2*, Technical Specifications, or Tier 2 that require a license amendment must be approved by the NRC prior to procedure completion and approval. Startup test procedure intent changes involving Tier 1, Tier 2*, Technical Specifications, or Tier 2 that require a license amendment must be approved by the NRC prior to procedure use. Timely notification of the NRC is made when procedures are changed that have been sent to the NRC.

The staff found that this revision to FSAR Section 14AA.3.4 is acceptable, and therefore, RAI 14.02-7 is resolved and closed.

The staff reviewed the North Anna 3 COL FSAR, Appendix 14AA and determined that the applicant has provided an adequate discussion and description of the process and organizational controls and requirements that are to be included in the SAM. The staff also determined that the applicant provided an adequate description of the change control process similar to 10 CFR 50.59 for evaluating major test procedure changes for test abstracts in the ITP.

The staff evaluated STD COL 14.2-1-A and North Anna 3 COL 14.2-1-A according to relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 along with the guidance in RGs 1.68 and 1.206, Section C.I.14, and finds that the applicant has satisfactorily addressed the ESBWR DCD COL Item 14.2-1-A.

- STD COL 14.2-2-A Startup Administrative Manual

Section 14.2.2.1 “Startup Administrative Manual,” of the DCD states in part that:

> The COL Applicant will provide a milestone for completing the Startup Administrative Manual and making it available for Nuclear Regulatory Commission (NRC) inspection (COL 14.2-2-A). [Note: The official designation of this manual may differ for the plant owner/operator referencing the ESBWR design certification Startup Administration Manual (SAM); [the term SAM is used throughout this discussion for illustrative purposes only.]

The applicant replaced the above section in Section 14.2.2.1 of the ESBWR DCD with a milestone for developing and providing the SAM no later than 60 days prior to initial use for preoperational test and scheduled fuel loading for initial startup tests. In Section 14.2.2.1 of the FSAR, the applicant stated that:

> The Startup Administration Manual will be developed and made available for review 60 days prior to scheduled start of the preoperational test program.

In addition, the applicant identified a license condition for STD COL 14.2-2-A. The applicant addressed the license condition for STD COL 14.2-2-A in Part 10: “Tier 1/ITAAC/Proposed License Conditions,” Revision 7, dated June 2014, Section 3.2.1,” Start-up Administrative Manual,” of North Anna 3 COL application (COLA), Revision 8, and is also addressed below in Post Combined License Activities. The licensee will track the development of the SAM in order to address this COL information item in accordance with applicable guidance.

14.2.4.3 Test Procedures

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

<u>COL Item</u>

- STD COL 14.2-3-A Test Procedures

The staff reviewed STD COL 14.2.3-A related to COL Information Item 14.2.3.

Section 14.2.2.2 “Test Procedures,” of the DCD states in part that:

> The COL Applicant will provide milestones for making available to the NRC approved test procedures satisfying the requirements for the ITP (COL 14.2-3-A).

The applicant replaced the above sentence of the ESBWR DCD with a milestone for developing and providing approved test procedures no later than 60 days prior to the intended use for preoperational test and scheduled fuel loading for initial startup tests. In Section 14.2.2.2 of the FSAR, the applicant stated that:

> Approved test procedures for satisfying this section will be developed and available for review no later than 60 days prior to their intended use for preoperational tests and scheduled fuel loading for initial startup tests.

In the North Anna 3 COL FSAR, the applicant addressed the STD COL-14.2-3-A as CWR COL 14.2-3-A indicating the information is consistent with the reference COL.

In addition, the applicant identified a license condition for STD COL 14.2-3-A. The applicant addressed the license condition for STD COL 14.2-3-A in Part 10: “Tier 1/ITAAC/Proposed License Conditions,” Revision 7, dated June 2014, Section 3.2.2, “Preoperational and Startup Test Procedures,” of the North Anna 3 COLA, Revision 8, and is also listed below in Post Combined License Activities. The licensee will track the development of test procedures in order to address this COL information item in accordance with applicable guidance.

The staff evaluated STD COL 14.2-3-A according to the relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 along with the guidance in RGs 1.68 and 1.206, Section C.I.14, and finds that the applicant has satisfactorily addressed DCD COL Item 14.2-3-A.

14.2.4.4 Test Records

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

Supplemental Information

- STD SUP 14.2-2 Test Records

In FSAR Section 14.2.2.5, "Test Records," the applicant added the following:

> Startup test reports are prepared in accordance with RG 1.16.

SRP Section 14.2, Paragraph II.3.F, "Review, Evaluation, and Approval of Test Results," states that the applicant should develop procedures to control the review, evaluation, and approval of test results for each phase of the test program. RG 1.16, addresses startup test reports.

Upon review of Revision 0 of North Anna 3 COL FSAR, Section 14.2.2.5, the staff determined that Section 14.2.2.5 did not include provisions to ensure that design organizations participate in the resolution of design-related problems that result in, or contribute to, a failure to meet test acceptance criteria. Therefore on June 28, 2008, the staff issued RAI 14.02-4 (ADAMS Accession No. ML081750645), and asked the applicant to revise FSAR Section 14.2.2.5 to include such provisions.

In a response letter dated August 7, 2008 to RAI 14.02-04 (ADAMS Accession No. ML082240413), the applicant stated, in part, that it will include the description of the ITP administration as Appendix 14AA of the FSAR. Appendix 14AA, Section 14AA.4.2, includes provisions to ensure that design organizations participate in the resolution of design-related problems that result in, or contribute to, a failure to meet test acceptance criteria. In response to RAI 14.2-04, the applicant proposed to revise FSAR Chapter 14 to incorporate Appendix 14AA.

In North Anna 3 COL FSAR, Appendix 14AA, Section 14AA.4.2 the applicant included the statement that General Electric-Hitachi Nuclear America, LLC, and other design organizations participate in the resolution of design-related problems that result in, or contribute to, a failure to meet test acceptance criteria. The staff found that this response was acceptable.

The staff reviewed North Anna 3 COL FSAR, Appendix 14AA, Revision 8, and determined that the applicant's inclusion of design organizations participation in the resolution of design-related problems resulting in or contributing to, a failure to meet test acceptance criteria has addressed the responsibility for design organization participation in test reviews. The staff found that this response is acceptable, and therefore RAI 14.2-04 is resolved and closed.

The staff determined that the COL applicant's supplemental information STD SUP 14.2-2 regarding the development of startup test reports is acceptable because it meets the regulatory basis in SRP Section 14.2, Item 3.f.v, "Review, Evaluation, and Approval of Test Results."

14.2.4.5 Test Program Schedule and Sequence

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

COL Item

- STD COL 14.2-4-A Test Program Schedule and Sequence

The applicant provided a license condition to develop and make detailed testing schedules available for NRC review prior to actual implementation. The implementation milestones for the ITP are provided in Section 13.4 of the North Anna 3 COL FSAR, Revision 8.

Section 14.2.7 "Test Program Schedule and Sequence," of the DCD states in part that:

> The COL applicant will provide a milestone for completing the detailed testing schedule and making it available to the NRC (COL 14.2-4-A).

In FSAR Section 14.2.7, "Test Program Schedule and Sequence," the applicant replaced the last paragraph with a description stating that a detailed testing schedule will be developed and made available for review prior to actual implementation. The applicant added that the schedule may be updated and continually optimized to reflect actual progress and subsequently revised projections and that the implementation milestones for the ITP are provided in Section 13.4.

In Table 13.4-204, "Operational Programs Required by NRC Regulations," of Section 13.4 in North Anna 3 COL FSAR, the ITP schedule is identified as a license condition.

The applicant identified a license condition for STD COL 14.2-4-A. The applicant addressed the license condition for STD COL 14.2-4-A, in Part 10: "Tier 1/ITAAC/Proposed License Conditions," Revision 7, dated June 2014, Section 3.6, "Operational Program Readiness," of the North Anna 3 COLA, Revision 8, and is also listed below in Post Combined License Activities. The licensee will track the development of the detailed testing schedule in order to address this COL information item in accordance with applicable guidance.

The staff evaluated STD COL 14.2-4-A according to the relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 along with the guidance in RGs 1.68 and 1.206, Section C.I.14, and finds that the applicant has satisfactorily addressed DCD COL Item 14.2-4-A.

14.2.4.6 AC Power Distribution System Preoperational Test General Test Methods and Acceptance Criteria

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

Supplemental Information

- STD SUP 14.2-4 — AC Power Distribution System Preoperational Test General Test Methods and Acceptance Criteria

In FSAR Section 14.2.8.1.36, "AC Power Distribution System Preoperational Test General Test Methods and Acceptance Criteria," the applicant added the following:

> Proper operation of the automatic transfer capability of the normal preferred power source to the alternate preferred power source.

The staff noted that the test requirement is consistent with the ESBWR DCD. The COL applicant also added STD SUP 14.2-4 to track supplemental preoperational test information in FSAR Section 14.2.8.1.36. The staff determined that the supplemental information item adequately addressed the need to verify the proper operation of the automatic transfer capability of the normal preferred power source to the alternate preferred power source. Therefore, the staff determined that STD SUP 14.2-4, which added the site-specific test acceptance criteria, is acceptable.

14.2.4.7 Plant Service Water System Preoperational Test and Purpose

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

Evaluation of Supplemental Information

- NAPS SUP 14.2-4 — Plant Service Water System Preoperational Test Purpose
- NAPS SUP 14.2-5 — Plant Service Water System Performance Test Purpose

In the North Anna 3 COL FSAR, Revision 6, the applicant added site-specific supplemental information that included details regarding preoperational and performance tests for the Alternate Heat Sink (AHS). Specifically, the applicant included AHS in the descriptions of the test objectives in Section 14.2.8.1.51, "Plant Service Water System Preoperational Test Purpose," and in Section 14.2.8.2.18, "Plant Service Water System Performance Test Purpose," of the FSAR. Further, the applicant replaced the first paragraph of Section 14.2.8.1.51 of the ESBWR DCD with the following description:

> The objective of this test is to verify proper operation of the PSWS including the AHS and its ability to supply design quantities of cooling water to the [reactor component cooling water system] RCCWS and [turbine component cooling water system] TCCWS heat exchangers.

In addition, the applicant added the following details and statement regarding AHS testing in FSAR Section 14.2.8.1.51:

- Proper operation of control interlocks and equipment protective devices in AHS fans, motors, and valves;
- Proper operation of the AHS fans, motors, and valves in all design operating modes;
- Automatic transfer between PSWS trains and components in response to Anticipated Operational Occurrences (AOOs); and
- Proper operation of water hammer mitigating design features.

> However, due to insufficient heat loads during preoperational test phase, the heat exchanger and the AHS performance verification is deferred until the startup phase.

In Section 14.2.8.2.18, "Plant Service Water System Performance Test Purpose," of North Anna 3 COL FSAR, the applicant replaced the first paragraph of Section 14.2.8.2.18 of the ESBWR DCD with the following description:

> The objective of this test is to verify performance of the PSWS including the AHS along with the RCCWS, and the TCCWS under expected reactor power operation load conditions.

Further, the applicant replaced the second sentence in the third paragraph of ESBWR DCD with the following description:

> Pertinent parameters shall be monitored in order to provide a verification of proper system flow balancing and heat exchanger and AHS performance under near design or special conditions, as appropriate.

The staff noted that the applicant's site-specific supplemental information NAPS SUP 14.2-4 and NAPS SUP 14.2-5 regarding preoperational and performance test for the AHS did not represent a reduction in commitment and were added based on the applicant's incorporation of its response dated August 3, 2009, to RAI 09.02.01-12 (ADAMS Accession No. ML092180975). In RAI 09.02.01-12 (ADAMS Accession No. ML091910257), dated July 8, 2009, the staff requested the applicant provide additional information to describe how the design capability of the plant-specific AHS will be verified by the initial plant test program. In addition, design features which minimize an AHS/PSWS water hammer event need to be tested to verify that a water hammer event does not occur when the PSWS pump starts. The staff's review of North Anna 3 response to RAI 09.02.01-12 is discussed in SER Section 9.2.1.4. The staff determined that the applicant's supplementary information (NAPS SUP 14.2-4 and NAPS SUP 14.2-5) relating to the AHS is acceptable.

North Anna 3 COL FSAR, Section 9.3.11.4, "Tests and Inspections," describes the tests and inspections for the Zinc Injection System. Since testing of the Zinc Injection System is not identified in either DCD Section 14.2.8 or the comparable section of the North Anna 3 COL FSAR (consistent with the guidance contained in RG 1.68, Appen43dix A, Item 1.n (6)), the staff issued RAI 14.02-17) (ADAMS Accession No. ML14318A601) requesting that the applicant revise the appropriate section of the North Anna 3 COL FSAR to describe the testing of the Zinc Injection System. Section 14.2.8.1.46, "Reactor Water Chemistry Control Systems Preoperational Test," of the ESBWR DCD describes the objectives of the preoperational test for the Oxygen Injection System, but not for the Zinc Injection System. In the applicant's response to RAI 14.02-17, dated January 8, 2015 (ADAMS Accession No. ML15009A235), the applicant stated that the North Anna 3 FSAR Section 14.2 will be revised to include testing of the Zinc Injection System. In addition, the applicant proposed to address testing of the Hydrogen Water Chemistry System (HWCS) and the On-line Noble Chem. Specifically, the applicant proposed to replace the first sentence of Section 14.2.8.1.46 of the DCD with the following:

> The objective of this test is to verify proper operation of the Oxygen Injection System, Zinc Injection System, Hydrogen Water Chemistry System (HWCS) and the On-line Noble Chem.

In addition, the applicant proposed to replace the second sentence of the DCD section entitled, "General Test Methods and Acceptance Criteria," with the following:

> Actual oxygen, zinc, hydrogen and On-line Noble Chem™ injection demonstrations and/or simulations shall be limited to only those cases where it is deemed practicable or appropriate with regards to the aforementioned precautions.

The staff finds the applicant's response to RAI 14.02-17 to be acceptable since the applicant proposes to amend North Anna 3 COL FSAR, Section 14.2.8.1.46 to include the Zinc Injection System, as well as the HWCS and the On-line Noble Chem™, as systems that will receive preoperational testing, in accordance with the guidance of RG 1.68 pertaining to chemistry control systems. Therefore, the staff determined that the applicant's supplementary information (NAPS SUP 14.2-4 and NAPS SUP 14.2-5) relating to the Zinc Injection System is acceptable.

The applicant has committed to incorporate the above described changes to the North Anna 3 FSAR in a future COLA submittal. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the applicant's January 8, 2016, letter regarding the testing of the Zinc Injection System; the HWCS and the On-line Noble Chem™. Therefore Confirmatory Item 14.2-1 from the staff advanced SER for North Anna 3 is resolved and closed.

14.2.4.8 Site-Specific Preoperational and Startup Tests

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

COL Items

- NAPS COL 14.2-5-A Site Specific Tests

Section 14.2.9, "Site-Specific Preoperational and Start up Tests," of the DCD states in part that:

> The COL Applicant will define any required site specific preoperational and startup testing. See Section 14.2.10 for COL Information item 14.2-5-A. Testing of such systems and components should be adequate to demonstrate conformance to such requirements as defined throughout the specific chapters of the Standard Safety Analysis Report (SSAR). Below are systems that may require such testing:
>
> - Electrical switchyard and equipment;
> - SWS;
> - Personnel monitors and radiation survey instruments; and

- The automatic dispatcher control system (if applicable)"

The applicant deleted FSAR Section 14.2.9.1.4 and moved preoperational tests for electrical switchyard equipment to FSAR Section 14.2.8.1.36. For additional details on preoperational testing of electrical equipment, see FSER Section 14.2.4.6. The applicant added site-specific supplemental information in North Anna 3, SUP 14.2-3 and North Anna 3, SUP 14.2-2 in FSAR Section 14.2.9.1.1, "Station Service Water Preoperational Test," and FSAR Section 14.2.9.2.1, "Cooling Tower Preoperational Test." The applicant also deleted FSAR Section 14.2.9.1.3 since the COL applicant took exception to guidance in RG 1.68, Appendix A, Items 1.k(2) "personnel monitors and radiation survey instruments" and 1.k(3) "laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations." The applicant did not address the automatic dispatcher control system testing since it is not applicable to North Anna 3.

In the COL FSAR, the applicant states the following:

> This section describes the site specific preoperational and initial startup tests not addressed in DCD Section 14.2.8.

The applicant identified supplemental information in North Anna 3, SUP 14.2-2 and North Anna 3, SUP 14.2-3 regarding the preoperational and initial startup tests not addressed in DCD Section 14.2.8. North Anna 3, SUP 14.2-3 contains the test abstracts for "Station Water System Pre-Operational Test," and "Cooling Tower Preoperational Test." North Anna 3, SUP 14.2-2 contains the test abstract for "Cooling Tower Performance Test."

The staff noted that, in addition to the individual test descriptions in Sections 14.2.8 of the FSAR, the applicant defined its required site-specific preoperational and startup testing, as noted in North Anna 3, SUP 14.2-2 and North Anna 3, SUP 14.2-3.

The staff evaluated North Anna 3, COL 14.2-5-A according to the relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 along with the guidance in RGs 1.68 and 1.206, Section C.I.14, and finds that the applicant satisfactorily addressed DCD COL Item 14.2- 5-A.

- NAPS COL 14.2-6-A Specific Testing - Test Procedures

Section 14.2.9 of the DCD states in part that:

> If site-specific preoperational or startup tests are identified as necessary, the appropriate procedures will be prepared by the same method and to the same standard as discussed in Section 14.2.2.2. The COL Applicant will provide milestones for making available to the NRC approved test procedures satisfying the requirements for the ITP (COL 14.2- 6-A).

In the COL FSAR, the applicant states the following:

> Specific testing to be performed and the applicable acceptance criteria for each preoperational and startup test are documented in test procedures to be made available to the NRC approximately 60 days prior to their intended use for preoperational tests, and not less than 60 days prior to scheduled fuel load for initial startup tests, or as otherwise specified in license conditions. Site-specific preoperational tests are in

accordance with the system specifications and associated equipment specifications for equipment in those systems provided by the licensee that are not part of the standard plant described in DCD Section 14.2.8. The tests demonstrate that the installed equipment and systems perform within the limits of these specifications.

The applicant identified a license condition for North Anna 3, COL 14.2-6-A, as discussed below in Post Combined License Activities. The licensee will track the development of test procedures for each preoperational and startup test in order to address this COL information item in accordance with applicable guidance.

The staff evaluated STD COL 14.2-6-A according to the relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 along with the guidance in RG s 1.68 and 1.206, Sec tion C.I.14, and finds that the applicant has satisfactorily addressed DCD COL Item 14.2-6-A.

Supplemental Information

- NAPS SUP 14.2-2 Site-Specific Startup Tests
- NAPS SUP 14.2-3 Site-Specific Pre-Operational Tests

As noted above for North Anna 3, COL 14.2-5-A, the applicant provided these supplemental information items regarding site-specific performance and preoperational tests. The applicant included this supplemental information in the FSAR in order to describe the site-specific preoperational and initial startup tests not addressed in DCD Section 14.2.8 per the requirements of STD COL 14.2-5-A.

RG 1.68, Section C.1, "Criteria for Selection of Plant Features to Be Tested," provides the criteria for the selection of plant features to be tested during the ITP. FSAR Section 14.2.9 contains the site-specific ITP testing that will be required for SSCs outside the ESBWR DCD. The site-specific test abstracts appear in the three sections listed above. In RAI 14.2-02, issued on June 23, 2008 (ADAMS Accession No. ML081750645), the staff requested that the applicant confirm that there are no more additional site-specific SSCs or design features that would meet the criteria in RG 1.68, Section C.1, and, if additional testing is identified, to add such testing to Section 14.2 of the FSAR.

In a response letter dated August 7, 2008 to RAI 14.2-02 (ADAMS Accession No. ML082240134), the applicant stated, "the criteria in RG 1.68, Section C.1, for the selection of plant features to be tested during the ITP were reviewed against the site specific SSCs, design features, and performance capabilities to determine if any additional testing is required. There were no additional site specific SSCs, design features, or performance capabilities identified that meet these criteria." The staff found that this response is acceptable, and therefore, RAI 14.2-02 is resolved and closed.

The applicant identified two site-specific preoperational tests in the FSAR:

- 14.2.9.1.1 Station Water System Pre-Operational Test

FSER Section 9.2.10 provides the technical discussion of the SWS. In North Anna 3, COL FSAR, Revision 6, the applicant for consistency with the Detroit Edison Fermi 3 (EF3) COLA, added to the SWS Pre-Operational Test abstract, as follows:

- Proper operation of traveling screens and motorized self-cleaning strainers

The staff reviewed the test abstract for the SWS Pre-Operational Test and finds that it contains adequate guidance to develop test procedures to verify that the SWS will operate as designed.

- 14.2.9.1.2 Cooling Tower Preoperational Test

FSER Section 10.4.5.2.1 provides the technical discussion of the CIRC which includes the cooling towers. The staff reviewed the test abstract for the Cooling Tower Preoperational test and finds that it contains adequate guidance to develop test procedures to verify that the cooling tower will operate as designed.

The applicant identified one site-specific startup test in the FSAR:

- 14.2.9.2.1 Cooling Tower Performance Test

FSER Section 10.4.5.2.1 provides the technical discussion of the CIRC which includes the cooling towers. The staff reviewed the site-specific startup test abstract for the Cooling Tower Performance Test. The staff finds that the test abstract provides adequate guidance to develop test procedures to verify proper operation of the waste heat rejection portion of the CIRC.

The staff found that the applicant's site-specific supplemental information in NAPS SUP 14.2-2 and NAPS SUP 14.2-3 regarding site-specific performance and preoperational tests were consistent with applicable regulations and guidance. Therefore, the staff determined that the applicant's supplementary information is acceptable.

Evaluation of the Deletion of two Site-Specific Preoperational Tests

- FSAR Section 14.2.9.1.3, "Personnel Monitors and Radiation Survey Instruments Preoperational Test," (Deleted in Revision 1 to FSAR 14.2.9, per NAPS SUP 14.2-3)

- FSAR Section 14.2.9.1.4, "Electrical Switchyard System Preoperational Test" (Deleted in Revision 1 to FSAR 14.2.9 per NAPS SUP 14.2-3)

In Revision 0 of FSAR Section 14.2.9.1.3, "Personnel Monitors and Radiation Survey Instruments Preoperational Test," described the preoperational test for personnel monitors and radiation survey instruments. The staff issued RAI 14.02-5 dated July 15, 2008 (ADAMS Accession No. ML081970390), in order to determine the general types of personnel monitors and radiation survey instruments that are covered by this preoperational test. The staff also issued RAI 14.02-6 dated July 15, 2008 (ADAMS Accession No. ML081970390), to determine why the applicant did not specify a preoperational test in FSAR Section 14.2.9.1.3 for the testing of laboratory equipment used to analyze or measure radiation levels and radioactivity levels.

In the applicant's response dated August 28, 2008 (ADAMS Accession No. ML082460847), to these RAIs, and to supplemental RAIs 14.02-9 and 14.02-10 dated February 10, 2009 (ADAMS Accession No. ML090430159), that requested further clarification for testing of the monitoring systems and laboratory equipment, the applicant stated that, after further evaluation, since personnel monitors, radiation survey instruments, and laboratory equipment are purchased as standard plant commercial grade equipment, and are routinely replaced over the life of the plant, this equipment does not meet the RG 1.68 criteria for plant features to be tested in the ITP and, therefore, is not subject to the ITP. Accordingly, in Revision 1 to the FSAR, the applicant deleted Section 14.2.9.1.3 from the FSAR and modified FSAR Table 1.9-202 to take exception to RG 1.68, Appendix A, Items 1.k(2) "personnel monitors and radiation survey instruments" and 1.k(3) "laboratory equipment used to analyze or measure radiation levels and radioactivity concentrations."

In lieu of testing this equipment as part of the ITP, the applicant determined that the Radiation Protection Program (RPP) provides for adequate testing of both laboratory and portable instrumentation used for radiation protection. The applicant's RPP is described in Nuclear Energy Institute (NEI) 07-03A, Revision 0, "Generic FSAR Template Guidance for Radiation Protection Program Description," which has been incorporated by the applicant in Appendix 12BB of the North Anna 3 COL FSAR accordingly. NEI 07-03A, Revision 0, provides adequate descriptions of the types of radiation protection instruments and equipment that will be used in the plant. The applicant stated that each new survey instrument or personnel monitor is tested prior to being placed in service to assure conformance with performance requirements.

The applicant's RPP as described in NEI 07-03A, specifies, in Section 12.5.3.2, "Monitoring Instrumentation and Equipment," of NEI 07-03A, Revision 0, that "radiation monitoring instrumentation and equipment are selected, maintained and used to provide the appropriate detection capabilities, ranges, sensitivities and accuracies required for the types and levels of radiation anticipated at the plant and in the environs during routine operations, major outages, abnormal occurrences, and postulated accident conditions." NEI 07-03A, also specifies the types of instruments and equipment that will be available (i.e., tested and ready for service) at specified milestones for the RPP. On the basis of the applicant's response to RAIs 14.02-5 and 14.02-6 and to the supplemental RAIs 14.02-9 and 14.02-10, the staff finds that the applicant's laboratory and portable instrumentation used for radiation protection will be adequately tested and maintained under the applicant's RPP and, therefore, does not need to be included in the ITP. Therefore, the staff finds the COL applicant's response to be acceptable and RAIs 14.02-5, 14.02-6, 14.02-9, and 14.02-10 are resolved and closed.

To effectively test radiation monitors and survey instruments with range selection for proper functioning, the testing must include the selection of the correct operating range of the device. During its review, the staff determined that the test abstract described in Section 14.2.9.1.3 of the FSAR did not include this description. Accordingly on August 8, 2008, the staff issued RAI 14.02-8 (ADAMS Accession No. ML082210547), and asked the applicant to revise the "General Test Methods and Acceptance Criteria" in Section 14.2.9.1.3 of the FSAR to specifically include a statement regarding the "proper functioning and operation of range selection and response in each range."

In a response letter dated September 19, 2008, to RAI 14.02-08 (ADAMS Accession No. ML082700252), the applicant made a determination to delete FSAR Section 14.2.9.1.3 in its entirety. However, in response to RAI 14.02-5, the applicant stated that the applicable standards for testing radiation monitors and survey instruments, including a description of the proper functioning and operation of range selection and response in each range, are described in the following standards documents:

- American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) N323A, "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments," dated December 31, 1997

- ANSI/IEEE N323D, "Installed Radiation Protection Instrumentation," issued in 2003

ANSI/IEEE N323A is referenced in Table 1.9-22 of the ESBWR DCD and is incorporated by reference by the COL applicant. Since the North Anna 3 FSAR did not contain a reference to ANSI/IEE N323D, the applicant added it to Table 1.9-204 of the FSAR in response to RAI 14.02-5. The staff reviewed Revision 8 of the North Anna 3 COL FSAR and verified that the COL applicant has added a reference to ANSI/IEEE N323D in Table 1.9-204. Therefore, RAI 14.02-8 is resolved and closed.

Revision 0 of North Anna 3 COL FSAR, Section 14.2.9.1.4 contained the following statement:

> Performance is observed and recorded during a series of individual component and integrated system tests to demonstrate the following:
>
> - Proper operation of initiating, transfer, and trip devices
>
> - Proper operation of relaying and logic
>
> - Proper operation of equipment protective devices, including permissive and prohibit interlocks
>
> - Proper operation of instrumentation and alarms used to monitor system and equipment status
>
> - Proper operation and load carrying capability of breakers, switchgear, transformers, and cables
>
> - The capability of transfer between onsite and offsite power sources as per design

The staff determined that additional information was required to complete its review in this area. On June 5, 2008, the staff issued RAI 14.02-1 (ADAMS Accession No. ML081580132) and asked the applicant to address the following additional items or provide justification for their exclusion: (a) availability of AC and direct current power to the switchyard equipment; (b) design limits of switchyard voltage, stability and switchyard interface agreements and protocols; (c) operation of current transformers and potential transformers; (d) operation of high-voltage disconnect switches and ground switches; and (e) proper operation of the automatic transfer capability of normal preferred power source to the alternate preferred power source.

In response to RAI 14.02-1 (ADAMS Accession No. ML082050559), the applicant proposed to delete this test from the FSAR and address the above RAI by cross-reference in the FSAR to ESBWR DCD test Section 14.2.8.1.36, "AC Power Distribution System Preoperational Test," since this DCD test abstract is exactly the same as FSAR test Section 14.2.9.1.4. In addition, the COL applicant added STD SUP 14.2-4, "Proper operation of the automatic transfer capability of the normal preferred power source to the alternate preferred power source," related to this test.

The staff found that this response was acceptable, given that the DCD describes this test and the FSAR incorporates it by reference. The staff reviewed the North Anna 3, COL FSAR, and verified that the applicant has deleted FSAR Section 14.2.9.1.4 and addressed the preoperational tests for electrical switchyard equipment in FSAR Section 14.2.8.1.36. Therefore, RAI 14.02-1 is resolved and closed.

License Conditions:

On May 27, 2010, in RAI 14.02-4 (ADAMS Accession No. ML101470123) to the Fermi 3 COL applicant, the staff identified license conditions that the applicant needs to address in its application. The NRC imposes license conditions for test activities that cannot be resolved during the COL applicant stage but are resolved after the COL is issued. In a North Anna 3 letter dated December 31, 2013, the applicant endorsed the Fermi 3 RAI response letter to RAI 14.02-4 on July 9, 2010 (ADAMS Accession No. ML101960646), and agreed that the license conditions proposed were appropriate. The applicant addressed these proposed license conditions in the North Anna 3 COLA, Part 10: "Tier 1/ITAAC/Proposed License Conditions," Revision 7, dated June 2014, Section 3.2, "License Conditions for Initial Test Program," and are presented in Section 14.2.5 below.

14.2.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds the following license conditions are acceptable:

Startup Administrative Manual, NAPS COL 14.2.2-A

> Prior to initiating the plant's initial test program (ITP), a site-specific SAM (procedures), which includes administrative procedures and requirements that govern the activities associated with the plant ITP is to be provided to on-site NRC inspectors 60 days prior to beginning of the preoperational test phase.

Preoperational and Startup Test Procedures, NAPS COL 14.2-3-A

> The licensee will make available to on-site NRC inspectors preoperational test procedures 60 days prior to their intended use and startup test procedures 60 days prior to fuel load.

Site-Specific Preoperational and Startup Test Procedures, NAPS COL 14.2.6-A

> The licensee will make available to on-site NRC inspectors site-specific preoperational test procedures 60 days prior to their intended use and startup test procedures 60 days prior to fuel load.

Power Ascension Test Phase Reports

In North Anna 3 COLA, Revision 8, Part 10: "Tier 1/ITAAC/Proposed License Conditions," Revision 7, dated June 2014, Section 3.2.4, "Power Ascension Test Phase Reports," the applicant proposed the following license conditions related to RAI 14.02-4:

Nuclear Fuel Loading and Pre-critical Testing

- Upon notifying the Director of the Office of New Reactors (NRO), or the Director's designee, in writing of successful completion of preoperational testing, and upon a Commission finding in accordance with 10 CFR 52.103(g) that all the acceptance criteria in the ITAAC in Appendix C to this license are met, the licensee is authorized to perform pre-critical tests in accordance with the conditions specified herein.

- The licensee shall review and evaluate the results of the pre-critical tests identified and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with the FSAR.

Initial Criticality and Low-Power Testing

- Upon notifying the Director of NRO, or the Director's designee, in writing of successful completion of pre-critical testing, the licensee is authorized to operate the facility at reactor steady-state core power levels not to exceed 5-percent thermal power in accordance with the conditions specified herein, but solely for the purposes of conducting initial criticality and low-power testing.

- The licensee shall review and evaluate the results of the initial criticality and low-power tests and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with the FSAR.

Power Ascension Testing

- Upon notifying the Director of NRO, or the Director's designee, in writing of successful completion of the initial criticality and low-power testing, the licensee is authorized to operate the facility at reactor steady-state core power levels not to exceed 100-percent thermal power in accordance with the conditions specified herein, but only for purposes of performing power ascension testing.

- The licensee shall review and evaluate the results of the power ascension tests and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with the FSAR.

The licensee is responsible for the review and evaluation of the adequacy of test results presented in the Power Ascension Test Phase reports, as well as final review of overall test results in these reports. Test results, which do not meet acceptance criteria, are identified and corrective actions and retests are performed. The Power Ascension Test Phase reports shall be made available to on-site NRC inspectors.

Test Changes

In the North Anna 3 COLA, Revision 8, of Part 10: "Tier 1/ITAAC/Proposed License Conditions," Revision 7, dated July 2014, Section 3.2.4, "Power Ascension Test Phase Reports," the applicant proposed the following license conditions related to RAI 14.02-4:

> Within 30 days of a change to the ITP described in FSAR Chapter 14, Initial Test Program, made in accordance with 10 CFR 50.59 or in accordance with 10 CFR Part 52, Appendix E, Section VIII, "Processes for Changes and Departures," the licensee shall report the changes or the Director of NRO, or the Director's designee, in accordance with 10 CFR 50.59(d).

Operational Program Readiness

In North Anna 3 COLA, Revision 8, of Part 10: "Tier 1/ITAAC/Proposed License Conditions," Revision 7, dated June 2014, Section 3.6," Operational Program Readiness," the staff has identified the following license condition which is related in part to STD COL 14.2-4-A:

> The licensee shall submit to the Director of the NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule should also address:
>
> (a) The implementation of site specific Severe Accident Management Guidelines.
> (b) The spent fuel rack coupon monitoring program implementation.

14.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff concludes that the relevant information presented within the North Anna 3 COL FSAR is acceptable and meets the 10 CFR 52.79(a)(28), Criterion XI of Appendix B to 10 CFR Part 50 along with the guidance in RGs 1.68 and 1.206. The staff has evaluated the STD COL items, North Anna 3 COL items, STD SUP items, and North Anna 3, SUP items identified for this subsection according to the relevant NRC regulations and acceptance criteria defined in SRP Section 14.2 and finds that the applicant has satisfactorily addressed these items.

14.3 Inspections, Tests, Analyses, and Acceptance Criteria

14.3.1 Introduction

Section 14.3 of the FSAR discusses the criteria and methodology for selecting the SSCs to be included in the ITAAC. This section includes the definitions and general provisions, design descriptions, ITAAC, significant site parameters, and significant interface requirements in order to determine whether the resultant ITAAC are adequate to verify that a facility referencing the ESBWR design has been constructed and will be operated in compliance with the DC and applicable regulations.

14.3.2 Summary of Application

Part 10 of the North Anna 3 COLA, Revision 8 includes the entire set of ITAAC which consists of four parts: DC ITAAC, Emergency Planning ITAAC, Physical Security ITAAC, and Site-Specific ITAAC. The Tier 1 DC ITAAC have been incorporated by reference in Part 10, Section 2.1, "Design Certification ITAAC," of the North Anna 3 COL FSAR, Revision 8. The staff's finding related to DC ITAAC incorporated by reference is in NUREG–1966.

The Emergency Planning ITAAC are presented in Part 10, Section 2.3, "Emergency Planning ITAAC," of the North Anna 3 COL FSAR, Revision 8, and listed in Table 2.3-1, "ITAAC For Emergency Planning." Evaluations of these ITAAC are contained in FSER Chapter 13.0, "Conduct of Operations," Section 13.3, "Emergency Planning," and discussed below regarding the evaluation of STD COL 14.3-1-A.

The Tier 1 Physical Security ITAAC for systems within the scope of the DCD are incorporated by reference in Part 10, Section 2.2, "Physical Security ITAAC," of the North Anna 3 COL FSAR, Revision 8 and the staff's findings related to this information is incorporated by reference in NUREG–1966. In addition, the evaluation of the Site-Specific Physical Security ITAAC that have been identified by the applicant in Part 10, Section 2.2.1, "Site Specific Physical Security ITAAC," of the North Anna 3 COL FSAR, Revision 8 and listed in Table 2.2.1-1, "ITAAC for the Site-Specific Security System," can be found in FSER Chapter 13.0, "Conduct of Operations," Section 13.6, "Physical Security," and in Section 13.6A, "Site-Specific ITAAC for Physical Security."

The Site-Specific ITAAC for site-specific systems that were not evaluated in the referenced DCD are presented by the applicant in Part 10, Section 2.4, "Site-Specific ITAAC," of the North Anna 3 COL FSAR, Revision 8. The evaluations of these ITAAC are discussed below under the evaluation of STD COL 14.3-2-A.

Section 14.3, of the North Anna 3 FSAR, Revision 8, incorporates by reference Section 14.3 of the ESBWR DCD, Revision 10. In addition, the North Anna 3 FSAR, Revision 8, Section 14.3, provides the following:

COL Item

- STD COL 14.3-1-A   Emergency Planning ITAAC

The applicant provided information regarding their Emergency Planning ITAAC based on industry guidance.

- CWR COL 14.3-2-A		Site Specific ITAAC

The applicant provided information regarding their Site-Specific ITAAC for systems not evaluated in the DCD.

- NAPS COL 14.3A-1-1		Schedule for Design Acceptance Criteria (DAC) ITAAC Closure

The applicant provided a DAC ITAAC closure schedule.

14.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966 and NUREG–1966, Supplement 1, the FSER related to the certified ESBWR DCD. In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for seismic classification are given in SRP Section 14.3.

The applicable regulatory requirements and guidance for the ITAAC are as follows:

10 CFR 52.79(d)(2), "Contents of applications, technical information in final safety analysis report," requires the COL applicant's FSAR to demonstrate that the design meets the interface requirements established under 10 CFR 52.47, "Contents of applications; technical information."

10 CFR 52.80(a),"Contents of applications; additional technical information," requires that a COLA contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and acceptance criteria met, the facility has been constructed and will operate in conformity with the COL, the provisions of the Act, and the Commission's rules and regulations.

10 CFR 52.99(a), "Inspection during construction," as it relates to ITAAC completion schedule

RG 1.206, Section C.II.1 as it relates to COL ITAAC and Section C.III.5 as it relates to DCA.

14.3.4 Technical Evaluation

As documented in NUREG–1966, staff reviewed and approved Section 14.3 of the certified ESBWR DCD. The staff reviewed Section 14.3 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR, Revision 8, appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information contained in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR, Revision 8, as follows:

COL Item

- STD COL 14.3-1-A Emergency Planning (EP) ITAAC

The staff evaluation for STD COL 14.3-1-A, “Emergency Planning ITAAC,” is addressed in Section 13.3, “Emergency Planning,” of Chapter 13, “Conduct of Operations,” of the North Anna 3 SER. The staff’s evaluation found that the information provided to address this COL item was acceptable. Therefore, for the purposes of this Chapter 14 SER evaluation, the staff finds that the applicant has addressed STD COL 14.3-1-A.

- STD COL 14.3-2-A Site Specific ITAAC

The selection criteria and methodology provided in this section of the referenced DCD were utilized as the site-specific selection criteria and methodology for ITAAC. These criteria and methodology were applied to those site-specific systems that were not evaluated in the referenced DCD. In Section 14.3.9 of the North Anna 3 COL FSAR, the applicant states that the selection criteria and methodology provided in Section 14.3 of the referenced DCD were utilized as the site-specific selection criteria and methodology for ITAAC. These criteria and methodology were applied to those site-specific systems that were not evaluated in the referenced DCD. If a site-specific system described in the FSAR does not meet an ITAAC selection criterion, then the applicant includes just the system title and the statement “No entry for this system.” The North Anna 3 COLA, Part 10, Section 2.4 addresses the site-specific ITAAC for the following SSCs.

2.4.1 ITAAC for Fill Concrete Under and Around Surrounding the Sides of Seismic Category I Structures

Section 2.5.4 of this SER contains the staff’s evaluation of ITAAC for concrete fill. In addition the applicant addressed concerns from the staff RAIs 02.05.04-12, 02.05.04-13 and 02.05.04-19 which address concrete fill under and around the seismic Category I structures as follows:

ITAAC for fill concrete under and around the seismic Category I Structures

Fill concrete placed under and around the sides of seismic Category I Structures to a thickness greater than 5 feet is designed and tested as specified in FSAR Section 2.5.

The staff concludes that the applicant has satisfactorily addressed the foundation interface requirement and site-specific ITAAC for this item.

2.4.2 ITAAC for Structural Fill Surrounding Seismic Category I Structures.

Section 2.5.4 of this SER contains the staff’s evaluation of ITAAC for structural fill surrounding seismic Category I Structures. The applicant specified structural fill surrounding the seismic Category I structures as follows:

ITAAC for structural fill surrounding seismic Category I Structures

Structural fill surrounding the embedded walls for seismic Category I Structures meets properties for

(1) the angle of internal friction;

(2) the local effect on wall pressure as determined by the product of: peak ground acceleration α, (in g), Poisson' ratio v, and density γ; and (3) soil density.

The staff concludes that the applicant has satisfactorily addressed the foundation interface requirement and site-specific ITAAC for this item.

2.4.3 ITAAC for Plant Service Water System (Portion Outside the Scope of the Certified Design)

In COL Part 10, Section 2.4.3, the applicant has identified interface requirements and site-specific ITAAC for this system. In the staff's SER for Section 9.2.1, the staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this system.

2.4.4 Circulating Water System (Portion Outside the Scope of the Certified Design)

In COL Part 10, Section 2.4.4, the applicant states that for the CWS there are no site-specific ITAAC required for this system. The staff concludes that the CWS does not perform a safety-related function and is not considered a system "important to safety" therefore, as-built verification, i.e., site-specific ITAAC, is not required.

2.4.5 Station Water System (Including Intake Structure and Servicing Equipment)

In COL Part 10, Section 2.4.5, the applicant states that for the SWS there are no site-specific ITAAC required for this system. The staff concludes that the SWS does not perform a safety-related function and is not considered a system "important to safety;" therefore, as-built verification, i.e., site-specific ITAAC, is not required.

2.4.6 Yard Fire Protection System (Portions Outside the Scope of the Certified Design)

In COL Part 10, Section 2.4.6, the applicant states that for the yard fire protection system there are no site-specific ITAAC required for this system. The staff concludes that the yard fire protection system does not perform a safety-related function and is not considered a system "important to safety;" therefore, as-built verification, i.e., site-specific ITAAC, is not required.

2.4.7 Potable and Sanitary Water Systems

In COL Part 10, Section 2.4.7, the applicant states that for the potable and sanitary water system there are no site-specific ITAAC required for this system. The staff concludes that the potable and sanitary water systems do not perform a safety-related function and are not considered a system "important to safety;" therefore, as-built verification, i.e., site-specific ITAAC, is not required.

2.4.8 Offsite Power Systems

In COL Part 10, Section 2.4.8, the applicant has identified interface requirements and site-specific ITAAC for this system. ITAAC for North Anna 3 is based on these interface requirements incorporated in Table 2.4.8-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff's SER for Section 8.2, the staff has found that the proposed ITAAC for this system will ensure that each as-built offsite circuit has sufficient capacity and capability. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this system.

2.4.9 Communication Systems (Emergency Notification System)

In COL Part 10, Section 2.4.9, the applicant states that the site-specific ITAAC for this system is addressed in Table 2.3-1, Topic 3.0, Emergency Communications. The complete review of the applicant's site-specific emergency plan ITAAC is contained in SER Section 13.3. Based on that evaluation, the staff has found that the applicant has satisfactorily addressed the site-specific ITAAC for this system.

2.4.10 Makeup Water System

In COL Part 10, Section 2.4.10, the applicant states that for the makeup water system there are no ITAAC required for this system. The staff concludes that the makeup water system does not perform a safety-related function and is not considered a system "important to safety;" therefore, as-built verification, i.e., site-specific ITAAC, is not required.

2.4.11 (Deleted)

In order to be consistent with the ESBWR DCD, on March 9, 2009 the staff issued RAI 14.03.07-1 (ADAMS Accession No. ML09068031) requesting for the applicant to update this section to no longer refer to the use of a mobile liquid waste management system. Per the applicant's RAI response dated April 3, 2009 (ADAMS Accession No. ML090990451), the applicant deleted this section accordingly. The staff found that this response is acceptable, and therefore, RAI 14.03.07-1 is resolved and closed.

2.4.12 (Deleted)

In order to be consistent with the ESBWR DCD, on March 9, 2009 the staff issued RAI 14.03.07-2 (ADAMS Accession No. ML09068031) requesting for the applicant to update this section to no longer refer to the use of a mobile solid waste management system. Per the applicant's RAI response dated April 9, 2009 (ADAMS Accession No. ML090990451), the applicant deleted this section accordingly. The staff found that this response is acceptable, and therefore, RAI 14.03.07-2 is resolved and closed.

2.4.13 Hydrogen Water Chemistry System

In COL Part 10, Section 2.4.13, the applicant states that for the HWCS there are no site-specific ITAAC required for this system. The staff concludes that the HWCS does not perform a safety-related function and is not considered a system "important to safety;" therefore, as described in ESBWR DCD, Table 14.3-1, Revision 9, an ITAAC is not required for this system.

2.4.14 Meteorological Monitoring System

In COL Part 10, Section 2.4.14, the applicant states that for the meteorological monitoring system there are no site-specific ITAAC required for this system. The staff notes that there are several emergency plan ITAACs in COL Part 10, Section 2.3 that require the acquisition and evaluation of meteorological data. The staff concludes that additional site-specific ITAAC are not required for the meteorological monitoring system.

Based on the staff evaluation of the information provided by the applicant related to the site-specific ITAAC cited above, the staff determined that the information meets the requirements in 10 CFR 52.79(d)(2), 52.80(a) and the acceptance criteria in SRP Section 14.3, “Inspections, Tests, analyses, and Acceptance Criteria.” In addition, the staff has reviewed the applicant’s information to address COL Item 14.3-2-A and found that it is acceptable and meets the relevant requirements and the guidance set forth in RG 1.206, Section C.II.1.

2.4.15 ITAAC for the Turbine Building

In COL Part 10, Section 2.4.15, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Turbine Building which is based on the interface requirements incorporated in Table 2.4.15-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff’s SER for Section 3.7.2, the staff has found that the proposed ITAAC for this building will ensure that the Unit 3 site-specific soil structure interaction (SSI) is adequate for the Turbine Building seismic design. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this building.

2.4.16 ITAAC for the Radwaste Building

In COL Part 10, Section 2.4.16, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Radwaste Building which is based on the interface requirements incorporated in Table 2.4.16-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff’s SER for Section 3.7.2, the staff has found that the proposed ITAAC for this building will ensure that the Unit 3 site-specific SSI is adequate for the Radwaste Building seismic design. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this building.

2.4.17 ITAAC for the Service Building

In COL Part 10, Section 2.4.17, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Service Building which is based on the interface requirements incorporated in Table 2.4.17-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff’s SER for Section 3.7.2, the staff has found that the proposed ITAAC for this building will ensure that the Unit 3 site-specific SSI is adequate for the Service Building seismic design. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this building.

2.4.18 ITAAC for the Ancillary Diesel Building

In COL Part 10, Section 2.4.18, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Ancillary Diesel Building which is based on the interface requirements incorporated in Table 2.4.18-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff’s SER for Section 3.7.2, the staff has found that the proposed ITAAC for this building will ensure that the Unit 3 site-specific SSI is adequate for the Ancillary Diesel Building seismic design. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this building.

2.4.19 ITAAC for the Control Rods

In COL Part 10, Section 2.4.19, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Control Rods which is based on the interface requirements incorporated in Table 2.4.19-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff's SER for Section 4.2, the staff has found that the proposed ITAAC will ensure that the control rods to be loaded into the core of Unit 3 will be capable of withstanding design seismic and dynamic loadings. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for this component.

2.4.20 ITAAC for Seismic Category I Buried Piping, Conduits and Tunnels Design Description

In COL Part 10, Section 2.4.20, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Buried Piping, Conduits and Tunnels which is based on the interface requirements incorporated in Table 2.4.20-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff's SER for Section 3.7.3, the staff has found that the proposed ITAAC will ensure that the buried piping, conduits and tunnels of Unit 3 will be capable of withstanding design seismic and dynamic loadings. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for these items.

2.4.21 ITAAC for Access Tunnel

In COL Part 10, Section 2.4.21, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Access Tunnel which is based on the interface requirements incorporated in Table 2.4.21-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff's SER for Section 3.7.3, the staff has found that the proposed ITAAC will ensure that the Access Tunnel of Unit 3 will be capable of withstanding design seismic and dynamic loadings. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for the Access Tunnel.

2.4.22 ITAAC for Radwaste Tunnel

In COL Part 10, Section 2.4.22, the applicant has identified interface requirements and site-specific ITAAC for the North Anna 3 Radwaste Tunnel which is based on the interface requirements incorporated in Table 2.4.22-1 in Part 10 of the North Anna 3 COL Revision 8. As discussed in the staff's SER for Section 3.7.3, the staff has found that the proposed ITAAC will ensure that the Radwaste Tunnel of Unit 3 will be capable of withstanding design seismic and dynamic loadings. The staff concludes that the applicant has satisfactorily addressed the interface requirement and site-specific ITAAC for the Radwaste Tunnel.

14.3.5 Post-Combined License Activities

As discussed above, the staff finds the following applicant proposed post COL activities acceptable:

Dominion shall submit to the NRC, no later than 1 year after issuance of the combined license or at the start of construction as defined in 10 CFR 50.10(a), whichever is later, its implementation schedules for completion of the following ITAAC. Dominion shall submit updates to the ITAAC schedules every 6 months thereafter and, within 1 year of its scheduled date for initial loading of fuel, shall submit updates to the ITAAC schedules every 30 days until the final notification is provided to the NRC under paragraph (c)(1) of 10 CFR 52.99.

For piping DAC ITAAC, (1) the as-designed Pipe Break Analysis Report will be completed per DCD ITAAC Table 3.1-1 and (2) the ASME Code design reports for safety-related piping packages will be completed for DAC ITAAC Tables 2.1.2-3 (2b1), 2.2.2-7 (2b1), 2.2.4-6 (10b1), 2.4.1-3 (2b1), 2.4.2-3 (2b1), 2.6.1-1 (8b1), 2.6.2-2 (2b1), 2.11.1-1 (9a), 2.15.1-2 (2a3), and 2.15.4-2 (2b1) for the applicable systems in order to support the closure of the DAC ITAAC. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process.

For human factors engineering (HFE) DAC, HFE DAC ITAAC consists of a series of results summary reports which verify that the specific associated Design Commitment is met. The summary reports will be made available at each stage for NRC review, inspection, and audit on an element by element basis. Information (procedures and test programs) will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process.

For instrumentation and controls, the set of ESBWR digital instrumentation and control DAC ITAAC establishes a phased closure process. Procedures and test programs necessary to demonstrate that the DAC ITAAC requirements are met will be used at each phase to certify to the NRC that the design is in compliance with the certified design. Information will be made available for NRC review, inspection, and audit on a system basis. Information will be made available to the NRC to facilitate reviews, inspections, and audits throughout the process.

14.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966 and NUREG–1966, Supplement 1. The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference are resolved.

In addition, the staff compared the information in the application to the relevant NRC regulations, the guidance in SRP Section 14.3, and other NRC RGs. The staff's review concludes that the design features and performance characteristics of the SSCs described in the COL FSAR can be verified adequately by the proposed ITAAC. Therefore, the North Anna 3 ITAAC are acceptable and meet the requirements of 10 CFR 52.79(d)(2), 10 CFR 52.80, and 10 CFR 52.99(a); and the guidance in RG 1.206, Regulatory Positions C.II.1 and C.III.5.

References

1. 10 CFR 50.10, "License required; limited work authorization."

2. 10 CFR 50.59, "Changes, tests and experiments."

3. 10 CFR 52.103, "Operation under a combined license."

4. 10 CFR 52.47, "Contents of applications; technical information."

5. 10 CFR 52.63, "Finality of standard design certification."

6. 10 CFR 52.79(d)(2), "Contents of applications; technical information in final safety analysis report."

7. 10 CFR 52.80(a), "Contents of applications; additional technical information."

8. 10 CFR 52.99(a), "Inspection during construction."

9. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

10. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

11. 10 CFR Part 52, Appendix E, Section VIII, "Processes for Changes and Departures."10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

12. ANSI/IEEE N323A, "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments," April 3, 1997.

13. ANSI/IEEE N323D, "Installed Radiation Protection Instrumentation," January 27, 2003.

14. ASME Boiler and Pressure Code (BPVC).

15. ASME BPVC, Section III, "Rules for Construction of Nuclear Facility Components," 2001 Edition, 2003 Addenda.

16. ASME BPVC, Section XI, "Rules for In-service Inspection of Nuclear Power Plant Components," 2001 Edition, 2003 Addenda.

17. ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear Facility Applications."

18. ASME OM Code-2001 including Addenda through 2003, "Code for Operation and Maintenance of Nuclear Power Plants."

19. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

20. NEI 07-03A, Revision 0, "Generic FSAR Template Guidance for Radiation Protection Program Description," May 2009 (ADAMS Accession No. ML091490684).

21. NRC RG 1.16, Revision 4, "Reporting of Operating Information -- Appendix A Technical Specifications," August 1975 (ADAMS Accession No. ML003739954). (Withdrawn August 11, 2009; see 74 FR 40244, ADAMS Accession No. ML14240A599.)

22. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

23. NRC RG 1.68, Revision 2, "Initial Test Programs for Water-Cooled Nuclear Power Plants," August 1978 (ADAMS Accession No. ML061880482).

24. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

25. NRC Staff NUREG 0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

26. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

27. U.S. Code 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

15.0 SAFETY ANALYSES

15.0 SAFETY ANALYSES

15.1 Introduction

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 responses to postulated disturbances in process variables and postulated equipment failures or malfunctions, determines their consequences, and evaluates the capability of the plant to control or accommodate these events. These analyses help determine the limiting conditions for operation, limiting safety system settings, and design specifications for safety-related components and systems.

The analyses in this chapter include a discussion of: (1) the classification of the transients and accidents and their results in the context of a sufficiently broad spectrum of initiating events and postulated equipment failures, (2) the frequency of occurrence of initiating events for anticipated operational occurrences and highly unlikely accidents, (3) plant characteristics considered in the safety evaluation, (4) assumed protection system actions, (5) evaluation of individual initiating events and systems that operate to reduce the probability of occurrence of specific events, and (6) analysis of anticipated transients without scram. The safety analyses provide a significant contribution to the selection of limiting conditions for plant operation, limiting safety system settings, and design specifications for plant components and systems from the standpoint of public health and safety.

15.2 Summary of Application

Chapter 15 of the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference Chapter 15 of the Economic Simplified Boiling–Water Reactor (ESBWR) Design Control Document (DCD), Revision 10, referenced in Appendix E, "Design Certification Rule for the ESBWR Design," to Title 10 of the Code of Federal Regulations (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in COL FSAR Chapter 15 the applicant provided the following additional information:

Supplemental Information:

- STD SUP 15.3-1 Radiological Consequences

The applicant added that procedures will detail the use of nuclear instrumentation to help in detecting a possible miss-located fuel bundle after fuel loading.

- NAPS SUP 15.3-2 Early Site Permit (ESP) Information

The applicant stated that Chapter 15 of the North Anna ESP Site Safety Analysis Report (SSAR) is incorporated by reference, except that plant parameter envelope (PPE) information in the ESP SSAR is replaced by Chapter 15 of the ESBWR DCD. This information is identified as NAPS ESP Variance (VAR) 2.0-6.

- NAPS SUP 15.4-1

The applicant provided supplemental information related to NAPS COL 2A.2 2 A, "Confirmation of Reactor Building χ/Q [V]alues," which discusses administrative control of certain doors or personnel air locks during movement of irradiated fuel, as related to the design-basis accident (DBA) control room habitability dose analysis for the fuel-handling accident (FHA).

15.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," issued April 2014, and it's Supplement 1, issued September 2014.

Compliance with the non-seismic siting criteria of 10 CFR 100.21 and General Design Criterion (GDC) 19, "Control Room," in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that the applicant show that, for a plant located at the North Anna site, the radiological consequences of postulated accidents meet the criteria set forth in 10 CFR 52.79(a)(1) and for GDC 19, that the control room provides adequate radiation protection to ensure that radiation exposures shall not exceed 0.05 sievert (Sv) (5 rem) total effective dose equivalent (TEDE) to permit access and occupancy of the control room under accident conditions for the duration of the accident. Requirements for the technical information in the FSAR in the COL application (COLA) for a combined license are given in 10 CFR 52.79. In particular, 10 CFR 52.79(a)(1)(vi) requires a description and safety assessment of the site on which the facility is to be located, including an evaluation of the offsite radiological consequences of postulated accidents to show that the site characteristics comply with 10 CFR Part 100.

Both 10 CFR 100.21, which references 10 CFR 50.34(a)(1), and 10 CFR 52.79(a)(1)(iv) have the same offsite radiological consequence evaluation factors as follows:

> *An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of [0.25 Sv] 25 rem total effective dose equivalent (TEDE).*
>
> *An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a radiation dose in excess of [0.25 Sv] 25 rem TEDE*

15.4 Technical Evaluation

The staff reviewed Chapter 15 of the North Anna 3 COL FSAR and the referenced DCD to ensure that the combination of the ESBWR DCD and the information in the COL FSAR, which incorporates the ESP SSAR, represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information contained in and incorporated by reference addresses the required information related to the safety analyses. The staff's technical evaluation of the information in the ESBWR DCD related to accident analysis is documented in NUREG–1966.

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[1] See "*Finality of Referenced NRC Approvals*" in Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included within a COL application that references a design certification.

In addition, the staff confirmed that the information contained in the North Anna 3 COLA, including information incorporated by reference, addresses the required information related to the DBA radiological consequence analyses. The staff's technical evaluation of the information incorporated by reference in the North Anna ESP SSAR related to the DBA radiological consequence analyses is documented in the corresponding SER (i.e., NUREG-1835, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site," issued September 2005).

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The staff reviewed the relevant information in the COL FSAR:

<u>Supplemental Information</u>:

- STD SUP 15.3-1 Radiological Consequences
- NAPS SUP 15.3-2 (NAPS ESP VAR 2.0-6) ESP Information

North Anna COL FSAR, Revision 0, incorporated by reference the analysis of the radiological consequences from the ESBWR DCD, Revision 4, Section 15.4, and from Chapter 15 of North Anna ESP SSAR. The staff review of the sections that were incorporated by reference noted that the isotopic time-dependent fission product release rates to the environment for each DBA analyzed in the ESBWR DCD, Revision 4 were not bounded by the values specified in Appendix B, "Controlling Values of Parameters and Design-Basis Accident Source Term Plant Parameters," in ESP No. ESP-003 issued for the North Anna site.

Therefore, the staff requested, in request for additional information (RAI) 15.06.05-1, that if the isotopic activity releases per time period specified in the radiological consequence analyses for each DBA analyzed in the ESBWR DCD and from Chapter 15 of North Anna ESP SSAR are not bounded by those specified in Appendix B to the North Anna ESP, that the applicant provide the site-specific radiological consequence doses for the exclusion area boundary (EAB), the low population zone (LPZ), and the control room for each DBA to demonstrate that North Anna site still meets the dose evaluation factors set forth in 10 CFR 50.34(a)(1)(ii)(D), 10 CFR 52.79(a)(1)(vi), and GDC 19.

In its response to RAI 15.06.05-1, dated October 17, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML082980134), the applicant clarified that that the COL FSAR would not incorporate by reference the information in the North Anna ESP PPE that was related to the ESBWR design, but instead would show compliance with the relevant regulations by incorporating by reference the DBA radiological consequence analyses from the ESBWR DCD. Revision 1 of the COL FSAR, and subsequent revisions, included this variance (NAPS ESP VAR 2.0-6) from the North Anna ESP, as described in Chapter 15 supplemental information NAPS SUP 15.3-2.

By taking a variance from the North Anna ESP with respect to the PPE information on the ESBWR, the analyses in the ESP SSAR that show compliance with the dose evaluation factors set forth in 10 CFR 50.34(a)(1) and 10 CFR 52.79(a)(1)(vi) are no longer being relied upon for the COL. Instead the COL FSAR is showing compliance with the relevant regulations by incorporating by reference the analyses from a more recent revision of the ESBWR DCD Chapter 15. Therefore, the staff agrees that it is unnecessary for the COL to show that the ESP PPE information is bounding for the COL, and the issue raised by the staff in RAI 15-06-05-1 is resolved and closed.

More specifically, the following summarizes the applicant's October 17, 2008, response to RAI 15.06.05-1 and the staff's evaluation:

- The applicant stated that, for the EAB and LPZ, North Anna 3 FSAR, Revision 0, Table 2.0-201, "Evaluation of Site/Design Parameters and Characteristics," shows that the site-specific atmospheric dispersion factor (χ/Q) values for Unit 3 fall within those values in DCD, Revision 5, and, therefore, North Anna 3 meets the dose evaluation factors set forth in 10 CFR 50.34(a)(1)(ii)(D) and 10 CFR 52.79(a)(1)(vi)..

The staff finds that this response is acceptable.

- For the control room, the DCD, Revision 5 χ/Qs also remain bounding except for those associated with the DCD COL Item 2A.2-2-A, "Confirmation of Reactor Building χ/Q values." This COL item specifies administrative controls to be implemented if the χ/Q values for a release from certain reactor building (RB) or fuel building (FB) doors are not bounded by the DCD, Revision 5 χ/Q values. The North Anna FSAR, Revision 0 did not specify this condition in its administrative controls. In the North Anna FSAR, Revision 1, Chapter 2, "Site Characteristics," NAPS COL 2A.2-2-A, the applicant stated that the North Anna administrative controls will be such that the doors and personnel air locks on the east side of the RB or FB are promptly closed under conditions indicative of a fuel handling accident.

The staff finds that this response is acceptable. The staff's evaluation of this topic, including additional supplemental information provided at a later date, is discussed in more detail below with regard to NAPS SUP 15.4-1.

- The bounding values for isotopic activity release rates to the environment for the DBAs in ESP No. ESP-003, Appendix B, were not available for inclusion in North Anna FSAR Revision 0 because the ESP was issued on the same day that the Unit 3 COLA was submitted. A subsequent review of the COLA with respect to the as-issued ESP by the applicant identified that the DBA source terms evaluated in the DCD Revision 4, Chapter 15 were not bounded by the ESP-003 source terms in all cases. Therefore, the applicant stated that it will revise the COLA to address the DCD Revision 5 source terms and will include a request for a variance to use the DCD Revision 5 source terms in lieu of the ESP values. In the North Anna FSAR, Revision 1, the applicant revised the FSAR to address the ESBWR DCD, Revision 5, Chapter 15 source terms and requested a variance, NAPS ESP VAR 2.0-6, to use the North Anna 3 source terms from the DCD Revision 5 in lieu of those values specified in the North Anna ESP.

The staff finds that this variance is acceptable because the calculated doses in the ESBWR, Revision 5 are within the regulatory limits and the site-specific χ/Q values are lower than those values specified in the ESBWR DCD, Revision 5.

- The applicant stated that the North Anna 3 COLA Departure Report is being revised to clarify the criteria under which a variance is requested. In the North Anna COL Departure Report, Revision 1, the applicant revised the variance sections to clarify the criteria under which a variance is requested.

Therefore, the staff requested information in RAI 15.06.05-1 is resolved and closed.

- NAPS SUP 15.4-1

By letter dated September 16, 2014, the applicant provided supplemental information to clarify operator actions that are related to the analysis of the design basis fuel-handling accident (FHA) radiological consequences in the North Anna Unit 3 control room. Specifically, the applicant proposes to add the following site-specific supplemental information to the next revision of FSAR Section 15.4.1.2.3, "Identification of Operator Actions:"

> During movement of irradiated fuel, those doors and personnel air locks on the plant east sides of the Reactor Building or Fuel Building that could act as a point source could result in control room χ/Q values that are higher than the ESBWR χ/Q values for a release in the Reactor Building or Fuel Building (See Section 2A.2.5). Therefore, those doors and personnel air locks on the plant east sides of the Reactor Building or Fuel Building that could act as a point source are administratively controlled to remain closed during movement of irradiated fuel. Administrative control of these doors and personnel air locks ensures that the control room habitability dose analysis for the fuel handling accident (FHA) incorporated by reference from DCD Section 15.4.1 is bounding for Unit 3 and control room doses do not exceed the requirements of GDC 19 in the event of an FHA.

ESBWR DCD, COL Item 2A.2-2-A, gives guidance to COL applicants that if the site-specific point source control room receptor χ/Q values for potential releases through doors or personnel air locks on the east sides of the RB and FB are greater than those used as site parameter values in the ESBWR DCD dose analysis for the FHA, and if the values would result in a higher radiological consequence than was reported in the DCD, then the affected doors or air locks are administratively controlled during movement of irradiated fuel. The applicant did not provide either site-specific point source control room receptor χ/Q values for releases through the doors and air locks on the east sides of the RB and FB or a comparison with the values used in the ESBWR DCD for the FHA to enable a determination of whether the dose in the control room for the FHA would be higher than reported in the ESBWR DCD. Instead, the applicant stated in NAPS COL 2A.2-2-A that those doors and personnel air locks on the plant east sides of the RB or FB that could act as a point source are administratively controlled to remain closed during movement of irradiated fuel. This statement was repeated in NAPS SUP 15.4-1 with additional information to include the relationship to the assumptions used in the FHA control room dose analysis. The staff found the supplemental information acceptable because administrative control of the doors and air locks on the east side of the RB and FB that could act as a point source during the movement of irradiated fuel provides assurance that, in the event of an FHA, releases through the doors are sufficiently prevented so that the FHA dose analysis incorporated by reference from ESBWR DCD, Section 15.4.1, is bounding for North Anna 3. The applicant committed to providing NAPS SUP 15.4-1 in a future revision of the FSAR. The staff verified that the North Anna 3 FSAR, Revision 9, includes the appropriate administrative controls to ensure that the air locks on the east side of the RB and FB would not act as a point source during the movement of irradiated fuel. Therefore, Confirmatory Item 15-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

ESBWR DCD, Revision 10, Section 15.4, provides details and results of analyses of the radiological consequences for the DBAs. The following lists the DBAs analyzed for radiological consequences and the sections where the radiological consequence analyses for those DBAs are discussed in the ESBWR DCD.

DCD Section	Design-Basis Accident
15.4.1	Fuel Handling Accident
15.4.4	Loss-of-Coolant Accident Inside Containment Radiological Analysis
15.4.5	Main Steamline Break Accident Outside Containment
15.4.6	Control Rod Drop Accident
15.4.7	Feedwater Line Break Outside Containment
15.4.8	Failure of Small Line Carrying Primary Coolant Outside Containment
15.4.9	RWCU/SDC [Reactor Water Cleanup/Shutdown Cooling] System Line Failure Outside Containment
15.4.10	Spent Fuel Cask Drop Accident

The DBA radiological consequence analyses in the ESBWR DCD, Revision 10, used design reference site parameter values for the offsite atmospheric dispersion factors, in place of site characteristic (site-specific) values. The χ/Q values are the only input to the DBA radiological consequence analyses that are affected by the site characteristics. The applicant provided and discussed the North Anna site characteristic short-term accident χ/Q values in resolution of NAPS COL Item 2.0-10-A, "Short-Term Dispersion Estimates for Accidental Atmospheric Releases," and NAPS ESP COL Item 2.3-2, "Atmospheric Dispersion Factors for Control Room." The applicant also provided supplemental information in North Anna 3 COL FSAR Table 2.3-207, "Unit 3 Cross Unit χ/Q Result," for evaluating the impact of a postulated DBA in North Anna 1 and 2 on the North Anna 3 control room. Table 2.3.4 1 of the North Anna COL FSAR gives site characteristic EAB and LPZ χ/Q values.

In Section 2.3.4, "Short-Term Diffusion Estimates," of this SER, the staff discusses its review and resolution of (1) NAPS COL Item 2.0-10-A, (2) NAPS ESP COL Item 2.3-2, and (3) the supplemental information, related to the North Anna site characteristic χ/Q values as stated above, included under Section 2.3.4 of the North Anna COL FSAR.

The estimated DBA dose calculated for a particular site is affected by the site characteristics through the calculated χ/Q input to the analysis; therefore, the resulting dose would be different than that calculated generically for the ESBWR design in the DCD. All other inputs and assumptions in the radiological consequences analyses remain the same as in the DCD. Smaller χ/Q values are associated with greater dilution capability, resulting in lower radiological doses. When comparing a DCD site parameter χ/Q value and a site characteristic χ/Q value, the site is acceptable for the design if the site characteristic χ/Q value is smaller than the site parameter χ/Q value. Such a comparison shows that the site has better dispersion characteristics than that required by the reactor design.

For each time averaging period, the North Anna site characteristic offsite and control room short-term χ/Q values are less than the site parameter χ/Q values used by the ESBWR DCD, Revision 10, radiological consequence analysis for each of the DBAs. Because the result of the radiological consequence analysis for a DBA during any time period of radioactive material release from the plant is directly proportional to the χ/Q for that time period, and because the North Anna site characteristic χ/Q values are less than the comparable ESBWR DCD, Revision 10, site parameter χ/Q values for all time periods and all accidents, the North Anna site-specific total dose for each DBA is therefore less than the ESBWR DCD, Revision 10, generic total dose for each DBA.

Because the analyses in ESBWR DCD, Revision 10, show that the offsite and control room radiological consequences meet the regulatory dose requirements of 10 CFR 100.21, 10 CFR 50.34(a)(1), 10 CFR 52.79(a)(1), and GDC 19, and because, by the logic above, the North Anna site-specific DBA offsite and control room radiological consequences are less than those for ESBWR DCD, Revision 10, the applicant has sufficiently shown that the DBA radiological consequences meet the requirements of 10 CFR 100.21, 10 CFR 50.34(a)(1), 10 CFR 52.79(a)(1), and GDC 19.

15.5 Post-Combined License Activities

The applicant states in Supplemental Information NAPS SUP 15.4-1 that the doors and personnel air locks on the east sides of the RB and FB are administratively controlled to remain closed during movement of irradiated fuel.

15.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this chapter. The results of the staff's technical evaluation of the DCD information incorporated by reference is in NUREG 1966. With the exception of Confirmatory Item 15-1, pursuant to 10 CFR 52.63(a)(5) and Section VI.B.1 of Appendix E, "Design Certification Rule for the ESBWR Design," to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," all nuclear safety issues relating to safety analyses that were incorporated by reference are resolved.

In addition, the staff has compared the additional COL supplemental information within the application to the relevant NRC regulations, acceptance criteria defined in Chapter 15, "Transient and Accident Analysis," of NUREG 0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," issued March 2007, and other NRC regulatory guides and concludes that the applicant is in compliance with NRC regulations.

References

1. 10 CFR 100.21, "Non-seismic siting criteria."

2. 10 CFR 50.34, "Contents of construction permit and operating license applications; technical information."

3. 10 CFR 50.34a, "Design objectives for equipment to control releases of radioactive material in effluents-nuclear power reactors."

4. 10 CFR 52.63, "Finality of standard design certification."

5. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

6. 10 CFR Part 100, "Reactor Site Criteria."

7. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

8. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

9. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

10. 10 CFR Part 50, Appendix A, GDC 19, "Control room."

11. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

12. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

13. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

14. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

15. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," and its Supplement 1, April 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

16. NRC Staff NUREG-1835 2006b, "Supplement to the Final Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site, September 2006 (ADAMS Accession No. ML063170371).

17. NRC Staff NUREG-1835 NRC 2005b, "Safety Evaluation Report for an Early Site Permit (ESP) at the North Anna ESP Site, September 2005 (ADAMS Accession No. ML052710305). Available at http://pbadupws.nrc.gov/docs/ML0527/ML052710305.pdf

16.0 TECHNICAL SPECIFICATIONS

16.0 TECHNICAL SPECIFICATIONS

16.1 Introduction

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 proposed technical specifications (TS). The TS impose limits, operating conditions, and other requirements on reactor facility operation for the protection of public health and safety. The North Anna 3 plant-specific technical specifications (PTS) are derived from the analyses and evaluations in the Economic Simplified Boiling-Water Reactor (ESBWR) generic Design Control Document (DCD) and the North Anna 3 Final Safety Analysis Report (FSAR). In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.36, "Technical Specifications"; 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors"; and 10 CFR 52.79(a)(30); Dominion Virginia Power (Dominion) provided PTS and the associated PTS bases for North Anna 3 in Chapter 16, "Technical Specifications," of Part 2, "Final Safety Analysis Report," and Part 4, "Technical Specifications," of the Combined License (COL) application.

16.2 Summary of Application

Chapter 16 of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Chapters 16 and 16B (the generic TS [GTS] and the associated GTS bases [bases], respectively) of Revision 10 of the DCD for the ESBWR, referenced in Appendix E to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in FSAR Chapter 16, the applicant provides the following:

<u>COL Item</u>

- STD COL 16.0-1-A COL Applicant Bracketed Items

The applicant provided additional information in Part 4 of the North Anna 3 COL application (COLA) to address the ESBWR DCD standard (STD) COL [Item] 16.0-1-A. The applicant replaced information indicated with brackets in the GTS and bases with site-specific information (site-specific TS and bases).

<u>Supplemental Information</u>

- STD SUP 16.0-1

The applicant provided the following supplemental (SUP) information stating that the PTS and PTS bases are maintained as separate documents.

The proposed PTS consist of the GTS and site-specific information. Dominion also proposed bases for the PTS that consist of the GTS bases and site-specific information.

The GTS items regarding site-specific information that a COL applicant must provide include the PTS information necessary to complete a particular GTS provision (e.g., incorporation of the U.S. Nuclear Regulatory Commission [NRC] approved methodology into a plant's licensing basis). Detailed design information, equipment selection, instrumentation settings, and other information not available at the time of design certification (DC) are necessary to establish the values or information included in the PTS. The GTS and bases indicate each preliminary or missing information item with brackets and a COL item number. Although the ESBWR generic

DCD refers to this preliminary or missing information as COL applicant bracketed items, and the COLA designates this information collectively as STD COL 16.0-1-A, this report identifies this information collectively as COL Item 16.0-1-A. Except for the completion of this COL item, the PTS and bases are identical to the GTS and bases.

Exemptions

In North Anna 3 Part 7, Revision 1, Dominion proposed two exemptions from ESBWR GTS and bases in the PTS and bases. In Part 7, Revision 6, Dominion proposed no exemptions from the GTS and bases.

COL Item Resolution

Table 16.1 of this report lists the GTS requirements and associated bases that contain placeholders for preliminary or missing information associated with COL items. The COL applicant must finalize these items to complete the PTS and bases. This table also lists the method (i.e., Option 1, 2, or 3, described below) that Dominion used to resolve each COL item, thereby completing the associated provisions in the PTS and bases.

The listed resolution method (RM) for each COL item is taken from Part 4 of the COLA and is based on the interim staff guidance (ISG) DC/COL-ISG-08, “Necessary Content of Plant-Specific Technical Specifications When a Combined License Is Issued,” dated December 9, 2008, and Section 16.0, “Technical Specifications,” Revision 3, issued March 2010 of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” (the Standard Review Plan (SRP)). This guidance lists three acceptable RMs for resolving COL items and finalizing the PTS. For each COL item, the applicant must provide one of the following:

- a site-specific value or site-specific information (Option 1)
- a useable value or useable information that is bounding to the site-specific value or information (Option 2)
- a NRC staff-approved administrative control TS for the use of an NRC-approved methodology to determine the site-specific value or information and establish a document for recording the site-specific value or information outside the PTS (Option 3)

The GTS contains bracketed, optional provisions that provide operational flexibility. However, adopting that flexibility in the PTS requires a site-specific justification in accordance with the reviewer’s notes in Table 16.0-1-A of the ESBWR DCD. In most cases, Dominion has not adopted this flexibility in the North Anna 3 PTS. The RM for such items is listed as Option 1 in Table 16.1 because finalizing bracketed information, where the brackets provide for operational flexibility, is equivalent to providing site-specific information and has been applied by the applicant.

For all COL items listed in the table, the staff has verified that the PTS and bases have been updated in accordance with the stated RM.

Table 16.1. Site-Specific Information to Resolve COL Item 16.0-1-A

COL Item Number	GTS Reference	Information Needing Finalization (See description in Revision 9 of ESBWR DCD, Tier 2, Section 16.0, Table 16.0-1-A and Revision 4 of the COLA, Part 4)	Resolution Method
1.1-1	GTS 1.1	Pressure and temperature (P/T) limits report (PTLR) definition.	Option 2
3.1.3-1	GTS 3.1.3 Required Action A.1 and bases	Stuck control rod separation requirements between “slow” control rod(s). (Operational flexibility not adopted.)	Option 1
3.1.3-2	Surveillance Requirement (SR) 3.1.3.4 and bases	Maximum scram time limits for operable control rods. If adopting slow control rod optional allowance, the SR should state, “Verify each control rod scram time from fully withdrawn to [60%] rod insertion is ≤ [ ] seconds.” Otherwise, the SR should state, “Perform applicable SRs of LCO 3.1.4.” (Operational flexibility not adopted.)	Option 1
3.1.4-1	GTS 3.1.4 and bases; Limiting Condition for Operation (LCO) 3.1.4 and bases; Action A and bases; Table 3.1.4-1 Notes and bases; bases’ applicable safety analyses (ASA) discussion; bases for SR 3.1.4.2 and SR 3.1.4.3.	“Slow” control rod optional allowance. (Operational flexibility not adopted.) Dominion removed the bracketed provisions for “slow” scram times in the GTS and bases.	Option 1
3.1.5-1	SR 3.1.5.1 and bases	Minimum and nominal control rod scram accumulator pressure.	Option 2
3.1.7-1	GTS 3.1.7 Required Action A.1 and bases	Alternative action for sodium pentaborate concentration not within limits. (Operational flexibility not adopted.)	Option 1
3.3.1.1-2	Bases for SR 3.3.1.1.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.1.2-1	Bases for SR 3.3.1.2.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.1.4-2	Bases for SR 3.3.1.4.7	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.1.5-2	Bases for SR 3.3.1.5.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.5.1-2	Bases for SR 3.3.5.1.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1

COL Item Number	GTS Reference	**Information Needing Finalization** **(See description in Revision 9 of ESBWR DCD, Tier 2, Section 16.0, Table 16.0-1-A and Revision 4 of the COLA, Part 4)**	Resolution Method
3.3.5.2-1	Bases for SR 3.3.5.2.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.5.3-2	Bases for SR 3.3.5.3.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.5.4-1	Bases for SR 3.3.5.4.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.6.1-2	Bases for SR 3.3.6.1.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.6.2-1	Bases for SR 3.3.6.2.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.6.3-2	Bases for SR 3.3.6.3.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.6.4-1	Bases for SR 3.3.6.4.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.7.1-2	Bases background for GTS 3.3.7.1	Control room habitability area (CRHA) option for design features to protect occupant exposures to hazardous chemicals. (Not adopted based on FSAR Section 6.4.5 and resolution of related Request for Additional Information (RAI) 02.02.03-8.)	Option 1
3.3.7.1-3	Bases for SR 3.3.7.1.4	Allowance to exclude certain sensors or other instrumentation components from response time testing. (Operational flexibility not adopted.)	Option 1
3.3.7.2-1	Bases background for GTS 3.3.7.2	CRHA option for design features to protect occupant exposures to hazardous chemicals. (Not adopted based on FSAR Section 6.4.5 and resolution of related RAI 02.02.03-8.)	Option 1
3.3.7.2-2	Bases for SR 3.3.7.2.4	Allowance to exclude certain portions of the actuation circuitry from response time testing. (Operational flexibility not adopted.)	Option 1
3.4.4-1	LCO 3.4.4 and bases; SRs 3.4.4.1, 2, 3, 4, and 5 and bases; bases background	Reference to PTLR or plant-specific P/T curves as figures in TS 3.4.4. (Adopted PTLR.)	Option 2
3.4.4-2	Notes to SR 3.4.4.4, and SR 3.4.4.5 and bases	Temperature for applicability of verification that reactor vessel flange and head flange temperatures are within limits.	Option 2

COL Item Number	GTS Reference	Information Needing Finalization (See description in Revision 9 of ESBWR DCD, Tier 2, Section 16.0, Table 16.0-1-A and Revision 4 of the COLA, Part 4)	Resolution Method
3.4.4-3	Bases references for GTS 3.4.4	Topical reports providing the methodology for determining the P/T limits. (Adopted PTLR.)	Option 2
3.7.2-1 (related to COL Item 6.4-2-A)	GTS 3.7.2 Required Action B.2 and bases; bases background discussion; bases ASA discussion; bases for LCO 3.7.2; bases for SR 3.7.2.7	CRHA option for design features to protect occupant exposures to hazardous chemicals. (Not adopted based on FSAR Section 6.4.5 and resolution of related RAI 02.02.03-8.)	Option 1
3.7.4-1	LCO 3.7.4 and bases; bases ASA discussion; bases for Required Action A.1	LCO 3.7.4 alternative to requiring the main turbine bypass system to be operable. The alternative LCO is to make applicable the LCO 3.2.2, "Minimum Critical Power Ratio (MCPR)," limits for an inoperable main turbine bypass system, as specified in the core operating limits report (COLR). (Operational flexibility not adopted.)	Option 1
3.7.4-2	SR 3.7.4.1 frequency and bases	Surveillance interval for cycling a turbine bypass valve. (Retained 31-day frequency. Operational flexibility not adopted.)	Option 1
3.7.6-1	LCO 3.7.6 and bases; bases ASA discussion; bases for Required Action A.1	LCO 3.7.6 alternative to requiring all selected control rod run-in (SCRRI) and select rod insert (SRI) functions to be operable. The alternative LCO is to make applicable the LCO 3.2.2 MCPR limits for an inoperable SCRRI and/or SRI function, as specified in the COLR. (Operational flexibility not adopted.)	Option 1
3.8.1-1	SR 3.8.1.2 and bases	Acceptance criteria for battery charger testing (minimum duration of test in hours) consistent with battery size. (Manufacturer's recommendations are the basis for bounding value for test duration.)	Option 2
3.8.1-4	Bases for SR 3.8.1.1	Battery cell parameters consistent with the manufacturer's specifications.	Option 1
3.8.1-5	Bases background for GTS 3.8.1, and bases for SR 3.8.1.1	Battery margin for aging factor and state of charge uncertainty (from expected battery life).	Option 1
3.8.3-1	Conditions B, C, and G; Required Actions B.2 and C.2; bases for Actions B, C, and G; bases for SR 3.8.3.1	Acceptance criteria for verification that battery is fully charged—maximum float current—consistent with manufacturer's recommendations.	Option 1

COL Item Number	GTS Reference	Information Needing Finalization **(See description in Revision 9 of ESBWR DCD, Tier 2, Section 16.0, Table 16.0-1-A and Revision 4 of the COLA, Part 4)**	Resolution Method
3.8.3-3	GTS 3.8.3: Actions A and G and SR 3.8.3.5; SR 3.8.3.2; bases background; bases for Actions A, B, C, and G; bases for SRs 3.8.3.2 and 3.8.3.5	Battery cell parameters consistent with the manufacturer's specifications. Minimum connected cell float voltage. Minimum pilot cell float voltage.	Option 1
3.8.3-4	SR 3.8.3.6 frequency and bases	Battery margin for aging factor and state of charge uncertainty (based on the manufacturer's recommendations).	Option 1
3.9.5-1	SR 3.9.5.2 and bases; bases for LCO 3.9.5	Minimum control rod drive scram accumulator pressure.	Option 2
4.1-1	GTS 4.1	Plant-specific description of site location.	Option 1
5.2.2-1	GTS 5.2.2	Non-licensed operator manning requirements for multi-unit site. (Not applicable; North Anna 3 is a single-unit facility.)	Option 1
5.3.1-1	GTS 5.3.1	Unit staff qualification requirements.	Option 1
5.4.1-1	GTS 5.4.1.a	Guidance documents for written procedures.	Option 1
5.4.1-2	GTS 5.4.1.b	Guidance documents for emergency operating procedures.	Option 1
5.5.6-1	GTS 5.5.6	Outdoor Liquid Storage Tank Radioactivity Monitoring Program. (Not applicable to North Anna 3.)	Option 1
5.5.9-1	GTS 5.5.9	Containment Leakage Rate Testing Program plant-specific exceptions to RG 1.163. (Dominion requested no additional plant-specific exceptions.)	Option 1
5.5.10-1	GTS 5.5.10.a	Battery cell parameters consistent with the manufacturer's specifications. Minimum connected cell float voltage.	Option 1
5.5.11-1	GTS 5.5.11	Setpoint Control Program references to NRC staff-approved setpoint methodology and the associated NRC SER.	Option 1
5.5.12-1	GTS 5.5.12	CRHA Boundary Program requirements for hazardous chemical releases. (Not adopted based on FSAR Section 6.4.5 and resolution of related RAI 02.02.03-8.)	Option 1
5.6.1-1	GTS 5.6.1	Applicant to determine if allowance for multiple-unit stations is applicable to PTS. If applicable, a single annual radiological environmental operating report may be prepared. (Allowance applies because North Anna 1, 2 and 3 are on the same site.)	Option 1
5.6.1-2	GTS 5.6.1	Applicant to determine format of annual radiological environmental operating report. (Multi-unit format applies.)	Option 1

COL Item Number	GTS Reference	Information Needing Finalization (See description in Revision 9 of ESBWR DCD, Tier 2, Section 16.0, Table 16.0-1-A and Revision 4 of the COLA, Part 4)	Resolution Method
5.6.2-1	GTS 5.6.2	Applicant to determine if allowance for multi-unit stations is applicable to PTS. If applicable, a single radioactive effluent release report, with content required for a multi-unit report, may be prepared. (Allowance applies because North Anna 2 and 3 are on the same site.)	Option 1
5.6.3-1	GTS 5.6.3	COLR reference to Specification 3.7.4, “Main Turbine Bypass System” (see COL Item 3.7.4-1). (Operational flexibility not adopted.)	Option 1
5.6.3-2	GTS 5.6.3.a	Reference in TS 5.6.3.a to any additional individual specifications that address core operating limits.	Option 1
5.6.4-1	GTS 5.6.4	Applicant to add list of analytical methods used to determine the reactor coolant system P/T limits in specification for PTLR, if PTLR adopted in PTS. In lieu of a PTLR, the applicant may insert its plant-specific P/T curves as figures in PTS 3.4.4 and omit PTS 5.6.4. (Adopted PTLR.)	Option 2

The above COL items are listed in Revision 10 to ESBWR DCD, Table 16.0-1-A, which provides the COL applicant with guidance on the necessary site-specific information for each item.

16.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, “Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design,” issued April 2014, and it’s Supplement 1, issued September 2014. In addition, the relevant requirements of the Commission regulations for TS, and the associated acceptance criteria, are in SRP Section 16.0.

The applicable regulatory requirements for TS are as follows:

- 10 CFR 50.36 and 50.36a
- 10 CFR 52.79(a)(30)

Section 182a of the Atomic Energy Act of 1954 (the Act) as amended (42 U.S.C. 2232), requires that applicants for nuclear power plant operating licenses will state the following:

> Such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued.

In 10 CFR 50.36, the Commission established the regulatory requirements related to TS content. In doing so, the Commission emphasized matters related to the prevention of accidents and the mitigation of the consequences of accidents. As recorded in the Statements of Consideration, “Technical Specifications for Facility Licenses; Safety Analysis Reports” (Volume 33 of the *Federal Register,* page 18,610 (33 FR 18610; December 17, 1968)), the Commission noted that applicants are expected to incorporate into their TS “those items that are directly related to maintaining the integrity of the physical barriers designed to contain radioactivity.” In 10 CFR 50.36(c), the NRC requires the TS for utilization facilities to contain (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation (LCOs); (3) surveillance requirements; (4) design features; and (5) administrative controls.

In 10 CFR 50.36(c)(2)(ii), the NRC requires the TS to include an LCO for each item that meets one or more of the following four criteria:

- “Criterion 1*.* Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.”

- “Criterion 2*.* A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.”

- “Criterion 3*.* A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.”

- “Criterion 4. A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.”

Regulatory Guidance

In 1992, the NRC issued standard TS (STS) to clarify the content and format of requirements necessary to ensure the safe operation of nuclear power plants. These STS were developed from the results of the TS improvement program in accordance with 10 CFR 50.36; the Commission’s “Proposed Policy Statement on TS Improvements for Nuclear Power Reactors,” (52 FR 3788; February 6, 1987) (interim policy statement); and SECY-93-067, “Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors,” dated March 17, 1993 (58 FR 39132; July 22, 1993) (final policy statement). The NRC published major revisions to the STS in 1995 (Revision 1), 2001 (Revision 2), 2004 (Revision 3), and 2012 (Revision 4).

The following documents contain the STS for boiling-water reactors (BWRs).

- NUREG–1433, “Standard Technical Specifications, General Electric Plants (BWR/4),” Volumes 1 and 2, Revision 3, issued June 2004

- NUREG–1434, “Standard Technical Specifications, General Electric Plants (BWR/6),” Volumes 1 and 2, Revision 3, June 2004

For each document, Volume 1 contains the TS and Volume 2 contains the associated TS bases. The STS include the bases for safety limits, limiting safety system settings, LCOs, and associated action and surveillance requirements.

The STS reflect the results of a detailed review of the application of the Commission's interim policy statement criteria to generic system functions. The NRC published these results—known as the split report (ML11264A057)—in a May 9, 1988, letter from T. E. Murley of the NRC to the nuclear steam supply system (NSSS) vendor-owner groups (e.g., W. S. Wilgus of the Babcock & Wilcox Owners Group and R. F. Janecek of the BWR Owners' Group). The split report provides the results of the staff's review of the NSSS vendor-owner groups' application of the Commission's interim policy statement criteria to the existing STS LCOs (e.g., NUREG-0123, "Standard Technical Specifications for General Electric Boiling Water Reactors," issued August 1971, for General Electric plants). The STS also reflect the results of extensive discussions about various drafts of the STS to ensure that the application of TS criteria will consistently reflect detailed system configurations and operating characteristics for all reactor designs. Therefore, the STS bases provide abundant information about the extent to which the STS reflect requirements that are necessary to protect public health and safety.

In the final policy statement, the Commission expressed the view that satisfying the guidance in the policy statement also satisfies Section 182a of the Act and 10 CFR 50.36. The final policy statement describes the safety benefits of the STS. It also encourages licensees to use the STS as the basis for license amendments to partially or completely convert existing TS requirements to improved TS based on the STS.

The format and content of the PTS and bases in a COLA referencing a certified design should be based on the GTS and bases for the certified design. PTS and bases may include appropriate plant-specific departures from the referenced certified GTS and bases when warranted.

16.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Chapter 16 of the certified ESBWR DCD. The staff reviewed Chapter 16 of the North Anna 3 COLA and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to the review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to this chapter.

The staff reviewed the PTS and bases which are in Part 4 of the North Anna 3 COLA, and the FSAR Chapter 16 which is in Part 2 of the COLA's FSAR, to ensure that this information incorporates by reference the latest revision to ESBWR DCD Section 16.0, "Introduction." DCD Section 16.0 contains guidance (i.e., reviewer's notes) for providing site-specific information to resolve the COL items, which are indicated by brackets in DCD Chapters 16 and 16B, the GTS and bases. The COL items are listed in Section 16.2, Table 16.1 of this SER. The PTS and bases contain the latest revision of the GTS and bases and the site-specific information in accordance with COL Item 16.0-1-A of the ESBWR DCD. The GTS and bases and the inserted site-specific information form a complete set of PTS and bases for staff review and approval. Part 4 of the COLA also describes and justifies the proposed RM for each COL item.

The staff confirmed that the PTS and bases, as presented in Part 4 of the COLA, incorporate the GTS and bases. The staff also reviewed the site-specific information provided in accordance with COL Item 16.0-1-A, as listed in Section 16.2, Table 16.1 of this report. The

[1] See "*Finality of Referenced NRC Approvals*" in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

staff focused the COLA review on the completion of the site-specific information in the PTS and bases.

Completion of the ESBWR Design Certification Rule (DCR)

The staff separately reviewed the GTS and bases on Docket No. 052-010 as part of the ESBWR DC review. The staff documents its review of the GTS and bases in Chapter 16 of the ESBWR DC Final Safety Evaluation Report (FSER). Because the staff's DC review of the GTS and bases applies to the PTS and bases, the staff did not review information in the PTS and bases that is identical to information in the GTS and bases.

Completion of the staff's technical evaluation of the PTS and bases was contingent on NRC approval and certification of the ESBWR design and publication of the ESBWR DCR. Consequently, the staff verified that except for the COL items, the PTS and bases are identical to the GTS and bases that have received final NRC approval. This technical evaluation thereby incorporates the resolution of all issues related to the GTS and bases that remain open at the time of the North Anna 3 COLA.

Resolution of COL Items Listed in Table 16.1

Dominion proposed to resolve each COL item using one of the three options permitted by DC/COL-ISG-08, as described in Section 16.2 of this SER (pg. 16-2).

Option 1. The staff determines whether the site-specific information provided under Option 1 is acceptable by verifying that the information is accurate and useable for unit operation. To make this determination, the staff (1) compares the information with the FSAR and the conditions in the associated reviewer's note in ESBWR DCD Section 16.0; and (2) reviews the justification included in the COLA. The following are the COL items resolved using Option 1:

- Optional provisions that would provide additional operational flexibility. The associated reviewer's notes for such COL items require the COL applicant to provide additional site-specific justifications in order to incorporate the operational flexibility in the PTS. These COL items are indicated in Table 16.1 by the phrase "(Operational flexibility not adopted)."
  - action and surveillance requirements for slow control rods (COL Items 3.1.3-1, 3.1.3-2 and 3.1.4-1)
  - action requirements for an out-of-limit sodium pentaborate concentration in the standby liquid control system accumulator (COL Item 3.1.7-1)
  - exclusion of instrumentation components from response time testing (COL Items 3.3.1.1-2, 3.3.1.2-1, 3.3.1.4-2, 3.3.1.5-2, 3.3.5.1-2, 3.3.5.2-1, 3.3.5.3-2, 3.3.5.4-1, 3.3.6.1-2, 3.3.6.2-1, 3.3.6.3-2, 3.3.6.4-1, 3.3.7.1-3, and 3.3.7.2-2)
  - specifying a minimum critical power ratio (MCPR) penalty in lieu of requiring an operable main turbine bypass system (COL Items 3.7.4-1 and 5.6.3-1)
  - specifying a surveillance frequency of greater than 31 days for cycling turbine bypass valves (COL Item 3.7.4-2)
  - specifying an MCPR penalty in lieu of requiring operable SCRRI/SRI functions (COL Item 3.7.6-1)

    For these COL items, Dominion elected to omit these allowances from the PTS. In each case, the resulting specification is more restrictive on unit operation than would be allowed by the omitted provision. Therefore, the resolution of these COL items is acceptable.

- Provisions related to protections against hazardous chemicals (COL Items 3.3.7.1-2, 3.3.7.2-1, 3.7.2-1, and 5.5.12-1). Dominion did not adopt these optional provisions based on the resolution of RAI 02.02.03-8 as discussed in Chapter 2 of this SER, and the evaluation of hazardous chemicals in FSAR Section 6.4.5.

- Unit staff minimum qualification standards (COL Item 5.3.1-1) in GTS 5.3.1. Dominion resolved this item in accordance with the reviewer's note in DCD Section 16.0, Table 16.0-1-A, by specifying the use of an overall qualification statement referencing an American National Standards Institute (ANSI) standard acceptable to the staff, as follows:

GTS 5.3.1 Each member of the unit staff shall meet or exceed the minimum qualifications of [Regulatory Guide 1.8, Revision 3, 2000, or more recent revisions, or ANSI Standard acceptable to the NRC staff]. [The staff not covered by Regulatory Guide 1.8 shall meet or exceed the minimum qualifications of Regulations, Regulatory Guides, or ANSI Standards acceptable to NRC staff].

PTS 5.3.1 Each member of the unit staff shall meet or exceed the minimum qualifications of Regulatory Guide 1.8, Revision 3, 2000, with the following exception:

a. During cold license operator training prior to Commercial Operation, the Regulatory Position C.1.b of Regulatory Guide 1.8, Revision 2, 1987, applies. Cold license operator candidates meet the training elements defined in ANSI/ANS 3.1-1993 but are exempt from the experience requirements defined in ANSI/ANS 3.1-1993.

The proposed minimum qualification standards reference Regulatory Guide (RG) 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," Revision 3, issued May 2000; and American Nuclear Society (ANS)/ANSI 3.1-1993, "Selection, Qualification, and Training of Personnel for Nuclear Power Plants," which are acceptable to the staff. RG 1.8 will cover all North Anna 3 staff, so the second bracketed sentence is omitted. Therefore, the resolution of this COL item is acceptable.

- Guidance documents for written procedures (COL Items 5.4.1-1 and 5.4.1-2) in GTS 5.4.1. In PTS 5.4.1, Dominion retained the GTS bracketed references to Appendix A to RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)," issued February 1978 and Generic Letter 82-33, "Supplement 1 to NUREG-0737—Emergency Response Capabilities," dated December 17, 1982, which are appropriate for North Anna 3. Therefore, the resolution of these COL items is acceptable.

- Containment leakage rate-testing program exceptions to RG 1.163, "Performance-Based Containment Leak-Test Program," issued September 1995 (COL Item 5.5.9-1) in GTS 5.5.9.a. In PTS 5.5.9.a, Dominion omitted the GTS 5.5.9.a bracketed placeholder for exceptions because Dominion did not propose any exceptions for North Anna 3. Therefore, the resolution of this COL item is acceptable.

- Annual radiological environmental operating report allowance for multiple-unit stations to submit a single report (COL Item 5.6.1-1) and the report format (COL Item 5.6.1-2) in GTS 5.6.1. In accordance with the reviewer's note in DCD Section 16.0, Table 16.0-1-A, Dominion retained in PTS 5.6.1 the GTS bracketed note (without the brackets) allowing a single report to be submitted for a multiple-unit station. Dominion also retained (without the brackets) the GTS bracketed phrase on the report format: "[in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979]." This information applies to North Anna 3 and is acceptable to the staff. Therefore, the resolution of these COL items is acceptable.

- Radioactive effluent release report allowance for multiple-unit stations to submit a single report (COL Item 5.6.2-1) in GTS 5.6.2. In accordance with the reviewer's note in DCD Section 16.0, Table 16.0-1-A, Dominion retained in PTS 5.6.2 the GTS bracketed note (without the brackets) allowing a single report to be submitted for a multiple-unit station. This information applies to North Anna 3 and is acceptable to the staff. Therefore, the resolution of this COL item is acceptable.
- References to any additional individual specifications that address core operating limits (COL Item 5.6.3-2) in GTS 5.6.3. Dominion omitted the GTS bracketed placeholder in PTS 5.6.3 because no additional plant-specific specifications address core operating limits. Therefore, the resolution of this COL item is acceptable.
- Description of site location (COL Item 4.1-1) in GTS 4.1. The staff verified that the PTS 4.1 description of the North Anna 3 site location is accurate. Therefore, the resolution of this COL item is acceptable.
- Non-licensed operator manning requirements (COL Item 5.2.2-1) in GTS 5.2.2. The reviewer's note in DCD Section 16.0, Table 16.0-1-A requires the COL applicant to determine whether the unit will be on a multi-unit site and clarifies that "two unit sites with both units shutdown or defueled require a total of three non-licensed operators for the two units." Because North Anna 3 is a stand-alone ESBWR unit, Dominion omitted the bracketed statement and retained the existing GTS 5.2.2.a unbracketed statement in PTS 5.2.2.a, which applies to both single-unit and two-unit sites. Therefore, the resolution of this COL item is acceptable.
- Outdoor liquid storage tank radioactivity monitoring program (COL Item 5.5.6-1). GTS 5.5.6, "Explosive Gas and [Storage Tank] Radioactivity Monitoring Program," contains bracketed provisions and a surveillance program for unprotected outdoor liquid radioactive waste storage tanks. The reviewer's note in DCD Section 16.0, Table 16.0-1-A requires the COL applicant to incorporate the GTS 5.5.6 bracketed requirements in PTS 5.5.6, if the site design includes such storage tanks. Because North Anna 3 does not include such storage tanks, PTS 5.5.6 omits these bracketed requirements. Therefore, the resolution of this COL item is acceptable.
- Battery cell parameters (COL Items 3.8.1-4, 3.8.3-3, and 5.5.10-1). The applicant has provided the site-specific values for battery parameters based on the manufacturer's recommendations for the BAE 2V-24OPzS-3000 battery, as in Table 16.2 of this SER.

The applicant completed the bases for PTS surveillance requirement (SR) 3.8.1.1, by replacing the GTS bracketed value with the plant-specific value of 2.22 volts per cell (Vpc) at 25 degrees Celsius (C) (77 degrees Fahrenheit [F]) for the minimum float voltage. This value is based on the battery manufacturer BAE's recommendation for the optimum long-term battery performance by limiting the formation of lead sulfate and self-discharge. Therefore, the staff finds the minimum float voltage of 2.22 Vpc at 25 degrees C for the optimum long-term battery performance acceptable. The staff also finds that the proposed location of "battery terminals" for monitoring the battery temperature for voltage compensation is acceptable because it is consistent with the battery manufacturer BAE's recommendation. Therefore, COL Item 3.8.1-4 is resolved.

The applicant completed Actions A and G, SR 3.8.3.2, and SR 3.8.3.5 and the associated bases of PTS 3.8.3, "Battery Parameters," by replacing the GTS bracketed values with the site-specific value of 2.09 volts (V) as the minimum battery cell float voltage. This value is based on the manufacturer BAE's recommendation.

Table 16.2. Battery Cell Parameters

COL Item	Location	Parameter/Information	PTS Value
3.8.1-4	"SR" section of bases for PTS SR 3.8.1.1	Minimum float voltage for a battery cell and for a battery with 120 cells	• 2.22 volts per cell (Vpc) • 266.4 V at 25 °C (77 °F) at the battery terminals
		Location for monitoring battery temperature for voltage compensation	Battery terminals
3.8.3-3	"Background" section of bases for PTS 3.8.3	Nominal specific gravity value of a fully charged battery cell	1.240
		Number of battery cells in battery	120
		Approximate open circuit voltage for a battery with 120 cells and a battery cell voltage corresponding to the nominal specific gravity value of a fully charged battery cell	• 249.6 V • ≥ 2.07 Vpc to 2.09 Vpc
		Time period that a fully charged battery cell will maintain its capacity without further charging	30 days
		Battery cell float voltage (over-potential) for optimal long-term performance and its benefit	• 2.22 to 2.24 Vpc at 25 °C (77 °F) • limits the formation of lead sulfate and self-discharge
		Nominal float voltage for a battery cell and for a battery with 120 cells	• 2.23 Vpc at 25 °C (77 °F) • 267.6 V
	PTS 3.8.3: • Condition A • Required Action A.3 • Bases for Actions A, B, C, and G • Condition G • SR 3.8.3.2 and bases • SR 3.8.3.5 and bases	Minimum battery cell float voltage	2.09 V
	SR 3.8.3.2 bases and SR 3.8.3.5 bases	Nominal float voltage for a battery cell and for a battery with 120 cells	• 2.23 Vpc at 25 °C (77 °F) • 267.6 V
		Battery cell float voltages addressed by PTS 5.5.10	< 2.13 Vpc but > 2.09 Vpc at 25 °C (77 °F)
		Short-term absolute minimum battery cell voltage	2.09 Vpc

COL Item	Location	Parameter/Information	PTS Value
	SR 3.8.3.4 bases	Battery pilot cell electrolyte design minimum temperature	16 °C (60 °F)
5.5.10-1	PTS 5.5.10.a	Minimum battery cell float voltage	< 2.13 V

The applicant also replaced other bracketed information with appropriate site-specific values. The staff found that a battery cell with a flooded lead-acid construction has a nominal specific gravity of 1.240. This specific gravity corresponds to a battery cell that has an open circuit voltage of 2.07 to 2.09 Vpc for a 120-cell battery at 25 degrees C (77 degrees F). Per the manufacturer’s instruction, the battery cell will maintain its capacity for 30 days without further charging once it is fully charged with its open-circuit voltage greater than or equal to 2.07 to 2.09 Vpc. The staff calculated the open-circuit voltage to be 2.085 Vpc (1.240 + 0.845), using the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) 450–2010, “IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications,” which is consistent with the manufacturer’s recommendation. The staff finds the site-specific value of 2.09 Vpc for the short-term absolute minimum battery cell float voltage and the values of other associated parameters, such as the specific gravity and duration of capacity retention, to be acceptable. Therefore, COL Item 3.8.3-3 is resolved.

The applicant completed PTS 5.5.10, “Battery Monitoring and Maintenance Program,” which requires establishing a program that provides for battery restoration and maintenance, by replacing GTS bracketed values with site-specific values for a specified battery cell float voltage. Specifically, PTS 5.5.10.a states that the program must include “with battery cell float voltage < 2.13 V, actions to restore cell(s) to ≥ 2.13 V and perform SR 3.8.3.5.” SR 3.8.3.5 verifies that each required battery-connected cell float voltage is ≥ 2.09 V. The value of 2.13 V for implementing programmatic actions for restoration and maintenance is based on the manufacturer’s recommendation. The staff finds that the value cell float voltage selected for the battery restoration and maintenance program to be consistent with IEEE Std 450–2010 and, therefore, acceptable. Therefore, COL Item 5.5.10-1 is resolved.

- Battery margin including the aging factor and state-of-charge uncertainty (COL Item 3.8.1-5). The applicant completed the “Background” section of the bases for PTS 3.8.1-by replacing the GTS bracketed value with the plant-specific value of 80 percent of the battery ampere-hour rating for the battery end-of-life capacity limit. This value is based on the battery manufacturer BAE’s recommendation. The staff finds this value acceptable because the battery sizing includes an aging factor of 125 percent that will provide a 100-percent design demand load with 80 percent of the battery ampere-hour rating, which is consistent with IEEE Std. 485–2010, “IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications,” and IEEE Std. 450-2010. Therefore, COL Item 3.8.1-5 is resolved.

- Battery margin including the aging factor and state-of-charge uncertainty (COL Item 3.8.3-4). The applicant completed PTS SR 3.8.3.6 by replacing the GTS bracketed value with the plant-specific value of a battery capacity greater than or equal to 80 percent of the manufacturer’s ampere-hour rating, when subjected to a performance discharge test. This test determines the overall degradation of the battery from age and usage. The staff finds that the battery capacity of 80 percent will meet 100 percent of the design demand loads, because the battery sizing includes an aging factor of 125 percent. The staff also finds that the proposed value is consistent with IEEE Std. 450 and IEEE Std. 485, which recommend that the battery be replaced if its capacity is below 80 percent of the manufacturer's rating. Therefore, the proposed performance discharge test battery capacity acceptance criterion value of greater than or equal to 80 percent of the manufacturer's ampere-hour rating is acceptable. Thus, COL Item 3.8.3-4 is resolved.

- The applicant completed PTS 3.8.3 Conditions B, C, and G; and Required Actions B.2 and C.2; the bases for Actions B, C, and G; and the bases for SR 3.8.3.1 by providing the float current acceptance criterion for verifying a fully charged battery (COL Item 3.8.3-1). Dominion intends to use batteries manufactured by BAE in the 250 V Safety-Related DC (direct current) System. For the selected batteries, a 30 amp battery float current is based on returning the battery to 95 percent charge and assumes a 5 percent design margin to account for uncertainties in the use of float current to measure the state of charge of the battery. These values are recommended by the battery manufacturer and are used to complete the GTS bracketed items in the North Anna 3 TS Bases for TS 3.8.3. Therefore, COL 3.8.3-1 is resolved.

- The applicant completed COL Item 5.5.11-1 regarding PTS 5.5.11, "Setpoint Control Program," by replacing the bracketed information in paragraph b with a reference to the NRC-approved setpoint methodology, NEDE-33304P-A, "GEH ESBWR Setpoint Methodology," Revision 4, issued May 2010, which was approved as part of the ESBWR DC review as documented in NUREG–1966, Section 7.1.4. Specifically, paragraph b states the following:

  > The Limiting Trip Setpoint (LTSP), Nominal Trip Setpoint ($NTSP_F$), Allowable Value (AV), As-Found Tolerance (AFT), and As-Left Tolerance (ALT) for each Technical Specification required automatic protection instrumentation function shall be calculated in conformance with the instrumentation setpoint methodology previously reviewed and approved by the NRC in NEDE-33304P-A, "GEH ESBWR Setpoint Methodology," Revision 4, dated May 2010, (Public Version ML101450251), and the conditions stated in the associated NRC safety evaluation, Letter to GEH from NRC, "Final Safety Evaluation Report for the Economic Simplified Boiling Water Reactor Design," dated March 9, 2011, (ML110050215, specifically Chapter 7 FSER ML110030049 and Chapter 16 FSER ML110030064).

Therefore, COL Item 5.5.11-1 is resolved.

Option 2. The staff determines whether the site-specific information provided under Option 2 is acceptable by verifying that the information is bounding and useable for unit operation. This verification is based on (1) a comparison of the information with the FSAR and the conditions in the associated reviewer's note in DCD Section 16.0, Table 16.0-1-A; and (2) a review of the justification in the COLA that includes how the bounding value was determined. The applicant selected Option 2 for resolving the following COL items:

- Battery charger surveillance test duration (COL Item 3.8.1-1). The applicant stated in Item 19 of the Introduction to Part 4 of the COLA that the proposed minimum test duration of 8 hours for battery charger testing in PTS SR 3.8.1.2 is bounding based on the GUTOR manufacturer's recommendations for battery charger test duration. An 8-hour time period is sufficient for the charger temperature to be stabilized and maintained for at least 2 hours. The staff concludes that 8 hours is a useable bounding value for the battery charger test duration. Therefore, the proposed resolution of COL Item 3.8.1-1 is acceptable.

- Requirements related to the reactor coolant system P/T limits report (PTLR) (COL Items 1.1-1, 3.4.4-1, 3.4.4-2, 3.4.4-3, and 5.6.4-1). Revision 5, Part 4 of the North Anna 3 COLA identified NEDC-33441P, “GE Hitachi Nuclear Energy Methodology for the Development of ESBWR Reactor Pressure Vessel Pressure-Temperature Curves,” Revision 6 as the document that contains the analytical methods used to determine the reactor coolant system P/T limits. The staff’s evaluation of the P/T limits and P/T methodology for North Anna 3 is in Section 5.3.2 of this SER. Based on the staff’s determination that the P/T limits in NEDC-33441P are useable bounding values for North Anna 3, the applicant completed the PTLR-related COL Items by (1) removing brackets from around PTS 5.6.4; (2) replacing the associated bracketed placeholder for the P/T methodology in GTS 5.6.4.b with a reference to NEDC-33441P Revision 5 issued in February 2011, in PTS 5.6.4.b and in the “References” section of the bases for PTS 3.4.4; and (3) removing the brackets from “[PTLR]” in PTS Sections 1.1 and 3.4.4. The staff finds that referencing Revision 5 of NEDC-33441P in the PTS and bases is acceptable because it describes the NRC-approved P/T methodology and bounding P/T limits that are applicable to North Anna 3. Therefore, these PTLR-related COL items are resolved in accordance with Option 2.
- Minimum control rod drive scram accumulator pressure (COL Items 3.1.5-1 and 3.9.5-1). The applicant proposed to replace the bracketed information in the bases for SR 3.1.5.1 as follows:

The GTS SR 3.1.5.1 bases state the following:

> The minimum accumulator pressure of [12.76 MPaG (1850 psig) is well below the expected pressure of 14.82 MPaG (2150 psig) (Ref. 2)].

The PTS SR 3.1.5.1 bases, instead state the following:

> The minimum accumulator pressure of 12.75 MPaG (1849 psig) reflects a bounding value based on the ABWR CRD HCU accumulator minimum pressure value. Using the ABWR minimum pressure value is bounding and thereby justified based on:
>
> a) ESBWR frictional pressure loss is similar to the ABWR design,
>
> b) ESBWR control rod is lighter in weight than the ABWR control rod,
>
> c) ESBWR normal reactor pressure on scram initiation is similar to ABWR, and
>
> d) Mechanical losses should be bounded, since the basic mechanical designs are the same.

For the reasons stated above in the proposed bases for PTS SR 3.1.5.1, the staff concludes that the value of 12.75 megapascals gauge (MPaG) (1,849 pounds per square inch gauge [psig]) is a useable bounding value for the minimum accumulator pressure and is therefore acceptable as a control rod operability criterion in PTS 3.1.5 and PTS 3.9.5. Because the “expected pressure” value is not a criterion for control rod operability, stating it in the bases for PTS SR 3.1.5.1 is not necessary. Therefore, the proposed resolution of COL Items 3.1.5-1 and 3.9.5-1 is acceptable.

Option 3. The staff determines whether the site-specific information provided under Option 3 is acceptable by verifying that the PTS administrative program for controlling the relocated information (1) conforms to the GTS, if the GTS contains such a program, or conforms to applicable regulatory requirements; (2) specifies using an NRC-approved methodology for determining site-specific information to be maintained outside of the PTS; (3) specifies establishing a document to record the most recent version of the relocated information; (4) specifies controlling changes to the specified document in accordance with 10 CFR 50.59, "Changes, Tests and Experiments," and the specified NRC-approved methodology; and (5) specifies the schedule for providing the NRC with updates to the specified document. The staff also verifies that the PTS include appropriate references to the proposed PTS administrative program, if they are needed to establish a connection between the relocated information and the associated individual PTS requirements.

Dominion does not need to use Option 3 to resolve any COL items, because the two areas of site-specific information to which Option 3 would potentially apply were resolved as part of the ESBWR DCD. These areas are (1) instrumentation allowable values for as-found trip settings, and (2) the list of required instrumentation functions for post-accident monitoring (PAM). The GTS specifies instrumentation allowable values by (a) removing all instrumentation settings and (b) specifying a setpoint control program that meets the acceptance criteria stated above for a PTS administrative program under Option 3. The only COL information needed to complete the PTS instrumentation requirements is in PTS 5.5.11. COL Item 5.5.11-1 guidance in Table 16.0-1-A of DCD Section 16.0 states that a COL applicant may complete this item by providing the reference to the NRC-approved setpoint methodology. As described above, the applicant resolved COL Item 5.5.11-1 using Option 1. Dominion incorporated GTS 5.5.11 by reference into the PTS. Because the ESBWR DCD references RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," Revision 4, issued in June 2006, the DC applicant recognized that the list of PAM instrumentation functions specified in GTS 3.3.3.2, "PAM Instrumentation," could not be finalized before the issuance of a COL. Therefore, the GTS include Specification 5.5.14, "PAM Instrumentation Program," which requires a program to provide controls to establish accident-monitoring instrumentation required by GTS 3.3.3.2 to include all Type A, B, and C functions as determined by RG 1.97, Revision 4. Dominion incorporated GTS 5.5.14 by reference into the PTS. Therefore, the staff finds that PTS 5.5.11 and 5.5.14 are acceptable. Based on the above information, COL Item 16.0-1-A is resolved.

In the phase 2 SER with Open Items, the staff stated that RAI 16-1 was a SER open item because the applicant had not completed all the COL items in Table 16.1. The staff's review of the COLA finds the options to resolve each COL item acceptable and in accordance with DC/COL-ISG-08; therefore, Open Item RAI 16-1 is resolved and closed. Also, in the phase 2 SER with Open Items, the staff stated that 16-1 was a SER open item concerning the resolution of the two exemption requests, completion of all the items in Table 16.1, and the incorporation of ESBWR certified design GTS and bases. The applicant's two exemptions requests are no longer part of the COLA. The completion of the COL items is fully described above and the staff finds this acceptable and in accordance with DC/COL-ISG-08. The incorporation of the ESBWR certified design GTS and bases is described above and the staff verified that, except for the COL items, the PTS and bases are identical to the GTS and bases that have received final NRC approval. Therefore, Open Item 16-1 is now resolved and closed. Further, in the phase 2 SER with Open Items, the staff stated that item [1-1] was a SER open item to track completion of the SER on the ESBWR GTS and bases. As stated earlier in Section 16.4 of this document the staff's review of the GTS and bases is completed and documented as part of the ESBWR DC FSER. Therefore, the phase 2 SER Open Item [1-1] is resolved and closed.

The staff also determined, after reviewing Part 7 of the COLA, that the North Anna 3 COLA contains no Tier 1, Tier 2*, or Tier 2 departures from the ESBWR generic DCD that affect the PTS and bases. The COLA also contains no issues concerning information outside of the generic DCD that need to be resolved before completing the review of the PTS and bases.

16.5 Post Combined License Activities

There are no post-COL activities related to this chapter.

16.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirms that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this chapter. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG-1966.

In addition, the staff compared the additional COL site-specific information (site-specific TS) in the application to the relevant NRC regulations, the acceptance criteria defined in SRP Section 16.0, and other regulatory guidance. The staff's evaluation finds that the site-specific information is acceptable and that the PTS and bases, without any exemptions, are complete and accurate for use in the operation of North Anna 3. The staff's review confirms that the applicant has adequately addressed COL Items STD COL 16.0-1-A and STD SUP 16.0-1.

Therefore, the staff concludes that the PTS and bases satisfy 10 CFR 50.36; 10 CFR 50.36a; 10 CFR 52.79(a)(30).

References

1. 10 CFR 50.36, "Technical specifications."

2. 10 CFR 50.36a, "Technical specifications on effluents from nuclear power reactors."

3. 10 CFR 50.59, "Changes, tests and experiments."

4. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

5. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

6. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

7. ANSI/ANS-3.1-1993, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants."

8. Federal Register, 33 FR 18610, "Technical Specifications for Facility Licenses; Safety Analysis Reports," December 17, 1968.

9. Federal Register, 52 FR 3788, "Proposed Policy Statement on TS Improvements for Nuclear Power Reactors," February 6, 1987.

10. Federal Register, 58 FR 39132, "Final Policy Statement on TS Improvements for Nuclear Power Reactors," July 22, 1993.

11. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

12. IEEE Std. 450-2010, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications."

13. IEEE Std. 485-2010, "IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications."

14. Murley, T.E., NRC, Letter to W.S. Wilgus, Chairman, Babcock & Wilcox Owners Group, May 9, 1988 (ADAMS Accession No. ML11264A057).

15. NEDE-33304P-A, Revision 4, "GEH ESBWR Setpoint Methodology, "May 2010 (ADAMS Accession Nos. ML101450250, ML101450251, ML101450253).

16. NEDO-33441 (and NEDC-33441P), "GE Hitachi Nuclear Energy Methodology for the Development of Economic Simplified Boiling Water Reactor (ESBWR) Reactor Pressure Vessel Pressure-Temperature Curves," Revision 5, March 3, 2011. (ADAMS Accession No. ML110670090.)

17. NRC GL 1982-33, "Supplement 1 to NUREG 0737-Emergency Response Capabilities," December 17, 1982. (ADAMS Accession No. ML031080548.)

18. NRC ISG DC/COL-ISG-08, "Necessary Content of Plant-Specific Technical Specifications When a Combined License Is Issued," December 9, 2008 (ADAMS Accession No. ML083310259).

19. NRC RG 1.163, "Performance-Based Containment Leak-Test Program," September 1995 (ADAMS Accession No. ML003740058).

20. NRC RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)," February 1978 (ADAMS Accession No. ML003739995).

21. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

22. NRC RG 1.97, Revision 4, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," June 2006 (ADAMS Accession No. ML061580448).

23. NRC Staff NUREG-0123, "Standard Technical Specifications for General Electric Boiling Water Reactors," August 1971 (Now replaced with NUREG-1433 and NUREG-1434).

24. NRC Staff NUREG-0737, Supplement 1, "Clarification of TMI Action Plan Requirements," January 1983 (ADAMS Accession No. ML051390367).

25. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

26. NRC Staff NUREG-1433, Volume 1, Revision 3, "Standard Technical Specifications, General Electric Plants, BWR/4," June 2004 (ADAMS Accession No. ML041910194).

27. NRC Staff NUREG-1434, Volume 1, Revision 3, "Standard Technical Specifications General Electric Plants, BWR/6," June 2004 (ADAMS Accession No. ML041910204).

28. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084)

29. SECY-93-067, "Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors," March 17, 1993 (58 FR 39132, July 22, 1993).

30. U.S Code 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

17.0 QUALITY ASSURANCE

17.0 QUALITY ASSURANCE

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) Quality Assurance (QA) Program, including the following:

- QA for design, fabrication, construction, testing, and operation
- The Reliability Assurance Program (RAP)
- The Maintenance Rule (MR) Program

17.0.1 Introduction

The QA Program for design, fabrication, construction, testing, and operation; the Design Reliability Program; and the MR Program are discussed in this chapter.

17.0.2 Summary of Application

Section 17.0 "Quality Assurance Records" of the North Anna 3, COL Final Safety Analysis Report (FSAR), Revision 8, incorporates by reference Section 17.0 of the certified Economic Simplified Boiling-Water Reactor (ESBWR) Design Control Document (DCD), Revision 10, issued April 2014, referenced in Appendix E, "Design Certification Rule for the ESBWR Design," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in FSAR Section 17.0, the applicant provided the following information:

Supplemental Information

- NAPS SUP 17.0-1

In Section 17.0 of the North Anna 3 COL FSAR, Revision 8, the applicant provided supplemental information that states:

> The QAPD [Quality Assurance Program Description] applicable to the COL licensee is described in Section 17.5. The licensee's QAPD describes the basis of the program, its scope of activities, and the control of work performed by suppliers.

17.0.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design." In addition to the relevant requirements of the Commission regulations in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," and in 10 CFR 52.79(a)(25) for QA during the design phase; the associated acceptance criteria are described in Section 17.5 of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," the Standard Review Plan (SRP).

17.0.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 17.0 of the certified ESBWR DCD. The staff reviewed Section 17.0 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>Supplemental Information</u>

- NAPS SUP 17.0-1

In FSAR Section 17.0, the applicant states:

> The QAPD applicable to the COL licensee is described in Section 17.5. The licensee's QAPD describes the basis of the program, its scope of activities, and the control of work performed by suppliers.

The staff's evaluation of North Anna 3 COL FSAR Section 17.0 is in Section 17.5 of this SER.

The staff reviewed NAPS SUP 17.0-1 and determined that it adequately references FSAR Section 17.5 for a description of the basis of the QA Program, its scope of activities, and the control of work performed by suppliers.

17.0.5 Post Combined License Activities

There are no post COL activities related to this section.

17.0.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COL application (COLA) to the relevant NRC regulations, the guidance in SRP Sections 17.1 and 17.5, and other NRC regulatory guides (RGs). The staff's review finds that the applicant has adequately addressed the supplemental information by referencing FSAR Section 17.5.

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[1] See "*Finality of Referenced NRC Approvals*" in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

17.1 Quality Assurance During Design

17.1.1 Introduction

This section of the North Anna 3 COL FSAR, Revision 8, addresses the QA Program related to the design phase, including the preparation of the COLA and site-specific design activities.

Nuclear Energy Institute (NEI) 06-14A, “Quality Assurance Program Description,” is a technical report that was approved by the staff to be used as a generic template by early site permit (ESP) and COL applicants to implement NRC regulatory requirements related to QA programs (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070510300). Upon the issuance of the North Anna 3 COL Chapter 17 SER with open items in 2009 (ADAMS Accession No. ML091240315), the North Anna Unit 3 QAPD was developed using NEI 06-14A, Revision 4. The North Anna Unit 3 QAPD included in Revision 8 of the North Anna 3 COL FSAR was written consistent with the SRP. The staff’s requests for additional information (RAIs) from the initial review of the QAPD, their resolution, and the review of the North Anna 3 QAPD included in the North Anna 3 COL FSAR, Revision 8, were reviewed using SRP Section 17.5 and are addressed in Section 17.5 of this SER.

17.1.2 Summary of Application

Section 17.1 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 17.1 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 17.1, the applicant provides the following:

Supplemental Information

- NAPS SUP 17.1-1

In FSAR Revision 8 Section 17.1, the applicant provides supplemental information that states:

> QA applied during the preparation of the ESPA [early site permit application] is described in SSAR [site safety analysis report] Chapter 17, which is incorporated by reference.

- NAPS SUP 17.1-2

In FSAR Revision 8 Section 17.1, the applicant provides supplemental information that states:

> QA applied during COL application preparation and site specific design activities is addressed in Section 17.5.

17.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition to the relevant requirements of the Commission regulations in 10 CFR Part 50, Appendix B and in 10 CFR 52.79(a)(25) for QA during the design phase, the associated acceptance criteria are described in SRP Section.

17.1.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 17.1 of the certified ESBWR DCD. The staff reviewed Section 17.1 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

Supplemental Information

- NAPS SUP 17.1-1

In FSAR Revision 8 Section 17.1, the applicant provides supplemental information that states:

> Quality Assurance (QA) applied during the preparation of the ESPA is described in SSAR Chapter 17, which is incorporated by reference.

- NAPS SUP 17.1-2

In FSAR Revision 8 Section 17.1, the applicant provides supplemental information that states:

> QA applied during COL application preparation and site specific design activities is addressed in Section 17.5.

The staff reviewed Supplemental Information NAPS SUP 17.1-1 and NAPS SUP 17.1-2 and determined that they adequately reference SSAR Chapter 17 and Section 17.5 of the North Anna 3 COL FSAR, Revision 8, for a description of the QA Program applied during the design phase and ESPA, including COLA preparation and site-specific design activities.

17.1.5 Post Combined License Activities

There are no post COL activities related to this section.

17.1.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional supplemental information in the COLA to the relevant NRC regulations, the guidance in SRP Sections 17.1 and 17.5, and other NRC RGs. The staff's review in Section 17.5 of this SER concluded that the applicant has presented adequate information in the North Anna 3 COL FSAR, Revision 8, to meet the requirements.

17.2 Quality Assurance During Construction and Operations

17.2.1 Introduction

This section of the North Anna 3 COL FSAR, Revision 8, addresses the QA Program during the construction and operations phases of the plant, including adapting the design to the plant-specific implementation.

17.2.2 Summary of Application

Section 17.2 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 17.2 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 17.2, the applicant provides the following:

COL Items

- NAPS COL 17.2-1-A — QA Program for the Construction and Operations Phases
- NAPS COL 17.2-2-A — QA Program for Design Activities

The applicant provided additional information to address DCD COL Items 17.2-1-A and 17.2-2-A. The applicant stated that the QA Program in place during the construction and operations phases, including the adaptation of the design to the specific plant implementation, is described in Section 17.5 of the North Anna 3 COL FSAR.

17.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition to the relevant requirements of the Commission regulations in 10 CFR Part 50, Appendix B and in 10 CFR 52.79(a)(25) for QA during the design phase, the associated acceptance criteria are described in SRP Section 17.5.

17.2.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 17.2 of the certified ESBWR DCD. The staff reviewed Section 17.2 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to this section.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Items

- NAPS COL 17.2-1-A — QA Program for the Construction and Operations Phases
- NAPS COL 17.2-2-A — QA Program for Design Activities

The licensee's QA Program in place during the construction and operations phases, including the adaptation of the design to the specific plant implementation, is described in Section 17.5. These COL Items are addressed in Section 17.5 of this SER.

The staff reviewed COL Items NAPS COL 17.2-1-A and NAPS COL 17.2-2-A to determine whether they meet NRC regulations by following the guidance in SRP Section 17.5. SRP Section 17.5 provides an outline of a QA program acceptable to the staff for the design certification, ESP, COL, construction permit, and operating license applicants. The staff developed SRP Section 17.5 using American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1–1994, "Quality Assurance Requirements for Nuclear Facility

Applications," supplemented by additional regulatory and industry guidance for nuclear operating facilities. SRP Section 17.5 also addresses additional QA requirements in 10 CFR Part 50, Appendix A, "General Design for Nuclear Power Plants," General Design Criterion 1 (GDC 1), and in 10 CFR 52.79(a)(25). GDC 1 requires that a QA program be established and implemented. 10 CFR 52.79(a)(25) addresses QA program requirements for the design, fabrication, construction, and testing of the structures, systems, and components (SSCs) of a facility.

The staff's safety evaluation of North Anna 3 COL FSAR Section 17.2 is in Section 17.5 of this SER. The staff determined that COL Items NAPS COL 17.2-1-A and NAPS COL 17.2-2-A adequately reference FSAR Section 17.5 for a description of the QA Program applied during the design, construction, and operations phases, including the adaptation of the design to the specific plant implementation. The technical evaluations of COL Items NAPS COL 17.2-1-A and NAPS COL 17.2-2-A are in Subsection 17.5.4.21, "Additional Quality Assurance and Administrative Controls for the Plant Operational Phase," of this SER.

17.2.5 Post Combined License Activities

There are no post COL activities related to this section.

17.2.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 17.2, and other NRC RGs. The staff's safety evaluation of North Anna 3 COL FSAR Section 17.2 is in Section 17.5 of this SER. The staff concluded that the North Anna 3 COL FSAR, Revision 8 Section 17.2, is acceptable and meets NRC regulatory requirements.

17.3 <u>Quality Assurance Program Description</u>

17.3.1 Introduction

This section of the North Anna 3 COL FSAR, Revision 8, addresses the overall QA Program.

17.3.2 Summary of Application

Section 17.3 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 17.3 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 17.3, the applicant provides the following:

<u>COL Item</u>

- NAPS COL 17.3-1-A   Quality Assurance Program Document

In FSAR Section 17.3, the applicant states:

> The Quality Assurance Program Document applicable to the licensee is described in Section 17.5.

17.3.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition to the relevant requirements of the Commission regulations in 10 CFR Part 50, Appendix B and in 10 CFR 52.79(a)(25) for QA during the design phase, the associated acceptance criteria are described in SRP Section 17.5.

17.3.4 Technical Evaluation

As documented in NUREG–1966, staff reviewed and approved Section 17.3 of the certified ESBWR DCD. The staff reviewed Section 17.3 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the QAPD.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- NAPS COL 17.3-1-A Quality Assurance Program Document

In FSAR Section 17.3, the applicant states:

> The Quality Assurance Program Document applicable to the licensee is described in Section 17.5.

The staff's review of this COL item is in Section 17.5 of this SER.

The staff reviewed COL Item NAPS COL 17.3-1-A to determine whether it meets NRC regulations by following the guidance in SRP Section 17.5. SRP Section 17.5 provides an outline of a QA program acceptable to the staff for the design certification, ESP, COL, construction permit, and operating license applicants. The staff developed SRP Section 17.5 using ASME NQA-1-1994 supplemented by additional regulatory and industry guidance for nuclear operating facilities. SRP Section 17.5 also addresses additional QA requirements in 10 CFR Part 50, Appendix A, GDC 1, and 10 CFR 52.79(a)(25). GDC 1 requires that a QA program be established and implemented. 10 CFR 52.79(a)(25) addresses QA program requirements for the design, fabrication, construction, and testing of the SSCs of a facility. The staff determined that COL Item 17.3-1-A adequately references FSAR Section 17.5 for details of the QAPD.

17.3.5 Post Combined License Activities

There are no post COL activities related to this section.

17.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Section 17.3, and other NRC RGs. The staff's technical evaluation of the QAPD is in Section 17.5 of this SER. The staff concluded that the North Anna 3 COL FSAR, Revision 8 Section 17.3, is acceptable and meets NRC regulatory requirements.

17.4 Reliability Assurance Program During Design Phase

17.4.1 Introduction

This section of the North Anna 3 COL FSAR, Revision 8, addresses the Commission's direction in the staff requirements memorandum (SRM) dated June 28, 1995, for Item E, "Reliability Assurance Program," of SECY–95–132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," dated May 22, 1995. The RAP was implemented using the guidance in Item E of SECY–95–132. The purposes of the RAP are to provide reasonable assurance that:

- A plant is designed, constructed, and operated consistent with the assumptions and risk insights for the SSCs in the scope of the RAP.
- These SSCs do not degrade to an unacceptable level of reliability, availability, or condition during plant operations.
- The frequency of transients that challenge these SSCs is minimized.
- These SSCs function reliably when challenged.

The purposes of the RAP can be achieved by implementing the program in two stages. The first stage applies to RAP activities that occur before the initial fuel load and is referred to as the Design-Reliability Assurance Program (D-RAP). The goal of the D-RAP is to ensure that the plant's design meets the considerations identified earlier through the plant's design, procurement, fabrication, construction, and preoperational testing activities and programs. The second stage applies to RAP activities for the operations phase of the plant's life cycle. The objective during this stage is to ensure that the reliability for the SSCs within the scope of the RAP is maintained during plant operations. Implementation of the D-RAP by the COL licensee is verified using the inspections, tests, analyses, and acceptance criteria (ITAAC) process, as well as inspections conducted during the detailed design and construction phases before the initial fuel load.

17.4.2 Summary of Application

Section 17.4 of the North Anna 3 COL FSAR, Revision 8, incorporates by reference Section 17.4 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 17.4, the applicant provides the following:

COL Item

- STD COL 17.4-1-A Identifying Site-Specific Structures, Systems, and Components Within the Scope of the Reliability Assurance Program

In FSAR Section 17.4.1, "Introduction," the applicant states:

> There are no site specific SSCs within the scope of the Reliability Assurance Program (RAP). The quality elements for all SSCs within the scope of the Design Reliability Assurance Program (D-RAP) are in accordance with the Quality Assurance Program Description (QAPD).

In FSAR Section 17.4.6, "SSC Identification/Prioritization," the applicant states:

> The list of risk-significant SSCs will be confirmed via the ITAAC (see DCD Tier 1 Table 3.6-1).

- STD COL 17.4-2-A Operation Reliability Assurance Activities

In FSAR Section 17.4.1, the applicant states:

> The objectives of reliability assurance during the operations phase are integrated into the Quality Assurance Program (Section 17.5), the MR Program (Section 17.6), and other operational programs. Specific reliability assurance activities are addressed within operational programs (e.g., maintenance rule, surveillance testing, in-service testing, in-service inspection, and quality assurance) and the maintenance programs.
>
> The MR Program incorporates the following aspects of operational reliability assurance (refer to Section 17.6):
>
> - Use of probabilistic risk assessment (PRA) importance measures, the expert panel process, and deterministic methods to determine the list of risk-significant SSCs.
> - Evaluation and maintenance of the reliability of SSCs in the scope of the D-RAP.
> - Monitoring the effectiveness of maintenance activities needed for operational reliability assurance.
> - Classifying, initially, as high-safety-significant, all SSCs that are in the scope of the D-RAP, or applying expert panel review for any exceptions.
> - Use of historical data and industry operating experience on equipment performance, as available.
> - Use of specific criteria to establish the level of performance or condition being maintained for SSCs within the scope of the MR Program; and use of monitoring to identify declining trends between surveillances and to minimize the likelihood of undetected performance or condition degradation to unacceptable levels, to the extent possible.

- Use of maintenance programs to determine the nature and frequency of maintenance activities to be performed on plant equipment, including SSCs within the scope of the MR Program.

In FSAR Section 17.4.9, "Operational Reliability Assurance Activities," the applicant states:

> Refer to Section 17.4.1 for the implementation of reliability assurance during the operations phase.

In FSAR Section 17.4.10, "Owner/Operator's Reliability Assurance Program," the applicant states:

> The MR Program is described in Section 17.6. Refer to Section 17.4.1 for the implementation of reliability assurance activities.

17.4.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition the associated acceptance criteria are described in SRP Section 17.4.

In particular, the relevant guidance for the RAP, including the associated acceptance criteria, is in the following sources:

- Item E of SECY-95-132

- Section 17.4, Revision 1, "Reliability Assurance Program," of NUREG–0800

17.4.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 17.4 of the certified ESBWR DCD. The staff reviewed Section 17.4 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the RAP.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>*COL Items*</u>

- STD COL 17.4-1-A — Identifying Site-Specific Structures, Systems, and Components Within the Scope of the Reliability Assurance Program

In Section 17.4.13 of the referenced ESBWR DCD, Tier 2, Revision 10, COL Item 17.4-1-A states:

> The COL Applicant will identify the site-specific SSCs within the scope of the RAP, and describe the quality elements for developing and implementing the D-RAP (that is, Organization, Design Control, Procedures and Instructions, Records, Corrective Action, and Audit Plans) that will be applied prior to the initial fuel load (Subsection 17.4.1).

The applicant addresses this COL item in Section 17.4.1 of the North Anna 3 COL FSAR, Revision 8.

ESBWR DCD, Tier 2, Revision 10, contains COL Item 17.4-1-A to ensure that COLAs referencing the ESBWR design contain a list of site-specific RAP SSCs (i.e., the RAP SSCs identified in Section 17.4 of ESBWR DCD Tier 2 and updated, as needed, using COL site- and plant-specific information) and describe the quality elements for developing and implementing the plant-specific D-RAP, which are applied during all plant design and construction activities prior to the initial fuel load. It is necessary to identify the site-specific RAP SSCs prior to the detailed design, procurement, fabrication, construction, inspection, and testing phases of the plant, because the nonsafety-related RAP SSCs are subjected to the appropriate QA controls in accordance with SRP Section 17.5, Part V ("Non-safety-Related SSC Quality Controls"). The quality elements of the D-RAP are processes and controls to ensure that (1) the risk insights and key assumptions from probabilistic, deterministic, and other methods of analysis used to identify and quantify risk are consistent with the designed and constructed plant; and (2) the list of RAP SSCs is appropriately developed, maintained, updated, and communicated to the appropriate organizations.

The applicant stated in Section 17.4.1 of the North Anna 3 COL FSAR, Revision 8 that no site-specific SSCs are within the scope of the RAP. The staff evaluated this assertion as follows.

In Appendix 19AA of the North Anna 3 COL FSAR, Revision 8, the applicant describes an evaluation of site-specific parameters to confirm that the values assumed in the PRA for these parameters provide bounding treatments of the parameters with respect to the results of the PRA. The staff considered this evaluation in its review of Appendix 19AA of the North Anna 3 COL FSAR, Revision 8, and found it acceptable. Further, in Appendix 19AA of the FSAR, the applicant states that in addition to the bounding treatment of the PRA parameters, there were no departures from the standard design in any systems considered in the PRA model. Therefore, there were no site-specific design features that affected the PRA because the boundary of the certified design covers all of the SSCs necessary for the PRA. Regarding the RTNSS SSCs, Appendix 19A of the ESBWR DCD, Tier 2, Revision 10, is incorporated by reference into North Anna 3 COL FSAR, Revision 8 with a single departure and no supplements. The departure specifies augmented design criteria for non-seismic structures housing the RTNSS Criterion C systems. This departure exceeds NRC expectations described in SECY-95-132 and will not result in the addition of site-specific nonsafety-related RTNSS systems beyond the scope of the DCD. Therefore, based on the review of information in Chapter 19 of North Anna 3 COL FSAR, Revision 8, the staff agrees that the list of SSCs within the scope of the RAP for North Anna 3 is identified in Section 17.4 of the ESBWR DCD, Tier 2, Revision 10, which is incorporated by reference into North Anna 3 COL FSAR, Revision 8.

The COL applicant added the following new paragraph at the end of FSAR Section 17.4.6:

> The list of risk-significant SSCs will be confirmed via ITAAC (see DCD Tier 1, Table 3.6-1).

The staff found this statement acceptable since the D-RAP ITAAC in ESBWR DCD Tier 1, Table 3.6-1 will ensure that the design of the SSCs within the scope of the RAP is consistent with the risk insights and key assumptions from the probabilistic, deterministic, and other methods of analysis used to identify and quantify risk. This includes applying the quality elements of the D-RAP during design and construction activities to ensure that the list of RAP SSCs is appropriately developed, maintained, and communicated to the appropriate organizations.

- STD COL 17.4-2-A Operation Reliability Assurance Activities

In Section 17.4.13 of the referenced ESBWR DCD Tier 2, Revision 10, COL Item 17.4-2-A requires the applicant to describe operational reliability assurance activities that meet the objectives of the RAP during the operations phase. In FSAR Section 17.4.1, the applicant describes an acceptable process for integrating the RAP into operational programs to meet the objectives of the RAP during the operations phase. The process involves integrating the RAP into operational programs that include the (1) MR Program with all RAP SSCs categorized as having a high safety significance; (2) QA Program for safety-related SSCs established through Appendix B to 10 CFR Part 50 requirements; (3) QA controls for nonsafety-related RAP SSCs established in accordance with Part V of SRP Section 17.5; and (4) in-service inspection, in-service testing, surveillance testing, and maintenance programs for the RAP SSCs. The applicant refers to FSAR Section 17.5 for the QA Program and Section 17.6 for the MR Program.

The second paragraph in Section 17.4.9 of the ESBWR DCD, Tier 2, Revision 10 states that the COL holder is responsible for implementing the operational reliability assurance activities. The applicant replaced the second paragraph with the following sentence:

> Refer to Section 17.4.1 for the implementation of reliability assurance during the operations phase.

The staff found this replacement acceptable, because FSAR Section 17.4.1 describes how the applicant will implement the reliability assurance activities during the operations phase.

The fifth bullet in Section 17.4.10 of the ESBWR DCD, Tier 2, Revision 10 describes the scope of the MR Program and that it is the responsibility of the licensee. The applicant replaced the fifth bullet with the following sentence:

> MR Program: The MR Program is described in Section 17.6.

The staff found this replacement acceptable because FSAR Section 17.6 describes the applicant’s MR Program, which meets the scope defined under the fifth bullet in DCD Section 17.4.10. The staff’s technical evaluation of North Anna 3 COL FSAR Section 17.6 is in Section 17.6 of this SER.

The last sentence in ESBWR DCD, Tier 2, Revision 10, Section 17.4.10 states, “See Subsection 17.4.1 for COL information requirements.” The applicant replaced this sentence with the following sentence:

> Refer to Section 17.4.1 for the implementation of reliability assurance activities.

The staff found this replacement appropriate.

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has adequately addressed the required information relating to COL Items STD COL 17.4-1-A and STD COL 17.4-2-A consistent with the applicable requirements described in Section 17.4.3 of this SER. Therefore, these COL items are closed.

17.4.5 Post Combined License Activities

There are no post COL activities related to this section.

17.4.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the RAP that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations, the guidance in SRP Section 17.4, Revision 1, and other NRC RGs. The staff's review concluded that the applicant has provided sufficient information to address the COL items and to satisfy the NRC requirements in Section 17.4.3 of this SER.

17.5 Quality Assurance Program Description – Design Certification, Early Site Permits, and New License Applicants

17.5.1 Introduction

This section of the North Anna 3 COL FSAR, Revision 8, discusses the overall QA Program; including the QA Program that is applicable during the design, construction, and operations phases of a nuclear power plant.

17.5.2 Summary of Application

Section 17.5 of the North Anna 3 COL FSAR, Revision 8 refers to Section 17.1 of the certified ESBWR DCD, Revision 10, referenced in 10 CFR Part 52, Appendix E. In addition, in FSAR Section 17.5, the applicant provides the following:

COL Items

- NAPS COL 17.2-1-A — QA Program for the Construction and Operations Phases

- NAPS COL 17.2-2-A — QA Program for Design Activities

In FSAR Section 17.5, the applicant states:

> QA applied to activities to adapt the design to specific plant implementation, construction, and operations is addressed in Dominion QAPD (Appendix 17AA). The QAPD is based on NEI 06-14A.

- NAPS COL 17.3-1-A — Quality Assurance Program Document

In FSAR Section 17.5, the applicant states:

> QA applied to the DC activities is described in DCD Section 17.1.
>
> QA applied during the preparation of the ESP application is described in SSAR Chapter 17.

Supplemental Information

- NAPS SUP 17.5-2

In FSAR Section 17.5, the applicant states:

> QA applied to safety-related activities performed prior to start of construction (e.g., site investigation, design and safety analysis, early procurements) is described in the Dominion Nuclear Facility QAPD (Reference 17.5-201) topical report for the Dominion operating nuclear plants as supplemented by COL Project procedures.

- NAPS SUP 17.5-3

Supplemental Information NAPS SUP 17.5-3 addresses and resolves ESBWR DCD COL Items 17.2-1-A, 17.2-2-A, and 17.3-1-A. This supplemental information describes the QA Program that will be applied to the construction and operations phases. Appendices 17AA and 17BB of the North Anna 3 COL FSAR include the QAPD and the North Anna 3 QAPD, respectively, which will be applied during construction and operations.

17.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966. In addition the relevant requirements of the Commission regulations for the QAPD, and the associated acceptance criteria, are in SRP Section 17.5.

The applicable regulatory requirements for Dominion’s QAPD are as follows:

- Appendix B to 10 CFR Part 50 requires the applicant to include in the application a description of the QA Program that will be applied to the design, fabrication, construction, and testing of the SSCs of the facility and to establish QA requirements for the design, construction, and operation of those SSCs. The pertinent requirements of Appendix B apply to all activities affecting the safety-related functions of the SSCs including designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling, and modifying these activities.

- 10 CFR 52.79(a)(17) requires that the application include information with respect to compliance with technically relevant positions of the Three Mile Island requirements of 10 CFR 50.34(f).

- 10 CFR 52.79(a)(25) requires that the description of the QA program include a discussion of how the applicable requirements of Appendix B have been and will be satisfied and a discussion of how the QA program will be implemented.

- 10 CFR 52.79(a)(27) requires that the application include information on the managerial and administrative controls to be used for a nuclear power plant and a discussion of how the applicable requirements of Appendix B will be satisfied.

From March 24 through March 27, 2014, the staff conducted a limited scope inspection at Dominion’s facility in Glen Allen, VA, as documented in Inspection Report 05200017/2014-202 dated April 15, 2014 (ADAMS Accession No. ML14101A098). The purpose of the NRC inspection was to verify that the QA processes and procedures were effectively implemented with regard to the North Anna 3 COLA. The NRC inspectors identified no findings of significance.

17.5.4 Technical Evaluation

Supplemental Information

- NAPS SUP 17.5-2

In RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” Regulatory Position C.I.17.5.3 states that applicants may use an existing QAPD that the NRC has approved for current use provided that the applicant identifies and justifies alternatives to or differences from the SRP in effect 6 months before the docket date of the application. The staff issued RAI 17.5-1 (ADAMS Accession No. ML081760334), dated June 24, 2008, and requested that the applicant provide an evaluation for the existing QAPD at that time against the acceptance criteria in SRP Section 17.5.

In the response to RAI 17.5-1 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant evaluated the QAPD with respect to SRP Section 17.5 acceptance criteria. The applicant provided a table illustrating each acceptance criterion in SRP Section 17.5, and whether the QAPD met the criteria or the criteria were not applicable. The table was included in the COL FSAR as Table 1.9-201. As a result of the evaluation, the applicant found that with the exception of some criteria, the QAPD conformed to the acceptance criteria in SRP Section 17.5. The staff found the applicant’s response to RAI 17.5-1 acceptable. Therefore, RAI 17.5-1 is resolved and closed.

- NAPS SUP 17.5-3

On June 24, 2008, the staff issued RAI 17.5-2 (ADAMS Accession No. ML081760334) and requested that the applicant clarify the scope of work for each Appendix as it relates to design and procurement activities, by identifying when and where these design and procurement activities will take place and specifying under which QAPD these activities will be conducted.

In the response to RAI 17.5-2 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant provided the current scope of work for each Appendix as it relates to design and procurement activities. The applicant clarified that General Electric-Hitachi (GEH) (Wilmington, NC) would be responsible for design activities associated with the COL review, and Bechtel (Frederick, MD) would be responsible for construction site preparation. In addition, Bechtel would oversee procurement for items and services such as design work, and GEH would oversee activities for manufacturing and fabricating the reactor pressure vessel. These activities would be conducted under the North Anna 3 QAPD described in FSAR Appendix 17BB. The North Anna 3 QAPD would be ready for implementation by June 2009. The staff found the applicant’s response to RAI 17.5-2 acceptable because the applicant had satisfactorily clarified the scope of each Appendix. Therefore, RAI 17.5-2 is resolved and closed.

The staff reviewed and evaluated the North Anna 3 QAPD supplemental information included in the RAI 17.5-2 response to determine whether it met NRC regulations by adhering to the guidance in SRP Section 17.5. SRP Section 17.5 provides the acceptance criteria for QA programs for DC, ESP, COL, and operating license applicants. The QAPD at this time for North Anna 3 was the top-level document that establishes the QA measures applied for activities related to the design, construction, and operation of an ESBWR at the North Anna 3 site. Part I, Section 1.1 of the North Anna 3 QAPD lists the quality activities to which the QAPD applies. Although this list is not all inclusive, the staff noted that siting is on the list. The staff issued RAI 17.5-3 (ADAMS Accession No. ML081760334) on June 24, 2008, and requested the applicant clarify how siting activities would be subject to this QAPD since the North Anna 3 ESP had been approved.

In the response to RAI 17.5-3 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that siting activities subject to the North Anna 3 QAPD are associated with any additional design work or measurements required to support construction. Additional subsurface measurement activities would be performed consistent with ASME NQA-1-1994, Basic Requirement 3, Supplement 3S-1, Basic Requirement 11, Supplement 11S-1, and subsurface investigation requirements in Subpart 2.20. The staff endorsed NQA-1-1994 as an acceptable approach to meet Appendix B to 10 CFR Part 50 requirements. Therefore, the staff finds the applicant’s response to RAI 17.5-3 acceptable. Therefore, RAI 17.5-3 is resolved and closed.

In evaluating the adequacy of the North Anna 3 QAPD, the staff used the guidance in SRP Section 17.5, “Quality Assurance Program Description – Design Certification, Early Site Permit and New License Applicants," hereafter referred to as SRP Section 17.5. SRP Section 17.5 provides acceptance criteria for the design certification, ESP, COL, construction permit, and operating license applicants and is based on ASME NQA-1-1994, as supplemented by additional regulatory and industry guidance for nuclear operating facilities. SRP Section 17.5 also addresses additional QA requirements in 10 CFR Part 50, Appendix A, GDC 1, and 10 CFR 52.79(a)(25). GDC 1 requires that a QA program be established and implemented. 10 CFR 52.79(a)(25) addresses the QA program requirements for the design, fabrication, construction, and testing of the SSCs of a facility.

The staff reviewed Revision 8 of the North Anna 3 COL FSAR. Appendix 17AA of the FSAR is the Topical Report DOM-QA-2, “North Anna Unit 3 Quality Assurance Program Description,” (North Anna 3 QAPD) Revision 6. The North Anna 3 QAPD addresses the QA Program that will be applied to activities after submitting the COLA to adapt the design to plant-specific implementation, construction, and operations.

The North Anna 3 QAPD is based on NEI 06–14A, Revision 7. The NRC concluded that the NEI 06-14 template provides an acceptable format for establishing a QA program that meets the requirements of Appendix B to 10 CFR Part 50, as documented in the SE for NEI 06-14, “Final Safety Evaluation for Technical Report NEI 06-14,’Quality Assurance Program Description,’ Revision 9,” (ADAMS Accession No. ML101800497).

17.5.4.1 Organization

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.A, by providing an organizational description for a new plant license, the independence of working and checking organizations, and the interrelationships of new plant and existing utility organizations. The North Anna 3 QAPD describes an organizational structure that clearly delineates those management positions responsible for establishing, maintaining, and implementing regulatory requirements from corporate through operating plant positions. The North Anna 3 QAPD describes functional responsibilities and position descriptions during the construction, preoperational, and operations phases; and characterizes the controls and transitions between phases. It allows management to size the QA organization commensurate with its assigned duties and responsibilities.

On June 24, 2008, the staff issued RAI 17.5-4 (ADAMS Accession No. ML081760334) and requested that the applicant provide a flow chart to delineate the organizational interfaces and interrelationships between the North Anna corporate and onsite QA organizations.

In the response to RAI 17.5-4 (ADAMS Accession No. ML082200545) dated August 4, 2008, and supplemented by a letter dated September 11, 2008 (ADAMS Accession No. ML082610417), the applicant included Figures II.1-1 and II.1-2 to identify the organization for the construction and operations phases, respectively. The staff's subsequent review of NEI 06-14A, which was used by the applicant to develop the QAPD and the evaluation of the extent of information that the organizational section of the QAPD needed to include, was tracked as Open Item 17.5-4. The NRC reviewed NEI 06-14A and concluded that the NEI template can be used by applicants of 10 CFR Part 52 permits or licenses, as applicable, for establishing a QA program that complies with the requirements of 10 CFR Part 50, Appendix B and 10 CFR Part 52. The review of the North Anna 3 QAPD, which is formatted to NEI 06-14A, provides a clear illustration in the QAPD of the interrelationships between the North Anna corporate and onsite QA organizations. The staff therefore finds the response to RAI 17.5-4 acceptable, and Open Item 17.5-4 is resolved and closed.

The staff noted that the North Anna 3 QAPD provides a reference to North Anna 3 COL FSAR Chapter 13 for a more detailed description of the operating organization. The staff issued RAI 17.5-7 (ADAMS Accession No. ML081760334), dated June 24, 2008, and requested the applicant to clarify which regulation (i.e., 10 CFR 50.54(a) or 10 CFR 50.59, "Changes, tests, and experiments,") will be applied to changes in the operating organizational description included in FSAR Chapter 13.

The applicant chose to describe the detailed organizational responsibilities for operating the facility in Chapter 13 of the FSAR to minimize duplication of information between Chapters 13 and 17. This detailed description is incorporated by reference in Chapter 17. Because the organization is implementing the QA Program described in Chapter 17, the applicant will manage any changes to the organization in accordance with 10 CFR 50.54(a) to ensure the appropriate review and approval process. On August 4, 2008, the applicant responded to RAI 17.5-7 (ADAMS Accession No. ML082200545) stating that FSAR Section 13.1.1 commits to the changes of the organization that will be reviewed under the provisions of 10 CFR 50.54(a). This review will ensure that any reduction in commitments under the QAPD will be submitted to and approved by the staff before implementation. On this basis, the staff finds the response to RAI 17.5-7 acceptable and therefore, RAI 17.5-7 is resolved and closed.

In establishing the QA Program controls, the North Anna 3 QAPD commits to implementing the quality requirements described in NQA-1-1994, Basic Requirement 1 and Supplement 1S-1, without alternatives or exceptions. The staff determined that the organization controls are in accordance with the guidance in SRP Section 17.5 and are therefore acceptable.

17.5.4.2 Quality Assurance Program

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.B for establishing the necessary measures to implement a QA program to ensure that the design, construction, and operation of nuclear power plants are in accordance with governing regulations and license requirements. The QA Program comprises those planned and systematic actions necessary to provide confidence that SSCs will perform their intended safety function, including certain nonsafety-related SSCs and activities that are significant contributors to plant safety. The QA Program requires a list or system identifying SSCs and activities applicable to the North Anna 3 QAPD.

10 CFR 52.79, "contents of applications; technical information in final safety analysis report," identifies the technical information required in the applicant's FSAR. The staff noted that an earlier version of the QAPD provides a reference to 10 CFR 50.34(b)(6)(ii). The staff issued

RAI 17.5-5 (ADAMS Accession No. ML081760334), dated June 24, 2008, and requested the applicant to revise the cited regulation.

In the response to RAI 17.5-5 dated August 4, 2008 (ADAMS Accession NO. ML082200545), the applicant correctly cited 10 CFR 52.79(a)(27) rather than 10 CFR 50.34(b)(6)(ii). The change was shown on the attached FSAR markup. The applicant submitted FSAR Revision 1 in December 2008 without incorporating the reference to the regulation. Instead, the applicant decided to change it to "Regulations." In a conference call on February 25, 2009, the applicant mentioned that the change was based on the latest revision to NEI 06-14A that included the word "regulation." The staff's subsequent review of NEI 06-14A that the applicant had used to develop the QAPD, and the evaluation of the reference to the regulation, were tracked as Open Item 17.5-5.

The applicant's change to the North Anna 3 QAPD in Revision 8, as discussed in Section 17.1 of this SER, and the submittal of FSAR Revision 8 updated the commitment to 10 CFR 50.54(a), which references 10 CFR 52.79 requirements. Therefore, Open Item 17.5-5 is resolved and closed.

The North Anna 3 QAPD provides measures to assess the adequacy of the QAPD and to ensure its effective implementation at least once each year or at least once during the life of a quality-related activity, whichever is shorter. The period for assessing the QAPD during the operations phase may be extended to once every 2 years. In addition, consistent with SRP Section 17.5, Paragraph II.B.8, a grace period of 90 days is applied to activities that must be performed on a periodic basis. The grace period does not allow the "clock" for a particular activity to be reset forward. However, the "clock" for an activity may be reset backwards when an activity is performed early.

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraphs II.S and II.T, for describing the necessary measures to establish and maintain formal indoctrination and training programs for personnel performing, verifying, or maintaining activities within the scope of the QAPD to ensure that task-related proficiency is maintained. Plant technical specifications delineate the minimum qualifications for plant and support staff. Personnel complete the training for positions identified in 10 CFR 50.120, "Training and qualification of nuclear power plant personnel," according to programs accredited by the National Nuclear Accrediting Board of the National Academy for Nuclear Training. The North Anna 3 QAPD provides the minimum training requirements for managers responsible for QAPD implementation and for the manager responsible for planning, implementing, and maintaining the QAPD.

The North Anna 3 QAPD commits the applicant to the quality requirements described in NQA-1-1994, Basic Requirement 2 and Supplements 2S-1, 2S-2, 2S-3, and 2S-4, with the following clarifications and exceptions:

- NQA-1-1994, Supplement 2S-1

    Supplement 2S-1 will include use of the guidance provided in Appendix 2A-1 the same as if it were part of the Supplement. During the operations phase, the following two alternatives may be applied to the implementation of this Supplement and Appendix:

    (1) In lieu of being certified as Level I, II, or III in accordance with NQA-1-1994, personnel that perform independent quality verification inspections, examinations, measurements, or tests of material, products, or activities will be required to possess qualifications equal to or better than those required for performing the task being verified; and the verification is within the skills of these personnel and/or is addressed by procedures. These

individuals will not be responsible for the planning of quality verification inspections and tests (i.e., establishing hold points and acceptance criteria in procedures, and determining who will be responsible for performing the inspections), evaluating inspection training programs, nor certifying inspection personnel.

The staff evaluated this proposed alternative and determined that it is consistent with inspection and test personnel initial qualification requirements specified in SRP Section 17.5, Paragraph II.T.5. Therefore, the staff concluded that this alternative is acceptable.

(2) A qualified engineer may be used to plan inspections, evaluate the capabilities of an inspector, or evaluate the training program for inspectors. For the purpose of these functions, a qualified engineer is one who has a baccalaureate in engineering in a discipline related to the inspection activity (such as electrical, mechanical, civil) and has a minimum of five years engineering work experience with at least two years of this experience related to nuclear facilities. The staff evaluated this proposed alternative and determined that the designation of a qualified engineer to plan inspections, evaluate inspectors, or evaluate the inspector qualification programs is consistent with the training and qualification criteria of 10 CFR Part 50, Appendix B, Criterion II, "Quality Assurance Program," and NQA-1–1994, Supplement 2S-1. Therefore, the staff concluded that this alternative is acceptable.

The staff evaluated this proposed alternative and determined that the designation of a qualified engineer to plan inspections, evaluate inspectors, or evaluate the inspector qualification programs is consistent with the training and qualification criteria of Appendix B to 10 CFR Part 50, Criterion II, and NQA-1–1994, Supplement 2S-1. Therefore, the staff concluded that this alternative is acceptable.

- NQA-1-1994, Supplement 2S-2

In lieu of Supplement 2S-2, for qualification of nondestructive examination personnel, North Anna 3 will follow the applicable standard cited in the version(s) of Section III and Section XI of the ASME Boiler and Pressure Vessel Code approved by the NRC for use at the North Anna 3 site.

The staff evaluated this proposed alternative and determined that it is consistent with the regulation in 10 CFR Part 50, Appendix B, Criterion II. Therefore, the staff concluded that this alternative is acceptable.

- NQA-1-1994, Supplement 2S-3

The requirement that prospective Lead Auditors have participated in a minimum of five audits in the previous 3 years is replaced by the following, "The prospective lead auditor shall demonstrate his/her ability to properly implement the audit process, as implemented by Dominion, to effectively lead an audit team, and to effectively organize and report results, including participation in at least one nuclear audit within the year preceding the date of qualification."

The staff evaluated this proposed alternative and determined that it is consistent with the regulation in 10 CFR Part 50, Appendix B, Criterion II. Therefore, the staff concluded that this alternative is acceptable.

The staff evaluated this proposed alternative and determined that it is consistent with quality requirements in SRP Section 17.5 and is therefore acceptable.

In establishing the QA Program controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 2 and Supplements 2S-1, 2S-2, 2S-3, and 2S-4, with the exceptions and alternatives described above. The staff determined that the QA Program controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.3 Design Control

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.C, for establishing the necessary measures to control the design; design changes; and temporary modifications (e.g., temporary bypass lines, electrical jumpers and lifted wires, and temporary setpoints) of items within the scope of the QAPD. The North Anna 3 QAPD includes provisions to control design inputs, outputs, changes, interfaces, records, and organizational interfaces among the applicant and the suppliers. These provisions ensure that the design inputs (such as design bases and the performance, regulatory, quality, and quality verification requirements) are correctly translated into design outputs (such as analyses, specifications, drawings, procedures, and instructions). In addition, the North Anna 3 QAPD provides for individuals knowledgeable about QA principles to review design documents to ensure that they contain the necessary QA requirements.

In establishing design controls, the North Anna 3 QAPD commits to implement the requirements described in NQA-1-1994, Basic Requirement 3, and Supplement 3S-1, Subpart 2.20 for subsurface investigation and Subpart 2.7 for computer software QA controls without alternatives or exceptions. The staff determined that the design controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.4 Procurement Document Control

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.D, for establishing the necessary administrative controls and processes to ensure that procurement documents include or reference applicable regulatory, technical, and QA Program requirements. Applicable technical, regulatory, administrative, quality, and reporting requirements (such as specifications, codes, standards, tests, inspections, and special processes); and the regulation in 10 CFR Part 21, “Reporting of Defects and Noncompliance,” are invoked for the procurement of items and services.

The North Anna 3 QAPD commits the applicant to the quality requirements described in NQA-1-1994, Basic Requirement 4 and Supplement 4S-1, with the following alternatives and exceptions:

- NQA-1-1994, Supplement 4S-1

    Section 2.3 of Supplement 4S-1 includes a requirement that procurement documents require suppliers to have a documented QA program that implements NQA-1-1994, Part 1. In lieu of this requirement, Dominion may require suppliers to have a documented supplier QA program that is determined to meet the applicable requirements of 10 CFR 50 Appendix B, as appropriate to the circumstances of the procurement.

The staff evaluated this proposed alternative and determined that it is consistent with 10 CFR Part 50, Appendix B, Criterion IV, “Procurement Document Control.” Therefore, the staff concluded that this alternative is acceptable.

> With regard to service performed by a supplier, Dominion procurement documents may allow the supplier to work under the North Anna 3 QAPD, including the implementation of procedures, in lieu of the supplier's own QA program.

The staff evaluated this proposed alternative and determined that the applicant's QAPD follows the guidance of SRP Section 17.5, Paragraph II.G. Specifically, the QAPD provides measures for evaluating prospective suppliers so that only qualified suppliers are selected; acceptance actions are performed for procuring products and services; and suppliers are periodically audited and evaluated to ensure that qualified suppliers continue to provide acceptable products and services. Therefore, the staff concluded that this alternative is acceptable.

> In NQA-1–1994, Section 3 of Supplement 4S-1 requires procurement documents to be reviewed prior to bidding for or awarding a contract. The quality assurance review of procurement documents is satisfied through review of the applicable procurement specification, including the technical and quality procurement requirements, prior to bid or award of contract. Procurement document changes (e.g., scope, technical or quality requirements) will also receive the quality assurance review.

The staff evaluated this proposed alternative and determined that it is in accordance with SRP Section 17.5 and provides an adequate review of procurement documents before awarding a contract and after any changes. Therefore, the staff concluded that this alternative is acceptable.

> Procurement documents for commercial-grade items that will be procured by Dominion for use as safety-related items shall contain technical and quality requirements such that the procured item can be appropriately dedicated.

The staff evaluated and determined that Dominion's action is consistent with the staff guidance in Generic Letter (GL) 89–02, "Actions to Improve the Detection of Counterfeit and Fraudulently Marked Products," dated March 21, 1989; and GL 91–05, "Licensee Commercial-Grade Procurement and Dedication Programs," dated April 9, 1991; as delineated in SRP Section 17.5, Paragraphs II.U.1.d and II.U.1.e. Therefore, the staff concluded that this alternative is acceptable.

In establishing the procurement document controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 4 and Supplement 4S-1, with the alternatives and exceptions described above. The staff determined that the procurement document controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.5 Instructions, Procedures, and Drawings

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.E, for establishing necessary measures and governing procedures to ensure that activities affecting quality are prescribed by and performed in accordance with documented instructions, procedures, and drawings.

In establishing controls for instructions, procedures, and drawings, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 5, without alternatives or exceptions. The staff determined that the controls for instructions, procedures, and drawings are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.6 Document Control

The North Anna 3 QAPD establishes the necessary measures and governing procedures to ensure that activities affecting quality are prescribed by and performed in accordance with documented instructions, procedures, and drawings.

In establishing document controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 6, without alternatives or exceptions. The staff determined that the document controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.7 Control of Purchased Material, Equipment, and Services

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.G, for establishing necessary measures and governing procedures that control the procurement of items and services to ensure conformance with specified requirements. The controls include measures for evaluating prospective suppliers and selecting only those that are qualified. In addition, controls include auditing and evaluating suppliers to ensure that qualified suppliers continue to provide acceptable products and services.

The program provides for acceptance actions such as source verification, receipt inspection, and pre- and post-installation tests and also reviews of documentation such as certificates of conformance to ensure that the procurement, inspection, and test requirements have been satisfied before relying on the item to perform its intended safety function. Purchased items (components, spares, and replacement parts necessary for plant operation, refueling, maintenance, and modifications) and services are subject to quality and technical requirements at least equivalent to those specified for original equipment or by properly reviewed and approved revisions to design documentation, thus ensuring that the items are suitable for the intended service and are of acceptable quality that is consistent with their effect on safety.

In establishing procurement verification controls, the North Anna 3 QAPD commits the applicant to the quality standards described in NQA-1-1994, Basic Requirement 7 and Supplement 7S-1, with the following clarifications and exceptions:

- NQA-1-1994, Supplement 7S-1

  North Anna 3 considers that other 10 CFR Part 50 licensees, authorized nuclear inspection agencies, National Institute of Standards and Technology (NIST), or other State and Federal agencies that may provide items or services to the Dominion North Anna 3 plant are not required to be evaluated or audited.

The staff acknowledged that no additional audits or evaluations are required for 10 CFR Part 50 licensees, authorized nuclear inspection agencies, the National Voluntary Laboratory Accreditation Program (NVLAP) administered by NIST, and other State and Federal agencies performing work under quality programs that are acceptable to the NRC. However, the applicant remains responsible for ensuring that procured items or services conform to Appendix B to 10 CFR Part 50, to applicable ASME Code requirements, and to other regulatory requirements and commitments. The applicant also remains responsible for ensuring that the items or services are suitable for their intended application and for documenting the evaluations that support this conclusion. The staff concluded that this exception is consistent with SRP Section 17.5 and is therefore acceptable.

When purchasing commercial-grade calibration services from a calibration laboratory, procurement source evaluation and selection measures do not need to be performed provided that all of the following conditions are met:

- The purchase documents impose any additional technical and administrative requirements, as necessary, to comply with the North Anna 3 QA Program and technical provisions. At a minimum, the purchase document shall require that the calibration certificate/report include identification of the laboratory equipment/standard used.

- The purchase documents require reporting as-found calibration data when calibrated items are found to be out-of-tolerance.

- A documented review of the supplier's accreditation will be performed and will include a verification of each of the following:

    1. The calibration laboratory holds a domestic (United States) accreditation by any one of the following bodies, which are recognized by the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement:

        a. NVLAP, administered by NIST;
        b. American Association for Laboratory Accreditation (A2LA);
        c. ACLASS Accreditation Services (ACLASS);
        d. International Accreditation Service (IAS);
        e. Laboratory Accreditation Bureau (L-A-B);
        f. Other NRC-approved laboratory accrediting body.

    2. The accreditation encompasses American Nuclear Society (ANS)/International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 17025, "General Requirements for the Competence of Testing and Calibration Laboratories."

    3. The published scope of accreditation for the calibration laboratory covers the necessary measurement parameters, range, and uncertainties.

The staff determined that the provisions of this exception are consistent with the guidance in SRP Section 17.5, Paragraph II.L.8, for the procurement of commercial-grade calibration services for safety-related applications and as documented in a previous staff SE (ADAMS Accession No. ML052710224). The staff expects full conformance to the guidance in SRP Section 17.5, Paragraphs II.L.8 and II.L.8.h that the alternative method is limited to domestic calibration suppliers.

- For NQA-1-1994, Section 8.1, Dominion considers documents that may be stored in approved electronic media under Dominion or vendor control, not physically located on the plant site, but are accessible from the respective nuclear facility site, as meeting the NQA-1 requirement for documents to be available at the site. When construction is complete, sufficient as-built documentation will be turned over to Dominion to support operations. The Dominion records management system will provide for timely retrieval of necessary records.

The staff determined that the implementation of this alternative would allow access to and review of the necessary documented evidence at the nuclear facility site, both before installation and before use. Therefore, the staff concluded that this alternative is acceptable.

- In lieu of the requirements of NQA-1-1994, Supplement 7S-1, Section 10, “Commercial Grade Items,” controls for commercial-grade items and services are established in North Anna 3 documents using 10 CFR Part 21 and the guidance of Electrical Power Research Institute (EPRI) NP-5652, “Guideline for the Utilization of Commercial-Grade Items in Nuclear Safety-Related Applications (NCIG-07),” dated 1988 and as discussed in GL 89-02 and GL 91-05.

- For commercial-grade items, special quality verification requirements are established and described in Dominion documents to provide the necessary assurance that an item will perform satisfactorily in service. The Dominion documents address determining the critical characteristics to ensure that an item is suitable for its intended use, that there is a technical evaluation of the item, that receipt requirements are met, and that there is a quality evaluation of the item.

  In establishing controls for commercial-grade dedication, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 7 and Supplement 7S-1; and in the guidance of EPRI NP-5652 as discussed in GL 89-02 and GL 91-05. The staff determined that the controls for commercial-grade dedication are in accordance with the guidance in SRP Section 17.5 and are therefore acceptable.

- Dominion will also use other appropriate and approved regulatory means and controls to support Dominion’s commercial-grade dedication activities. Dominion will assume 10 CFR Part 21 reporting responsibility for all items that Dominion dedicates as safety-related.

The staff evaluated this clarification and concluded that it is acceptable with the understanding that any work conducted under this QA Program, Dominion assumes reporting responsibility.

In establishing the controls for purchased materials, equipment, and services, the North Anna 3 QAPD commits to implement the quality requirements described NQA-1-1994, Basic Requirement 7 and Supplement 7S-1, with the exceptions and alternatives described above. The staff determined that the controls for purchased materials, equipment, and services are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.8 Identification and Control of Materials, Parts, and Components

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.H, for establishing necessary measures for the identification and control of items such as materials — including consumables and items with a limited shelf life; parts, components, and partially fabricated subassemblies. The identification of items is maintained throughout fabrication, erection, installation, and use so that the item is traceable to its documentation.

In establishing the controls for the identification and control of materials, parts, and components; the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 8 and Supplement 8S-1, without alternatives or exceptions. The staff determined that the controls for the identification and control of materials, parts, and components are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.9 Control of Special Processes

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.I, for the control of special processes. The North Anna 3 QAPD establishes programs, procedures, and processes to ensure that special processes requiring interim controls to maintain quality (such as welding, heat treating, and nondestructive examination); are implemented and controlled in accordance with applicable codes, specifications, and standards.

In establishing the controls for special processes, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 9 and Supplement 9S-1, without alternatives or exceptions. The staff determined that the controls for special processes are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.10 Inspection

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.J, for establishing necessary measures to implement inspections ensuring that items, services, and activities affecting safety meet established requirements and conform to documented specifications, instructions, procedures, and design documents. The inspection program establishes requirements for planning inspections, determining applicable acceptance criteria, setting the frequency of inspection, and identifying special tools needed to perform the inspection. Qualified personnel perform the inspections and are independent of those who performed or directly supervised the work.

In establishing inspection requirements, the North Anna 3 QAPD commits the applicant to the quality requirements described in NQA-1-1994, Basic Requirement 10, Supplement 10S-1; and Subparts 2.4, 2.5, and 2.8, with the following alternatives and exceptions:

- Subpart 2.4 commits Dominion to the use of the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 336–1985, “IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities.” IEEE Std 336–1985 refers to IEEE Std 498–1985, “IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities.” Both IEEE Std 336–1985 and IEEE Std 498-1985 use the definition of “Safety Systems” from IEEE Std 603–1980, “IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations.” North Anna 3 commits to the definition of safety systems in IEEE Std 603–1980 but does not commit to the balance of that standard. This definition is only applicable to equipment in the context of Subpart 2.4.

- An additional exception to Subpart 2.4 is addressed in Part II, Section 12 of the QAPD.

- Where inspections at the operating facility are performed by persons within the same organization (e.g., maintenance group), Dominion takes exception to the requirements of NQA-1-1994, Supplement 10S-1, Section 3.1, in that the inspectors report to the site’s Senior Manager for Safety and Licensing while performing those inspections.

The staff concluded that the North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.J, for inspections. The North Anna 3 QAPD establishes the necessary measures for implementing inspections to ensure that items, services, and activities affecting safety meet established requirements and conform to applicable documented specifications, instructions, procedures, and design documents. The inspection program establishes requirements for planning inspections, determining applicable acceptance criteria, setting the frequency of inspections, and identifying special tools needed to perform the inspection. Properly qualified personnel independent of those who performed or directly supervised the work are required to perform the inspections.

In establishing the controls for inspections, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 10, Supplement 10S-1; and Subparts 2.4, 2.5, and 2.8, with the alternatives and exceptions described above. The staff determined that the controls for inspections are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.11 Test Control

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.K, for establishing necessary measures and governing provisions to demonstrate that items within the scope of the QAPD will perform satisfactorily in service. Test programs include criteria for determining when testing is required, in order to demonstrate that the performance of equipment and plant systems is in accordance with the design. Testing programs also include provisions to establish and adjust test schedules, and to maintain the status for periodic or recurring tests when applicable. Tests are performed according to applicable procedures that include (as applicable and consistent with the effect on safety) (1) instructions and prerequisites for performing the tests; (2) the use of proper test equipment and acceptance criteria; (3) mandatory verification points as needed to confirm satisfactory test completion; (4) any special qualification requirements for personnel; and (5) any special environmental conditions. Test results are documented and evaluated by the organization performing the test and are reviewed by a responsible authority to assure that the test requirements have been satisfied.

In establishing provisions for testing, the North Anna 3 QAPD commits the applicant to comply with the quality requirements described in NQA-1-1994, Basic Requirement 11 and Supplement 11S-1. In establishing provisions to ensure that computer software used in applications affecting safety is prepared, documented, verified, tested, and used so that the expected outputs are obtained and the configuration control is maintained; the North Anna 3 QAPD commits the applicant to the quality requirements described in NQA-1-1994, Supplement 11S-2 and Subpart 2.7.

In establishing the test controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Supplement 11S-2 and Subpart 2.7, to establish the appropriate provisions for testing and computer program testing with no alternatives or exceptions. The staff determined that the test controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.12 Control of Measuring and Test Equipment

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.L, for establishing necessary measures to control the calibration; maintenance; and use of measuring and test equipment (M&TE) that provide information important to safe plant operation.

In establishing provisions for the control of M&TE, the North Anna 3 QAPD commits the applicant to comply with the quality standards described in NQA-1-1994, Basic Requirement 12 and Supplement 12S-1, with the following clarifications and exceptions:

- The out-of-calibration conditions described in Paragraph 3.2 of Supplement 12S-1 of NQA-1-1994 refers to when the M&TE is found to be out of the required accuracy limits (i.e., out of tolerance) during calibration.

The staff determined that this clarification for the out-of-calibration conditions is consistent with SRP Section 17.5. Therefore, the staff concluded that this alternative is acceptable.

- M&TE is not required to be marked with the calibration status when it is impossible or impractical due to equipment size or configuration (such as the label will interfere with the operation of the device), provided that the required information is maintained in suitable documentation traceable to the device. This exception also applies to the calibration labeling requirement stated in NQA-1-1994, Subpart 2.4, Section 7.2.1 (ANSI/IEEE Std 336–1985).

The staff determined that this alternative is consistent with the staff's guidance provided in SRP Section 17.5, Paragraph II.L.3. Therefore, the staff concluded that this alternative is acceptable.

In establishing the controls for M&TE, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 12 and Supplement 12S-1, with the alternatives and exceptions described above. The staff determined that the controls for M&TE are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.13 Handling, Storage, and Shipping

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.M, for establishing necessary measures to control the handling, storage, packaging, shipping, cleaning, and preservation of items to prevent inadvertent damage or loss and to minimize deterioration.

In establishing provisions for handling, storage, and shipping, the North Anna 3 QAPD commits the applicant to the quality standards described in NQA-1-1994, Basic Requirement 13 and Supplement 13S-1. The North Anna 3 QAPD also commits the applicant—during the construction and preoperational phase of the plant as applicable—to comply with the guidance of NQA-1-1994, Subpart 2.1, Subpart 2.2, Subpart 2.3, Subpart 3.2, and Appendix 2.1, with the following clarifications and exceptions:

- NQA-1-1994, Subpart 2.1

  Subpart 2.1, Sections 3.1 and 3.2 establish criteria for classifying items into cleanness classes, with requirements for each class. Instead of using the cleanness level system of Subpart 2.1 during the operational phase, Dominion may establish cleanness requirements on a case-by-case basis that are consistent with the other provisions of Subpart 2.1. Dominion will establish appropriate cleanliness controls for work on safety-related equipment to minimize the introduction of foreign material and to maintain system/component cleanliness throughout maintenance or modification activities, including documented verification of the absence of foreign materials before system closure.

The staff determined that this alternative is consistent with the staff's guidance in SRP Section 17.5. Therefore, the staff concluded that this alternative is acceptable.

- NQA-1-1994, Subpart 2.2

Subpart 2.2, Section 2.2 establishes criteria for classifying items into protection levels. Instead of classifying items into protection levels during the operational phase, Dominion may establish controls for the packaging, shipping, handling, and storage of such items on a case-by-case basis; with regard to the item's complexity, use, and sensitivity to damage. Before installation or use, the items are inspected and serviced as needed to assure that no damage or deterioration exists that could affect their functionality.

The staff determined that this alternative is consistent with the staff's guidance in SRP Section 17.5. Therefore, the staff concluded that this alternative is acceptable.

Subpart 2.2, Section 6.6 requires written records containing information on personnel access. As an alternative to this requirement, North Anna 3 documents establish controls for storage areas that describe those who are authorized to access areas and the requirements for recording personnel access. However, these records of access are not considered quality records and will be retained in accordance with the administrative controls of the applicable plant.

The staff determined that these records did not meet the classification of a QA record as defined in NQA-1–1994 Supplement 17S-1, Section 2.7. Therefore, the staff concluded that this alternative is acceptable.

Subpart 2.2, Section 7.1 refers to Subpart 2.15 for requirements related to the handling of items. The scope of Subpart 2.15 includes hoisting, rigging, and transporting items for the nuclear power plant during construction. The staff determined that this clarification is acceptable because it distinguishes between the requirements for construction and operations.

- NQA-1-1994, Subpart 2.3

Subpart 2.3 of Section 2.3 requires the establishment of five zone designations for housekeeping cleanliness controls. Instead of the five-level zone designation during the operational phase, Dominion bases its control over housekeeping activities on a consideration of what is necessary and appropriate for the activity involved. The controls are implemented through procedures or instructions which, in the case of maintenance or modification work, are developed on a case-by-case basis. Factors considered in developing the procedures and instructions include cleanliness control, personnel safety, fire prevention and protection, and radiation control and security. The procedures and instructions make use of standard janitorial and work practices to the extent possible.

The staff concluded that this clarification is consistent with SRP Section 17.5 and is therefore acceptable.

- NQA-1-1994, Subpart 3.2

Subpart 3.2 of Appendix 2.1 establishes cleaning and cleanness controls for fluid systems and associated components. Dominion commits only to Section 3 precautions in accordance with RG 1.37, Revision 1, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants." In addition, North Anna 3 QAPD states that a suitable chloride stress-cracking inhibitor should be added to the fresh water used to flush systems containing austenitic stainless steels.

The staff concluded that this clarification is consistent with SRP Section 17.5 and is therefore acceptable.

In establishing the controls for handling, storage, and shipping, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 12 and Supplement 12S-1, with the exceptions and alternatives described above. The staff determined that the controls for handling, storage, and shipping are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.14 Inspection, Test, and Operating Status

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.N, for establishing necessary measures to identify the inspection, testing, and operating status of items and components within the scope of the QAPD to maintain personnel and reactor safety; and to avert the inadvertent operation of equipment.

In establishing the inspection, test, and operating status controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 14, without alternatives or exceptions. The staff determined that the test controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.15 Nonconforming Materials, Parts, or Components

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.O for establishing necessary measures to control items, including services that do not conform to specified requirements to prevent their inadvertent installation or use. Nonconformances are evaluated for their impact on the operability of quality SSCs to ensure that the final condition does not adversely affect the safety, operation, or maintenance of the item or service. Results of evaluations of conditions adverse to quality are analyzed to identify quality trends that are documented and reported to upper management, in accordance with the applicable procedures.

In addition, the North Anna 3 QAPD establishes the necessary interfaces between the QA Program for the identification and control of nonconforming materials, parts, and components; and the non-QA reporting programs that satisfy the applicable requirements of 10 CFR 50.55(e) and/or 10 CFR Part 21 during the design, construction, and operation phases.

In establishing the controls for nonconforming materials, parts, or components, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 15 and Supplement 15S-1, without alternatives or exceptions. The staff determined that the controls for nonconforming materials, parts, or components are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.16 Corrective Action

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.P for establishing necessary measures to promptly identify, control, document, classify, and correct conditions adverse to quality. The QAPD template requires personnel to identify known conditions adverse to quality. Reports of these conditions are analyzed to identify trends. Significant conditions adverse to quality are documented and reported to the responsible management. In the case of suppliers working on safety-related activities or similar situations, the applicant or holder (as applicable) may delegate specific responsibility for the corrective action program, but the applicant or holder maintains responsibility for the program's effectiveness.

In addition, the North Anna 3 QAPD establishes the necessary interfaces between the QA corrective actions program and the non-QA reporting program to identify, evaluate, and report defects and non-compliance to satisfy the applicable requirements of 10 CFR 50.55(e) and/or 10 CFR Part 21.

In establishing the corrective action controls, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 16 without alternatives or exceptions. The staff determined that the corrective action controls are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.17 Quality Assurance Records

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.Q, for establishing necessary measures to ensure that sufficient records of items and activities affecting quality are generated, identified, retained, maintained, and able to be retrieved.

Regulatory Position C.2 of RG 1.28, Revision 3, "Quality Assurance Program Requirements (Design and Construction)," provides record retention times for lifetime and nonpermanent records. In establishing the retention time for records, the North Anna 3 QAPD provides ESP and COL applicants with the guidance to base the retention on Regulatory Position C.2 and Table 1 of RG 1.28, Revision 3; or by including their specific table in the QAPD. Concerning the use of electronic records storage and retrieval systems, the North Anna 3 QAPD complies with the NRC guidance in GL 88-18, "Proposed Final NRC Generic Letter 88-18, Supplement 1"; "Guidance on Managing Quality Assurance Records in Electronic Media," dated September 13, 1999; RIS 2000-18, "Guidance on Managing Quality Assurance Records in Electronic Media," dated October 23, 2000; and associated Nuclear Information and Records Management Association (NIRMA) Technical Guidelines (TG) 11-1998, "Authentication of Records and Media"; TG 15- 1998, "Management of Electronic Records"; and TG 21-1998, "Electronic Records Protection and Restoration."

In establishing provisions for records, the North Anna 3 QAPD commits the applicant to comply with the quality requirements described in NQA-1-1994, Basic Requirement 17 and Supplement 17S-1, with the following alternatives and exception:

- NQA-1-1994, Supplement 17S-1

  Supplement 17S-1, Section 4.2(b) requires records to be firmly attached in binders or placed in folders or envelopes for storage in steel file cabinets or on shelving in containers. For hard-copy records maintained by Dominion, the records are suitably stored in steel file cabinets or on shelving in containers, except that methods other than binders, folders, or envelopes may be used to organize the records for storage.

The staff concluded that this alternative is consistent with SRP Section 17.5 and is therefore acceptable.

In establishing the controls for QA records, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 17 and Supplement 17S-1, with the exception described above. The staff determined that the controls for QA records are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.18 Quality Assurance Audits

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.R, for establishing necessary measures to implement audits verifying that activities covered by the

North Anna 3 QAPD are performed in conformance with the established requirements. The effectiveness of the audit program is reviewed as part of the overall audit process. The North Anna 3 QAPD provides for the applicant or holder (as applicable) to conduct periodic internal and external audits. Internal audits are conducted to determine the adequacy of the program and its procedures and to determine whether they are meaningful and comply with North Anna 3 QAPD requirements. Internal audits are performed with a frequency commensurate with safety significance and in such a manner as to ensure that an audit of all applicable QA Program elements is completed for each functional area within a period of 2 years after the initial determination that the audit program has been soundly established. External audits determine the adequacy of a supplier's or contractor's QA Program. The applicant's responsible management reviews audit results; these reviews are documented. Management responds to all audit findings and initiates corrective action where indicated. Where corrective actions are indicated, documented follow-up of applicable areas are conducted through inspections, reviews, re-audits, or other appropriate means to verify that corrective actions have been adequately implemented.

In establishing the controls for audits, the North Anna 3 QAPD commits to implement the quality requirements described in NQA-1-1994, Basic Requirement 18 and Supplement 18S-1, without alternatives or exceptions. The staff determined that the controls for audits are in accordance with the guidance of SRP Section 17.5 and are therefore acceptable.

17.5.4.19 Nonsafety-Related SSC Quality Assurance Control

17.5.4.19.1 Nonsafety-Related SSCs – Significant Contributors to Plant Safety

The North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.V.1, for establishing specific program controls to be applied to nonsafety-related SSCs that are significant contributors to plant safety and to which Appendix B of 10 CFR Part 50 does not apply. The North Anna 3 QAPD applies specific controls to these items in a selected manner, so as to target characteristics or critical attributes that render the SSC a significant contributor to plant safety consistent with applicable sections of the Dominion QA Program.

The staff determined that this approach, as described in the North Anna 3 QAPD, is acceptable because it is in alignment with the guidance of SRP Section 17.5, Paragraph II.V.1.

17.5.4.19.2 Nonsafety-Related SSCs Credited for Regulatory Events

In establishing the quality requirements for nonsafety-related SSCs credited for regulatory events, the North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.V.2; and Dominion commits to implement the following regulatory guidance:

- The quality requirements for the fire protection system are in accordance with Regulatory Position 1.7, "Quality Assurance," in RG 1.189, Revision 2, "Fire Protection for Operating Nuclear Power Plants," dated October 2009.

- The quality requirements for anticipated transient without scram (ATWS) equipment are in accordance with GL 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety Related," dated January 16, 1985.

- The quality requirements for station blackout equipment are in accordance with Regulatory Position 3.5, "Quality Assurance and Specific Guidance for Station Blackout Equipment That Is Not Safety-Related," and Appendix A, "Quality Assurance Guidance for Non-Safety Systems and Equipment," in RG 1.155, "Station Blackout," dated August 1988.

The staff determined that this approach, as described in the North Anna 3 QAPD, is acceptable because it is in alignment with the guidance of SRP Section 17.5, Paragraph II.V.2.

17.5.4.20 Regulatory Commitments

The staff evaluated and determined that the North Anna 3 QAPD follows the guidance of SRP Section 17.5, Paragraph II.U, for describing regulatory commitments based on the following information. The QAPD establishes QA Program commitments. In the QAPD, the applicant provides assurance of compliance with the following RGs and other QA standards to supplement and support the QAPD:

- RG 1.8, Revision 3, “Qualification and Training of Personnel for Nuclear Power Plants.”
- RG 1.26, Revision 4, “Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants.” In the QAPD, the applicant provides assurance of compliance with the regulatory positions of this guidance for site-specific SSCs not classified by the ESBWR.
- RG 1.28, Revision 3, “Quality Assurance Program Requirements (Design and Construction).”
- RG 1.29, Revision 4, “Seismic Design Classification.” In the QAPD, the applicant provides assurance of compliance with the regulatory positions of this guidance for site-specific SSCs not classified by the ESBWR.
- RG 1.37, Revision 1, “Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants.”
- RG 1.54, Revision 1, “Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants.”
- RG 1.33, Revision 2, “Quality Assurance Program Requirements (Operations).”
- ASME NQA-1–1994 (Parts I, II, and III).
- NIRMA TGs, as described in Section 17 of the QAPD.

The staff issued RAI 17.5-6 (ADAMS Accession No. ML081760334), dated June 24, 2008, requesting the applicant to clarify its intent regarding its commitment to the guidance of RG 1.37, Revision 1 in DOM-QA-1. Specifically, the staff noted that Section 13.2 of the applicant’s QAPD references the commitment to RG 1.37, Revision 1; but Part IV, “Regulatory Commitments,” of the QAPD does not identify RG 1.37 as a commitment.

In the response to RAI 17.5-6 dated August 4, 2008 (ADAMS Accession No. ML082200545), the applicant stated that the omission of the commitment to RG 1.37 in Part IV of the QAPD was inadvertent. The applicant has revised the FSAR, including the North Anna 3 QAPD, to include the commitment to the guidance of RG 1.37. The staff finds the response to RAI 17.5-6 acceptable, and this RAI is therefore resolved and closed.

On December 2, 2010, the staff issued RAI 17.5-9 (ADAMS Accession No. ML103560116) which requests the following:

> Part IV, "Regulatory Commitments," of Appendix 17AA, "North Anna Power Station Unit 3 Quality Assurance Program Description," states under Regulatory Guide 1.28 that “in ANSI/ASME NQA-1-1983 and the NQA-1a-1993 Addenda provide an adequate basis for complying with the pertinent QA requirements of Appendix B during the design and construction phases of nuclear plants. Dominion commits to the basic and supplementary requirements of NQA-1-1994 in lieu of the 1993 edition and addendum of NQA-1 subject to the clarifications contained in Parts II, IV, and V.” Please clarify whether “NQA-1a-1993” and [the] “1993 edition” are the correct references to be cited in this paragraph.

In the response to this RAI dated January 10, 2011 (ADAMS Accession No. ML110110612), the applicant stated:

> The reference to “NQA-1a-1993 Addenda” and “1993 edition” in FSAR Appendix 17AA, Part IV, “Regulatory Commitments,” for Regulatory Guide 1.28 should be “NQA-1a-1983 Addenda” and “1983 edition,” respectively. FSAR Appendix 17AA will be revised to correct this administrative error.

The staff verified that the FSAR was revised to incorporate this correction. Therefore, RAI 17.5-9 is resolved and closed.

17.5.4.21 Additional Quality Assurance and Administrative Controls for the Plant Operational Phase

The staff evaluated and determined that Part V, “Additional Quality Assurance and Administrative Controls for the Plant Operational Phase,” of the QAPD provides requirements for meeting the regulatory positions of RG 1.33, Revision 2, as an alternative to RG 1.33. In a letter dated January 10, 2011 (ADAMS Accession No. ML110110612), the applicant verified that the North Anna 3 QAPD has incorporated the administrative controls in American Nuclear Standards Institute (ANSI) N18.7–1976/ANS-3.2, “Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants,” and in RG 1.33, Revision 2, which are not included in NQA-1–1994. The applicant also provided an annotated version of NEI 06–14A, Revision 7, Appendix 1, “Table of Where Regulatory Guide 1.33, Revision 2, and ANSI N18.7-1976 Requirements are addressed by NQA-1–1994 Standards and/or the NEI 06-14A QAPD,” which documents this verification. The staff reviewed Part V of the QAPD and the annotated version of NEI 06–14A, Revision 7, Appendix 1. The staff evaluated and determined that the alternative is consistent with the guidance in NEI 06–14, Section 3.2.3.1, “Alternative for Commitment to RG 1.33,” and is therefore acceptable.

On December 2, 2010, the staff issued RAI 17.5-8 (ADAMS Accession No. ML103560116) requesting information on Appendix 17AA to Chapter 17, which was based on NEI 06-14A. Consistent with the staff’s safety evaluation of NEI 06-14A, applicants that do not wish to include a commitment to RG 1.33, Revision 2 in their QAPDs must explicitly address the provisions in Attachment 4 to NEI 06-14A, while also including Part V in their QAPDs. Accordingly, Dominion needed to submit (on the docket) the information in Attachment 4 to NEI 06-14A, as it pertains to the North Anna 3 application; or otherwise include an explicit commitment RG 1.33, Revision 2 in Part IV, “Regulatory Commitments,” of Appendix 17AA.

In the response to RAI 17.5-8 dated January 10, 2011 (ADAMS Accession No. ML110110612), the applicant presented information identified in an accompanying “Table 1” showing how the QAPD met the requirements of RG 1.33, Revision 2. “Table 1” contains and addresses the provisions of NEI 06-14A, Attachment 4. The applicant stated that because the QAPD has since been revised (Revision 2 submitted on June 28, 2010), a revised Table 1 is provided in

Attachment 1 to the RAI response. The revised Table 1 provides the comparison of how NQA-1-1994 and the North Anna 3 QAPD meet the requirements of RG 1.33, Revision 2 and ANSI N18.7-1976. In addition to the revised table, Attachment 1 included a summary of the Revision 2 changes to the North Anna Unit 3 QAPD. Furthermore, the applicant added that NEI 06-14A includes Part V which is required to be addressed; therefore it was incorporated into Revision 2 of the North Anna Unit 3 QAPD. The staff's review finds that the applicant's response is consistent with the guidance in SRP Section 17.5. The staff thus considers the QAPD revision acceptable, and therefore, RAI 17.5-8 is resolved and closed.

On February 9, 2011, the staff issued RAI 17.5-10 (ADAMS Accession No. ML110400768) requesting additional information on Appendix 17AA to Chapter 17, which is based on NEI 06-14A. The RAI states:

> Part V, "Additional Quality Assurance and Administrative Controls for the Operational Phase," Section 2, "Review of Activities Affecting Safe Plant Operation," of Appendix 17AA, describes the independent review function. However:
>
> 1. Reviews of internal audit reports," as a task performed by the organization that executes the independent review functions, is missing from the North Anna Power Station Unit 3 Quality Assurance Program Description. Please explain the basis for not performing the above task.
>
> 2. In NEI 06-14, Revision 9 (NEI 06-14, Rev 7), the independent review function performs, in part, "Reviews proposed tests and experiments not described in the SAR prior to implementation. Verifies the determination of whether changes to proposed tests and experiments not described in the SAR require a technical specification change or license amendment." Whereas the North Anna Power Station Unit 3 Quality Assurance Program Description states "Reviews proposed tests and experiments not described in the SAR. Changes to proposed tests and experiments not described in the SAR that do require a technical specification change must be reviewed by the IRC prior to NRC submittal and implementation." Please provide justification for the deviation from the exact language used in NEI 06-14, Revision 9 (NEI 06-14A, Rev 7).

In the response to RAI 17.5-10 dated March 1, 2011 (ADAMS Accession No. ML110630198), the applicant stated:

> The two discrepancies noted in the question are the result of an administrative error that occurred during the COLA revision process. It is Dominion's intent that the North Anna 3 QAPD be consistent with NEI 06-14, Revision 9 (NEI 06-14A, Rev 7) with regard to the independent review function. Therefore, the North Anna 3 QAPD will be revised to include the internal audit report review requirement as an independent review organization task. Similarly, the description of the independent review function regarding tests and experiments will be revised to be consistent with the wording in the NEI template.

The staff accepted the response to RAI 17.5-10 and verified that the subsequent QAPD revision is consistent with the guidance in SRP Section 17.5. Therefore, RAI 17.5-10 is resolved and closed.

Additionally, the staff verified that the administrative controls included in SRP Section 17.5 were appropriately incorporated into the North Anna 3 COL FSAR. The staff therefore accepted the applicant's verification that all of the required administrative controls had been incorporated into the North Anna 3 QAPD.

Based on the preceding information, the staff concluded that the applicant's QAPD follows the guidance in SRP Section 17.5 for describing additional QA and administrative controls during the operational phase.

The staff evaluated the alternative for the commitment to RG 1.33 and determined that the alternative is consistent with the guidance in SRP Section 17.5 and is therefore acceptable.

17.5.5 Post Combined License Activities

There are no post COL activities related to this section.

17.5.6 Conclusion

The staff reviewed and evaluated Section 17.5 of the North Anna 3 COL FSAR, Revision 8 and the North Anna Unit 3 QAPD, Revision 6. The staff's review concludes that the QA Program described in the Dominion QAPD follows the NRC guidance in and conforms to the format of, SRP Section 17.5. The staff used the acceptance criteria of SRP Section 17.5 as the basis for evaluating the acceptability of Dominion's QA Program and find it in conformance with the provisions of 10 CFR 52.79(a)(17), 10 CFR 52.79(a)(25), 10 CFR 52.79(a)(27), 10 CFR Part 21, and 10 CFR Part 50, Appendix B. The staff finds that the program description adequately describes how the requirements of Appendix B will be implemented. The staff concludes that the proposed Dominion QAPD, Revision 6 complies with Appendix B to 10 CFR Part 50; 10 CFR 52.79(a)(17); 10 CFR 52.79(a)(25); 10 CFR 52.79(a)(27); and 10 CFR Part 21 and is therefore acceptable.

17.6 <u>Maintenance Rule Program</u>

17.6.1 Introduction

This FSAR section addresses the program for MR implementation based on the requirements of 10 CFR 52.79(a)(15) and 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants"; and on the guidance in RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"; and RG 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants." RG 1.160 endorses Nuclear Management and Resource Council (NUMARC) 93–01 Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," which provides one acceptable method for implementing the MR (ADAMS Accession No. ML101020415).
RG 1.182 was issued in May 2000 and is a companion guide to RG 1.160. RG 1.182 provides guidance on implementing the provisions of 10 CFR 50.65(a)(4) by endorsing the February 22, 2000, revision to Section 11 of NUMARC 93–01, Revision 2.

17.6.2 Summary of Application

In the North Anna 3 COL FSAR, Section 17.6, Revision 8, the applicant provides the following:

COL Items

- STD COL 17.4-2-A Maintenance Rule Program

In FSAR Section 17.6, the applicant states:

> NEI 07-02A, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed under 10 CFR Part 52," (Reference 17.6-4) is incorporated by reference with the following supplemental information:

Supplemental Information

- STD SUP 17.6-1

In FSAR Section 17.6, the applicant states:

> The text of the template provided in NEI 07-02A is generically numbered as "17.X." When the template is incorporated by reference into this section, numbering is changed from "17.X" to "17.6."

- STD SUP 17.6-2

In FSAR Section 17.6.3, the applicant states:

> Reliability during the operations phase is assured through the implementation of operational programs described in the FSAR, i.e., the MR Program (FSAR Section 17.6), the Quality Assurance Program (FSAR Section 17.5), the In-service Inspection Program (FSAR Subsection 5.2.4, Section 6.6, and Subsection 3.8.1.7.3), and the In-service Testing Program (FSAR Subsection 3.9.6, and Subsection 3.9.3.7.1(3)(e), as well as the Technical Specifications Surveillance Requirements (FSAR Chapter 16), and maintenance programs.

- STD SUP 17.6-3

In FSAR Subsection 17.6.1.1, the applicant states:

> In Paragraph 17.6.1.1.b, replace "(DRAP - see FSAR Section 17.Y)" with the following text "(See Section 17.4)".

- STD SUP 17.6-4

In FSAR Section 17.6.4, the applicant states:

> Condition monitoring of underground or inaccessible cables is incorporated into the MR Program. The cable condition monitoring program incorporates lessons learned from industry operating experience addresses regulatory guidance, and utilizes information from detailed design and procurement documents to determine the appropriate inspections, tests and monitoring criteria for underground and inaccessible cables within the scope of the maintenance rule (10 CFR 50.65).

17.6.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1966, the FSER related to the certified ESBWR DCD. In addition the program for MR implementation incorporated by reference is in the NRC final SER for NEI 07–02A, Revision 0 dated January 24, 2008 (ADAMS Accession No. ML073650081). NEI 07-02A, Revision 0 provides a complete generic program description for use in developing the section of the COL FSAR associated with SRP Section 17.6 (“Maintenance Rule”).

In addition, the regulatory basis for accepting the MR Program is in the following:

- 10 CFR 50.65
- 10 CFR 52.79(a)(15), which requires a COL FSAR to contain a description of the program and its implementation for monitoring the effectiveness of maintenance necessary to meet the requirements of 10 CFR 50.65.
- RG 1.206, Regulatory Position C.I.17.6, “Description of the Applicant’s Program for Implementation of 10 CFR 50.65, the Maintenance Rule.”

17.6.4 Technical Evaluation

The staff reviewed Section 17.6 of the North Anna 3 COL FSAR, Revision 8, and checked the referenced Topical Report NEI 07-02A template guidance to ensure that the combination of the information in the COL FSAR and the information in NEI 07-02A appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this MR Program.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

<u>COL Items</u>

- STD COL 17.4-2-A		Maintenance Rule Program

The applicant incorporates by reference NEI 07-02A with the following supplemental information. The text in the NEI template guidance is generically numbered as “17.X.” The staff approved this template for FSAR Section 17.6 with site-specific inputs (ADAMS Accession No. ML073650081).

Supplemental Information

- STD SUP 17.6-1

Because the NEI template guidance is generically numbered as “17.X,” the applicant has appropriately changed the numbering from “17.X” to “17.6.” The staff finds this change acceptable.

- STD SUP 17.6-2

In FSAR Section 17.6.3, the applicant specifies the various FSAR sections that discuss the relationship of the MR Program to the RAP activities. The applicant states that the reliability of the SSCs during the operations phase is assured through the implementation of operational programs (i.e., the MR Program) in Section 17.6; the QA Program in Section 17.5; the In-service Inspection Program in Section 5.2.4, Section 6.6, and Subsection 3.8.1.7.3; and the In-service Testing Program in Section 3.9.6 and Subsection 3.9.3.7.1(3)e; the Technical Specifications Surveillance Requirements in Chapter 16; and the maintenance programs. The staff finds that the applicant has adequately addressed this information in FSAR Section 17.6.3.

- STD SUP 17.6-3

Because the NEI template guidance is generically numbered as “17.X” in Paragraph 17.6.1.1.b, the applicant appropriately replaces “(DRAP - see FSAR Section 17.Y)” with “(See Section 17.4).” The staff finds this change acceptable.

- STD SUP 17.6-4

In FSAR Section 17.6.4, the applicant provides supplemental information that discusses the relationship of the MR Program with the industry operating experience activities. In this section, the applicant incorporates condition monitoring of underground or inaccessible cables into the MR Program. The applicant states that the Cable Condition Monitoring Program (1) incorporates lessons learned from industry operating experience; (2) addresses regulatory guidance; and (3) uses detailed design and procurement information to establish appropriate inspections, tests, and monitoring criteria for underground and inaccessible cables within the scope of the MR (10 CFR 50.65). The staff’s documented evaluation of the Cable Condition Monitoring Program is in Section 8.2.4 of this SER.

The staff reviewed the North Anna 3 COL FSAR, Revision 8, Table 13.4-201, “Operational Programs Required by NRC Regulations.” The staff determined that the applicant had identified the MR Program and its associated implementation milestone. The License Condition for the operational program implementation schedule, which includes the MR Program, is in Section 13.4.4, “Post Combined License Activities,” of this SER.

The staff concludes that the information above meets NRC requirements and is thus acceptable.

17.6.5 Post Combined License Activities

There are no post COL activities related to this section.

17.6.6 Conclusion

The staff’s finding related to information incorporated by reference is in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the North Anna 3 COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the MR Program that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations; the guidance in SRP Section 17.6, Revision 1; and other NRC RGs. The staff's review concluded that the applicant has provided sufficient information to address the COL items and to satisfy the NRC requirements. Therefore, the staff finds that the information in Section 17.6 of the North Anna 3 COL FSAR is acceptable and meets the requirements of 10 CFR 52.79(a)(15) and 10 CFR 50.65.

References

1. 10 CFR 50.120, "Training and qualification of nuclear power plant personnel."

2. 10 CFR 50.55a, "Codes and standards."

3. 10 CFR 50.59, "Changes, tests, and experiments."

4. 10 CFR 50.60, "Acceptance criteria for fracture prevention measures for light-water nuclear power reactors for normal operation."

5. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

6. 10 CFR Part 21, "Reporting of Defects and Noncompliance."

7. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

8. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

9. 10 CFR Part 50, Appendix A, GDC 1, "Quality standards and records."

10. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

11. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

12. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

13. ANSI N18.7-1976/ANS-3.2, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants."

14. ASME, NQA-1-1984, "Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants."

15. ASME NQA 1 1994, “Quality Assurance Requirements for Nuclear Facility Applications,” 1994.

16. EPRI-NP-5652, "Guideline for the Utilization of Commercial-Grade Items in Nuclear Safety-Related Applications (NCIG-07)," June 1988.

17. IEEE Std 336-1985, "IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities," 1985.

18. IEEE Std 498-1985, "IEEE Standard Requirements for the Calibration and Control of Measuring and Test Equipment Used in Nuclear Facilities," 1985.

19. IEEE Std 603-1980, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," 1980.

20. NEI 06-14A, Revision 7, "Quality Assurance Program Description," August 2010. (ADAMS Accession No. ML102370305.)

21. NIRMA (Nuclear Information and Records Management Association Technical Guideline, TG 11-1998, "Authentication of Records and Media."

22. NIRMA, TG 15-1998, "Management of Electronic Records."

23. NIRMA, TG 21-1998, "Electronic Records Protection and Restoration."

24. NRC GL 1988-018, "Plant Record Storage on Optical Disks," dated October 20, 1988. (ADAMS Accession No. ML031130450.)

25. NRC GL 1989-002, "Actions to Improve the Detection of Counterfeit and Fraudulently Marked Products," March 21, 1989 (ADAMS Accession No. ML031140060).

26. NRC GL 1991-005, "Licensee Commercial-Grade Procurement and Dedication Programs," April 9, 1991 (ADAMS Accession No. ML031140508).

27. NRC GL 85-06, "Quality Assurance Guidance for ATWS Equipment That Is Not Safety Related," April 16, 1985 (ADAMS Accession No. ML031140390).

28. NRC RG 1.155, Station Blackout," August 1988 (ADAMS Accession No. ML003716792).

29. NRC RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," March 1997 (ADAMS Accession No. ML003761662).

30. NRC RG 1.182, Revision 0, "Assessing and Managing Risk before Maintenance Activities at Nuclear Power Plants," May 2000 (ADAMS Accession No. ML003740117).

31. NRC RG 1.189, Revision 2, Revision 2, "Fire Protection for Operating Nuclear Power Plants," October 2009 (ADAMS Accession No. ML092580550).

32. NRC RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," June 2007 (ADAMS Accession No. ML070720184).

33. NRC RG 1.26, Revision 4, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," March 2007.

34. NRC RG 1.28, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

35. NRC RG 1.29, Revision 4, "Seismic Design Classification," March 2007 (ADAMS Accession No. ML070310052).

36. NRC RG 1.33, Revision 2, "Quality Assurance Program Requirements (Operation)," February 1978 (ADAMS Accession No. ML003739995).

37. NRC RG 1.37, Revision 1, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," March 2007 (Withdrawn- See 79FR38963, July 9, 2014, ADAMS Accession No. ML13345A259).

38. NRC RG 1.54, Revision 1, "Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants," October 2010 (ADAMS Accession No. ML102230344).

39. NRC RG 1.8, Revision 3, "Qualification and Training of Personnel for Nuclear Power Plants," May 2000 (ADAMS Accession No. 003706932).

40. NRC RIS 2000-18, "Guidance on Managing Quality Assurance Records in Electronic Media," October 23, 2000.

41. NRC SECY-95-132, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems (RTNSS) in Passive Plant Designs (SECY-94-084)," May 22, 1995, (ADAMS Accession No. ML003708005), and the related SRM dated June 28, 1995 (ADAMS Accession No. ML003708019).

42. NRC SER on NEI 06-14, "Final Safety Evaluation for Technical Report NEI 06-14,'Quality Assurance Program Description,' Revision 9," July 13, 2010 (ADAMS Accession No. ML101800497).

43. NRC Staff NUREG–0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

44. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

45. NUMARC 93-01, Revision 2, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," April 1996 (ADAMS Accession No. ML101020415).

18.0 HUMAN FACTORS ENGINEERING

18.0 HUMAN FACTORS ENGINEERING

18.1 Introduction

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the proposed North Anna 3 Human Factors design. This includes the human-system interface (HSI) design development, the HSI design goals and bases, the standard HSI design features, and the detailed HSI design and implementation process, with embedded design acceptance criteria, for the Economic Simplified Boiling-Water Reactor (ESBWR).

18.2 Summary of Application

Chapter 18 of the North Anna 3 Combined License (COL) Final Safety Analysis Report (FSAR), Revision 9, incorporates by reference, with no departures and one supplement, Chapter 18 of Revision 10 of the Design Control Document (DCD) for the Economic Simplified Boiling-Water Reactor (ESBWR), referenced in Appendix E to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." In addition, in FSAR Chapter 18, the applicant provides the following:

<u>*COL Item*</u>

- STD COL 18.13-1-A Milestone for Human Performance Monitoring Implementation.

The COL applicant is responsible for providing a milestone for the implementation of the Human Performance Monitoring (HPM) Program. The applicant indicates that a HPM Program will be implemented prior to the beginning of the first licensed operator training class.

18.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design." In addition, the relevant requirements of the Commission regulations for human factors engineering (HFE), and the associated acceptance criteria, are in Chapter 18 of NUREG-0800, "Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)."

18.4 Technical Evaluation

As documented in NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the ESBWR Standard Design," the staff reviewed and approved Chapter 18 of the certified ESBWR DCD. The staff reviewed Chapter 18 of the North Anna 3 COL FSAR and checked the referenced ESBWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference addresses the required information related to HFE.

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[1] See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

COL Item

- STD COL 18.13-1-A   Milestone for Human Performance Monitoring Implementation.

The applicant stated that an HPM program will be implemented before the beginning of the first licensed operator training class.

In ESBWR DCD, Revision 10, Section 18.13.3, "Elements of Human Performance Monitoring Process" states that the HPM strategy is implemented through the use of a representative training simulator during periodic training exercises.

Senior reactor operator and reactor operator licensing requires the use of a full scope training simulator to develop and demonstrate operating competencies. By implementing the monitoring program at the beginning of the first licensing class, the COL applicant has selected the earliest opportunity subsequent to the completion of the HFE design verification and validation to begin collecting performance information. Accordingly, the staff finds that the applicant has adequately addressed this COL item.

18.5 Post Combined License Activities

- STD COL 18.13-1-A   Milestone for Human Performance Monitoring Implementation.

The HPM Program will be implemented prior to the beginning of the first licensed operator training class.

18.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff finds that the application includes all the information relevant to the North Anna 3 HFE design, and the staff confirmed that no outstanding information related to this section remains to be addressed in the COL FSAR. The staff's finding related to information incorporated by reference is in NUREG-1966.

In addition, the staff compared the additional COL information in the application to the relevant NRC regulations, the guidance in SRP Chapter 18, and other NRC regulatory guides. The staff concluded that the applicant has adequately addressed COL Item STD COL18.13-1-A.

References

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

3. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

4. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

5. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

19.0 PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENTS

ATTACHMENT 19.A LOSS OF LARGE AREAS OF THE PLANT DUE TO EXPLOSIONS OR FIRES

19.0 PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENTS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the North Anna 3 Combined License (COL) plant-specific probabilistic risk assessment (PRA) and severe accident evaluations and the applicants adherence to the corresponding regulatory requirements. In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 52.79(a)(46), a combined license application (COLA) is required to contain a description of the plant-specific PRA and its results. In addition,10 CFR 52.79(d)(1) specifies that if the COLA references a design certification (DC), then plant-specific PRA information must use the PRA information from the DC and be updated to account for site-specific design information and any design changes or departures. The PRA provides an evaluation of the risk of core damage and release of radioactive material associated with both internal and external events that can occur during plant operation at power or while shut down.

Attachment 19.A, "Loss of Large Areas of the Plant Due to Explosions or Fire" (public-version), to this chapter of the North Anna 3 SER evaluates the measures identified by the applicant that are needed to comply with requirements to address the loss of large areas (LOLA) of the plant due to explosions or fires from a beyond-design-basis event (BDBE). The NRC regulations in 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) describe these requirements. It should be noted that the non-public Attachment 19.B "Loss of Large Areas of the Plant Due to Explosions or Fire," as well as some documents referenced in Attachment 19.A, include security-related or safeguards information. Therefore, Attachment 19.B, and the references that include security-related or Safeguards Information are withheld from the public in accordance with 10 CFR 2.390, "Public inspections, exemptions, requests for withholding."

19.1 Introduction

This section describes the objectives of the design-specific PRA and severe accident evaluations, and the corresponding regulatory requirements. Section 19.1 of the North Anna 3 COL Final Safety Analysis Report (FSAR), Revision 9, incorporates by reference, with supplemental information to Chapter 19.1, "Introduction," of the Economic Simplified Boiling–Water Reactor (ESBWR) Design Control Document (DCD), Revision 10, referenced in Appendix E, "Design Certification Rule for the ESBWR Design," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," The North Anna 3 COL FSAR Section 19.1 includes a description of site-specific assessments that supplement the standard design PRA and that will be considered when developing a plant-specific PRA prior to initial fuel load.

As documented in NUREG–1966, "Final Safety Evaluation Report related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," the staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Appendix E, "Design Certification Rule for the ESBWR Design," Section VI.B.1, all nuclear safety issues relating to the "Introduction" section, that were incorporated by reference have been resolved.

1 See *"Finality of Referenced NRC Approvals"* in SER Section 1.2.2 for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

In addition the applicant provided in this section of the COL FSAR and Appendix 19AA a description of the site-specific assessments that supplement the standard design PRA. The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes as a result of the NAPS DEP 3.7-1 referred to in this section. Therefore, Confirmatory Item 19.01-1 from the staff advanced SER for North Anna 3 is resolved and closed. This NAPS DEP 3.7-1 provides an evaluation of the impacts of the seismic exceedances of the Certified Seismic Design Response Spectra (CSDRS) on the seismic margin analysis (SMA) for site-specific evaluation of North Anna 3. The staff evaluated the North Anna 3 SMA in Section 19.2 of this SER.

19.2 PRA Results and Insights

19.2.1 Introduction

This section of the SER addresses the results and insights from the North Anna 3 plant-specific PRA, which are documented in Section 19.2, "PRA Results and Insights," of the North Anna 3 COL FSAR, Revision 9.

19.2.2 Summary of Application

Section 19.2 of the North Anna 3 COL FSAR, Revision 8 incorporates by reference Section 19.2 of the ESBWR DCD, Revision 10 with two departures.

Tier 2 Departure

- NAPS DEP 3.7-1 Seismic Margin Analysis

The applicant replaced the third and fourth sentences of the first paragraph under the heading, "Introduction to Evaluation of External Event Seismic," in Section 19.2.3.2.4 of the ESBWR DCD, Revision 10 with the following:

> The seismic margin earthquake for the PRA-based seismic margin assessment is the SSE for each seismic Category I structure as provided in Section 3.7.1. The site specific seismic margins High Confidence, Low Probability of Failures (HCLPF) accident sequence analysis shows that Unit 3 is inherently capable of safe shutdown in response to beyond design basis earthquakes and has a plant level HCLPF of at least 1.67 times the peak ground acceleration of a safe shutdown earthquake (SSE), where the SSE for each seismic Category I structure is provided in Section 3.7.1, in compliance with the SECY 93-087 (DCD Reference 19.2-7) requirement that "PRA insights will be used to support a margins-type assessment of seismic events. A PRA-based seismic margins analysis will consider sequence-level HCLPFs and fragilities for all sequences leading to core damage or containment failures up to approximately one and two-thirds the ground motion acceleration of the Design Basis SSE.

- NAPS DEP 3.7-1 Table 19.2-4R - ESBWR Systems and structures in Seismic Margins Analysis

The applicant replaced note 1 in Table 19.2-4R that stated that the ESBWR DCD minimum HCLPF value of 1.67*SSE, for each seismic Category I structure, will be met for the structures and equipment shown with the plant-specific SSE as described in North Anna 3 FSAR Section 3.7.1.

COL Item

- NAPS COL 19.2.6-1-A — Seismic High Confidence Low Probability of Failure Margins

The applicant replaced the second, third, and fourth sentences of the first paragraph under the heading, “Significant Core Damage Sequences of External Event Seismic,” in Section 19.2.3.2.4 of the ESBWR DCD, Revision 10 with the following.

> As-built SSC [systems, structures, and components] HCLPFs will be compared to those assumed in the seismic margin analysis for the SSCs listed in Table 19.2-4R for the Unit 3 SSE, as defined in Section 3.7.1. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation will be analyzed to determine if any new vulnerabilities have been introduced. This comparison and analysis will be completed prior to fuel load. A minimum HCLPF value of 1.67*SSE will be met for the SSCs identified in Table 19.2-4R.

In Section 19.2.6 of North Anna 3 COL FSAR, Revision 8, the applicant stated that Section 19.2.3.2.4 of the COL FSAR addresses COL Item 19.2.6-1-A, “Seismic High Confidence Low Probability of Failure Margins.” In North Anna 3 FSAR, Section 19.2.3.2.4, the applicant provided information to address DCD COL Item 19.2.6 1 A. The applicant stated that an SMA update (Reference 19.1 201) using site-specific seismic loads documents the results of the fragility analyses and HCLPF values. In addition, a comparison of the as-built SSC HCLPFs will be performed before fuel load.

19.2.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is in NUREG–1966. In addition, the relevant requirements of the Commission regulations for PRA results, and the associated acceptance criteria, are in Chapter 19, “Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors,” of NUREG 0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)” (SRP). The staff review also follows the guidance in DC/COL ISG 020, “Implementation of a Probabilistic Risk Assessment-Based Seismic Margin Analysis for New Reactors,” dated March 15, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML100491233), which contains a detailed process that a COL applicant may use to update the PRA-based SMA of the referenced DC.

The NRC has indicated in SECY-93-087, “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,” dated April 2, 1993, and the associated staff requirements memorandum (SRM), dated July 21, 1993, that a plant designed to withstand the design-basis SSE should have a plant HCLPF capacity of at least 1.67 times the acceleration of the SSE to demonstrate an adequate safety margin with respect to BDBEs.

- 10 CFR 52.79(a)(46) requires that each application for a COL must include a description of the plant-specific PRA and its results. 10 CFR 52.79 (d) (1) further requires that this plant-specific PRA must use the PRA information for the referenced

DC and must be updated to account for site-specific design information and any design changes or departures.

- 10 CFR 50.71(h)(1) requires each COL holder shall maintain and upgrade the PRA. The upgraded PRA must cover initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect 1 year prior to the scheduled date for initial loading of fuel and each required upgrade thereafter.

19.2.4 Technical Evaluation

As documented in NUREG–1966, the NTV staff reviewed and approved Section 19.2 of the certified ESBWR DCD, Revision 10. The staff reviewed Section 19.2, “PRA Results and Insights,” of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the information in the ESBWR DCD and the information in the North Anna 3 COL FSAR, Revision 8 represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR, related to this section. The results of the staff’s technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

In addition, the staff reviewed Parts 4 and 7 of the North Anna 3 COLA which includes the Technical Specifications and Departures Report, respectively. The staff has determined from this review that the ESBWR Generic Technical Specifications and Bases of the referenced certified design are incorporated by reference into the North Anna 3 plant-specific technical specifications with only minor modifications that would not impact the ESBWR design-specific PRA. The staff has also determined that the applicant has taken one departure from the information provided in Section 19.2.3.2.4 of the ESBWR DCD, Revision 10. The departure is described in two parts above in SER Section 19.2.2.

- NAPS DEP 3.7-1 Seismic Margins Analysis DCD

The staff has reviewed North Anna 3 DEP 3.7-1 with respect to the seismic margins assessment provided in ESBWR DCD, Revision 10, including a review of General Electric Hitachi (GEH) Report 003N1084, Revision 2, “North Anna Unit 3 Site-Specific Seismic Margins Analysis Update,” dated February 25, 2016. The staff has also conducted two audits of the applicant’s seismic analysis and seismic design evaluation of North Anna Unit 3, the latter of which included a review of the supporting documents for HCLPF calculations for reactor building/fuel building, reinforced concrete containment vessel, reactor pressure vessel (RPV) Support Brackets, RPV Pedestal, control building, firewater system, and fire protection equipment. From its review the staff has found that the applicant’s departure from the DCD included the use of the North Anna 3 site-specific SSE for seismic Category I structures as described in Section 3.7.1 of the North Anna 3 COL FSAR, Revision 9 as the seismic margin earthquake for the PRA-based site-specific seismic margin assessment rather than the ESBWR CSDRS. Section 3.7.1 of the North Anna 3 COL FSAR, Revision 9 describes the seismic design basis earthquake for structures that must withstand the effects of the earthquakes according to General Design Criteria (GDC) 2, “Design Bases for Protection Against Natural Phenomena,” Appendix S, “Earthquake Engineering Criteria for Nuclear Power Plants,” of 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities” (i.e., the design basis SSE). The staff notes that the site-specific ground motion response spectra defined as the foundation input response spectra (FIRS) at the foundation level of each seismic Category I structure in the FSAR Section 3.7.1 are not enveloped by the ESBWR DC CSDRS. The staff finds that use of the North Anna 3 design basis SSE in the PRA-based seismic margins assessment as the bases for establishing adequate seismic margin is acceptable because it is consistent with guidance provided by the NRC in SECY-93-087, the associated SRM and DC/OL-ISG-020. As described in Section 3.7.1 of the North Anna 3 COL FSAR, Revision 9, the seismic demands for the North Anna 3 SSCs are based on the CSDRS and the site-specific FIRS. In response to a request for additional information (RAI) 19.02-1 dated December 16, 2015 (ADAMS Accession No ML15364A384), the applicant indicates that the SMA for the CSDRS continues to be applicable to North Anna 3, to the extent that seismic analyses using the CSDRS continue to apply, and is supplemented by the site-specific SMA update. The staff finds this approach is acceptable because the North Anna 3 site-specific design improvements in a limited number of locations are not considered to reduce the capacities of the SSCs to resist the CSDRS induced loads, and the applicant has updated the SMA for the standard design's seismic Category I structures to reflect the North Anna 3 site conditions in accordance with the DC/COL-ISG-020 guidance.

This RAI response also indicates that except for the seismic margin earthquake being the North Anna 3 design basis SSE, there is no other changes to the DCD PRA model including seismic initiating events, site-specific effects and plant-specific features, and the systems model. The North Anna 3 PRA-based site-specific SMA update as documented in GEH Report 003N1084, Revision 2, and the supporting calculations describes the seismic fragility calculations for the seismic Category I structures for which seismic design information is available. For safety-related components that do not have detailed information yet, the North Anna 3 site-specific SMA update assumes a HCLPF capacity of 1.67*SSE, with a commitment that these components will be designed to achieve at least this capacity. GEH Report 003N1084, Revision 2 also presents a brief summary of the seismic capacity results of the Lungmen Nuclear Power Plant and finds that there is a high confidence that a HCLPF capacity of 1.67*SSE is achievable for key components at North Anna 3. The North Anna 3 site-specific SMA update concludes that the North Anna 3 site-specific ESBWR plant is inherently capable of safe shutdown in response to beyond design-basis earthquake events, and the plant level HCLPF value is at least 1.67 times the North Anna 3 site-specific SSE. The staff review and audit confirmed the validity of the North Anna 3 seismic fragility calculations and the reasonableness of the assumptions (i.e., the commitment for safety-related components), and finds the North Anna 3 site-specific SMA updates acceptable.

NAPS DEP 3.7-1 also affects Table 19.2-4R - ESBWR Systems and structures in Seismic Margins Analysis, in that the applicant has taken a departure from the standard COL Item 19.2.6-1-A associated with Table 19.2-4R. The staff has reviewed the proposed departure and identified the following differences between the North Anna 3 departure and the ESBWR DCD.

The minimum plant-level HCLPF value (1.67*SSE) for the systems and structures listed in Table 19.2-4R will be different from that described in the ESBWR DCD, because the seismic margin earthquake for the North Anna 3 PRA-based seismic margin assessment is the North Anna 3 design basis SSE rather than the ESBWR CSDRS. The North Anna 3 design basis SSE is the SSE for seismic Category I structures as described in Section 3.7.1 of the North Anna 3 COL FSAR, Revision 9. The staff verified that the North Anna 3 FSAR, Revision 9, incorporated the appropriate changes described in the applicant's response to RAI 19.02-1. Therefore, Confirmatory Item 19.02-1, from the staff advanced SER for North Anna 3 is resolved and closed. This departure is acceptable because the applicant will ensure, prior to fuel load, that the as-built HCLPF capacity will be at least 1.67 times the acceleration of the site-specific SSE, consistent with the criteria provided in SECY 93-087 and DC/COL-ISG-020.

The staff reviewed the following COL information item contained in the North Anna 3 COL FSAR, Revision 8:

COL Item

- NAPS COL 19.2.6-1-A Seismic High Confidence Low Probability of Failure Margins

The standard COL item is described in ESBWR DCD Tier 2, Section 19.2.6, Revision 10, and reads as follows:

> The COL applicant will identify a milestone for completing a comparison of the as-built SSC HCLPFs to those assumed in the ESBWR seismic margin analysis shown in Table 19.2-4. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation shall be analyzed to determine if any new vulnerabilities have been introduced. A minimum HCLPF value of 1.67*SSE will be met for the SSCs identified in DCD Table 19.2-4 (Subsection 19.2.3.2.4).

As-built SSCs whose HCLPF values will be compared with values assumed in the ESBWR SMA are described in Table 19.2-4R of the North Anna 3 COL FSAR, Revision 8 rather than Table 19.2-4 of the ESBWR DCD, Revision 10.

The acceptability of using a site-specific characterization for the design basis SSE instead of the ESBWR CSDRS is evaluated in SER Section 3.7.

The staff compared the list of SSCs in Table 19.2-4R of the North Anna 3 COL FSAR, Revision 8 with the list of SSCs in Table 19.2-4 of the ESBWR DCD, Revision 10 and found them to be identical. The staff compared the footnote referenced in the title of Table 19.2-4R and the footnote referenced in the title of Table 19.2-4 of the ESBWR DCD and found that both stated that a minimum HCLPF value of 1.67*SSE for each seismic Category I structure will be met for the structures and systems listed in the respective Table, but that the footnote in Table 19.2-4R defines the seismic margin earthquake as the North Anna 3 design basis SSE for seismic Category I structures as described in Section 3.7.1 of the North Anna 3 COL FSAR, Revision 8 while the footnote in Table 19.2-4 of the ESBWR DCD, Revision 10 defines the seismic margin earthquake as the ESBWR CSDRS.

The staff noted that the only difference between the two is the definition of seismic margin earthquake, which is used to determine the HCLPF values. GEH Report 003N1084, Revision 2 explains that verification of the plant-specific HCLPF includes an as-built engineering walk-down to verify assumptions made in the SMA and identify any components that require strengthening if the as-built SMA indicates additional capacity margin is required. The staff found the applicant’s response to this COL item acceptable because: (1) consistent with guidance in DC/COL-ISG-020, the applicant has updated the SMA for the standard design of seismic Category I structures to reflect the North Anna 3 site SSE and (2) the applicant will conduct an as-built engineering walk-down as part of verification of the plant-specific HCLPF values.

19.2.5 Post-Combined License Activities

The applicant identified the following in the FSAR to address COL Item 19.2.6-1-A:

As-built SSC HCLPFs will be compared to those assumed in the seismic margin analysis for the SSCs listed in Table 19.2-4R for the Unit 3 SSE, as defined in Section 3.7.1. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation will be analyzed to determine if any new vulnerabilities have been introduced. This comparison and analysis will be completed prior to fuel load. A minimum HCLPF value of 1.67*SSE will be met for the SSCs identified in Table 19.2-4R.

19.2.6 Conclusion

The staff reviewed North Anna 3 COL FSAR Revision 8, the proposed North Anna 3 COL FSAR, Revision 9 markup and the associated reports and calculations in accordance with the relevant NRC regulations and the guidance in SRP Chapter 19 and DC/COL-ISG-020. The staff's review concludes that the applicant has presented adequate information in proposed North Anna 3 COL FSAR, Revision 9 markup, and finds acceptable the applicant's conclusion that the North Anna 3 site-specific ESBWR plant has a HCLPF capacity of at least 1.67 times the NA3 design basis SSE with a commitment that the as-built safety-related components will be ensured to have a HCLPF capacity of at least 1.67 times the North Anna 3 design basis SSE. The staff verified that the North Anna 3 FSAR, Revision 9, incorporated the appropriate changes described in the applicant's response to RAI 19.02-1. Therefore, Confirmatory Item 19.02-1 from the staff advanced SER for North Anna 3 is resolved and closed.

19.3 <u>Severe Accident Evaluation</u>

Section 19.3 of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Section 19.3, "Severe Accident Evaluations," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating the severe accident evaluations and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna COLA are documented in NUREG–1966.

19.4 <u>PRA Maintenance</u>

Section 19.4 of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Section 19.4, "PRA Maintenance," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating the severe accident evaluations and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna COLA are documented in NUREG–1966.

19.5 <u>Conclusions</u>

19.5.1 Introduction

The PRA and severe accident evaluations contained in Chapter 19 of the ESBWR DCD Tier 2, Revision 10 demonstrate that the ESBWR is designed with safety features that have high reliability and availability with significant redundancy and diversity.

19.5.2 Summary of Application

Section 19.5, “Conclusions,” of the North Anna 3 COL FSAR, Revision 8 incorporates by reference, with no departures, Section 19.5 of the ESBWR DCD, Tier 2, Revision 10.

In addition, in FSAR Section 19.5, the applicant provided the following information:

<u>Supplemental Information</u>

- NAPS SUP 19.5-1

In FSAR Section 19.5, the applicant stated that it reviewed site- and plant-specific information to determine if any changes from the certified design PRA were warranted.

- NAPS DEP 3.7-1

In FSAR, Revision 9, Section 19.5, the applicant stated that the description of the certified design PRA results and insights, together with the treatment of the seismic exceedance described in FSAR Section 19.2.3.2.4, satisfy the requirement of 10 CFR 52.79(a)(46) for a description of the plant-specific PRA and its results.

19.5.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is in NUREG–1966. In addition, the regulatory basis for requiring the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(a)(46) and in 10 CFR 52.79(d)(1), which requires (1) a COL applicant referencing a certified design to include, in the FSAR, information sufficient to demonstrate that the site characteristics fall within the site parameters specified in the DC, and (2) that plant-specific PRA information in a COLA that references a standard DC must use the PRA information from the DC and must be updated to account for site-specific design information and any design changes or departures.

Consistent with 10 CFR 50.71(h)(1), each COL holder shall maintain and upgrade the PRA. The upgraded PRA must cover initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect 1 year before each required upgrade.

19.5.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Section 19.5 of the certified ESBWR DCD. The staff reviewed Section 19.5 of the North Anna 3 COL FSAR, Revision 9, and checked the referenced DCD to ensure that the combination of the information in the COL

FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1]

The staff's review confirmed that the information in the application and the information incorporated by reference address the required information related to this section.

In addition the staff reviewed the following site-specific information in the COL FSAR:

Supplemental Information

- NAPS SUP 19.5-1
- NAPS DEP 3.7-1

In FSAR Section 19.5 and Appendix 19AA, the applicant provided supplementary information (North Anna 3 SUP 19.5-1 and NAPS DEP 3.7-1) which describes the results of its review and evaluation of site-specific information, plant-specific information, design changes and departures from the certified design. The purpose of this evaluation is to determine if any changes from the certified design PRA are warranted. The evaluation included consideration of site-specific information such as site meteorological data and site-specific population distributions, as well as plant-specific design information that replaced the conceptual design information described in the DCD. The applicant also reviewed Section 1.8.5 of North Anna 3 COL FSAR, Revision 8 to determine if there were any departures affecting the PRA results. The review of site-specific information and plant-specific design information determined that, with one exception, the DCD PRA bounds site-specific and plant-specific design parameters and design features. The exception is that the site-specific seismic design response spectra exceed the CSDRS for the SMA of the standard plant design. The applicant stated that this departure is accounted for in the plant-specific PRA by requiring a minimum HCLPF value of 1.67*SSE for each seismic Category I and II structure and therefore, did not have a measureable impact on the DCD PRA results and insights. The staff findings associated with North Anna 3 SUP 19.5-1 and NAPS DEP 3.7-1 are addressed as part of the staff evaluation of Appendix 19AA in Section 19AA of this SER below. The staff verified that the North Anna 3 COL FSAR, Revision 9, incorporated the appropriate changes as a result of NAPS DEP 3.7-1. Therefore, Confirmatory Item 19.05-1 from the staff's advanced SER for North Anna 3 is resolved and closed.

19.5.5 Post Combined License Activities

There are no post COL activities related to this section.

19.5.6 Conclusion

The staff's findings related to information incorporated by reference are in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review finds that the applicant has addressed the required information and that there is no outstanding information expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to this section that were incorporated by reference have been resolved.

Based on the above, the staff concludes that the applicant's information to address supplemental information item NAPS SUP 19.5-1 as provided in the North Anna 3 COL FSAR meets the relevant guidelines in SRP Chapter 19, and is therefore, acceptable.

The staff finds that the information in the evaluation summarized in Section 19.5 and discussed in Appendix 19AA of this SER supports the conclusion that differences between site-specific parameters and features and assumptions in the DCD are minimal and do not invalidate the applicant's reference of the DCD PRA results and insights provided in Chapter 19 of the certified ESBWR DCD.

Appendix 19A Regulatory Treatment of Non-Safety Systems (RTNSS)

Appendix 19A of the North Anna 3 COL FSAR incorporates by reference, with an exemption and two departures, Appendix 19A, "Regulatory Treatment of Non-Safety Systems," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. In addition the staff reviewed the following North Anna 3 exemption and Tier 2 departures.

As discussed below, the staff requested that the applicant address site-specific missiles generated from hurricane winds associated with Exemption 5 and Departure 19A-1. The applicant provided the necessary information in North Anna 3 FSAR Revision 9 which incorporated the appropriate changes described in the applicant's response to RAI 03.05.01.04-2. Therefore, Confirmatory Item 19.A-1 from the staff advanced SER for North Anna 3 is resolved as discussed below under NAPS DEP 19A-1.

Exemption and Tier 1 and Tier 2 Departures

The applicant proposed a site-specific Tier 1 DCD departure from DCD Tier 1, Table 5.1-1, "Envelope of ESBWR Standard Plant Site Parameters," which includes criteria for the design of structures housing RTNSS SSCs to resist maximum hurricane winds and hurricane wind generated missiles.

- Exemption 5: Design of Structures Housing RTNSS Equipment for Hurricane Wind Generated Missiles

As permitted by 10 CFR 52.7, "Specific exemptions," and Section VIII.A.4 of the DC Rule, an exemption is requested for certain information described in ESBWR DCD Tier 1. The applicant has requested that DCD Tier 1 Table 5.1-1 be modified to include North Anna 3 structures housing RTNSS equipment to withstand the most limiting hurricane missiles generated by hurricane winds using a missile spectrum and velocities that take into account both the hurricane generated missiles described in the DCD and the Unit 3 site-specific hurricane generated missiles evaluated in accordance with new NRC guidance since the ESBWR DCD approval, in Regulatory Guide (RG) 1.221, "Design Basis-Hurricane and Hurricane Missiles for Nuclear Power Plants." The applicant stated that:

This exemption modifies Footnote 7 to DCD Tier I Table 5.1-1 to specify that the Unit 3 site-specific missile velocities derived in accordance with RG 1.221 are used in the design of structures housing RTNSS equipment when the site-specific missiles are more severe than the missiles specified in the DCD.

This Tier 1 departure is further described in detail below under NAPS DEP 19A-1.

Exemption Approval determination:

In the North Anna 3 COLA, Revision 7, Part 7, "Departures Report," the applicant requested an exemption from the provisions of 10 CFR Part 52, Appendix E, "Design Certification Rule for ESBWR Design," Section III.B, "Design Certification Rule for the ESBWR Design, Scope and Contents," which requires an applicant referencing a certified design to incorporate by reference Tier 1 information. Specifically, in North Anna Part 7, Exemption 5, the applicant proposed to revise the ESBWR DCD, Tier 1, Table 5.1-1, to include new RG 1.221 guidance on wind generated missile protection for RTNSS systems. This RG followed the final DC rule on October 15, 2014 (79 FR 61944) as Appendix E to 10 CFR Part 52.

Regulations

- 10 CFR Part 52, Appendix E, Section VIII.A.4 states that exemptions from Tier 1 information are governed by the requirements of 10 CFR 52.63(b) and 10 CFR 52.98(f). 10 CFR Part 52, Appendix E, Section VIII.A.4 also states that the Commission will deny such a request if it finds that the design change will result in a significant reduction in the level of safety otherwise provided by the design.

- 10 CFR Part 52.63(b)(1) allows an applicant to request NRC approval for an exemption from one or more elements of the certification information. The Commission may only grant such a request if it determines that the request complies with the requirements of 10 CFR 52.7, which, in turn, points to the requirements listed in 10 CFR 50.12 for specific exemptions, and if the special circumstances present outweigh the potential decrease in safety due to reduced standardization. Therefore, any exemption from the Tier 1 information certified by 10 CFR Part 52, Appendix E must meet the requirements of 10 CFR 50.12, "Specific exemptions," 10 CFR 52.7, and 10 CFR 52.63(b)(1).

Evaluation of Exemption

As stated in 10 CFR Part 52, Appendix E, Section VIII.A.4, an exemption from Tier 1 information is governed by the requirements of 10 CFR 52.63(b)(1) and 52.98(f). Additionally, the Commission will deny an exemption request if it finds that the requested change to Tier 1 information will result in a significant decrease in safety. Pursuant to 10 CFR 52.63(b)(1), the Commission may, upon application by an applicant or licensee referencing a certified design, grant exemptions from one or more elements of the certification information, as long as the criteria given in 10 CFR 50.12 are met and the special circumstances as defined by 10 CFR 50.12 outweigh any potential decrease in safety due to reduced standardization.

Applicable criteria for when the Commission may grant the requested specific exemption are provided in 10 CFR 50.12(a)(1) and (a)(2). 10 CFR 50.12(a)(1) provides that the requested exemption must be authorized by law, not present an undue risk to the public health and safety, and be consistent with the common defense and security. The provisions of 10 CFR 50.12(a)(2) list six special circumstances for which an exemption may be granted. It is necessary for one of these special circumstances to be present in order for NRC to consider granting an exemption request. The applicant stated that the requested exemption meets the special circumstances of 10 CFR 50.12(a)(2)(ii). That subsection defines special circumstances as when "…[a]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The staff's analysis of each of these findings is presented below.

Authorized by Law

This exemption would allow the applicant to implement approved changes to Tier 1 information. This is a permanent exemption limited in scope to particular Tier 1 information, and subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section III.B. As stated above, 10 CFR 52.63(b)(1) allows the NRC to grant exemptions from one or more elements of the certification information, namely, Tier 1. The staff determined that granting of the applicant's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC regulations. Therefore, as required by 10 CFR 50.12(a)(1), the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant and will maintain a level of detail consistent with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. The affected design description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the RTNSS requirements and the associated design function. The site-specific hurricane wind generated missile velocities derived in accordance with the new NRC guidance in RG 1.221 exceed the missile velocities specified in the DCD for certain missiles specified by RG 1.221. The applicant has incorporated protection from wind generated missiles from both the DCD requirements as well as the new RG 1.221 requirement; therefore, these proposed changes are evaluated and found to be acceptable. Consequently, the staff finds the exemption presents no undue risk to public health and safety as required by 10 CFR 50.12(a)(1).

Consistent with Common Defense and Security

The proposed exemption would allow the applicant to implement modifications to the Tier 1 information requested in the applicant's submittal. This is a permanent exemption limited in scope to this particular Tier 1 information. Subsequent changes to this Tier 1 information or any other Tier 1 information would be subject to full compliance by the applicant as specified in 10 CFR Part 52, Appendix E, Section VIII.A.4. This change is not related to security issues. Therefore, as required by 10 CFR 50.12(a)(1), the staff finds that the exemption is consistent with the common defense and security.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purposes of the rule or is not necessary to achieve the underlying purpose of the rule. The applicant included wind generated missile protection from both the DCD requirements as well as from the new RG 1.221 requirements that followed the approval of the DCD in North Anna 3 FSAR Section 19A as NAPS DEP 19A-1 and therefore the underlying purpose of the specific ESBWR DCD Tier 1, RTNSS missile protection is not changed. Accordingly, special circumstances are present because application of the requirement to incorporate the certified design information in specific ESBWR DCD, Tier 1, Table 5.1-1, "Envelope of ESBWR Standard Plant Site Parameters," is not necessary to achieve the underlying purpose of the rule. Therefore, the staff finds that special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption from Tier 1, exist.

Special Circumstances Outweigh Reduced Standardization

This exemption would allow the applicant to change certain ESBWR DCD Tier 1 information proposed in the North Anna 3 COLA. The key design functions of the RTNSS will be maintained. Since the changes are from new NRC guidance that is different than the generic ESBWR DCD Tier 1 design wind missile protection function for RTNSS, it is likely that all other ESBWR licensees and applicants would request the same exemption using the same required guidance in RG 1.221 in subsequent COLAs.

However, this exemption request and the associated changes to North Anna 3 COL Tier 1 information, demonstrate that there is a minimal change from the standard information provided in the ESBWR DCD. Consequently, the decrease in safety due to reduced standardization is minimal. For this reason, the staff determined that even if other ESBWR licensees and applicants do not request similar departures, the special circumstances outweigh the potential decrease in safety due to reduced standardization of the ESBWR design, as required by 10 CFR 52.63(b)(1).

No Significant Reduction in Safety

The proposed exemption would not significantly modify the function of the North Anna 3 missile protection for RTNSS as described in the ESBWR DCD. Therefore, the staff finds that granting the exemption would not result in a significant decrease in the level of safety otherwise provided by the design, as required by 10 CFR Part 52, Appendix E, Section VIII.A.4.

Conclusion

For the reasons set forth above, the staff has concluded that pursuant to 10 CFR Part 52, Appendix E, Section VIII.A.4, the exemption: (1) is authorized by law, (2) presents no undue risk to the public health and safety, (3) is consistent with the common defense and security, (4) has special circumstances that outweigh the potential decrease in safety due to reduced standardization, and (5) does not significantly reduce the level of safety at the licensee's facility. Therefore, the staff finds that the applicant's request to depart from the information in ESBWR DCD Tier 1, design of missile protection for RTNSS systems, to be acceptable and the applicant's request for an exemption from these Tier 1 requirements is granted.

The applicant has taken two departures from ESBWR DCD, Revision 10, regarding augmented design standards discussed in Section 19A.8.3.

The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. In addition the staff reviewed the following North Anna 3 Tier 2 departures.

- NAPS DEP 3.7-1 — Non-seismic structures that house RTNSS Criterion C systems

The applicant has removed the reference to ESBWR Certified Seismic Design Spectra taken from Figures 2.0-1 and 2.0-2 of the ESBWR DCD, Revision 10, as the source for the SSE ground motion input for design of certain non-seismic structures that house RTNSS systems and replaced it with a reference to the site-dependent SSE at grade taken from Section 3.7.1 of the North Anna 3 COL FSAR, Revision 8. This departure is acceptable to the staff because the site-dependent SSE is the appropriate source for the SSE ground motion input for non-seismic structures that house RTNSS systems and are located on the North Anna 3 site.

- NAPS DEP 19A-1 — Design of Structures Housing RTNSS Equipment for Hurricane Wind Generated Missiles

This departure addresses higher North Anna 3 site-specific hurricane wind generated missile velocities since the site-specific missile parameters are more severe than those specified in the ESBWR DCD.

In 2011 the NRC issued new guidance for hurricanes in RG 1.221. This guidance demonstrated that hurricane missiles could be more severe than tornado missiles. In addition, the ESBWR DC rule (10 CFR Part 52, Appendix E) includes an exclusion from finality for loads on applicable SSCs from hurricane-generated missiles, but only to the extent that such loads are not bounded by other loads analyzed in the ESBWR DCD. It was not clear to the staff whether North Anna 3 site-specific hurricane missile loads were bounded by the ESBWR standard plant. Therefore, the staff issued RAI 03.05.01.04-1 dated April 2, 2014, (ADAMS Accession No. ML14092A573), requesting the applicant to address hurricane missiles in accordance with RG 1.221.

The applicant’s response to RAI 03.05.01.04-1 dated April 29, 2014 (ADAMS Accession No. ML14120A239), stated that for seismic Category I structures, all missiles generated by extreme winds at the North Anna 3 site are bounded by the DCD standard plant tornado missile spectrum, and provided a table showing the ESBWR standard-plant tornado and hurricane missile spectra and associated velocities compared to North Anna 3 site-specific values. This table indicates that site-specific wind-borne missiles are indeed bounded by the referenced DCD for seismic Category I structures. However, the response did not discuss other ESBWR standard plant structures, such as structures housing RTNSS equipment, which, as non-seismic Category I structures, are designed for hurricane missiles but not tornado missiles. The table included in the applicant’s response indicated that all site-specific missiles are bounded by the ESBWR standard plant design except for the hurricane induced automobile impact on RTNSS structures. Therefore, the staff issued follow-up RAI 03.05.01.04-2 dated June 18, 2014 (ADAMS Accession No. ML14169A655), requesting the applicant to address the site-specific automobile hurricane generated missile and its impact on RTNSS structures, and whether this requires a departure from the DCD.

The applicant’s response to RAI 03.05.01.04-2 dated November 25, 2014 (ADAMS Accession No. ML14337A116), stated that:

> Dominion is taking a departure and exemption from the ESBWR design certification rule in order to meet the guidance provided in RG 1.221…the methodology specified in the RG for calculating missile velocities results in higher velocities for certain hurricane wind generated missiles. Dominion will design structures housing RTNSS equipment to withstand the most limiting hurricane missiles generated by hurricane winds using a missile spectrum and velocities that take into account both the hurricane generated missiles described in the DCD and the Unit 3 site-specific hurricane generated missiles described in the response to RAI 03.05.01.04-01 dated April 29, 2014 (ML14120A239).

The applicant also proposed to insert the following at the end of the tenth paragraph of DCD Tier 2, Section 19A.8.3, “Augmented Design Standards:”

The design of these structures also accounts for the Unit 3 site-specific hurricane generated missile velocities calculated in accordance with RG 1.221. The limiting hurricane generated missile velocities are shown in Table 19A-201.

Table 19A-201, "Limiting Hurricane Missile Parameters for NA3 [North Anna 3] Structures Housing RTNSS Equipment," is a new table added to the FSAR and identifies which hurricane generated missiles are most limiting for RTNSS structures. In addition, the applicant identified conforming changes to FSAR Tables 2.0-201, 19A-3R, 19A-4R, and DCD Tier 1, Table 5.1-1, Footnote 7 in order to clarify that the design of RTNSS structures will account for the most limiting hurricane missile.

The applicant provided a description of departure NAPS DEP 19A-1 in COLA Part 7, which states, "[t]his departure add[s] requirements to address the site-specific hurricane wind generated missile velocities when the site specific missile parameters exceed those specified in the DCD." The applicant also included an evaluation of the departure and determined that it complies with the requirements of 10 CFR Part 52, Appendix E, Section VIIIB.5.

The staff reviewed the information above and finds that the applicant has provided sufficient information to determine NAPS DEP 19A-1 to be acceptable because it conforms to the guidance of RG 1.221, and complies with 10 CFR Part 52, Appendix E, Section VIIIB.5. In addition, the design requirements added by the departure ensure that RTNSS structures will be designed to the most limiting hurricane missile.

The staff verified that the North Anna 3 FSAR, Revision 9, incorporated the appropriate changes described in the applicant's response to 03.05.01.04-2. Therefore, Confirmatory Item 19.A-1 from the staff advanced SER for North Anna 3 is resolved and closed

The staff's review confirmed that the application addressed the required information relating to RTNSS and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this appendix. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna COLA are documented in NUREG-1966.

Appendix 19ACM **<u>Availability Controls Manual</u>**

Appendix 19ACM of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Appendix 19ACM, "Availability Controls Manual," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating to the availability controls manual and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this appendix. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

Appendix 19B Deterministic Analysis for Containment Pressure Capability

Appendix 19B of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Appendix 19B, "Deterministic Analysis for Containment Pressure Capability," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating to the deterministic analysis performed and results obtained for the containment ultimate capability under internal pressure and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this appendix. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

Appendix 19C Probabilistic Analysis for Containment Pressure Fragility

Appendix 19C of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Appendix 19C, "Probabilistic Analysis for Containment Pressure Fragility," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating to the probabilistic analyses and results for the fragility of the ESBWR primary containment system for over-pressurization and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this appendix. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

Appendix 19D Assessment of Malevolent Aircraft Impact

Appendix 19D of the North Anna 3 COL FSAR incorporates by reference, with no departures or supplements, Appendix 19D, "Assessment of Malevolent Aircraft Impact," of the ESBWR DCD, Revision 10. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review[1]. The staff's review confirmed that the application addressed the required information relating a design-specific assessment of the intentional impact of a large commercial aircraft on the ESBWR and there is no outstanding information expected to be addressed in the North Anna 3 COL FSAR related to this appendix. The results of the staff's technical evaluation of the information incorporated by reference in the North Anna 3 COLA are documented in NUREG–1966.

Appendix 19AA Summary of Plant-Specific PRA Review

19AA.1 Introduction

In accordance with 10 CFR 52.79(a)(46), this FSAR appendix provides a summary of plant-specific PRA and its results.

19AA.2 Summary of Application

Appendix 19AA of the North Anna 3 COL FSAR provides a summary of plant-specific PRA and its results. In FSAR Appendix 19AA, the applicant summarized the results of its evaluation of site-specific and plant-specific information with respect to pertinent assumptions made in the certified design PRA. In addition, the applicant provides a summary of the Supplemental Information NAPS SUP 19.5-1 in Appendix 19AA.

In Section 19AA.2 of the application, the applicant discussed the following North Anna 3 site-specific PRA attributes that were compared to ESBWR PRA.

The parameters and features discussed by the applicant included the following:

- loss of preferred power (LOPP) frequency
- loss of service water frequency
- site-specific terrain and meteorological data
- seismic fragilities
- other known site-specific issues

19AA.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is in NUREG–1966. In addition, the regulatory basis for requiring the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(a)(46) and in 10 CFR 52.79(d)(1), which requires (1) COL applicants referencing a certified design to include, in the FSAR, information sufficient to demonstrate that the site characteristics fall within the site parameters specified in the DC, and (2) plant-specific PRA information in a COLA that references a standard DC must use the PRA information from the DC and must be updated to account for site-specific design information and any design changes or departures. Consistent with 10 CFR 50.71(h)(1), each COL holder shall maintain and upgrade the PRA. The upgraded PRA must cover initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect 1 year before each required upgrade.

19AA.4 Technical Evaluation

As documented in NUREG–1966, the staff reviewed and approved Chapter 19 of the certified ESBWR DCD, Revision 10. The staff reviewed Appendix 19AA of the North Anna 3 COL FSAR, Revision 8, and checked the referenced DCD to ensure that the combination of the information in the COL FSAR and the information in the ESBWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that information in the application and the information incorporated by reference address the required information related to this section.

Supplemental Information

The staff reviewed the following information in the COL FSAR:

- loss of preferred power (LOPP) frequency;
- loss of service water frequency;
- site-specific terrain and meteorological data
- seismic fragilities
- plant-specific flooding zones of the yard and service water building.

Each of these parameters and features are evaluated below.

Loss of Preferred Power Frequency

The applicant stated in Section 19AA.2 of the North Anna 3 COL FSAR, Revision 8 that North Anna 3 frequencies for LOPP accident scenarios were compared with LOPP frequencies assumed in the ESBWR design PRA described in the ESBWR DCD, Revision 10. The applicant also stated that, although there are variances between the values assumed for North Anna 3 and the values assumed in the ESBWR design PRA, they are minor and their range is acceptable.

To determine whether the North Anna 3 specific values for LOPP frequencies are bounded by the values assumed in the ESBWR design PRA, the staff issued RAI 19-7 dated November 7, 2013 (ADAMS Accession No. ML13311C289), which requested that the applicant (1) specify the plant-specific values of the LOPP frequencies expected for North Anna 3, (2) provide the technical basis for the values, and (3) provide a comparison of the LOPP frequencies assumed for North Anna 3 with those assumed in the ESBWR PRA. In its response to RAI 19-7 on December 11, 2013 (ADAMS Accession No. ML13351A046), the applicant provided the requested information for at-power and shutdown conditions and included tabular data and the related references. The staff compared the LOPP frequencies reported by the applicant for North Anna 3 with the latest published data for North Anna 1 and 2 and found the North Anna 3 frequencies to be the same as the higher of the values for North Anna 1 and 2. The staff considers this comparison to be acceptable and reasonable since all units are on the same site. The staff compared expected North Anna 3 values with values used in the ESBWR design PRA (NEDO-33201, “ESBWR Design Certification Probabilistic Risk Assessment,” Revision 6, dated October 25, 2010) and found the values used in the ESBWR design PRA to be bounding. Therefore, the staff finds that the ESBWR design PRA provides a bounding assessment of LOPP events.

Loss of Service Water Frequency

The applicant stated in Section 19AA.2 of the North Anna 3 COL FSAR, Revision 8 that the ESBWR loss of service water frequency is based on NUREG/CR-5750, “Rates of Initiating Events at U.S. Nuclear Power Plants: 1987-1995,” issued February 1999. The applicant also stated that the value assumed in the ESBWR PRA would be bounding for North Anna 3. To justify the assertion that this approach is bounding, the applicant provided a detailed description of the features included in the North Anna 3 service water system design to improve reliability over that of designs used in operating plants. The applicant also stated in Section 19AA.2 of the North Anna 3 COL FSAR, Revision 8 that in addition to the bounding treatment of PRA parameters, there are no changes from the standard design in any systems considered in the PRA model, and therefore, there are no site-specific design features that affect the PRA because the boundary of the certified design covers all of the SSCs necessary for the PRA.

The staff evaluated the assertions regarding service water system failure frequency by comparing the North Anna 3 service water system design with the service water system modeled in the ESBWR design PRA. The staff found that the North Anna 3 service water system design as described in the North Anna 3 COL FSAR, Revision 8 was included in the ESBWR PRA model. The staff finds this to be a reasonable basis to expect that the plant-specific service water system will not introduce design differences that would create substantial additional risk over and above that described in the certified ESBWR DCD.

Site-Specific Terrain and Meteorological Data

The applicant stated that there are no terrain features specific to North Anna 3 that would affect the meteorological data or plume dispersion and that the site is bounded by the DCD in Section 19.2.5 for offsite consequences.

Based on its review of information in the PRA report referenced in the ESBWR DCD, Tier 2, Revision 10, the staff found that the assumptions for tornado and hurricane frequencies in the ESBWR PRA are bounding with respect to the North Anna 3 site. Indeed, the tornado frequencies assumed in the ESBWR PRA were generated using data from the central region of the United States (U.S.) where the tornado intensities and frequencies of occurrence are highest. The North Anna 3 site is an inland site located in Virginia on the shore of Lake Anna. Historical data from the National Oceanic and Atmospheric Administration (NOAA) (www.noaa.gov) show that the frequency of tornados in Virginia is less than half of that for states in the middle of the United States. The hurricane frequencies applied in the ESBWR PRA were developed using data from a set of plants operating on the Atlantic coast in the southeastern U.S. Data in NOAA Technical Memorandum NWS NHC-6, dated August 2011, show the frequency of intense hurricane winds in Virginia to be far below that on the south eastern coast of the United States. Based on the location of the North Anna site, the staff finds it reasonable to conclude that the tornado and hurricane frequencies applied in the ESBWR PRA are bounding with respect to the North Anna 3 site.

Site-Specific Seismic Design Response Spectra

The acceptability of using the North Anna 3 site-specific characterization for the design basis SSE, which exceeds ESBWR CSDRS, is evaluated in Section 3.7 of this SER.

Plant-Specific Flooding Zones of the Yard and Service Water Building

The evaluation of flooding associated with the yard area provided in Section 19AA.3 of the North Anna 3 application indicated that site-specific design basis flooding conditions would not cause risk to increase beyond the level determined in the ESBWR design PRA because all SSCs modeled in the PRA are located above the design basis flood level. External flooding events that could cause a flood more severe than the design basis flood were not addressed in the application.

The applicant stated that the service water structure is a site-specific design feature and is treated in a bounding manner in the ESBWR PRA. The service water structure houses the four service water pumps and their associated power supplies and controls. The applicant stated that in the ESBWR PRA model, the service water structure is conservatively considered to be one flood zone and all four pumps are assumed to fail in an internal flood. It was also stated that the ESBWR PRA model does not credit operator actions to mitigate a service water structure flooding event, so differences in building location are not significant.

Based on its evaluation, the applicant concluded that none of the North Anna 3 parameters and features have a significant impact on the DCD PRA results and insights; and therefore, there is no significant change from the certified design PRA, and incorporation of DCD Chapter 19 into the North Anna 3 COL FSAR, Revision 8 satisfies the requirement of 10 CFR 52.79(a)(46) for a description of the plant-specific PRA and its results.

Plant-Specific Flooding Zone of the Yard

Because the applicant only addressed design basis flooding in the application, the staff issued RAI 19-8 dated November 7, 2013 (ADAMS Accession No. ML13311C289), requesting that the applicant address the risk associated with beyond design basis external flooding events for North Anna 3. In its response to RAI 19-8 dated December 11, 2013 (ADAMS Accession No ML13351A046), the applicant addressed potential flooding from severe precipitation, dam failures, surge or seiche flooding and tsunami flooding. The applicant also stated that flooding from extreme precipitation presented the highest potential risk from external flooding for the following reasons:

1. There are no dams located upstream of the facility, and therefore it is not subject to sudden flooding due to dam failure.

2. The facility is not located on an estuary or open coast, and therefore not subject to flooding due to seiche, surge or tsunami.

The staff considered the applicant's response and compared it with information regarding potential flooding at the site provided in Chapter 2 of the North Anna 3 COL FSAR, Revision 8. The information in the response is consistent with information provided in the North Anna 3 COL FSAR, Revision 8. Based on the features of the North Anna site listed above and information provided in Chapter 2 of the North Anna 3 COL FSAR, Revision 8 regarding flooding from extreme precipitation, the staff finds the applicant's bases for concluding that potential severe flooding from extreme precipitation poses the greatest risk from external flooding events are logical and reasonable, and therefore acceptable.

In its response, the applicant cited the following screening criterion from the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," as the basis for not providing a further risk evaluation of floods from precipitation beyond the probable maximum precipitation described in Chapter 2 of North Anna 3 COL FSAR, Revision 8:

> *Criterion 5:* The event is slow in developing, and it can be demonstrated that there is sufficient time to eliminate the source of the threat or to provide an adequate response.

The staff agrees that flooding from severe precipitation would present a challenge to the plant that is slow in developing compared to most upset conditions. The staff also finds that there is a reasonable basis for concluding that an adequate response to such a flooding event that challenged safe plant operation could be made expeditiously. This is because the design of North Anna 3, as described in the North Anna 3 COL FSAR, Revision 8, includes safety systems (i.e., the isolation condenser system, automatic depressurization system, gravity driven cooling system and the primary containment cooling system) whose components are located either inside containment or above the containment, and therefore protected from floods. Once initiated, these systems can be used to remove decay heat for up to 72 hours with no intervention, as described in the North Anna 3 COL FSAR, Revision 8. Initiating these safety systems generally involves only a few valve manipulations that can be performed from the control room. The isolation condenser system initiates automatically on loss of electric power. Since these are safety-related systems, procedures for initiating cooling with these systems must be provided in accordance with the Commission's regulations in 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing

Plants." After 72 hours, action is required to refill cooling water tanks in the containment which allows these systems to maintain cooling for an additional 4 days. These actions are described in the North Anna 3 COL FSAR, Revision 8 and the staff's review of these actions is contained in Chapter 22 of NUREG–1966.

Based on its evaluation, the staff finds the applicant's bases for screening external floods from quantitative analysis in the PRA to be acceptable.

Plant-specific Flooding Zone of the Service Water Building

The staff reviewed flooding analysis documented in Chapter 13 of the ESBWR PRA report referenced in the ESBWR DCD, Revision 10 and confirmed that the service water building is considered a single flood zone in the ESBWR PRA model. The staff also confirmed that all equipment in a single flood zone is assumed to fail in the model, and the model does not credit operator actions to mitigate a service water structure flooding event. In light of these assumptions, the staff finds that flooding of the service water building is treated in a bounding manner in the ESBWR PRA, and this provides reasonable assurance that site-specific differences in service water structure design will not have a significant effect on the PRA results.

19AA.5 Post-Combined License Activities

As-built SSC HCLPFs will be compared to those assumed in the ESBWR SMA and site-specific update shown for the SSCs listed in Table 19.2-4R for the Unit 3 SSE, as defined in Section 3.7.1. Deviations from the HCLPF values or other assumptions in the seismic margins evaluation will be analyzed to determine if any new vulnerabilities have been introduced. This comparison and analysis will be completed prior to fuel load. A minimum HCLPF value of 1.67*SSE will be met for the SSCs identified in Table 19.2-4R.

19AA.6 Conclusion

The staff's findings related to information incorporated by reference are in NUREG–1966. The staff reviewed the application and checked the referenced DCD. The staff's review confirms finds that the applicant has addressed the required information relating to the PRA and that there is no outstanding information expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix E, Section VI.B.1, all nuclear safety issues relating to the summary of plant-specific PRA review that were incorporated by reference have been resolved.

The staff also compared the supplemental COL information within the application to the relevant NRC regulations. The regulatory basis for acceptance of the supplementary information on consideration of site-specific and plant-specific information and design features is established in 10 CFR 52.79(d)(1). The staff finds the applicant's consideration of site-specific and plant-specific information and design features sufficient to support the conclusion that differences between the site-specific parameters, other than the seismic ground motion departure NAPS DEP 3.7-1 that was explicitly evaluated to ensure a minimum plant-level HCLPF value of 1.67*SSE, and features and the assumptions in the DCD are small and do not invalidate the applicant's reference to the DCD PRA results and insights provided in Chapter 19 of the ESBWR DCD.

References

1. 10 CFR 2.390, "Public inspections, exemptions, requests for withholding."

2. 10 CFR 50.12," Specific exemptions."

3. 10 CFR 50.54(hh)(2), "…loss of large areas of the plant due to explosions or fire…"

4. 10 CFR 50.54, "Conditions of licenses."

5. 10 CFR 50.71(h)(1), "…level 1 and a level 2 probabilistic risk assessment (PRA)…[requirements]."

6. 10 CFR 50.71, "Maintenance of records, and making of reports."

7. 10 CFR 52.63, "Finality of standard design certification."

8. 10 CFR 52.7, "Specific exemptions."

9. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

10. 10 CFR 52.98, "Finality of combined licenses; information requests."

11. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

12. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

13. 10 CFR Part 50, Appendix A, GDC 2, "Design bases for protection against natural phenomena."

14. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

15. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

16. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

17. ASME/ANS RA-Sa-2009, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," Addendum A to RA-S-2008, ASME, New York, NY, American Nuclear Society, La Grange Park, Illinois, February 2009.

18. *Federal Register,* 79 FR 61944, "ESBWR DC Final Rule," October 15, 2014.

19. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

20. GEH Report 003N1084, Revision 2, "North Anna Unit 3 Site-Specific Seismic Margins Analysis Update," February 25, 2016 (ADAMS Accession No. ML16060A263).

21. NEDO-33201, "ESBWR Certification Probabilistic Risk Assessment," Revision 6.

22. NRC DC/COL-ISG-020, "Implementation of a Probabilistic Risk Assessment- Based Seismic Margin Analysis for New Reactors," March 15, 2010 (ADAMS Accession No. ML100491233).

23. NRC RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," October 2011 (ADAMS Accession No. ML110940300).

24. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

25. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

26. SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," April 2, 1993 (ADAMS Accession No. ML003708021), and the related SRM, dated July 21, 1993 (ADAMS Accession No. ML003708056).

27. U.S. Code 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

ATTACHMENT 19.A

LOSS OF LARGE AREAS OF THE PLANT DUE TO EXPLOSIONS OR FIRES

19.A.1 Introduction

The applicant described the strategies for North Anna 3 loss of large areas (LOLA) in Appendix 8B of the “North Anna 3 Combined License Application Part 8: Security,” Revision 4, submitted December 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14007A424, non-public) (hereafter referred to as the mitigative strategies report (MSR)).

In the submittal, the applicant described how it will meet the requirements to address LOLAs of the plant due to explosions or fires from a beyond design basis event (BDBE). Title 10 of the *Code of Federal Regulations* (10 CFR) 52.80(d) and 10 CFR 50.54(hh)(2) detail these requirements. The attachment to this safety evaluation section, Attachment 19.B, “Loss of Large Areas of the Plant due to Explosions or Fire” (non-public), as well as some documents referenced in this safety evaluation section, include security-related or safeguards information and are not publicly available.

The provisions of 10 CFR 52.80(d) require an applicant for a combined license (COL) to submit a description and plans for implementation of the guidance and strategies intended to maintain or restore core cooling, containment, and spent fuel pool (SFP) cooling capabilities under the circumstances associated with LOLAs of the plant due to explosions or fire as required by 10 CFR 50.54(hh)(2).

The provisions of 10 CFR 50.54(hh)(2) require licensees to develop and implement guidance and strategies for addressing LOLAs of the plant due to explosions or fires from a BDBE. Specifically, the guidance and strategies are intended to maintain or restore core cooling, containment, and SFP cooling capabilities and include the following:

- Firefighting;
- Operations to mitigate fuel damage; and
- Actions to minimize radiological release.

19.A.2 Summary of Application

The applicant submitted (Appendix 8B to ADAMS Accession No. ML14007A424, non-public) the MSR for the North Anna 3 LOLA strategies titled “North Anna 3 Mitigative Strategies Description and Plans.” The applicant will incorporate this report, including any applicable changes identified in response to NRC requests for additional information into a future revision of the North Anna 3 COLA. The applicant stated that it would implement the LOLA mitigative strategies, including implementation of operational and programmatic aspects of responding to LOLA events, before initial fuel load.

19.A.3 Regulatory Basis

NRC regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” and 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” provide the regulatory basis for the staff’s review of the information in the North Anna 3 COLA. For example, the applicable regulatory requirements for LOLAs of the plant due to explosions or fires are as follows:

- 10 CFR 50.54(hh)(2); and
- 10 CFR 52.80(d).

The applicable regulatory guidance includes Interim Staff Guidance (ISG) DC/COL-ISG-016, “Interim Staff Guidance Compliance with 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) Loss of Large Areas of the Plant Due to Explosions or Fires from a Beyond-Design-Basis Event,” dated April 20, 2010 (ADAMS Accession No. ML101030529) (not publically available), which provides an acceptable means of meeting the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d). DC/COL-ISG-016 references the February 25, 2005, guidance letter (non-public) to operating reactor licensees for Phase 1 and the Nuclear Energy Institute (NEI) document NEI 06-12, Revision 3, “B.5.b Phase 2 & 3 Submittal Guideline,” issued September 2009, Revision 3 (ADAMS Accession No. ML092890400) (non-public), for Phases 2 and 3. DC/COL-ISG-016 takes exception to a few areas of NEI 06-12 and provides additional clarification and enhancement of NEI 06-12 and the staff’s guidance letter dated February 25, 2005, based on NRC inspections of operating reactor implementation. DC/COL-ISG-016 has two attachments: Attachment 1, “Supplementary Guidance for Implementing Mitigation Strategies;” and Attachment 2, “Experience Gained from Implementation of Temporary Instruction 2515/171 at Currently Licensed Power Reactor Sites and Related Staff Positions.”

19.A.4 Technical Evaluation

The staff reviewed the applicant’s submittal consistent with the requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2). The staff also used the guidance in DC/COL-ISG-016 to perform its review. DC/COL-ISG-016 references the February 25, 2005, guidance letter for Phase 1 and NEI 06-12 for Phases 2 and 3. Attachment 19.B (non-public), discusses the staff’s technical evaluation of the North Anna 3 LOLA Plan submittal.

The North Anna 3 COL applicant provided the LOLA event evaluation via a three-phase approach similar to that for existing plants and consistent with Phases 1, 2, and 3 in the NEI 06-12 guidance. The applicant wrote its “Mitigative Strategies Description and Plans” issued December, 2013, at the programmatic level for licensing approval; the implementation details and documentation will be made available for inspection by the NRC before initial fuel load.

The applicant’s submittal of the MSR, the applicant follows the template guidance in Appendix D to NEI 06-12, addresses various areas and issues pertinent to LOLAs, and describes commitments for areas that are best resolved closer to the completion of the building of North Anna 3. All commitments made in the submittal will be implemented before the initial fuel load of the unit.

The MSR addresses the three phases considered in NEI 06-12:

- Phase 1—firefighting response strategy
- Phase 2—SFP cooling
- Phase 3—reactor core cooling and fission product release mitigation

Phases 1, 2, and 3 of NEI 06-12 are similar to the three areas included as part of the requirements in 10 CFR 50.54(hh)(2): firefighting, operations to mitigate fuel damage, and actions to minimize radiological release. However, the three phases are categorized differently. In 10 CFR 50.54(hh)(2), the category of operations to mitigate fuel damage includes both the reactor core and the SFP, and the category of actions to minimize radiological release is separate. In NEI 06-12, separate phases address SFP and reactor core cooling, and reactor core cooling and fission product release mitigation are combined. Despite the differences between the categorization of the phases in NEI 06-12 and the areas of the regulatory requirements, the staff finds that the submittal included all of the necessary information.

The guidance for Phases 1, 2, and 3 suggests development of certain strategies or processes to mitigate the consequences of a LOLA event. The applicant addressed all of these suggested strategies or processes. In evaluating each plant-specific mitigating strategy against its functional objective, the staff weighed whether the strategy reasonably can be expected to successfully provide SFP cooling or to maintain or restore the key safety functions necessary to protect the reactor core and containment. The staff's review considered the expected effectiveness of strategies and the ease and timeliness of strategy implementation.

The staff reviewed the MSR for content using DC/COL-ISG-016 and finds that it includes all strategies considered essential for such a program and is acceptable. The staff finds that the regulatory requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2) are met.

19.A.5 Post Combined License Activities

Although some strategies needed to meet 10 CFR 50.54(hh)(2) can be developed and implemented in the near future, some strategies and planning efforts cannot be effectively determined or implemented until the plant is further along in construction.

In Part 10 of the North Anna 3 COLA Revision 8, the applicant has identified the following license conditions to meet the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80, "Contents of application; additional technical information."

Fuel Load Authorization

> The licensee shall implement the operational program identified below prior to fuel load authorization per 10 CFR 52.103(g):
>
> Mitigative Strategies Description and Plans (for responding to circumstances associated with loss of large areas of the plant due to explosions or fire developed in accordance with 10 CFR 50.54(hh)(2)).

Operational Program Implementation Schedule

The licensee shall submit to the Director of NRO, a schedule, no later than 12 months after issuance of the COL, for implementation of the operational programs listed in FSAR Table 13.4-201. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until the operational programs in the FSAR table have been fully implemented. This schedule shall also address:

- The implementation of site-specific Severe Accident Management Guidelines
- The spent fuel rack coupon monitoring program implementation

The staff reviewed the license conditions proposed by the applicant in its submittal and is satisfied that the timing of all procedural or strategy development was appropriately scheduled before the initial fuel load.

19.A.6 Conclusion

The staff reviewed the information provided by the applicant under 10 CFR 52.80(d). The staff concludes that the applicant has adequately followed the guidance of DC/COL-ISG-016, NEI 06-12, and the February 25, 2005, guidance letter. The staff finds that the applicant provided sufficient information at the COLA stage, including commitments made in the North Anna 3 COLA, to meet the requirements of 10 CFR 52.80(d) and to provide reasonable assurance that the requirements in 10 CFR 50.54(hh)(2) will be met before the initial fuel load of North Anna 3.

References

1. 10 CFR 50.54(hh)(2), "…loss of large areas of the plant due to explosions or fire…"

2. 10 CFR 50.54, "Conditions of licenses."

3. 10 CFR 52.79, "Contents of applications; technical information in final safety analysis report."

4. 10 CFR 52.80, "Contents of applications; additional technical information."

5. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

6. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

7. 10 CFR Part 52, Appendix E, "Design Certification Rule for the ESBWR Design."

8. DC/COL-ISG-016, "Interim Staff Guidance Compliance with 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) Loss of Large Areas of the Plant Due to Explosions or Fires from a Beyond-Design-Basis Event," dated April 20, 2010 (Non-Public ADAMS Accession No. ML101030529).

9. NEI 06-12, Revision 3, "B.5.b Phase 2 & 3 Submittal Guideline," September 2009. (ADAMS Accession Nos. ML092890396, ML092890400).

10. NRC Staff NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," March 2007 (ADAMS Accession No. ML070660036).

11. NRC Staff NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

20.0 REQUIREMENTS RESULTING FROM FUKUSHIMA NEAR-TERM TASK FORCE RECOMMENDATIONS

20.0 REQUIREMENTS RESULTING FROM FUKUSHIMANEAR-TERM TASK FORCE RECOMMENDATIONS

This chapter of the U.S. Nuclear Regulatory Commission's (NRC's) safety evaluation report (SER) provides the NRC staff evaluation of the Fukushima Near-Term Task Force (NTTF) recommendations that are applicable to the North Anna 3 Combined License (COL). The applicable recommendations address three topics: mitigation strategies for beyond-design-basis external events (related to Recommendation 4.2), spent fuel pool (SFP) instrumentation (related to Recommendation 7.1), and emergency preparedness (EP) staffing and communications (related to Recommendation 9.3).

Background

In response to the events at Fukushima resulting from the March 11, 2011, Great Tohoku earthquake and tsunami in Japan, NRC established the NTTF to conduct a systematic and methodical review of NRC processes and regulations (1) to determine whether the agency should make additional improvements to its regulatory system, and (2) to make recommendations to the Commission for policy directions. In July 2011, the NTTF issued a 90-day report, SECY-11-0093, "Near Term Report and Recommendations for Agency Actions Following the Events in Japan," (Agencywide Documents Access and Management System (ADAMS) Accession Number ML11186A950) identifying 12 recommendations. On September 9, 2011, in SECY-11-0124, "Recommended Actions To Be Taken Without Delay From The NTTF Report," (ADAMS Accession No. ML11245A127), the staff submitted to the Commission for its consideration NTTF recommendations that can and—in the staff's judgment—should be partially or entirely initiated without delay. In SECY-11-0124, the staff identified and concluded that specific actions to address a subset of the NTTF recommendations would provide the greatest potential for improving safety in the near term:

1. Recommendation 2.1: Seismic and Flood Hazard Reevaluations

2. Recommendation 2.3: Seismic and Flood Walkdowns

3. Recommendation 4.1: Station Blackout Regulatory Actions

4. Recommendation 4.2: Equipment Covered under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54(hh)(2)

5. Recommendation 5.1: Reliable Hardened Vents for Mark I Containments

6. Recommendation 8: Strengthening and Integration of Emergency Operating Procedures, Severe Accidents Management Guidelines, and Extensive Damage Mitigation Guidelines

7. Recommendation 9.3: Emergency Preparedness Regulatory Actions (staffing and communications)

On October 3, 2011, in SECY-11-0137, "Prioritization of Recommended Actions to Be Taken in Response to Fukushima Lessons Learned" (ADAMS Accession No. ML11272A203), the staff identified two actions in addition to the actions discussed in SECY-11-0124 that had the greatest potential for improving safety in the near term. The additional actions are as follows:

- Inclusion of Mark II containments in the staff's recommendation for reliable hardened vents associated with NTTF Recommendation 5.1

- The implementation of SFP instrumentation proposed in Recommendation 7.1

The staff also proposed to the Commission three tiers of prioritization for the NTTF recommendations. The first tier consists of those NTTF recommendations that the staff determined should be started without unnecessary delay and for which sufficient resource flexibility, including availability of critical skill sets, exists. The second tier consists of those NTTF recommendations that could not be initiated in the near term due to factors that include the need for further technical assessment and alignment, dependence on Tier 1 issues, or availability of critical skill sets. These actions do not require long-term study and can be initiated when sufficient technical information and applicable resources become available. The third tier consists of those NTTF recommendations that require further staff study to support a regulatory action, have an associated shorter-term action that needs to be completed to inform the longer-term action, are dependent on the availability of critical skill sets, or are dependent on the resolution of NTTF Recommendation 1 (See SECY-11-0093).

On February 17, 2012, in SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami" (ADAMS Accession No. ML12039A111), the staff provided the Commission with proposed orders and requests for information to be issued to all power reactor licensees and holders of construction permits.

On March 9, 2012, the Commission approved issuing the proposed orders with some modifications in the staff requirements memorandum (SRM) to SECY-12-0025. As set forth in SRM-SECY-12-0025, the proposed orders are needed for continued adequate protection or to provide a substantial increase in the protection of public health and safety. In accordance with its statutory authority under Section 161 of the Atomic Energy Act of 1954, as amended (the Act), the Commission may impose these requirements.

On March 12, 2012, the NRC issued Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events."; and Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession Nos. ML12054A735 and ML12054A679, respectively), to the appropriate licensees and permit holders, including the only holder at that time of a COL issued under 10 CFR Part 52, Southern Nuclear Operating Company, the licensee and operator of the Vogtle Electric Generating Plant Units 3 and 4. The staff also issued the requests for information pursuant to 10 CFR 50.54(f) regarding Recommendations 2.1, 2.3, and 9.3 to the appropriate licensees and construction permit holders in March 12, 2012, letters (ADAMS Accession No. ML12053A340).

The following Tier 1 recommendations from SECY-11-0137, as modified in SECY-12-0025, were considered in determining those that are applicable to North Anna 3 COL review:

1. Recommendation 2.1: Seismic and Flood Hazard Reevaluations

2. Recommendation 2.3: Seismic and Flood Walkdowns

3. Recommendation 4.1: Station Blackout Regulatory Actions

4. Recommendation 4.2: Equipment Covered under 10 CFR 50.54(hh)(2)

5. Recommendation 5.1: Reliable Hardened Vents for Mark I and Mark II Containments

6. Recommendation 7.1: Spent Fuel Pool Instrumentation

7. Recommendation 8: Strengthening and Integration of Emergency Operating Procedures, Severe Accidents Management Guidelines, and Extensive Damage Mitigation Guidelines

8. Recommendation 9.3: Emergency Preparedness Regulatory Actions (staffing and communications)

The staff determined that the following three recommendations are applicable and should be addressed by the North Anna 3 COL applicant:

1. Recommendation 4.2: Equipment covered under 10 CFR 50.54(hh)(2) - Order licensees to provide reasonable protection for equipment currently provided pursuant to 10 CFR 50.54(hh)(2) from the effects of design-basis external events, and to add equipment as needed to address multiunit events while other requirements are being revised and implemented.

2. Recommendation 7.1: Spent fuel pool instrumentation - Order licensees to provide sufficient safety-related instrumentation, able to withstand design-basis natural phenomena, and to monitor SFP parameters (i.e., water level, temperature, and area radiation levels) from the control room.

3. Recommendation 9.3: Emergency preparedness regulatory actions (staffing and communications) - Order licensees to do the following until rulemaking is complete:

   - Determine and implement the required staff to fill all necessary positions for responding to a multi-unit event.

   - Provide a means to power communications equipment needed to communicate onsite (e.g., radios for response teams and between facilities) and offsite (e.g., cellular telephones and satellite telephones) during a prolonged station blackout.

The staff determined that the remaining Tier 1 recommendations did not need to be considered further in North Anna 3 COL application (COLA) review. The applicant evaluated the seismic and flood hazards using current guidance and methodologies. For the seismic hazard, the applicant performed an evaluation consistent with guidance in Regulatory Guide (RG) 1.208, “A Performance-Based Approach to Define the Site Specific Earthquake Ground Motion.” Regarding the need to consider the latest information in the evaluation of seismic hazard, the applicant’s evaluation included consideration of the NUREG–2115, “Central and Eastern United States

Seismic Source Characterization for Nuclear Facilities," (CEUSSSC) model as described in this SER for North Anna 3, Chapter 2, Section 2.5.2. For flood hazards, as evaluated in this SER Chapter 2, Sections 2.4.5 and 2.4.6, the applicant used RG 1.59, "Design Basis Floods for Nuclear Power Plants," supplemented by best current practices, as it relates to providing assurance that natural flooding phenomena that could potentially affect the site have been appropriately identified and characterized. Thus, the staff determined that the applicant has already addressed the seismic and flood hazard reevaluation portion of Recommendation 2.1. Therefore, there are no additional matters left to be addressed in Recommendation 2.1 for seismic and flooding reevaluations related to the North Anna 3 COLA. Additionally, the staff determined that Recommendation 2.3 was not applicable to the North Anna 3 COL because the plant is not yet constructed. The staff also determined that Recommendation 5.1 is not applicable because it applies to boiling-water reactor plant designs with Mark I and Mark II containments, which the Economic Simplified Boiling-Water Reactor (ESBWR) does not have.

Recommendations 4.1 and 8 did not need to be considered further because SECY-11-0137 and the associated SRM direct that regulatory actions associated with these recommendations should be initiated through rulemaking.

In SECY-12-0025, the staff stated that all COL applicants would be asked to provide the information addressed in the orders and the requests for information through the review process. Accordingly, for the North Anna 3 COLA, the staff issued several requests for additional information (RAIs) related to the implementation of Fukushima NTTF recommendations pertaining to mitigation strategies for beyond-design-basis external events; SFP instrumentation; and EP staffing and communications based on Recommendations 4.2, 7.1, and 9.3, as modified by SRM-SECY-12-0025. The following sections of this chapter present the staff's safety evaluation related to these areas.

20.1 Recommendation 4.2, Mitigation Strategies for Beyond-Design-Basis External Events

In a December 18, 2013, letter (ADAMS Accession No. ML14013A113), the North Anna 3 COL applicant provided the results of its review of RAIs, including RAIs related to the mitigating strategies for beyond-design-basis external events, submitted by the Fermi 3 COLA, considered for the purpose of this SER chapter the reference COL (R-COL) applicant. As the subsequent COL (S-COL) for the purposes of this SER chapter North Anna 3 indicated that the Fermi 3 responses to RAIs applicable to mitigating strategies were incorporated into the North Anna 3 COLA, or the North Anna 3 COLA meets the intent of those Fermi 3 RAI responses.

In a January 23, 2015, letter (ADAMS Accession No. ML15028A185) North Anna 3 submitted markups to align with the Fermi 3 October 2014 R-COL submissions (ADAMS Accession No. ML14295A354 and ML14308A337). These COLA markups for North Anna 3 in FSAR Section 1.5.1.1.1 are consistent with the standard COL information contained in the FERMI 3 application.

The staff completed the review and finds the evaluation of the Fermi 3 COL standard content directly applicable to the North Anna 3 COLA. This report identifies the standard content material with italicized, double-indented formatting.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

20.1.1 Introduction

20.2.1 Introduction

SECY-12-0025 states that the staff will request all COL applicants to provide the information addressed in the orders (EA-12-049, EA-12-050, and EA-12-051) through the review process. For mitigation strategies for beyond-design-basis external events, SECY-12-0025 outlines a three-phase approach. The initial phase involves the use of installed equipment and resources to maintain or restore core cooling, containment, and spent fuel pool cooling (SFPC) without alternating current power. The transition phase involves providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase involves obtaining sufficient offsite resources to sustain those functions indefinitely.

The Japan Lesson-Learned Project Directorate (JLD)-ISG-2012-01, Revision 0, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," (ADAMS Accession No. ML12229A174) endorses with clarification the methodologies described in the industry guidance document Nuclear Energy Institute (NEI) 12–06, Revision 0, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," (ADAMS Accession No. ML12242A378) and provides an acceptable approach for satisfying the applicable requirements.

Application of JLD-ISG-2012-01 to new reactors, such as Fermi 3, requires appropriate consideration of the approaches to nuclear safety inherent in the specific designs. The Fermi 3 nuclear power plant references the Economic Simplified Boiling-Water Reactor (ESBWR) standard design that utilizes passive design features that provide core cooling, containment, and SFPC capabilities for 72 hours without relying on alternating current (ac) power. The ESBWR design also includes additional installed ancillary equipment that could extend the time period from 72 hours to 7 days to maintain safety functions using available onsite resources.

20.1.2 Summary of Application

20.2.2 Summary of Application

The applicant addresses mitigation strategies in Section 1.5.1.1.1, "Recommendation 4.2, Mitigating Strategies for Beyond-Design-Basis External Events" of the application. The NRC issued RAI Letter Number 78 (RAI 01.05-3 and RAI 01.05-4) dated July 3, 2012 (ADAMS Accession No. ML121850099);

and RAI Letter Number 84 (RAI 01.05-5 and RAI 01.05-6) dated March 19, 2013 (ADAMS Accession No. ML13078A436). The NRC requested the applicant to address the three-phase approach for mitigating beyond-design-basis external events and the mitigating strategies for ensuring that core cooling, containment, and SFPC capabilities function indefinitely. In letters responding to RAI Letter 84 dated April 18, 2013 (ADAMS Accession No. ML13109A426); July 9, 2013 (ADAMS Accession No. ML13192A301); and February 28, 2014 (ADAMS Accession No. ML14064A284), the applicant described the three-phase mitigation strategies for beyond-design-basis external events. The applicant responded to RAI Letter Number 78 in a letter dated August 24, 2012 (ADAMS Accession No. ML12240A184); and in subsequent supplemental response letters dated January 25, 2013 (ADAMS Accession No. ML13028A402); and February 19, 2013 (ADAMS Accession No. ML13051A657). In the response to the RAIs, the applicant proposed adding the following license condition related to mitigation strategies for beyond-design-basis external events:

> *At least 180 days before the date scheduled for initial fuel load as set forth in the notification submitted in accordance with 10 CFR § 52.103(a), DTE Electric Company shall use the guidance contained in JLD-ISG-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0 and the information presented in Fermi FSAR Section 01.05 to complete the development of strategies and guidance for maintaining and, if necessary restoring core cooling, containment, and SFPC capabilities beginning 72 hours after loss of all normal and emergency ac power sources, including any alternate ac source under 10 CFR 50.63. These strategies must be capable of:*
>
> - *Mitigating a simultaneous loss of all ac power sources, both from the onsite and offsite power systems, and loss of normal access to normal heat sink,*
> - *Maintaining core cooling, containment, and SFPC capabilities for Fermi Unit 3 during and after such an event affecting both Fermi Unit 2 and 3, and*
> - *Being implemented in all plant modes.*
>
> *Before initial fuel load, DTE Electric Company shall fully implement the strategies and guidance required in this license condition, including procedures, training, and acquisition, staging or installation of equipment and consumables relied upon in the strategies.*

The RAI response also included a proposed revision to the COL application Part 10, Section 3.8.2, "Mitigation Strategies for Beyond-Design-Basis External Events."

In the response to the Fermi COLA RAIs as reflected in the Fermi R-COLA, the applicant added the following license condition related to mitigation strategies for beyond-design-basis external events in Revision 7 of the North Anna COLA Part 10, Section 3.8.2, Mitigation Strategies for Beyond-Design-Basis External Events:

At least 180 days before the date scheduled for initial fuel load as set forth in the notification submitted in accordance with 10 CFR 52.103(a), the licensee shall use the guidance contained in JLD-Interim Staff Guidance (ISG)-2012-01, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0 and the information presented in FSAR Section 1.5 to complete the development of strategies and guidance to maintain and, if necessary, restore core cooling, containment, and spent fuel pool cooling capabilities beginning 72 hours after loss of all normal and emergency alternating current (ac) power sources, including any alternate ac source under 10 CFR 50.63. These strategies must be capable of:

- Mitigating a simultaneous loss of all ac power sources, both from the on-site and off-site power systems, and loss of normal access to the normal heat sink,
- Maintaining core cooling, containment, and spent fuel pool cooling capabilities for NA3 during and after such an event affecting all units on site, and
- Being implemented in all plant Modes.

Before initial fuel load, the licensee shall fully implement the strategies and guidance required in this license condition, including procedures, training, and acquisition, staging or installing of equipment and consumables relied upon in the strategies.

20.1.3 Regulatory Basis

20.2.3 Regulatory Basis

The requirements and guidance for mitigation strategies for beyond-design-basis external events are established or described in the following:

- *Atomic Energy Act of 1954, as amended (the Act), Section 161, authorizes the Commission to regulate the possession and utilization of special nuclear material in a manner that is protective of public health and in accordance with the common defense and security.*
- *10 CFR 52.97(a)(1) which authorizes the Commission to issue a COL if it finds, among other things, that issuance of the license will not be inimical to the health and safety of the public. This regulation applies here because the Commission found in Order EA-12-049 that it is necessary for power reactor licensees to develop, implement and maintain guidance and strategies to restore or maintain core cooling, containment, and SFP*

cooling capabilities in the event of a beyond-design-basis external event in order to ensure adequate protection of the public health and safety.

- *SRM-SECY-12-0025, "Staff Requirements – SECY-12-0025 – Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated March 9, 2012, approves the issuance of orders for beyond-design-basis external events, as necessary, for ensuring the continued adequate protection under the 10 CFR 50.109(a)(4)(ii) exception to the Backfit Rule.*

- *Order EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012. Although Order EA-12-049 does not apply to Fermi 3, the staff has followed the current NRC and industry guidance for mitigation strategies in evaluating the equipment used as part of the FLEX mitigation strategy for Fermi 3.*

- *JLD-ISG-2012-01, Revision 0, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design- Basis External Events," issued August 29, 2012, endorses NEI 12–06, Revision 0, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (issued August 21, 2012), with exceptions/clarifications.*

20.1.4 Technical Evaluation

20.2.4 Technical Evaluation

The NRC issued Order EA-12-049 on March 12, 2012, which required operating reactor licensees and construction permit holders to deploy strategies that will enhance their ability to cope with conditions resulting from beyond-design-basis external events. Attachment 2 to Order EA-12-049 specifies the use of a three-phase approach for mitigating these events. The initial phase involves the use of installed equipment and resources to maintain or restore core cooling, containment and SFPC capabilities. The transition phase involves providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase involves obtaining sufficient offsite resources to sustain those functions indefinitely. Application of the three-phase approach to new reactors, such as Fermi 3, requires appropriate consideration of the approaches to nuclear safety inherent in the specific designs.

In RAI 01.05-5, the staff requested the applicant to address how the initial and transition phase mitigation will be accomplished in the event of an extended loss of ac power (ELAP) event at Fermi 3. RAI 01.05-3 requested the applicant to address the final phase mitigation describing the strategies for maintaining and restoring core cooling, containment and SFPC capabilities with use of offsite *resources. The staff also requested the applicant to address the ability to implement the strategies in all modes.*

<u>*Initial and Transition Phase Mitigation – Core Cooling and Containment Function*</u>

In the response to RAI 01.05-5 dated April 18, 2013 (ADAMS Accession No. ML13109A426), the applicant provided information on the mitigating strategies that would be used to cope with an ELAP resulting from a beyond-design-basis external event. For this evaluation, the applicant assumed that the plant would be in a station blackout (SBO), which assumes a loss of all offsite power sources with a concurrent loss of the onsite standby diesel generators.

The applicant's response indicated that, for the ESBWR, the underlying strategies for coping with an extended loss of ac power events involve a three-phase approach; and that the passive safety features of the ESBWR and the installed ancillary equipment provide a significant coping period.

In regard to the initial phase mitigation, the applicant's response to RAI 1.05-5 states the following:

> *Section 15.5.5 and Section 19A.2.2 of the ESBWR Design Control Document (DCD), which are incorporated by reference into the Fermi 3 FSAR, provide a performance evaluation for station blackout and show conformance to the requirements of 10 CFR 50.63 as it relates to maintaining core cooling, inventory control, and containment heat removal.*
>
> *The analysis in DCD Tier 2, Section 15.5.5 demonstrates that reactor water level is maintained above the top of the active fuel by operation of the ICS [isolation condenser system], a safety-related system. Because the ICS removes the reactor decay heat to the IC/PCCS [passive containment cooling system] pools that are outside the containment, the containment and suppression pool pressures and temperatures are maintained within the design limits. Therefore the integrity of the containment is maintained. As described in DCD, Section 15.2.2.9, during refueling mode, GDCS [gravity-driven cooling system] is available to ensure extended core cooling and inventory control for at least 72 hours.*

The applicant indicated that the design basis for the ESBWR standard plant includes passive features that provide core, containment, and SFPC capabilities for 72 hours, with no reliance on ac power. Section 19A.2.2 of the ESBWR DCD states that "the ESBWR is designed such that no operator actions or AC power are required for a station blackout event, for 72 hours," and the ESBWR is designed to successfully mitigate an SBO event to meet the requirements of 10 CFR 50.63, "Loss of all alternating current," using safety-related [systems structures and components]*SSCs. This 72-hour mitigation capability addresses the initial phase mitigation for ESBWR plants such as Fermi 3, and this mitigation* *capability provides adequate time to transition to final phase mitigation, without necessarily relying upon a transition phase. This is because the transition phase is defined as the time necessary for resources to be brought from offsite and 72 hours is a sufficiently long time period. Nevertheless, the ESBWR design includes installed ancillary equipment that could potentially extend the time period for transition from the initial phase mitigation to final phase mitigation to 7 days.*

10 CFR 50.63(a)(2) includes a provision that is the premise for the acceptance of an SBO for core cooling and the containment function. The provision requires the following:

> *The reactor core and associated coolant, control, and protection systems, including station batteries and any other necessary support systems, must provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity is maintained in the event of an SBO for the specified duration. The capability for coping with an SBO of specified duration shall be determined by an appropriate coping analysis.*

ESBWR DCD, Tier 2, Section 15.5.5 contains the results of the DCD applicant's performance evaluation for an SBO showing conformance to the requirements of 10 CFR 50.63.

NRC staff reviewed ESBWR DCD, Tier 2, Section 15.5.5, as part of the ESBWR DCD review. In Subsection 15.5.5.4 of the ESBWR Final Safety Evaluation Report SER (FSER) in NUREG–1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor," the staff concluded that

> *The ESBWR reactor core and associated coolant, control, and protection systems, including station batteries and other necessary support systems, provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity in the event of an SBO for 72 hours. The applicant conducted an appropriate coping analysis to demonstrate the capability for coping with an SBO with a 72-hour duration, and hence, the acceptance criteria are satisfied.*

Fulfilling the requirements for an SBO, per 10 CFR 50.63, but without reliance on an alternate ac source, assures adequate core and containment cooling of the plant for operating modes ranging from normal power operation (Mode 1) to safe shutdown (Mode 4). Adequate cooling must also be provided when the plant is in cold shutdown (Mode 5) and refueling (Mode 6).

In Mode 5, when insufficient steam is available to drive the ICS, the GDCS can be used to perform the core cooling function. In Mode 6, the only core cooling systems available during the ELAP event are the GDCS and the suppression pool. In ESBWR FSER Section 16.2.8, the staff's discussion of RAI 16.2-37 *states that General Electric-Hitachi performed an analysis to show that the water above the core will be sufficient to keep the core covered and to maintain an adequate level of shielding. Based on the results of this analysis, the staff concludes that in Mode 6 with the reactor cavity flooded up, a sufficient water inventory would exist for 72 hours to passively provide decay heat removal and to protect the fuel. DCD Tier 2, Subsection 19A.3.1.1 states that during shutdown conditions, either the GDCS or the flooded-up refueling volume is sufficient to ensure core cooling. Once activated, neither power nor controls are necessary to maintain these functions for 72 hours. The staff therefore concludes that the strategies adequately address that for an ELAP in Modes 5 and 6, core cooling, has been adequately addressed because sufficient water either from the GDCS pools and the suppression pool or from the flooded-up refueling volume will be available, and is sufficient to ensure core cooling for 72-hours.*

For the transition phase, NRC order EA-12-049 allows use of portable, onsite equipment and consumables to maintain or restore core cooling, containment, and SFPC functions until they can be accomplished with resources brought from offsite (e.g., on Page 4 of the order). As discussed above, the initial phase mitigation of 72 hours provides sufficient time for resources to be brought from offsite. As such, reliance on a transition phase is not necessary for Fermi 3.

In the response to RAI 01.05-5 the applicant also discusses a coping strategy to extend the cooling capability beyond 72 hours and for up to 7 days. In particular, the applicant states that following the 72-hour passive system coping time, support is required to continue passive system cooling and makeup to the IC/PCCS pools and spent fuel storage pools. This support could be provided by installed plant ancillary equipment as discussed in ESBWR DCD Tier 2, Section 19A.3.1, "Actions Required Beyond 72 Hours." Section 19A.3.1 describes the post 72- hour actions and the use of installed regulatory treatment of non-safety systems (RTNSS) equipment for core, containment, and spent fuel cooling safety functions. NRC's evaluation of the ESBWR RTNSS program is provided in Chapter 22, "Regulatory Treatment of Nonsafety Systems," of the ESBWR FSER, and includes an evaluation of the augmented design standards for RTNSS equipment to withstand external events such as earthquakes, hurricanes, tornadoes, and floods.

<u>Initial and Transition Phase Mitigation – Spent Fuel Pool Cooling</u>

The applicant addressed mitigation strategies for SFPC in the response to the first question in RAI 01.05-5. That response addressed the initial phase mitigation with the following statement:

> *As described in the ESBWR DCD, Section 9.1.3.2, which is incorporated by reference into the Fermi 3 FSAR, during a loss of spent fuel pool and buffer pool cooling, cooling of the spent fuel pool and buffer pool is accomplished by allowing the water in the*

> *pools to heat and boil. There is sufficient water in each pool to ensure adequate fuel cooling for 72 hours.*

The applicant addressed the transition phase mitigation by stating the following:

> *DCD Section 19A.3.1, which is incorporated by reference into the Fermi 3 FSAR, describes the post 72-hr actions and credits use of installed regulatory treatment of non-safety systems (RTNSS) equipment.*
>
> *After 72 hours, nonsafety-related systems are used to replenish the passive systems to perform these safety functions directly. As described in Section 9.1.3, and 19A.3.1, after 72 hours, makeup water can be provided through installed safety-related connection to the Fire Protection System (FPS) or spent fuel storage pool. Between 72 hours and seven days, the resources for performing theses safety functions are available onsite.*

The staff reviewed the information regarding the ESBWR SFPC as part of the review of the ESBWR DCD, which is documented in Section 9.1.3 of the ESBWR DCD FSER. The staff concludes that for both the buffer pool and the SFP, the water levels and free volumes are sufficient to ensure that for 72 hours following a loss of forced cooling without active cooling water makeup, the water levels in the pools will remain above the top of active fuel (TAF) which provides sufficient time for initial phase mitigation and for resources to be bought from offsite.

Similar to that for the core cooling and containment functions discussed above, installed plant ancillary equipment could potentially extend this time period to 7 days.

<u>Final Phase Mitigation</u>

To support core cooling, containment, and spent fuel pool cooling post 72-hours, the ESBWR design has installed ancillary equipment with sufficient capacity. This equipment is designed to augmented design standards for external events, such as earthquakes, hurricanes, tornadoes, and floods, as documented in the ESBWR DCD Section 19A.3.1 and the NRC's ESBWR FSER Section 22.5.6. The ancillary equipment is capable of delivering at least minimum water quantities, at the minimum makeup rates, needed to support heat removal from the core and spent fuel pool. In its response to RAI 01.05-5 the applicant describes the use of this equipment to allow the extension of the initial mitigation phase from 72 hours up to 7 days.

In its response to RAI 01.05-5, the applicant indicated that the ESBWR has safety-related connections through which makeup water can be supplied. These connections allow portable equipment brought in from offsite to be used to support continued operation of the ESBWR passive systems, as an alternative to the plant installed ancillary equipment if it is not available or operable. These connections would be used during the final mitigation phase.

The staff reviewed the North Anna application, RAI responses from FERMI, and the January 23, 2015, letter regarding alignment with the R-COLA, and determined that the supplemental Information is consistent with the FERMI R-COLA information. Therefore, the North Anna 3 supplemental information that addresses mitigating strategies for beyond-design-basis external events is acceptable. The staff provided a license condition with the same provisions as the comparable license condition for Fermi that reflects the same mitigating strategies. This license condition ensures that the applicant will have developed the overall plan of mitigating strategies for North Anna 3 at least 1 year before completion of the final inspections, tests, analyses, and acceptance criteria (ITAAC).

The staff verified that the North Anna 3 FSAR Revision 9 incorporated the appropriate changes described in the January 23, 2015, letter regarding R-COLA alignment, as listed in the North Anna 3 FSAR Section 1.5.1.1. Therefore Confirmatory Item 20.1-1 from the staff advanced SER for North Anna 3 is resolved and closed.

20.1.5 Post Combined License Activities

The ESBWR design, incorporated by reference into the North Anna 3 COL, includes passive design features that provide core cooling, containment, and SFPC for 72 hours without reliance on ac power. These features do not rely on access to any external water sources. The ESBWR design also includes onsite equipment to replenish water sources and charge batteries.

Connections are provided for using generators and pumping equipment that can be brought from offsite.

For the reasons discussed in Section 20.1.4 of this report, (Fermi Section 20.2.4), Technical Evaluation, the staff will include a license condition related to the mitigating strategies program:

> **License Condition (20.1-1)**: Mitigation Strategies for Beyond-Design-Basis External Events
>
> a. The Licensee shall complete development of an overall integrated plan of strategies to mitigate a beyond-design-basis external event at least 1 year before the completion of the last ITAAC on the schedule required by 10 CFR 52.99(a).
>
> b. The overall integrated plan required by this condition must include guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities. The overall integrated plan must include provisions to address all accident mitigation procedures and guidelines (including the guidance and strategies required by this section, emergency operating procedures, abnormal operating procedures, and extensive damage management guidelines).
>
> c. The guidance strategies required by this condition must be capable of (i) mitigating a simultaneous loss of all ac power and loss of normal access to the normal heat sink and (ii) providing for adequate capacity to perform the functions upon which the guidance and strategies rely for all units on the North Anna site and in all modes at each unit on the site.

d. Before initial fuel load, Dominion shall fully implement the guidance and strategies required by this condition, including:

1. Procedures;

2. Training;

3. Acquisition, staging, or installation of equipment and consumables relied upon in the strategies; and

4. Configuration controls and provisions for maintenance and testing (including testing procedures and frequencies for preventative maintenance) of the equipment upon which the strategies and guidance required by this condition rely.

e The training required by condition d.2 must use a Systematic Approach to Training (SAT) to evaluate training for station personnel, and must be based upon plant equipment and procedures upon which the guidance and strategies required by this condition rely.

f The Licensee shall maintain the guidance and strategies described in the application upon issuance of the license, and the integrated plan of strategies upon its completion as required by condition a. The Licensee may change the strategies and guidelines required by this condition provided that the Licensee evaluates each such change to ensure that the provisions of conditions b and c continue to be satisfied and the Licensee documents the evaluation in an auditable form.

20.1.6 Conclusion

The staff reviewed the applicant’s proposed mitigating strategies discussed in FSAR Section 1.5.1.1.1 of the application for ensuring that core cooling, containment, and SFPC capabilities function indefinitely without ac power, in the event of a beyond-design-basis external event resulting in an ELAP. The staff finds that the approach for mitigating beyond-design-basis external events to be used at North Anna 3 is consistent with NRC Order EA-12-049. The staff also finds that the ESBWR passive design features provide for initial phase mitigation because core cooling, containment function and SFPC are achieved without ac power or operator action for the first 72 hours. In addition, through the implementation of the final phase mitigation using offsite FLEX equipment, core cooling, containment function and SFPC can be extended indefinitely.

20.2 Recommendation 7.1, Reliable Spent Fuel Pool Instrumentation

In North Anna 3 FSAR Revision 7, the applicant incorporated Supplemental Information Consistent with R-COLA (CWR Sup) 1.5-1, which addresses Recommendation 7.1, Reliable Spent Fuel Pool Instrumentation.

Dominion, the North Anna 3 applicant, included in their application the same supplemental information submitted by Fermi 3 as the R-COLA.

The CWR Sup 1.5-1 includes FSAR Tier 2, Subsection 1.5.1.1.2, Recommendation 7.1, "Reliable Spent Fuel Pool Instrumentation," which describes the design features for SFP instrumentation as incorporated by reference in Revision 10 of the ESBWR DCD.

The staff completed the review and finds the evaluation of the Fermi 3 COL standard content directly applicable to the North Anna 3 COLA. This SER identifies the standard content material with italicized, double-indented formatting.

The staff reviewed the information in the North Anna 3 COL FSAR as follows:

20.2.1 Introduction

> ***20.3.1 Introduction***
>
> *During the events in Fukushima, responders were without reliable instrumentation to determine the water level in the SFP. This raised concerns that the pool may have boiled dry, resulting in fuel damage, which highlighted the need for reliable SFP instrumentation. The current SFP water level instrumentation at U.S. nuclear power plants is typically a narrow range and, therefore, it is only capable of monitoring normal and slightly off-normal conditions. Although the likelihood of a catastrophic event affecting nuclear power plants and the associated SFPs in the United States remains very low, beyond-design-basis external events could challenge the ability of existing SFP instrumentation to provide emergency responders with reliable information on the condition of the SFPs. Reliable and available indicators are essential to ensure that plant personnel can effectively prioritize emergency actions.*
>
> *SECY-12-0025 (ADAMS Accession No. ML12039A103) states that for DC* [direct current] *and COL applications submitted under 10 CFR Part 52 and in active staff review, the staff plans to assure that the Commission-approved Fukushima actions are addressed before certification or licensing. The staff will request all COL applicants to provide the information addressed in the orders (EA-12-049, EA-12-050, and EA-12-051) and the request for information letters described in this SECY paper, as applicable, through the review process.*
>
> *JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," (ADAMS Accession No. ML12221A339) endorses with exceptions and clarifications the methodologies described in the industry guidance document NEI 12–02, Revision 1, "Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," (ADAMS Accession No. ML122400399) and provides an acceptable approach for satisfying the applicable requirements.*

20.2.2 Summary of Application

20.3.2 Summary of Application

The applicant addresses reliable spent fuel pool instrumentation in Section 1.5.1.1.2, "Recommendation 7.1, Reliable Spent Fuel Pool Instrumentation" of the application. The NRC issued RAI Letter Number 78 (RAI 01.05-4) dated July 3, 2012 (ADAMS Accession No. ML121850099), and RAI Letter 84 (RAI 01.05-6) dated March 19, 2013 (ADAMS Accession No. ML13078A436). In these RAI letters, the staff requested the applicant to address the provisions for monitoring key SFP parameters as described in Order EA-12-051 dated March 12, 2012 (ADAMS Accession No. ML12054A679), which are not part of the ESBWR DCD, and to include any proposals for changes to the current application. The applicant responded to these RAIs in letters dated August 24, 2012 (ADAMS Accession No. ML12240A184); January 25, February 19, April 18, July 9 and October 15, 2013 (ADAMS Accession Nos. ML13028A402, ML13051A057, ML13109A426, ML13192A301, and ML13311A101 respectively). As part of the RAI responses, the applicant described the SFP and the buffer pool level instrument design features that ensure a reliable indication of the water level in the SFP and buffer pools. The applicant proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2, "Recommendation 7.1, Reliable Spent Fuel Pool Instrumentation"; and a license condition in Part 10, Revision 4, Section 3.8.3, "Reliable Spent Fuel Pool/Buffer Pool Level Instrumentation," which verifies that the programmatic aspects of the order are completed and implemented prior to initial fuel loading.

20.2.3 Regulatory Basis

20.3.3 Regulatory Basis

The requirements and guidance for reliable SFP instrumentation are established or described in the following:

- *Atomic Energy Act of 1954, as amended, (the Act), Section 161, authorizes the Commission to regulate the possession and utilization of special nuclear material in a manner that is protective of public health and in accordance with common defense and security.*

- *10 CFR 52.97(a)(1) which authorizes the Commission to issue a COL if it finds, among other things, that issuance of the license will not be inimical to the health and safety of the public. This regulation applies here because the Commission found in Order EA-12-049 that it is necessary for power reactor licensees to develop, implement and maintain guidance and strategies to restore or maintain core cooling, containment, and SFP cooling capabilities in the event of a beyond-design-basis external event in order to ensure adequate protection of the public health and safety.*

- *SRM-SECY-12-0025, "Staff Requirements – SECY-12-0025 – Proposed Orders and Requests for Information in Response to Lessons Learned* *from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated March 9, 2012, approves the issuance of orders for reliable SFP instrumentation under an administrative exemption to the Backfit Rule.*

- *Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012.*

- *JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," issued August 29, 2012, endorses NEI 12–02, Revision 1, "Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," with exceptions and clarifications.*

20.2.4 Technical Evaluation

20.3.4 Technical Evaluation

As a result of SECY-12-0025, the staff issued RAI Letter 78 (RAI 01.05-4) requesting additional information in relation to the lessons learned from the Great Tohoku Earthquake and Tsunami. In RAI 01.05-4, the staff requested the applicant to address the provisions for monitoring key SFP parameters as described in the order dated March 12, 2012, which are not part of the ESBWR design—including any proposals for changes to the current application.

In Commission Order EA-12-051, the NRC describes the key parameters used to determine that a level instrument is considered reliable. NEI 12–02, Revision 1 provides an acceptable approach for satisfying the applicable requirements. The staff evaluated the applicant's response to RAI 01.05-4 and determined that additional information was needed. The staff issued RAI 01.05-6 requesting the applicant to provide further clarification on the level instrument design criteria and programmatic aspects. In the applicant's responses, they suggested the creation of a new license condition in Section 3.8.3 to Part 10 of the COL application; and FSAR changes to Tier 2, Subsection 1.5.1.1.2 that provided further design information and discussed how the SFP level instrument is designed to be reliable according to the guidance in NEI 12–02. The applicant's response and the proposed FSAR changes take credit for design information already described in several sections of the ESBWR DCD. The staff's evaluation of the DCD sections is discussed in the ESBWR DCD FSER (NUREG-1966) and is not part of this SER.

<u>Instruments</u>

In Commission Order EA-12-051, Attachment 2, Section 1.1 states that the SFP level instrument channels shall consist of a permanent and fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor the SFP water level under conditions which restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.

The applicant's response to RAI 01.05-6 (ADAMS Accession No. ML13192A301) proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2, which references ESBWR DCD, Tier 2, Section 9.1.3 which states that the SFP and the buffer pool each have two wide-range, safety- related level transmitters that transmit signals to the main control room. These signals are used to indicate a collapsed water level and to initiate high/low-level alarms, both locally and in the main control room. ESBWR DCD, Tier 2, Subsection 7.5.5.3.1 indicates that the safety-related pool monitoring instrumentation design conforms to Institute for Electrical and Electronics Engineers (IEEE) Standard (Std) IEEE Std 603–1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

The staff noted that the ESBWR DCD credits the SFP pool level instruments as operational in environmental conditions consistent with boiling down to the top of the active fuel. These conditions would result in a high temperature (100 degrees Celsius [212 degrees Fahrenheit]), high humidity, steaming environment, loss of shielding, and high radiation doses. The staff evaluated the instrument description in the RAI response and the proposed changes to the FSAR. The staff determined that crediting two permanently installed, safety-related, seismic Category I instruments is in accordance with the design features identified in Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

Arrangement

In Commission Order EA-12-051, Attachment 2, Section 1.2 states that the SFP level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP. This protection may be provided by locating the safety-related instruments to maintain instrument channel separation within the SFP area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the SFP structure.

The applicant's response to RAI 01.05-6 states that the SFP level instrument channels will be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP. The applicant's response refers to ESBWR DCD, Tier 2, Subsection 7.5.5.3.2, which indicates that the SFP and the buffer pool instrumentation meets the separation criteria set forth in 10 CFR Part 50, Appendix A, GDC 24, "Separation of protection and control system." Also, ESBWR DCD, Tier 2, Section 7.5.5 indicates that the safety-related pool monitoring instrumentation is designed to satisfy the requirements of IEEE Standard 603–1991, as endorsed by RG 1.153, Revision 1, "Criteria for Safety Systems," which includes requirements for the physical separation of channels to avoid a common mode failure due to a missile. ESBWR DCD, Tier 2, *Subsection 3.8.4.1.1 indicates that the reactor building, which houses the buffer pool, is a seismic Category I structure. ESBWR DCD, Tier 2, Subsection 3.8.4.1.3 describes the fuel building, which houses the SFP facilities and their supporting system and heat, ventilation, and air conditioning (HVAC) equipment, as a seismic Category I structure except for the penthouse that houses HVAC equipment. The penthouse is a seismic Category II structure. ESBWR DCD, Tier, 2 Section 3.5 describes the missile assessment for the ESBWR. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 reference the ESBWR DCD sections mentioned above.*

The staff evaluated the ESBWR DCD and confirmed that the DCD provides design features to protect safety-related components against missiles. The staff evaluated the instrument location description in the applicant's RAI response and the proposed changes to the FSAR. The staff determined that crediting the channel separation is an acceptable approach that provides reasonable protection against missiles. Therefore, the staff concludes that these features are in conformance with Commission Order EA-12-051 and the guidance in JLD- ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

<u>Mounting</u>

In Commission Order EA-12-051, Attachment 2, Section 1.3 states that the installed instrument channel equipment within the SFP shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the SFP structure.

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Subsection 7.5.5.3.3 indicates that the SFP and the buffer pool instrumentation are seismically qualified and this includes the equipment mounting configuration. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 reference the ESBWR DCD section mentioned above.

The staff evaluated the RAI response and the proposed FSAR changes. The staff determined that designing the instrument and its mounting to be seismically qualified will ensure that both will retain their design functionality following a seismic event. The staff concludes that these features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

Qualification

In Commission Order EA-12-051, Attachment 2, Section 1.4 states that primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the SFP water at saturation conditions for an extended period.

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Section 9.1.3 indicates that both the SFP and the buffer pool each have two wide-range, safety-related level transmitters. ESBWR DCD, Tier 2, Subsection 7.5.5.3.3 indicates that the pool instrumentation is subject to environmental qualification and post-accident monitoring criteria. ESBWR DCD, Tier 2, Subsections 7.5.5.3.1 and 7.5.5.3.2 indicate that the pool instrumentation system conforms to quality standards for safety-related equipment. The ESBWR DCD credits the SFP pool level instruments as operational in environmental conditions consistent with boiling down to the top of the active fuel. These conditions would result in a high temperature (100 degrees Celsius [212 degrees Fahrenheit]), high humidity, steaming environment, loss of shielding, and high radiation doses. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 reference the ESBWR DCD sections mentioned above.

The staff reviewed the applicant's response and the proposed FSAR changes. The staff determined that the instrumentation will be designed to quality standards for safety-related equipment and to remain operational while exposed to the environmental conditions following an accident event. The staff finds that these features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1.

Independence

In Commission Order EA-12-051, Attachment 2, Section 1.5 states that the primary instrument channel shall be independent of the backup instrument channel.

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Subsection 7.5.5.3.2 states that the instrument channels are physically and electronically independent, in accordance with GDC 24.

The staff reviewed the applicant's response and concludes that this feature is in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved.

Power Sources

In Commission Order EA-12-051, Attachment 2, Section 1.6 states that the permanently installed instrumentation channels shall each be powered by a *separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and direct current (dc) power distribution systems, such as portable generators or replaceable batteries.*

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Subsection 7.5.5.3.2 states that the instrument channels are physically and electronically independent, in accordance with GDC 24. The safety-related primary and backup instrumentation channels are controlled by the safety-related distributed control and information system (Q-DCIS). ESBWR DCD, Tier 2, Section 7.1.2 describes the divisional Q-DCIS components as powered by redundant, independent, and separated uninterruptible power supplies (UPSs) dedicated to their division with a battery backup (per division) for at least 72 hours. After 72 hours, the Q-DCIS can operate continuously on power from the ancillary diesel generators until offsite power is restored.

Commission Order EA-12-051 specifies that all permanently installed instrumentation channels are to be provided with power connections from sources independent of the plant ac and dc power distribution systems. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 state that the instrument channels will be provided with an alternate connection to sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries, thus allowing for quick and accessible connections of sources. The alternate power source and replaceable batteries used for instrument channel power will have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

The staff reviewed the applicant's response and the proposed changes to FSAR Subsection 1.5.1.1.2. The staff noted that the level instrument channels are powered by separated safety-related sources capable of powering the instruments for up to 72 hours. After 72 hours, the instrument channel can be powered by the ancillary diesel generators. In the event that these power sources are not available, the applicant's proposed changes to FSAR Subsection 1.5.1.1.2 state that these instrument channels will have the capability of being quickly connected to an alternate power source independent from the plant ac and dc power distribution systems. The staff evaluated the applicant's RAI response and the proposed FSAR changes. The staff concludes that these design features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

Accuracy

In Commission Order EA-12-051, Attachment 2, Section 1.7 states that the instrument shall maintain its designed accuracy following a power interruption or a change in the power source without recalibration.

The applicant's response to RAI 01.05-6 and the proposed changes to FSAR Subsection 1.5.1.1.2 state that the instrument channels will be capable of maintaining the original accuracy following a power interruption or a change in power source without recalibration. The revised FSAR subsection also references ESBWR DCD, Tier 1, Table 2.6.2-2, which verifies that the instruments meet the minimum instrument accuracy of ±300 millimeters (mm) (±1 ft).

The staff reviewed the applicant's system description and the proposed FSAR changes. The staff concludes that these design features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

Testing

In Commission Order EA-12-05, Attachment 2, Section 1.8 states that the instrument channel design shall provide for routine testing and calibration.

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Subsection 9.1.3.4 indicates that the fuel and auxiliary pools cooling system (FAPCS) is designed to permit surveillance testing and in-service inspection of the safety-related components and the components required to perform the post-accident recovery functions in accordance with GDC 45, "Inspection of cooling water system," and American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section XI. In addition, Fermi 3 COL Application Part 4, "Technical Specifications," Section 3.7.5, includes periodic surveillance of the fuel pools water level during the movement of irradiated fuel assemblies in the associated fuel storage pool or when irradiated fuel assemblies are stored in the associated fuel storage pool. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 reference the ESBWR DCD and the technical specifications sections mentioned above.

The staff reviewed the applicant's system description, the ESBWR design, and the proposed FSAR changes. The staff concludes that these design features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these *changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.*

Display

In Commission Order EA-12-051, Attachment 2, Section 1.9 states that trained personnel shall be able to monitor the SFP water level from the control room, the alternate shutdown panel, or other appropriate and accessible locations. The display shall provide on-demand or continuous indication of the SFP water level.

The applicant's response to RAI 01.05-6 noted that ESBWR DCD, Tier 2, Section 9.1.3 states that both the SFP and the buffer pool each have two wide-range, safety-related, level transmitters that transmit signals to the main control room. These signals are used for on demand or continuous collapsed water level indications and to initiate high/low-level alarms, both locally and in the main control room. The proposed changes to FSAR Tier 2, Subsection 1.5.1.1.2 reference the ESBWR DCD section mentioned above.

The staff reviewed the applicant's system description and the proposed FSAR changes. The staff concludes that these design features are in conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the proposed FSAR changes are in the next FSAR revision was being tracked as part of Confirmatory Item 20.3-1. The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

Programs

In Commission Order EA-12-051, Attachment 2, Section 2 states that the SFP instrumentation shall be maintained to be available and reliable through the appropriate development and implementation of a training program. Personnel shall be trained in the use and maintenance (including test and calibration), and in the procedures for providing alternate power to the level instrument channels.

The applicant's response to RAI 01.05-6 stated that FSAR Section 13.2 includes a description of the training programs for operators and emergency response actions. FSAR Section 13.5 describes the development of procedures under the Plant Operating Procedures Development Plan that will address the procedures, testing, and calibration requirements of the installed instrument channels as identified in the Commission's order. In addition, the applicant has proposed new license condition in Section 3.8.3 to Part 10 of the COL application requiring that prior to fuel loading, the SFP and the buffer pool instrumentation shall be maintained to be available and reliable through the appropriate development and implementation of a training program. Personnel shall be trained in the use and the provision of alternate power to the safety-related level instrument channels.

The staff evaluated the applicant's RAI response and the proposed license condition. The staff finds that the program descriptions provided are in *conformance with Commission Order EA-12-051 and the guidance in JLD-ISG-2012-03. Therefore, this part of RAI 01.05-6 is resolved. Confirmation that the license condition changes are in the next revision of the COL application, Part 10, Section 3.8.3, was being tracked as part of Confirmatory Item 20.3-1.*

The staff confirmed that these changes have been incorporated into the Fermi 3 COL FSAR. Therefore, this part of Confirmatory Item 20.3-1 is closed.

The staff reviewed the North Anna incorporated supplemental Information and finds that it is consistent with the FERMI R-COLA information in Section 1.5.1.1.2 of the FERMI R-COL FSER. Therefore, the North Anna 3 supplemental information that addresses reliable SFP level instrumentation is acceptable.

20.2.5 Post Combined License Activities

For the reasons discussed in the "Technical Evaluation" section above, and to be consistent with the R-COL, the staff proposed to include the following license condition related to the SFP instrumentation in order to verify that the programmatic aspects of the order are completed and implemented prior to initial fuel loading.

> **License Condition (20.3-1)**: Reliable Spent Fuel Pool/Buffer Pool Level Instrumentation
>
> Prior to initial fuel load, Dominion shall address the following requirements using the guidance contained in JLD-ISG-2012-03, "Compliance with Order EA-2012-051, Reliable Spent Fuel Pool Instrumentation," Revision 0:
>
>> The spent fuel pool/buffer pool instrumentation shall be maintained available and reliable through the development and implementation of a training program. The training program shall include provisions to ensure trained personnel can route the temporary power lines from the alternate power source to the appropriate connection points, and connect the alternate power source to the safety-related level instrument channels.

20.2.6 Conclusion

The staff evaluated the applicant's FSAR sections related to the SFP and Buffer Pool water level instrumentation and concluded that these instruments are designed in accordance with the guidance in JLD-ISG-2012-03. Therefore, these instruments are considered reliable, able to withstand beyond-design-basis natural phenomena, and able to monitor key SFP level parameters as described in Commission Order EA-12-051.

20.3 Recommendation 9.3, Emergency Preparedness

20.3.1 Introduction

The accident at Fukushima reinforced the need for effective EP. The objective of EP is to ensure that the capability exists for a licensee (or will exist for a COL applicant) to implement measures that mitigate the consequences of a radiological emergency and to provide for protective actions of the public. The accident at Fukushima highlighted the need to determine the staffing needed to respond to a multi-unit event. Additionally, there is a need to ensure that the communication equipment relied on has adequate power to coordinate the response to an event during an ELAP.

20.3.2 Summary of Application

In the North Anna 3 COLA, Part 10, the applicant proposed License Condition 3.8.1 to address Fukushima NTTF Recommendation 9.3.

20.3.3 Regulatory Basis

The requirements for EP for beyond-design-basis external events are established or described in the following:

- 10 CFR 50.47(b)(1) states, in part, that “each principal response organization has staff to respond and to augment its initial response on a continuous basis.”

- 10 CFR 50.47(b)(2) states, in part, that “adequate staffing to provide initial facility accident response in key functional areas is maintained at all times” and that “timely augmentation of response capabilities is available.”

- 10 CFR 50.47(b)(6) states that “[p]rovisions exist for prompt communications among principal response organizations to emergency personnel and to the public.”

- 10 CFR Part 50, Appendix E, “Emergency Planning and Preparedness for Production and Utilization Facilities,” Section IV.E.P, states, in part, that adequate provisions shall be made and described for emergency facilities and equipment, including at least one onsite and one offsite communications system, and that each system shall have a backup power source.

The guidance for EP for beyond-design-basis external events is established or described in the following:

- SECY-12-0025 states, in part, that the staff will also request all COL applicants to provide information required by the orders and request for information letters described in this paper, as applicable, through the review process.

- NEI 12–01, “Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities,” Revision 0, May 2012 (ADAMS Accession No. ML12125A412).

- NUREG–0654/FEMA-REP-1, Revision 1, “Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,” Section B, “Onsite Emergency Organization,” states, in part, the following:

> Each licensee shall specify the positions or title and major tasks to be performed by the persons to be assigned to the functional areas of emergency activity. . . .These assignments shall cover the emergency functions in Table B-1 entitled, “Minimum Staffing Requirements for Nuclear Power Plant Emergencies.” The minimum on-shift staffing levels shall be as indicated in Table B-1. The licensee must be able to augment on-shift capabilities within a short period after declaration of an emergency. This capability shall be as indicated in Table B-1.

- NUREG–0696, “Functional Criteria for Emergency Response Facilities,” offers guidance on how to meet the requirements of 10 CFR Part 50, Appendix E, and describes the onsite and offsite communications requirements for the licensee’s emergency response facilities.

20.3.4 Technical Evaluation

Regarding NTTF Recommendation 9.3 (Emergency Preparedness), the NRC request for information letter of March 12, 2012, requested that all power reactor licensees and holders of construction permits (in active or deferred status) assess their current staffing levels and determine the appropriate staff to fill all necessary positions for responding to a multi-unit event during a beyond-design-basis natural event, and determine if any enhancements are appropriate. Single-unit sites should provide the requested information, as it pertains to an extended loss of all ac power and impeded access to the site.

With regard to communications, NTTF Recommendation 9.3 requests that all power reactor licensees and holders of construction permits (in active or deferred status) assess their current communications systems and equipment used during an emergency event, including consideration of any enhancements that might be appropriate for the emergency plan with respect to the communications requirements of 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG–0696. In addition, the means necessary to power the new and existing communications equipment during a prolonged SBO should be considered.

Accordingly, the staff requested that the North Anna 3 COL applicant address staffing and communications provisions to enhance EP. The staff reviewed the applicant’s submitted information and documented its evaluation and conclusions involving the staffing levels and communications in Chapter 13, Sections 13.3.4.2 and 13.3.4.6, of this North Anna 3 SER respectively.

20.3.5 Post Combined License Activities

Post-combined license activities consist of two staff-proposed license conditions to address NTTF Recommendation 9.3, which are provided in this SER in Chapter 13, Section 13.3.4.2.

20.3.6 Conclusion

The staff’s conclusions regarding how the applicant addressed NTTF Recommendation 9.3 is provided in this SER in Chapter 13, Section 13.3.4.2.

References

1. 10 CFR 50.47, "Emergency plans."

2. 10 CFR 50.54(f), "…information request…."

3. 10 CFR 50.54(hh)(2), "…loss of large areas of the plant due to explosions or fire…."

4. 10 CFR 50.63, "Loss of all alternating current power."

5. 10 CFR 52.103, "Operation under a combined license."

6. 10 CFR 52.97, "Issuance of combined licenses."

7. 10 CFR 52.99, "Inspection during construction."

8. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

9. 10 CFR Part 50, Appendix A, GDC 24, "Separation of protection and control system."

10. 10 CFR Part 50, Appendix A, GDC 45, "Inspection of cooling water system."

11. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

12. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

13. ASME Boiler and Pressure Code (BPVC).

14. ASME BPVC, Section XI, "Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components."

15. GEH ESBWR Design Control Document (DCD), Revision 10, April 2014 (ADAMS Accession No. ML14104A929).

16. IEEE Std 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

17. NEI 12-01, Revision 0, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities," May 2012. (ADAMS Accession No. ML12125A412.)

18. NEI 12-02, Revision 1, "Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," August 2012 (ADAMS Accession No. ML122400399)

19. NEI 12-06, Revision 0, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," August 2012 (ADAMS Accession Number ML12242A378).

20. NRC ISG JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," August 29, 2012 (ADAMS Accession No. ML12229A174).

21. NRC ISG JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," August 29, 2012 (ADAMS Accession No. ML12221A339).

22. NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (ADAMS Accession No. ML 12054A735).

23. NRC Order EA-12-050, "Order to Modify Licenses With Regard To Reliable. Hardened Containment Vents.'

24. NRC Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012 (ADAMS Accession No. ML12054A679).

25. NRC SECY-11-0093, "Near Term Report and Recommendations for Agency Actions Following the Events in Japan," July 13, 2011 (ADAMS Accession No. ML11186A950).

26. NRC SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," February 17, 2012 (ADAMS Accession Number ML12039A103).

27. NRC SECY-12-0124, "Recommended Actions to Be Taken without Delay from NTTF Report," September 9, 2011 (ADAMS Accession No. ML11245A144).

28. NRC Staff, NUREG-0654/ FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980 (ADAMS Accession No. ML 040420012).

29. NRC Staff, NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 28, 1981 (ADAMS Accession No. ML051390358).

30. NRC Staff, NUREG-1966, "Final Safety Evaluation Report Related to the Certification of the Economic Simplified Boiling-Water Reactor Standard Design," April 2014, and Supplement 1, September 2014 (ADAMS Accession Nos. ML14099A519, ML14099A522, ML14099A532, ML14100A187, ML14100A190, ML14100A194, ML14265A084).

31. NRC Staff, NUREG-2115, "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities," January 2012 (ADAMS Accession No. ML12048A859).

32. NRC, RG 1.153, Revision 1, "Criteria for Safety Systems," June 1996 (ADAMS Accession No. ML003740022).

33. NRC, RG 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," March 2007 (ADAMS Accession No. ML070310619).

34. NRC, RG 1.59, Revision 2, "Design Basis Floods for Nuclear Power Plants," September 2014 (ADAMS Accession No. ML14266A562).

35. U.S. Code 42 U. S. C. 2232 "Atomic Energy Act of 1954," as amended.

APPENDIX A. POST NORTH ANNA 3 COMBINED LICENSE ACTIVITIES – LICENSE CONDITIONS, INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA, AND FINAL SAFETY ANALYSIS REPORT COMMITMENTS

A.1 License Conditions

The United States (U.S.) Nuclear Regulatory Commission's (NRC's) regulations at Title 10 of the *Code of Federal Regulations* (10 CFR) 52.97, "Issuance of combined licenses," requires a combined license (COL) to specify any terms and conditions of the COL the Commission deems appropriate. A license condition is not needed when an existing NRC regulation requires a future regulatory review of a matter to ensure adequate safety during design, construction, inspection activities or operation for a new plant. The staff is proposing that the Commission include the following license conditions, which are set forth below, to control various safety matters.

Proposed License Condition	SER Section	Description
1-1	1.5.5.6	A. This COL applies to North Anna Unit 3, a light-water nuclear reactor and associated equipment (the facility), owned by Dominion. The facility would be located on the existing NAPS site; adjacent to and generally west of the existing Units 1 and 2. The NAPS site is located in Louisa County, Virginia, approximately 40 miles north northwest of Richmond, Virginia. B. Subject to the conditions and requirements incorporated herein, the Commission hereby licenses:
	1.5.5.6	(1)(a) Dominion, pursuant to Sections 103 and 185b. of the Act and 10 CFR Part 52, to construct, possess, use, and operate the facility at the designated location in accordance with the procedures and limitations set forth in this license;
3.3	1.5.5.6	(2)(a) Dominion, pursuant to the Act and 10 CFR Part 70, to receive and possess at any time, special nuclear material as reactor fuel, in accordance with the limitations for storage and in amounts necessary for reactor operation, described in the final safety analysis report (FSAR), as supplemented and amended;

	1.5.5.6	(b)Dominion, pursuant to the Act and 10 CFR Part 70, to use special nuclear material as reactor fuel, after a Commission finding under 10 CFR 52.103(g) has been made, in accordance with the limitations for storage and in amounts necessary for reactor operation, described in the FSAR, as supplemented and amended;
	1.5.5.6	(3)(a) Dominion, pursuant to the Act and 10 CFR Parts 30 and 70, to receive, possess, and use, at any time before a Commission finding under 10 CFR 52.103(g), such byproduct and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as necessary;
	1.5.5.6	(b) Dominion, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use, after a Commission finding under 10 CFR 52.103(g), any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as necessary;
	1.5.5.6	(4)(a) Dominion, pursuant to the Act and 10 CFR Parts 30 and 70, to receive, possess, and use, before a Commission finding under 10 CFR 52.103(g), in amounts not exceeding those specified in 10 CFR 30.35(d) and 10 CFR 70.25(d) required for establishing decommissioning financial assurance, any byproduct or special nuclear material that is (1) in unsealed form; (2) on foils or plated surfaces, or (3) sealed in glass, for sample analysis or instrument calibration or other activity associated with radioactive apparatus or components;

	1.5.5.6	(b) Dominion, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess, and use, after a Commission finding under 10 CFR 52.103(g), in amounts as necessary, any byproduct, source, or special nuclear material without restriction as to chemical or physical form, for sample analysis or instrument calibration or other activity associated with radioactive apparatus or components but not uranium hexafluoride; and
	1.5.5.6	(5) Dominion, pursuant to the Act and 10 CFR Parts 30 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility. C. The license is subject to, and the licensee shall comply with, all applicable provisions of the Act and the rules, regulations, and orders of the Commission, including the conditions set forth in 10 CFR Chapter I, now or hereafter in effect. D. The license is subject to, and Dominion shall comply with, the conditions specified and incorporated below: (1) <u>Changes during Construction</u> (a) Dominion may request use of a preliminary acceptability review (PAR) process, for license amendments, at any time before a Commission finding under 10 CFR 52.103(g). To use the PAR process, Dominion shall submit a written request to the Office of New Reactors (NRO) in accordance with COL-ISG-025, “Changes during Construction under Part 52.” (b) Before NRO’s issuance of a written PAR notification, Dominion shall submit the license amendment request (LAR). Thereafter, NRO will issue a written PAR notification, setting forth whether Dominion may proceed in accordance with the PAR, LAR, and COL-ISG-025. If Dominion elects to proceed and the LAR is subsequently denied, Dominion shall return the facility to its current licensing basis.

3.2.1	13.3.5	(2) Startup Administration Manual (SAM), Preoperational and Startup Test Procedures (a) Prior to initiating the plant's initial test program (ITP), a site-specific SAM (procedures), which includes administrative procedures and requirements that govern the activities associated with the plant ITP, is to be provided to on-site NRC inspectors 60 days prior to beginning of the preparation test phase. (b) Dominion will make available to on-site NRC inspectors preoperational test procedures 60 days prior to their intended use and startup test procedures 60 days prior to fuel load. (c) Dominion will make available to on-site NRC inspectors site-specific preoperational test procedures 60 days prior to their intended use and startup test procedures 60 days prior to fuel load.
3.2.4	13.3.5	(3) Nuclear Fuel Loading and Pre-Critical Testing (a) [RESERVED] (b) Upon a Commission finding in accordance with 10 CFR 52.103(g) that all the acceptance criteria in the inspections, tests, analyses, and acceptance criteria (ITAAC) in Appendix C to this license are met, Dominion is authorized to perform pre-critical tests in accordance with the conditions specified herein; (c) Dominion shall perform the pre-critical tests identified in ESBWR DCD, Revision 10, Sections 14.2.6 "Initial Fuel Loading and Initial Criticality," and 14.2.8.2 "General Discussion of Startup Tests."; (d) Dominion shall review and evaluate the results of the tests identified in Condition 2.D.(3)(c) of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with ESBWR DCD, Revision 10, Section 14.2.8.2; and

	14.2.5	(e) Dominion shall notify the Director of NRO, or the Director's designee, in writing, upon successful completion of the pre-critical tests identified in Condition 2.D(3)(c) of this license
	14.2.5	(4) <u>Initial Criticality and Low-Power Testing</u> (a) Upon submission of the notification required by Condition 2.D.(3)(e) of this license, Dominion is authorized to operate the facility at reactor steady-state core power levels not to exceed 5-percent thermal power in accordance with the conditions specified herein; (b) Dominion shall perform the following: 1. the initial criticality and low-power tests identified in ESBWR DCD, Revision 10, Sections 14.2.6, "Initial Fuel Loading and Initial Criticality," 14.2.7, "Test Program Schedule and Sequence," tests and 2. the Reactor Pre Critical Heatup with Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) Natural Core Circulation Test (first of a kind test as identified in ESBWR DCD, Revision 10, Section 14.2.8.2.35.1, "Reactor Pre Critical Heatup With RWCU/SDC,") and the Isolation Condenser Performance Test and Heatup and Steady State Operation Test (first of a kind test) as identified in ESBWR DCD, Revision 10, Sections 14.2.8.2.34, "Isolation Condenser Performance Test," and 14.2.8.2.35.2, "Isolation Condenser System Heatup and Steady State Operation." (c) Dominion shall review and evaluate the results of the tests identified in: 1. Condition 2.D.(4)(b)1. of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with ESBWR DCD, Revision 10, Section 14.2.6, 14.2.7, 14.2.8.2; and

		2. Condition 2.D.(4)(b)2. of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with ESBWR DCD, Revision 10, Section 14.2.8.2; and (d) Dominion shall notify the Director of NRO, or the Director's designee, in writing, upon successful completion of initial criticality and low-power tests identified in Condition 2.D.(4)(b) of this license, including the design-specific tests identified therein.
3.2.4.3	14.2.5	(5) Power Ascension Testing (a) Upon submission of the notification required by Condition 2.D.(4)(d) of this license, Dominion is authorized to operate the facility at reactor steady-state core power levels not to exceed 100-percent thermal power in accordance with the conditions specified herein, but only for the purpose of performing power ascension testing; (b) Dominion shall perform: 1. the power ascension tests identified in the ESBWR DCD, Revision 10, Section 14.2.8.2 and Table 14.2-1, "Power Ascension Test Matrix"; and 2. the design-specific startup tests identified below: (i) Core Performance Test (first of a kind test as identified in ESBWR Design Control Document (DCD), Revision 10, Section 14.2.8.2.7); (ii) Power Maneuvering in the Feedwater (FW) Temperature Operation Domain Test (first of a kind test as identified in ESBWR DCD, Revision 10, Section 14.2.8.2.35.3, "Power Maneuvering In the FW Temperature Operating Domain");

		(iii) Load Maneuvering Capability Test (first of a kind test as identified in ESBWR DCD, Revision 10, Section 14.2.8.2.35.4, "Load Maneuvering Capability"); and (iv) Defense-In-Depth Stability Solution Evaluation Test (first of a kind plant test as identified in ESBWR DCD, Revision 10, Section 14.2.8.2.35.5, "Defense-In-Depth Stability Solution Evaluation Test").
	14.2.5	(c) Dominion shall review and evaluate the results of the tests identified in: 1. Condition 2.D.(5)(b)1. of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with ESBWR DCD, Revision10, Section 14.2.8.2; and 2. Condition 2.D.(5)(b)2. of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with ESBWR DCD, Revision 10, Section 14.2.8.2; and
	14.2.5	(d) Dominion shall notify the Director of NRO, or the Director's designee, in writing, upon successful completion of power ascension tests identified in Condition 2.D.(5)(b) of this license, including the design-specific tests identified therein.
3.2.4.4		(6) Maximum Power Level Upon submission of the notification required by Condition 2.D.(5)(d) of this license, Dominion is authorized to operate the facility at steady state reactor core power levels not to exceed 4500 megawatts thermal (100-percent thermal power), as described in the FSAR, in accordance with the conditions specified herein.

3.2.5	14.2.4	(7) Reporting Requirements (a) Within 30 days of a change to the initial test program described in FSAR Section 14, “Initial Test Program,” made in accordance with 10 CFR 50.59, “Changes, Tests and Experiments,” or in accordance with 10 CFR Part 52, Appendix E, Section VIII, “Processes for Changes and Departures,” Dominion shall report the change to the Director of NRO, or the Director’s designee, in accordance with 10 CFR 50.59(d). (b) Dominion shall report any violation of a requirement in Conditions 2.D.(3), 2.D.(4), 2.D.(5), and 2.D.(6) of this license within 24 hours. Initial notification shall be made to the NRC Operations Center in accordance with 10 CFR 50.72, “Immediate Notification Requirements for Operating Nuclear Power Reactors,” with written follow up in accordance with 10 CFR 50.73, “License Event Report System.: (8) Incorporation The Technical Specifications, Environmental Protection Plan, and ITAAC in Appendices A, B, and C, respectively, of this license are hereby incorporated into this license. (9) Technical Specifications The technical specifications in Appendix A to this license become effective upon a Commission finding that the ITAAC are met in accordance with 10 CFR 52.103(g).

3.5	13.4.4	(10) Operational Program Implementation Dominion shall implement the following: (a) the Environmental Qualification Program implemented before initial fuel load; (b) the Flow-Accelerated Corrosion Program implemented prior to commercial service; (c) the Reactor Vessel Material Surveillance Program implemented before initial fuel load; (d) the Preservice Testing Program implemented prior to initial fuel load; (e) the Containment Leakage Rate Testing Program implemented before initial fuel load;
	1.5.5.6	(f) the Fire Protection Program (for elements necessary to support receipt and storage of fuel) prior to initial receipt of fuel:
3.4		1. The fire protection measures in accordance with Regulatory Guide (RG) 1.189, "Fire Protection for Nuclear Power Plants," for designated storage building areas (including adjacent fire areas that could affect the storage area) implemented before initial receipt of byproduct or special nuclear materials that are not fuel (excluding exempt quantities as described in 10 CFR 30.18, "Exempt Quantities"); 2. The fire protection measures in accordance with RG 1.189 for new fuel storage area (including adjacent fire areas that could affect the new fuel storage area) implemented before receipt of fuel onsite; 3. Before receipt of fuel on site, a formal letter of agreement shall be in place with the local fire department specifying the arrangements in support of the Fire Protection Program;

		4. All fire protection program features implemented before initial fuel load; (g) the Standard Radiological Effluent Controls implemented before initial fuel load; (h) the Offsite Dose Calculation Manual implemented before initial fuel load; (i) the Radiological Environmental Monitoring Program implemented before initial fuel load; (j) the Process Control Program implemented before initial fuel load; (k) the Lifecycle Minimization of Contamination Program implemented before initial fuel load; (l) the Radiation Protection Program (RPP) (including ALARA principle) or applicable portions thereof as identified in FSAR Section 12.5, “Operational Radiation Protection Program”: 1. RPP features applicable to receipt of by-product, source, or special nuclear materials (excluding exempt quantities as described in 10 CFR 30.18) implemented before initial receipt of such materials; 2. RPP features (including the ALARA principle) applicable to new fuel implemented before receipt of initial fuel on site; 3. All other RPP features (including the ALARA principle) except for those applicable to control radioactive waste shipment implemented before initial fuel load; and 4. RPP features (including the ALARA principle) applicable to radioactive waste shipment implemented before first shipment of radioactive waste;

3.5.4	14.2.5 9.2.1	(m) the Initial Test Program: 1. Preoperational Test Program implemented 60 days before the first preoperational test; 2. Startup Test Program implemented 60 days before initial fuel load; (n) the Special Nuclear Material Control and Accounting Program implemented before initial receipt of special nuclear material; (o) the Special Nuclear Material Physical Protection Plan implemented before initial receipt of special nuclear material on site; and (p) the Reactor Operator Training Program implemented no later than 18 months before scheduled fuel load.
3.5	13.2.4 13.4.4	(11) Operational Program Implementation Schedule No later than 12 months after issuance of the COL, Dominion shall submit to the Director of NRO, or the Director's designee, a schedule for implementation of the operational programs listed in FSAR Table 13.4-201, "Operational Programs Required by NRC Regulations," including the associated estimated date for initial loading of fuel. The schedule shall be updated every 6 months until 12 months before scheduled fuel loading, and every month thereafter until all the operational programs listed in FSAR Table 13.4-201 have been fully implemented. This schedule shall also address: (a) The implementation of site specific Severe Accident Management Guidelines, and (b) The spent fuel rack coupon monitoring program implementation.

		(12) Site- and Unit-specific Conditions
3.10	3.9.5	(a) Steam Dryer Monitoring Plan 1. Dominion shall prepare a Steam Dryer Monitoring Plan (SDMP) and submit the SDMP to the NRC no later than 90 days before the scheduled date for initial fuel loading. 2. Dominion shall provide Power Ascension Test (PAT) procedures for steam dryer monitoring to the NRC resident inspectors at least 10 days before the scheduled date for initial fuel loading. The PAT procedures must include the following: (i) Level 1 and Level 2 acceptance limits, as defined in Report NEDE 33313P, "ESBWR Steam Dryer Structural Evaluation," (Revision 5, December 2013), for on-dryer strain gage and on-dryer accelerometer measurements to be used up to 100 percent power; (ii) The power levels at which the steam dryer will be monitored (subject to Conditions 2.D.(12)(a)3. and 2.D.(12)(a)4. of this license) during power ascension, and the duration of monitoring at each power level; (iii) A description of activities to be accomplished during monitoring at each power level; (iv) Plant parameters to be monitored; (v) A description of the actions to be taken if acceptance criteria are not satisfied; and (vi) A description of the process for verification of the completion of commitments and planned actions specified in the PAT procedures. 3. Dominion shall complete the actions specified in Item 2 of the model license condition specified in paragraph (c) of Section 10.2, "Comprehensive Vibration Program Elements for a COL Applicant," in NEDE-33313P, (Revision 5) between 65 and 75 percent thermal power.

		4. Dominion shall measure, record, and evaluate pressures, strains, and accelerations from the steam dryer instrumentation at power levels approximately 5 percent higher than the previous power level at which Dominion measured, recorded, and evaluated such parameters until 100 percent thermal power is reached. Dominion shall generate data trending and a projection of strain levels for each successive power level, including full power. Dominion shall use data trending analysis to assess whether the Level 1 or Level 2 acceptance limits would be exceeded at the next higher power level for which the PAT specifies monitoring. Dominion shall provide the data trending results and revised limit curves to the NRC project manager by facsimile or electronic transmission. 5. At each power level for which Conditions 2.D.(12)(a)3. and 2.D.(12)(a)4. of this license require steam dryer monitoring, Dominion shall measure and record pressure, strain, and acceleration responses over a range of plant conditions sufficient to confirm that loading and fatigue effects from normal variations in plant conditions at power levels up to and including 100 percent thermal power will not adversely affect the life of the dryer. Dominion shall include its evaluation of steam dryer performance during such variations in plant conditions, including during Power Maneuvering in the Feedwater Temperature Operating Domain testing, in the dryer structural response as part of the full stress analysis report described in Condition 2.D.(12)(a)9. of this license. 6. If a flow-induced resonance is identified at any power level at which Conditions 2.D.(12)(a)3and 2.D.(12)(a)4. of this license require steam dryer monitoring, and the strains or vibrations exceed the pre-determined Level 1 or Level 2 limit curve, Dominion shall cease power ascension until completing the actions specified in Item 5 of the model license condition specified in paragraph (c) of Section 10.2 in NEDE-33313P, (Revision 5) and the following:

		(i) If a Level 1 limit curve is exceeded, Dominion shall reduce power to the last power level at which Dominion performed steam dryer monitoring pursuant to Conditions 2.D.(12)(a)3. and 2.D.(12)(a)4. of this license and at which the Level 1 limit curve was not exceeded. Dominion shall perform a stress analysis to develop a new Level 1 limit curve before increasing power to the next level at which Condition 2.D.(12)(a)4. of this license requires steam dryer monitoring. (ii) If a Level 2 limit curve is exceeded, or if data trending indicates that a Level 1 limit curve may be challenged before the next power level at which Condition 2.D.(12)(a)4. of this license requires steam dryer monitoring is reached, Dominion shall evaluate the Level 1 and Level 2 limit curves and perform a stress analysis that demonstrates that the stress acceptance limits are satisfied at the higher power level before power is increased. 7. Dominion shall determine end-to-end bias and uncertainties by comparing the predicted and measured strain or acceleration on the steam dryer at each power level at which Dominion performs steam dryer monitoring pursuant to Conditions 2.D.(12)(a)3. and 2.D.(12)(a)4. of this license and confirm the conservatism of the predicted dryer stress field. At each such power level, Dominion shall adjust the predicted strain and acceleration responses using the frequency-dependent end-to-end bias errors and uncertainty values. If any of the measured sensor data at that power level exceeds the adjusted predictions, Dominion shall either (a) modify the bias errors and uncertainty values and limit curves and ensure measured sensor responses do not exceed the adjusted predictions, or (b) quantitatively evaluate the effect on fatigue life. 8. At the initial power level at which Condition 2.D.(12)(a)3. of this license requires steam dryer monitoring and at approximately 85 and 95 percent power, Dominion shall provide the steam dryer data analysis and results to the NRC project manager by facsimile or electronic transmission; and shall not exceed the power level at which it performed the steam dryer monitoring for at least 72 hours after the NRC project manager has confirmed receipt of the transmission.

		9. Dominion shall provide data collected from the steam dryer monitoring required by Condition 2.D.(12)(a)4. of this license at 100 percent power to the NRC project manager by facsimile or electronic transmission within 72 hours of completing the collection of that data, with receipt confirmation from the NRC project manager. Dominion shall submit a full stress analysis report and evaluation to the NRC document control desk in accordance with 10 CFR 52.3within 90 days of first reaching 100 percent thermal power. The report must include the minimum stress ratio and the final dryer load definition using steam dryer data, and associated bias errors and uncertainties, and must demonstrate that the steam dryer will maintain its structural integrity over its design life considering variations in plant parameters, including, but not limited to, reactor pressure and core flow rate. If the structural integrity of the steam dryer for the full plant life is not demonstrated by the stress analysis, Dominion shall describe its compensatory actions, such as future dryer replacement, in the stress analysis report. 10. Dominion shall implement a periodic steam dryer inspection program as follows: (i) During the first two refueling outages after first reaching 100 percent thermal power, Dominion shall perform a visual inspection of all accessible areas and susceptible locations of the steam dryer in accordance with industry guidance on steam dryer inspections in the latest NRC staff-approved version of BWRVIP-139-A, "BWR Vessel and Internals Project, Steam Dryer Inspection and Flaw Evaluation Guidelines," with any conditions or limitations specified in the NRC staff approval. The results of these baseline inspections shall be submitted to the NRC within 60 days following startup after each outage. (ii) At the end of the second refueling outage after reaching 100 percent thermal power, Dominion shall update the Steam Dryer Monitoring Program to include a long-term inspection plan based on plant-specific and industry operating experience, and shall submit the updated program to the NRC within 180 days following startup from the second refueling outage.

3.7.1	13.3.5	(b) No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a), Dominion shall submit to the Director of NRO, or the Director's designee, in writing, a fully developed set of plant-specific emergency action levels (EALs), in accordance with NEI 07-01, "Methodology for Development of Emergency Action Levels – Advanced Passive Light Water Reactors," Revision 0, with no deviations. The EALs shall have been discussed and agreed upon with State and local officials.
	13.3.4	(c) No later than eighteen (18) months before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, Dominion shall have performed a detailed staffing analysis, in accordance with NEI 10-05, "Assessment of On-Shift Emergency Response Organization Staffing and Capabilities," Revision 0. No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a), Dominion shall have revised the Emergency Plan to incorporate any changes identified in the staffing analysis that are needed to staffing to the required levels.
3.9.	3.9.5	(d) Before initial fuel load, Dominion shall: 1. Implement a surveillance program for explosively actuated valves (squib valves) in the Gravity Driven Cooling System and the Automatic Depressurization System at North Anna Unit 3 that includes the following provisions in addition to the requirements specified in the American Society of Mechanical Engineers (ASME) "Code for Operation and Maintenance of Nuclear Power Plants" (OM Code) as incorporated by reference in 10 CFR 50.55a.

3.9.a	3.9.5	(i) Preservice Testing All explosively actuated valves shall be preservice tested by verifying the operational readiness of the actuation logic and associated electrical circuits for each explosively actuated valve with its pyrotechnic charge removed from the valve. This must include confirmation that sufficient electrical parameters (voltage, current, and resistance) are available at the explosively actuated valve from each circuit that is relied upon to actuate the valve. In addition, a sample of at least 20 percent of the pyrotechnic charges in all explosively actuated valves shall be tested in the valve or a qualified test fixture to confirm the capability of each sampled pyrotechnic charge to provide the necessary motive force to operate the valve to perform its intended function without damage to the valve body or connected piping. The sampling must select at least one explosively actuated valve from each redundant safety train. Corrective action shall be taken to resolve any deficiencies identified in the operational readiness of the actuation logic or associated electrical circuits, or the capability of a pyrotechnic charge. If a charge fails to fire or its capability is not confirmed, all charges with the same batch number shall be removed, discarded, and replaced with charges from a different batch number that has demonstrated successful 20 percent sampling of the charges.
3.9.b	3.9.5	(ii) Operational Surveillance Explosively actuated valves shall be subject to the following surveillance activities after commencing plant operation: a. At least once every 2 years, each explosively actuated valve shall undergo visual external examination and remote internal examination (including evaluation and removal of fluids or contaminants that may interfere with operation of the valve) to verify the operational readiness of the valve and its actuator. This examination shall also verify the appropriate position of the internal actuating mechanism and proper operation of remote position indicators. Corrective action shall be taken to resolve any deficiencies identified during the examination with post-maintenance testing conducted that satisfies the PST requirements.

		b. At least once every 10 years, each explosively actuated valve shall be disassembled for internal examination of the valve and actuator to verify the operational readiness of the valve assembly and the integrity of individual components and to remove any foreign material, fluid, or corrosion. The examination schedule shall provide for each valve design used for explosively actuated valves at the facility to be included among the explosively actuated valves to be disassembled and examined every 2 years. Corrective action shall be taken to resolve any deficiencies identified during the examination with post-maintenance testing conducted that satisfies the PST requirements. c. For explosively actuated valves selected for test sampling every 2 years in accordance with the ASME OM Code, the operational readiness of the actuation logic and associated electrical circuits shall be verified for each sampled explosively actuated valve following removal of its charge. This must include confirmation that sufficient electrical parameters (voltage, current, resistance) are available for each valve actuation circuit. Corrective action shall be taken to resolve any deficiencies identified in the actuation logic or associated electrical circuits. d. For explosively actuated valves selected for test sampling every 2 years in accordance with the ASME OM Code, the sampling must select at least one explosively actuated valve from each redundant safety train. Each sampled pyrotechnic charge shall be tested in the valve or a qualified test fixture to confirm the capability of the charge to provide the necessary motive force to operate the valve to perform its intended function without damage to the valve body or connected piping. Corrective action shall be taken to resolve any deficiencies identified in the capability of a pyrotechnic charge in accordance with the PST requirements.

		This license condition shall expire upon (1) incorporation of the above surveillance provisions for explosively actuated valves into the facility's in-service testing program, or (2) incorporation of in-service testing requirements for explosively actuated valves in new reactors (i.e., plants receiving a construction permit, or COL for construction and operation, after January 1, 2000) to be specified in a future edition of the ASME OM Code as incorporated by reference in 10 CFR 50.55a, including any conditions imposed by the NRC, into the facility's in-service testing program. (e) Dominion shall perform detailed geologic mapping of excavations for safety related structures; examine and evaluate geologic features discovered in these excavations; and shall notify the Director of NRO, or the Director's designee, in writing, no later than 30 days before any such excavations are open for NRC examination and evaluation.
3.8.2	13.4.3.2 20.1.4 20.2.4	(f) Mitigation Strategies for Beyond-Design-Basis External Events 1. Dominion shall complete development of an overall integrated plan of strategies to mitigate a beyond-design-basis external event at least 1 year before the completion of the last ITAAC on the schedule required by 10 CFR 52.99(a). 2. The overall integrated plan required by this condition must include guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities. The overall integrated plan must include provisions to ensure that all accident mitigation procedures and guidelines (including the guidance and strategies required by this section, emergency operating procedures, abnormal operating procedures, and extensive damage management guidelines) are coherent and comprehensive.

		3. The guidance and strategies required by this condition must be capable of (i) mitigating a simultaneous loss of all alternating current (ac) power, both from the onsite and offsite power systems, and loss of normal access to the normal heat sink and (ii) providing for adequate capacity to perform the functions upon which the guidance and strategies rely for all units on the NAPS site and in all modes at each unit on the site. 4. Before initial fuel load, Dominion shall fully implement the guidance and strategies required by this condition, including: (i) Procedures; (ii) Training; (iii) Acquisition, staging, or installation of equipment and consumables relied upon in the strategies; and (iv) Configuration controls and provisions for maintenance and testing (including testing procedures and frequencies for preventative maintenance) of the equipment upon which the strategies and guidance required by this condition rely. 5. The training required by Condition 2.D.(12)(f)4.(ii) of this license must use a Systematic Approach to Training (SAT) to evaluate training for station personnel, and must be based upon plant equipment and procedures upon which the guidance and strategies required by Condition 2.D.(12)(f) of this license rely. 6. Dominion shall maintain the guidance and strategies described in the application upon issuance of the license, and the integrated plan of strategies upon its completion as required by Condition 2.D.(12)(f)1. of this license. Dominion may change the strategies and guidelines required by this Condition provided that Dominion evaluates each such change to ensure that the provisions of Conditions 2.D.(12)(f)2. and 2.D.(12)(f)3. of this license continue to be satisfied and Dominion documents the evaluation in an auditable form.

3.8.3	20.2.4	(g) Reliable Spent Fuel Pool/Buffer Pool Level Instrumentation Prior to initial fuel load, Dominion shall address the following requirements using the guidance contained in JLD-ISG-2012-03, “Compliance with Order EA 2012-051, Reliable Spent Fuel Pool Instrumentation,” Revision 0: The spent fuel pool/buffer pool instrumentation shall be maintained available and reliable through the development and implementation of a training program. The training program shall include provisions to ensure trained personnel can route the temporary power lines from the alternate power source to the appropriate connection points, and connect the alternate power source to the safety-related level instrument channels.
3.7	13.3.4.2	(h) Emergency Planning Actions 1. Communications (i) No later than eighteen (18) months before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, Dominion shall have performed an assessment of on-site and off-site communications systems and equipment relied upon during an emergency event to ensure communications capabilities can be maintained during an extended loss of alternating current power. The communications capabilities assessment shall be performed in accordance with NEI 12-01, “Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities,” Revision 0. (ii) No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a), Dominion shall have completed implementation of corrective actions identified in the communications capability assessment, including revisions to the Emergency Plan.

3.7.2	13.3.4.2	2. Staffing (i) No later than eighteen (18) months before the latest date set forth in the schedule submitted in accordance with 10 CFR 52.99(a) for completing the inspections, tests, and analyses in the ITAAC, Dominion shall have performed an assessment of the on-site and augmented staffing capability for response to a multi-unit event. The staffing assessment shall be performed in accordance with NEI 12-01, “Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities,” Revision 0.
	13.3.4.2	(ii) No later than one hundred eighty (180) days before the date scheduled for initial fuel load, as set forth in the notification submitted in accordance with 10 CFR 52.103(a), Dominion shall revise the Emergency Plan to include the following: a. Incorporation of corrective actions identified in the staffing assessment required by this license condition; and b. Identification of how the augmented staff will be notified, given degraded communications capabilities.
	13.3.4.2	(i) No later than one hundred eighty (180) days before the date scheduled for initial fuel load set forth in the notification submitted in accordance with 10 CFR 52.103(a), Dominion shall update its North Anna Units 1 and 2 Letters of Agreement with the following entities, or their successors, and revise the Unit 3 Emergency Plan to include these updated Letters of Agreement after they have been executed. These updated Letters of Agreement shall identify the specific nature of arrangements in support of emergency preparedness for the NAPS site, including North Anna Unit 3, and reflect expected assistance associated with hostile action at the NAPS site, as defined in 10 CFR Part 50, Appendix E, Section IV.A.7.

		1. Commonwealth of Virginia Department of Emergency Management 2. Commonwealth of Virginia Department of Health 3. Commonwealth of Virginia Department of State Police 4. Commonwealth of Virginia Department of Game and Inland Fisheries 5. Virginia Commonwealth University Medical Center 6. Louisa County Administrator 7. Louisa County Sheriff 8. Louisa County Department of Fire and Emergency Medical Services 9. Spotsylvania County Sheriff 10. Spotsylvania Department of Fire, Rescue, and Emergency Management 11. Orange County Administrator 12. Orange County Sheriff 13. Caroline County Sheriff 14. Caroline County Department of Fire, Rescue, and Emergency Management 15. Hanover County Administrator 16. Hanover County Sheriff These Letters of Agreement shall identify the specific nature of arrangements in support of emergency preparedness for operation of North Anna Unit 3. The Emergency Plan shall be revised to include these Letters of Agreement after they have been executed. (j) Reactor Vessel Material Surveillance Program Dominion shall, as part of its reactor vessel material surveillance program, withdraw and test three surveillance capsules in accordance with the schedule provided in Column 1 (Predicted transition temperature shift at vessel inner surface of less than or equal to 100 oF) of Table 1, "Minimum Recommended Number of Surveillance Capsules and Their Withdrawal Schedule," in the 1982 Revision of ASTM Standard E185 (ASTM E185-82), "Standard Practice for Conducting Surveillance Tests of Light-Water Cooled Nuclear Power Reactor Vessels." The scheduling of capsule withdrawals to meet this condition shall be in accordance with ASTM E185-82.

3.11	1.5.1	E. Dominion shall have and maintain financial protection of such type and in such amounts as the Commission shall require in accordance with Section 170 of the Atomic Energy Act of 1954, as amended, to cover public liability claims.
	1.5.1	(1) Prior to the scheduled date of initial fuel load, and within ninety (90) days after the NRC publishes the notice of intended operation in the Federal Register, Dominion shall provide evidence to the Director of NRO, or the Director's designee, that it would have the ability to pay into the industry self-insurance program in the event of a nuclear incident and in the amount specified in 10 CFR 140.11(a)(4) for one calendar year using one of the methods specified in 10 CFR 140.21, "Licensee Guarantees of Payment of Deferred Premiums." Thereafter, Dominion shall annually provide evidence of the guarantees of payment of deferred premiums in accordance with the provisions specified in 10 CFR 140.21.
	1.5.1	(2) Before the scheduled date for initial fuel load, and within ninety (90) days after the NRC publishes the notice of intended operation in the Federal Register, Dominion shall provide satisfactory documentary evidence to the Director of NRO, or the Director's designee, that it has obtained the appropriate amount of secondary financial protection pursuant to 10 CFR 140.11(a)(4), and the appropriate amount of financial protection pursuant to 10 CFR 50.54(w).

A.2 Inspections, Tests, Analyses, and Acceptance Criteria

The staff has identified the certain inspections, tests, analyses, and acceptance criteria (ITAAC) that it will recommend the Commission impose with respect to a COL issued to the applicant. The COL application ITAAC consists of the following four parts:

1. Design Certification ITAAC
2. Physical Security ITAAC
3. Emergency Planning ITAAC
4. Site-specific ITAAC

1. Design Certification ITAAC

The design certification ITAAC are in the ESBWR DCD, Revision 10, Tier 1, which will be incorporated by reference into the COL should a COL be issued to the applicant.

2. Physical Security ITAAC

The physical security ITAAC are provided in Table 2-1. The licensee shall perform and satisfy the ITAAC defined in Table 2-1 (from North Anna 3 SER Table 13.6-1 and North Anna 3 COL Application Part 10, Table 2.2-1).

Table 2-1
ITAAC For Site-Specific Security System

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
1(a). Vital equipment will be located only within a vital area.	1(a). All vital equipment locations will be inspected.	1(a). Vital equipment is located only within a vital area.
1(b). Access to vital equipment will require passage through at least two physical barriers.	1(b). All vital equipment physical barriers will be inspected.	1(b). Vital equipment is located within a protected area such that access to the vital equipment requires passage through at least two physical barriers.
2(a). Physical barriers for the protected area perimeter will not be part of vital area barriers.	2(a). The protected area perimeter barriers will be inspected.	2(a). Physical barriers at the perimeter of the protected area are separated from any other barrier designated as a vital area barrier.
2(b). Penetrations through the protected area barrier will be secured and monitored.	2(b). All penetrations through the protected area barrier will be inspected.	2(b). All penetrations and openings through the protected area barrier are secured and monitored by intrusion detection equipment.
2(c). Unattended openings that intersect a security boundary, such as underground pathways, will be protected by a physical barrier and monitored by intrusion detection equipment or provided surveillance at a frequency sufficient to detect exploitation.	2(c). All unattended openings within the protected area barriers will be inspected.	2(c). All unattended openings (such as underground pathways) that intersect a security boundary (such as the protected area barrier), are protected by a physical barrier and monitored by intrusion detection equipment or provided surveillance at a frequency sufficient to detect exploitation.

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
3(a). Isolation zones will exist in outdoor areas adjacent to the physical barrier at the perimeter of the protected area and will be designed of sufficient size to permit observation and assessment on either side of the barrier.	3(a). The isolation zones in outdoor areas adjacent to the protected area perimeter barrier will be inspected.	3(a). The isolation zones exist in outdoor areas adjacent to the physical barrier at the perimeter of the protected area and are of sufficient size to permit observation and assessment of activities on either side of the barrier in the event of its penetration or attempted penetration.
3(b). Isolation zones will be monitored with intrusion detection and assessment equipment that is designed to provide detection and assessment of activities within the isolation zone.	3(b). The intrusion detection equipment within the isolation zones will be inspected.	3(b). Isolation zones are equipped with intrusion detection and assessment equipment capable of providing detection and assessment of activities within the isolation zone.
3(c). Areas where permanent buildings do not allow sufficient observation distance between the intrusion detection system and the protected area barrier (e.g., the building walls are immediately adjacent to, or are an integral part of the protected area barrier) will be monitored with intrusion detection and assessment equipment that is designed to detect the attempted or actual penetration of the protected area perimeter barrier before completed penetration of the barrier and assessment of detected activities.	3(c). Inspections of areas of the protected area perimeter barrier that do not have isolation zones will be performed.	3(c). Areas where permanent buildings do not allow sufficient observation distance between the intrusion detection system and the protected area barrier (e.g., the building walls are immediately adjacent to, or an integral part of, the protected area barrier) are monitored with intrusion detection and assessment equipment that detects attempted or actual penetration of the protected area perimeter barrier before completed penetration of the barrier and assessment of detected activities.
4(a). The perimeter intrusion detection system will be designed to detect penetration or attempted penetration of the protected area perimeter barrier before completed penetration of the barrier, and for subsequent alarms to annunciate concurrently in at least two continuously manned onsite alarm stations (central and secondary alarm stations).	4(a). Tests, inspections, or a combination of tests and inspections of the intrusion detection system will be performed.	4(a). The intrusion detection system can detect penetration or attempted penetration of the protected area perimeter barrier before completed penetration of the barrier, and subsequent alarms annunciate concurrently in at least two continuously manned on site alarms stations (central and secondary alarm stations).
4(b). The perimeter assessment equipment will be designed to provide video image recording with real-time and playback capability that can provide assessment of detected activities before and after each alarm annunciation	4(b). Tests, inspections, or a combination of tests and inspections of the video assessment equipment will be performed.	4(b). The perimeter assessment equipment is capable of real-time and playback video image recording that provides assessment of detected activities before and after each

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
at the protected area perimeter barrier.		alarm at the protected area perimeter barrier.
4(c). The intrusion detection and assessment equipment at the protected area perimeter will be designed to remain operable from an uninterruptible power supply in the event of the loss of normal power.	4(c). Tests, inspections, or a combination of tests and inspections of the uninterruptible power supply will be performed.	4(c). All Intrusion detection and assessment equipment at the protected area perimeter remains operable from an uninterruptible power supply in the event of the loss of normal power.
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
5. Isolation zones and exterior areas within the protected area will be provided with illumination to permit assessment in the isolation zones and observation of activities within exterior areas of the protected area.	5. The illumination in isolation zones and exterior areas within the protected area will be inspected.	5. Illumination in isolation zones and exterior areas within the protected area is 0.2 foot candles measured horizontally at ground level or alternatively augmented, sufficient to permit assessment and observation.
6. The external walls, doors, ceiling, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area will be bullet resistant, to at least Underwriters Laboratories Ballistic Standard 752, “The Standard of Safety for Bullet-Resisting Equipment,” Level 4, or National Institute of Justice Standard 0108.01, “Ballistic Resistant Protective Materials,” Type III.	6. Type test, analysis, or a combination of type test and analysis of the external walls, doors, ceiling, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area will be performed.	6. A report exists and concludes that the walls, doors, ceilings, and floors in the Secondary Alarm Station, and the last access control function for access to the protected area are bullet resistant to at least Underwriters Laboratories Ballistic Standard 752, Level 4, or National Institute of Justice Standard 0108.01, Type III.
7. The vehicle barrier system will be designed, installed, and located at the necessary standoff distance to protect against the design-basis threat vehicle bombs.	7. Type test, inspections, analysis or a combination of type tests, inspections, and analysis will be performed for the vehicle barrier system	7. A report exists and concludes that the vehicle barrier system will protect against the threat vehicle bombs based on the standoff distance for the system.
8(a). Access control points will be established and designed to control personnel and vehicle access into the protected area.	8(a). Tests, inspections, or a combination of tests and inspections of installed systems and equipment will be performed.	8(a). Access control points exist for the protected area and are configured to control access.
8(b). Access control points will be established and designed with equipment for the detection of firearms, explosives, and incendiary devices at the protected area personnel access points.	8(b). Tests, inspections, or a combination of tests and inspections of installed systems and equipment will be performed.	8(b). Detection equipment exists and is capable of detecting firearms, explosives, and incendiary devices at the protected area personnel access control points.
9. An access control system with a numbered photo	9. The access control system and the numbered photo	9. The access authorization system with a numbered photo

Table 2.2.1-1 ITAAC for the Site-Specific Security System		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
identification badge system will be installed and designed for use by individuals who are authorized access to protected areas and vital areas without escort.	identification badge system will be tested.	identification badge system is installed and provides authorized access to protected and vital areas only to those individuals with unescorted access authorization.
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
10. Unoccupied vital areas will be designed with locking devices and intrusion detection devices that annunciate in the Secondary Alarm Station.	10. Tests, inspections, or a combination of tests and inspections of unoccupied vital area intrusion detection equipment and locking devices will be performed.	10. Unoccupied vital areas are locked, and intrusion is detected and annunciated in the Secondary Alarm Station.
11(a). Intrusion detection equipment and video assessment equipment will annunciate and be displayed concurrently in at least two continuously manned onsite alarm stations (Central and Secondary Alarm Stations).	11(a). Tests, inspections, or a combination of tests and inspections of intrusion detection equipment and video assessment equipment will be performed.	11(a). Intrusion detection equipment and video assessment equipment annunciate and display concurrently in at least two continuously manned onsite alarm stations (Central and Secondary Alarm Stations).
11(b). The Secondary Alarm Station will be located inside the protected area and will be designed so that the interior of the alarm station is not visible from the perimeter of the protected area.	11(b). The Secondary Alarm Station location will be inspected.	11(b). The Secondary Alarm Station is located inside the protected area, and the interior of the alarm station is not visible from the perimeter of the protected area.
11(c). The alarm system will not allow the status of a detection point, locking mechanism or access control device to be changed without the knowledge and concurrence of the alarm station operator in the other alarm station.	11(c).Tests, inspections, or a combination of tests and inspections of intrusion detection equipment and access control equipment will be performed.	11(c). The alarm system will not allow the status of a detection point, locking mechanism or access control device to be changed without the knowledge and concurrence of the alarm station operator in the other alarm station.
11(d). Central and Secondary Alarm Stations will be designed, equipped and constructed such that no single act, in accordance with the design-basis threat of radiological sabotage, can simultaneously remove the ability of both the central and secondary alarm stations to (1) detect and assess alarms, (2) initiate and coordinate an adequate response to alarms, (3) summon offsite assistance, and (4) provide effective command and control.	11(d). Tests, inspections, or a combination of tests and inspections of the Central and Secondary Alarm Stations will be performed.	11(d). Central and Secondary Alarm Stations are designed, equipped, and constructed such that no single act, in accordance with the design-basis threat of radiological sabotage, can simultaneously remove the ability of both the central and secondary alarm stations to (1) detect and assess alarms, (2) initiate and coordinate an adequate response to alarms, (3) summon offsite assistance, and (4) provide effective command and control.

Table 2.2.1-1
ITAAC for the Site-Specific Security System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
11(e). Both the Central and Secondary Alarm Stations will be constructed, located, protected, and equipped to the standards for the Central Alarm Station (alarm stations need not be identical in design but shall be equal and redundant, capable of performing all functions required of alarm stations).	11(e). Tests, inspections, or a combination of tests and inspections of the Central and Secondary Alarm Stations will be performed.	11(e). The Central and Secondary Alarm Stations are located, constructed, protected, and equipped to the standards of the Central Alarm Station and are functionally redundant (stations need not be identical in design).
12. The secondary security power supply system for alarm annunciator equipment contained in the Secondary Alarm Station and non-portable communications equipment contained in the Secondary Alarm Station is located within a vital area.	12. The secondary security power supply system will be inspected.	12. The secondary security power supply system for alarm annunciator equipment contained in the Secondary Alarm Station and non-portable communications equipment contained in the Secondary Alarm Station is located within a vital area.
13(a). Security alarm devices, including transmission lines to annunciators, will be tamper-indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs or when on standby power), and alarm annunciation indicates the type of alarm (e.g., intrusion alarms, emergency exit alarm) and location.	13(a). All security alarm devices and transmission lines will be tested.	13(a). Security alarm devices including transmission lines to annunciators are tamper indicating and self-checking (e.g., an automatic indication is provided when failure of the alarm system or a component occurs, or when the system is on standby power), and the alarm annunciation indicates the type of alarm (e.g., intrusion alarm, emergency exit alarm) and location.
13(b). Intrusion detection and assessment systems will be designed to provide visual display and audible annunciation of alarms in the Secondary Alarm Station.	13(b). Intrusion detection and assessment systems will be tested.	13(b). The intrusion detection and assessment systems provide a visual display and audible annunciation of alarms in the Secondary Alarm Station (concurrently with the display and annunciation in the Central Alarm Station).
14. No Site-Specific ITAAC specified.	14. No Site-Specific ITAAC specified.	14. No Site-Specific ITAAC specified.

Table 2.2.1-1
ITAAC for the Site-Specific Security System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
15. Emergency exits through the protected area perimeter and vital area boundaries will be alarmed with intrusion detection devices and secured by locking devices that allow prompt egress during an emergency.	15. Tests, inspections, or a combination of tests and inspections of emergency exits through the protected area perimeter and vital area boundaries will be performed.	15. Emergency exits through the protected area perimeter and vital area boundaries are alarmed with intrusion detection devices and secured by locking devices that allow prompt egress during an emergency.
16(a). The Secondary Alarm Station will have conventional (land line) telephone service with the Main Control Room and local law enforcement authorities.	16(a). Tests, inspections, or a combination of tests and inspections of the Secondary Alarm Stations' conventional (land line) telephone service will be performed.	16(a). The Secondary Alarm Station is equipped with conventional (land line) telephone service with the Main Control Room and local law enforcement authorities.
16(b).The Secondary Alarm Station will be capable of continuous communication with on-duty security force personnel.	16(b). Tests, inspections, or a combination of tests and inspections of the Secondary Alarm Stations' continuous communication capabilities will be performed.	16(b). The Secondary Alarm Station is capable of continuous communication with on-duty watchmen, armed security officers, armed responders, or other security personnel who have responsibilities within the physical protection program and during contingency response events.
16(c). Non-portable communications equipment in the Secondary Alarm Station will remain operable from an independent power source in the event of loss of normal power.	16(c). Tests, inspections, or a combination of tests and inspections of the non-portable communications equipment will be performed.	l6(c). All non-portable communication devices (including conventional telephone systems) in the Secondary Alarm Station are wired to an independent power supply that enables those systems to remain operable (without disruption) during the loss of normal power.

3. Emergency Planning ITAAC.

The emergency planning (EP)-ITAAC are provided in Table 3-1. The licensee shall perform and satisfy the ITAAC defined in Table 3.-1 (from North Anna 3 COL Application Part 10, Table 2.3-1)

Table 3-1
ITAAC For Emergency Planning

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
1.0 Emergency Classification System			
10 CFR 50.47(b)(4) – A standard emergency classification and action level scheme, the bases of which include facility system and effluent parameters, is in use by the nuclear facility licensee, and State and local response plans call for reliance on information provided by facility licensees for determinations of minimum initial offsite response measures.	1.1 A standard emergency classification and emergency action level (EAL) scheme exists, and identifies facility system and effluent parameters constituting the bases for the classification scheme. [D.1**] [**D.1 corresponds to NUREG-0654/FEMA-REP-1 evaluation criteria.] ITAAC element addressed in: Combined license (COL) Emergency Plan (EP) II.D.1	1.1 An inspection of the control room, technical support center (TSC), and emergency operations facility (EOF) will be performed to verify that they have displays for retrieving facility system and effluent parameters that constitute the bases for the classification scheme identified in the Emergency Plan Implementing Procedures (EPIPs).	1.1.1 The specific parameters identified in the EAL thresholds listed in the EPIPs have been retrieved and displayed in the control room, TSC, and EOF. 1.1.2 The ranges available in the control room, TSC, and EOF encompass the values for the specific parameters identified in the EAL thresholds listed in the EPIPs.
2.0 Notification Methods and Procedures			
10 CFR 50.47(b)(5) – Procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations and the public has been established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone	2.1 The means exist to notify responsible State and local organizations within 15 minutes after the licensee declares an emergency. [E.1] ITAAC element addressed in: COL EP II.E.1	2.1 A test will be performed of the capabilities.	2.1 A means to notify responsible organizations, within 15 minutes after the licensee declares an emergency, has been established via the Operational Hot Line among the control room, the Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange County, and Spotsylvania County.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
(EPZ) have been established.			
	2.2 The means exist to notify emergency response personnel. [E.2] ITAAC element addressed in: COL EP II.E.2	2.2 A test will be performed of the capabilities.	2.2 A means exists to notify the North Anna 3 emergency response organization.
	2.3 The means exist to notify and provide instructions to the populace within the plume exposure EPZ. [E.6] ITAAC element addressed in: COL EP II.E.6	2.3 The full test of notification capabilities will be conducted.	2.3 A means exists to notify and provide instructions to the public in accordance with the emergency plan requirements.
3.0 Emergency Communications			
10 CFR 50.47(b)(6) – Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public.	3.1 The means exist for communications among the control room, TSC, EOF, principal State and local emergency operations centers (EOCs), and radiological field assessment teams. [F.1.d] ITAAC element addressed in: COL EP II.F.1.d	3.1 A test will be performed of the capabilities.	3.1.1 Communications have been established between the control room and TSC. 3.1.2 Communications have been established among the control room, TSC, and EOF. 3.1.3 Communications via the Operational Hot Line have been established among the TSC and EOCs, which include the Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange County, and Spotsylvania County. 3.1.4 Communications have been established between the TSC and radiological monitoring teams. 3.1.5 Communications have been established between the EOF and radiological monitoring teams.
	3.2 The means exist for communications	3.2 A test will be performed of the capabilities.	3.2 Communications have been established from the control room,

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	from the control room, TSC, and EOF to the Nuclear Regulatory Commission (NRC) headquarters and regional office EOCs (including establishment of the Emergency Response Data System (ERDS) between the onsite computer system and the NRC Operations Center). [F.1.f] ITAAC element addressed in: COL EP II.F.1.f		TSC, and EOF to the NRC headquarters and Region II EOCs and an access port for ERDS is provided.
4.0 Public Education and Information			
[Deleted]	[Deleted]	[Deleted]	[Deleted]
5.0 Emergency Facilities and Equipment			
10 CFR 50.47(b)(8) – Adequate emergency facilities and equipment to support the emergency response are provided and maintained.	5.1 The licensee has established a TSC and onsite operational support center (OSC). [H.1] ITAAC element addressed in: COL EP II.H.1	5.1 An inspection of the as-built TSC and OSC will be performed.	5.1.1 The TSC has at least 1950 square feet of floor space. 5.1.2 The following communications equipment have been provided in the TSC and voice transmission and reception have been accomplished: a. NRC systems: Emergency Notification System (ENS), Health Physics Network (HPN), Reactor Safety Counterpart Link (RSCL), Protective Measures Counterpart Link (PMCL),

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Management Counterpart Link (MCL) b. Dedicated telephone to EOF c. Dedicated telephone to control room d. Dedicated telephone to OSC 5.1.3 The TSC has been located in the Electrical Building. 5.1.4 The TSC includes radiation monitors and a ventilation system with a high efficiency particulate air (HEPA) and charcoal filter. 5.1.5 A back-up electrical power supply is available for the TSC.
			5.1.6 The OSC is in a location separate from the control room. 5.1.7 The following communications equipment have been provided in the OSC and voice transmission and reception have been accomplished: a. Dedicated telephone to control room b. Dedicated telephone to TSC c. Plant page system (voice transmission only)
	5.2 The licensee has established an EOF. [H.2] ITAAC element addressed in: COL EP II.H.2	5.2 An inspection of the EOF will be performed.	5.2.1 A report exists that confirms the EOF has at least 243 square meters (2625 square feet). 5.2.2 Voice transmission and reception have been accomplished between the EOF and TSC. 5.2.3 A report exists that confirms voice transmission and reception have been accomplished via the Operational Hot Line among the EOF, Commonwealth of Virginia, Caroline County, Hanover County, Louisa County, Orange

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			County, and Spotsylvania County. 5.2.4 The EOF has the means to acquire, display and evaluate radiological, meteorological, and plant system data pertinent to determining offsite protective measures.
6.0 Accident Assessment			
10 CFR 50.47(b)(9) – Adequate methods, systems, and equipment for assessing and monitoring actual or potential offsite consequences of a radiological emergency condition are in use.	6.1 The means exist to provide initial and continuing radiological assessment throughout the course of an accident. [I.2] ITAAC element addressed in: COL EP II.I.2, Appendix 2	6.1 A test of the emergency plan will be conducted by performing an exercise or drill to verify the capability to perform accident assessment.	6.1 An exercise or drill has been accomplished, including use of selected monitoring parameters identified in the EAL thresholds listed in the EPIPs, to assess simulated degraded plant conditions and initiate protective actions in accordance with the following criteria: A. *Accident Assessment and Classification* 1. Initiating conditions identified, EAL parameters determined, and the emergency correctly classified throughout the drill. 2. Protective action recommendations developed and communicated to appropriate authorities. B. *Radiological Assessment and Control* 1. Onsite radiological surveys performed and samples collected. 2. Radiation exposure of emergency workers monitored and controlled. 3. Field monitoring teams assembled and deployed. 4. Field team data collected and disseminated. 5. Dose projections developed. .

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			6. The decision whether to issue radioprotective drugs to NAPS 6. The NAPS emergency workers made.
	6.2 The means exist to determine the source term of releases of radioactive material within plant systems, and the magnitude of the release of radioactive materials based on plant system parameters and effluent monitors. [I.3] ITAAC element addressed in: COL EP II.I.3, Appendix 2	6.2 An analysis of EPIPs and the Offsite Dose Calculation Manual (ODCM) will be completed to verify the ability to determine the source term and magnitude of release.	6.2 The EPIPs and ODCM correctly calculate source terms and magnitudes of postulated releases.
	6.3 The means exist to continuously assess the impact of the release of radioactive materials to the environment, accounting for the relationship between effluent monitor readings, and onsite and offsite exposures and contamination for various meteorological conditions. [I.4] ITAAC element addressed in: COL EP II.I.4, Appendix 2	6.3 An analysis of EPIPs and the ODCM will be completed to verify the relationship between effluent monitor readings and offsite exposures and contamination for various meteorological conditions has been established.	6.3 The EPIPs and ODCM calculate the relationship between effluent monitor readings and offsite exposures and contamination for various meteorological conditions.
	6.4 The means exist to acquire and evaluate meteorological information. [I.5] ITAAC element addressed in: COL EP II.I.5	6.4 An inspection of the control room, TSC, and EOF will be performed to verify the availability of the following meteorological data: • Wind speed (at 10 meters (m) and 48.4 m) • Wind direction (at 10 m and 48.4 m)	6.4 The following meteorological data is available in the control room, TSC, and EOF: • Wind speed (at 10 m and 48.4 m) • Wind direction (at 10 m and 48.4 m) • Ambient air temperature (at 10 m) • Differential air temperature (between 10 m and 48.4 m)

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
		• Ambient air temperature (at 10 m) • Differential air temperature (between 10 m and 48.4 m)	
	6.5 The means exist to make rapid assessments of actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways, including activation, notification means, field team composition, transportation, communication, monitoring equipment, and estimated deployment times. [I.8] ITAAC element addressed in: COL EP II.I.8	6.5 A test will be performed of the capabilities.	6.5 Demonstrate the capability for making rapid assessment of the actual or potential magnitude and locations of any radiological hazards through liquid or gaseous release pathways.
	6.6 The capability exists to detect and measure radioiodine concentrations in air in the plume exposure EPZ, as low as 10^{-7} μCi/cc (microcuries per cubic centimeter) under field conditions. [I.9] ITAAC element addressed in: COL EP II.I.9	6.6 A test of NAPS field survey instrumentation will be performed to verify the capability to detect airborne concentrations as low as 1E-07 μCi/cc.	6.6 Instrumentation used for monitoring I-131 to detect airborne concentrations as low as 1E-07 μCi/cc has been provided.
	6.7 The means exist to estimate integrated dose from the projected and actual dose rates, and for comparing these estimates with the Environmental Protection Agency (EPA) protective	6.7 An analysis of EPIPs will be performed to verify that a methodology is provided to establish means for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity	6.7 A report exists and concludes a methodology has been established for relating contamination levels and airborne radioactivity levels to dose rates and gross radioactivity measurements for the specified isotopes (Kr-88, Ru-106, I-131, I-132,

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
	action guides (PAGs). [I.10] ITAAC element addressed in: COL EP II.I.10, Appendix 2	measurements for the following isotopes: Kr-88, Ru-106, I-131, I-132, I-133, I-134, I-135, Te-132, Xe-133, Xe-135, Cs-134, Cs-137, Ce-144	I-133, I-134, I-135, Te-132, Xe-133, Xe-135, Cs-134, Cs-137, Ce-144), and for comparing the dose estimates with the EPA PAGs.
7.0 Protective Response			
10 CFR 50.47(b)(10) – A range of protective actions has been developed for the plume exposure EPZ for emergency workers and the public. In developing this range of actions, consideration has been given to evacuation, sheltering, and, as a supplement to these, the prophylactic use of potassium iodide (KI), as appropriate. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place, and protective actions for the ingestion exposure EPZ appropriate to the locale have been developed.	7.1 The means exist to warn and advise onsite individuals of an emergency, including those in areas controlled by the operator, including: [J.1] a. employees not having emergency assignments; b. visitors; c. contractor and construction personnel; and d. other persons who may be in the public access areas, on or passing through the site, or within the owner controlled area. ITAAC element addressed in: COL EP II.J.1	7.1 A test of the onsite warning and communications capability will be performed during a drill or exercise.	7.1.1 During a drill or exercise, notification and instructions were provided to onsite workers and visitors, within the Protected Area, over the plant public announcement system. 7.1.2 During a drill or exercise, audible warnings were provided to individuals outside the Protected Area, but within the Owner Controlled Area.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
8.0 Exercises and Drills			
10 CFR 50.47(b)(14) – Periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted to develop and maintain key skills, and deficiencies identified as a result of exercises or drills are (will be) corrected.	8.1 Licensee conducts a full-participation exercise to evaluate major portions of emergency response capabilities, which includes participation by each State and local agency within the plume exposure EPZ, and each State within the ingestion control EPZ. [N.1] ITAAC element addressed in: COL EP II.N.1	8.1 A full-participation exercise (test) will be conducted within the specified time periods of Appendix E to 10 CFR Part 50.	8.1.1 The exercise is completed within the specified time periods of 10 CFR Part 50, Appendix E, and a report exists that confirms onsite exercise objectives listed below have been met and there are no uncorrected onsite exercise deficiencies. A. *Accident Assessment and Classification* 1. Demonstrate the ability to identify initiating conditions, determine EAL parameters, and correctly classify the emergency throughout the exercise. Standard Criteria: a. Determine the correct highest emergency classification level based on events which were in progress, considering past events and their impact on the current conditions, within 15 minutes from the time the initiating condition(s) or EAL(s) is (are) identified. B. *Notifications* 1. Demonstrate the ability to alert, notify, and mobilize site emergency response personnel. Standard Criteria: a. Initiate activation of the emergency recall system following initial event classification for an Alert or higher. 2. Demonstrate the ability to notify responsible State and local government agencies within 15 minutes and the NRC within 60 minutes after declaring an emergency. a. Initiate transmittal of initial information to the Commonwealth of

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Virginia and risk jurisdictions using the designated EPIP within 15 minutes of event classification. b. Initiate transmittal of follow-up information to the Commonwealth of Virginia and risk jurisdictions using the designated EPIP within appropriate interval. c. Initiate transmittal of initial information to the NRC using the designated EPIP within 60 minutes of event classification. 3. Demonstrate the ability to warn or advise onsite individuals of emergency conditions. Standard Criteria: a. Initiate notification of onsite individuals (via plant page or telephone), using the designated EPIP within 15 minutes of notification. 4. Demonstrate the capability of the Alert and Notification System (ANS) sirens to operate properly when required. Standard Criteria: a. 90 percent of the sirens operate properly. C. *Emergency Response* 1. Demonstrate the capability to direct and control emergency operations. Standard Criteria: a. Command and control is demonstrated by the control room in the early phase of the emergency and the TSC, after its activation. 2. Demonstrate the ability to transfer emergency direction from the control room (simulator) to the TSC. Standard Criteria:

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			a. Briefings were conducted prior to turnover responsibility. Personnel document transfer of duties. 3. Demonstrate the ability to prepare for around-the-clock staffing requirements. Standard Criteria: a. Complete 24-hour staff assignments. 4. Demonstrate the ability to perform assembly and accountability for all onsite individuals during an emergency requiring Protected Area assembly and accountability. Standard Criteria: a. Protected Area personnel assembly and accountability completed within 30 minutes following initiation of assembly and accountability measures. D. *Emergency Response Facilities* 1. Demonstrate activation of the OSC, and full functional operation of the TSC and EOF. Standard Criteria: a. The TSC, OSC, and EOF are activated within about 60 minutes of the initial notification. 2. Demonstrate the adequacy of equipment, security provisions, and habitability precautions for the TSC, OSC, EOF, and Joint Information Center (JIC), as appropriate. Standard Criteria: a. Demonstrate the adequacy of the emergency equipment in the emergency response facilities. b. The Security Team Leader implements and follows applicable EPIPs.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			c. The Health Physics (HP) personnel implement the designated EPIP provisions if an onsite or offsite release has occurred. 3. Demonstrate the adequacy of communications for all emergency support resources. Standard Criteria: a. Emergency response facility personnel are able to operate all specified communication systems. b. Clear primary or backup communications links are established and maintained for the duration of the exercise. E. *Radiological Assessment and Control* 1. Demonstrate the ability to obtain onsite radiological surveys and samples. Standard Criteria: a. HP personnel demonstrate the ability to obtain appropriate instruments (range and type) and take surveys. b. Airborne samples are taken when the conditions indicate the need for the information. 2. Demonstrate the ability to continuously monitor and control radiation exposure to emergency workers. Standard Criteria: a. Emergency workers are issued self-reading dosimeters when radiation levels require, and exposures are controlled to 10 CFR Part 20 occupational dose limits (unless the Emergency Coordinator/EOF

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			Director authorizes emergency limits). b. Exposure records are available. c. Emergency workers include Security and personnel within all emergency facilities. 3. Demonstrate the ability to assemble and deploy field monitoring teams. Standard Criteria: a. One field monitoring team is ready to be deployed within 60 minutes of being requested, and no later than 90 minutes from the declaration of an Alert or higher emergency. 4. Demonstrate the ability to satisfactorily collect and disseminate field team data. Standard Criteria: a. Field team data to be collected is dose rate or counts per minute (cpm) from the plume, both open and closed window, and air sample (gross/net cpm) for particulate and iodine, if applicable. b. Satisfactory data dissemination is from the field team to HP (Plume Tracking/Dose Assessment) personnel. 5. Demonstrate the ability to develop dose projections. Standard Criteria: a. Timely and accurate dose projections are performed in accordance with EPIPs. 6. Demonstrate the ability to make the decision whether to issue radioprotective drugs to emergency workers. Standard Criteria: a. Radioprotective drugs are taken (simulated) if the estimated dose to the

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			thyroid will exceed 25 rem committed dose equivalent (CDE). 7. Demonstrate the ability to develop appropriate protective action recommendation(s) (PAR(s)) and notify appropriate authorities within 15 minutes of development. Standard Criteria: a. Total effective dose equivalent (TEDE) and CDE dose projections from the dose assessment computer code are compared to criteria in EPIPs. b. PAR(s) is (are) developed within 15 minutes of data availability, as appropriate. c. PAR(s) is (are) transmitted to responsible State and local government agencies within 15 minutes of development. F. *Public Information* 1. Demonstrate the capability to develop and disseminate clear, accurate, and timely information to the news media. Standard Criteria: a. Media information (e.g., press releases, press briefings, electronic media) is made available following notification of Dominion External Affairs personnel. 2. Demonstrate the capability to establish and effectively operate rumor control in a coordinated fashion. Standard Criteria: a. Calls are answered in a timely manner with the correct information.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			b. Rumors are identified and addressed. G. *Evaluation* 1. Demonstrate the ability to conduct a post-exercise critique, to determine areas requiring improvement and corrective action. Standard Criteria: a. An exercise time-line is developed, followed by an evaluation of the objectives. b. Significant problems in achieving the objectives are discussed to ensure understanding of why objectives were not fully achieved. c. Recommendations for improvement in non-objective areas are discussed.

Planning Standard	EP Program Elements	Inspections, Tests, Analyses	Acceptance Criteria
			8.1.2 Onsite emergency response personnel are mobilized in sufficient number to fill the emergency positions identified in COL EP II.B, Onsite Emergency Organization, and a report exists that confirms they successfully perform their assigned responsibilities as outlined in Acceptance Criterion 8.1.1.D, Emergency Response Facilities.
			8.1.3 The exercise is completed within the specified time periods of 10 CFR Part 50, Appendix E, a report exists that confirms offsite exercise objectives have been met and there are no uncorrected offsite deficiencies, or a license condition requires offsite deficiencies to be corrected prior to operation above 5 percent of rated power.
9.0 Implementing Procedures			
10 CFR Part 50, Appendix E.V – No less than 180 days prior to the scheduled issuance of an operating license for a nuclear power reactor or a license to possess nuclear material, the applicant's detailed implementing procedures for its emergency plan shall be submitted to the Commission.	9.1 The licensee has submitted detailed implementing procedures for its emergency plan no less than 180 days prior to fuel load.	9.1 An inspection will be performed to confirm that the detailed implementing procedures for the North Anna 3 Emergency Plan were submitted to the NRC.	9.1 Each of the detailed implementing procedures for the North Anna 3 Emergency Plan, as defined in Appendix 5 of the Emergency Plan, are submitted to the NRC no less than 180 day prior to fuel load.

4. Site-Specific ITAAC

The site-specific ITAAC are provided in Table 4-1 through 4-8.

4.1 ITAAC for Fill Concrete Under Seismic Category I Structure

ITAAC for Fill Concrete Under and Around the Sides of Seismic Category I Structures is provided in Table 4-1. The licensee shall perform and satisfy the ITAAC defined in Table 4-1 (from North Anna 3 COL Application Part 10, Table 2.4.1-1).

Table 4-1
ITAAC for Fill Concrete Under and Around Seismic Category I Structures

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1. The foundation grade for the FWSC will be established using fill concrete. Fill concrete placed under and around the sides of Seismic Category I Structures to a thickness greater than 5 feet is designed and tested as specified in FSAR Section 2.5..	Testing will be performed to determine the mean compressive strength for the fill concrete.	A report exists that demonstrates that the mean 28-day compressive strength of the fill concrete is equal to, or greater than, 17.2 MPa (2,500 psi).

4.2 ITAAC for Backfill Surrounding Seismic Category I Structures

Structural fill surrounding the embedded walls for Seismic Category I structures meets properties for (1) the angle of internal friction; (2) the local effect on wall pressure as determined by the product of: peak ground acceleration α, (in g), Poisson's ratio v, and density γ; and (3) soil density. is provided in Table 4-2. The licensee shall perform and satisfy the ITAAC defined in Table 4-2 (from North Anna 3 COL Application Part 10, Table 2.4.2-1).

Table 4-2
ITAAC for Structural Fill Surrounding Seismic Category I Structures

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1. The structural fill material surrounding Seismic Category I structures meets the following properties: • the angle of internal friction ≥35 degrees • the local effect on wall lateral pressures ≤1220 kg/m3 (76 lbf/ft3), as determined by the following equation: $\alpha\ (0.95\nu + 0.65)\gamma$ where: α = peak ground acceleration (in g) ν = Poisson's ratio γ = density • the soil density γ ≥2000 kg/m3 (125 lbf/ft3).	Tests, inspections, analyses, or a combination thereof, will be performed to evaluate the properties of the structural fill.	A report exists and concludes that the tests, inspections, analyses, or a combination thereof, confirm that the structural fill material surrounding Seismic Category I structures meets the following properties: • the angle of internal friction ≥35 degrees • the local effect on wall lateral pressures ≤1220 kg/m3 (76 lbf/ft3), as determined by the following equation: $\alpha\ (0.95\nu + 0.65)\gamma$ where: α = peak ground acceleration (in g) ν = Poisson's ratio γ = density • the soil density γ ≥2000 kg/m3 (125 lbf/ft3).

4.3 ITAAC for Plant Service Water System

The site-specific ITTAC for the plant service water system are related to plant service water reserve storage capacity as listed in Table 4-3. The licensee shall perform and satisfy the ITAAC defined in Table 4-3 (from North Anna 3 COL Application Part 10, Table 2.4.3-1).

Table 4-3
ITAAC for Plant Service Water Reserve Storage Capacity

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1. The volume of water in the PSWS basin shall be sufficient such that:		
a. No active makeup shall be necessary to remove 2.02 × 107 MJ (1.92 × 1010 BTU) over a period of seven days.	Inspections and analysis will be performed of the PSWS basin and cooling towers.	A report exists and concludes that the volume of water in the PSWS basin is sufficient such that no active makeup is necessary to remove 2.02 × 107 MJ (1.92 × 1010 BTU) over a period of seven days.
b. The PSWS pumps must have sufficient available net positive suction head at the pump suction location for the lowest probable water level of the heat sink.	Inspections and analysis will be performed of the PSWS basin.	A report exists and concludes that the PSWS pumps have sufficient available net positive suction head at the pump suction location for the lowest probable water level of the heat sink.

4.4 Offsite Power Systems ITAAC

Table 4-4 provides the site-specific offsite power ITAAC. The licensee shall perform and satisfy the ITAAC defined in Table 4-4 (from North Anna 3 COL Application Part 10, Table 2.4.8-1).

Table 4-4
ITAAC for offsite Power Systems

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1.Independent offsite power sources supply electric power from the transmission network to the interface with the onsite plant power system (PPS)		
a. A minimum of two offsite power circuits are provided to the interface with the onsite PPS and are physically separate.	a. Inspections of the as-built offsite power supply transmission system will be performed.	a. A report exists and concludes the following inspection results: i) At least two offsite transmission circuits are provided to the interface with the onsite PPS. ii) The two offsite power circuits are physically separated by distance or physical barriers so as to minimize to the extent practical the likelihood of their simultaneous failure under design basis conditions. iii) The two offsite power circuits do not have a common takeoff structure or use a common structure for support.
b. The two offsite power circuits interfacing with the onsite PPS are electrically independent.	b. Test of the as-built offsite power system will be conducted by providing a test signal in only one offsite power circuit at a time.	b. A report exists and concludes that a test signal exists in only the circuit under test.
c. The breaker control power. Instrumentation and control circuits for the two offsite Dower circuits interfacing with the onsite PPS are electrically independent.	c. Tests of the as-built offsite breaker control power. Instrumentation and control circuits will be conducted by providing a test signal in only one offsite power circuit at a time.	c. A report exists and concludes that a test signal exists in only the circuit under test.
2. At least two offsite power circuits interfacing with the onsite portions of the PPS are each adequately rated to supply necessary load requirements during design basis operating modes.	2. Analyses of the offsite power system will be performed to evaluate the as-built ratings of each offsite power circuit interfacing with the onsite portions of the PPS against the load requirements determined in DCD ITAAC 2.13.1-2, Item, 9.	2. A report exists and concludes that at least two offsite power circuits from the transmission network up to the interface with the onsite portions of the PPS are each rated to supply the load requirements, during design basis operating modes, of their respective safety-related and nonsafety-related load groups.
3. Under normal steady state operation of the transmission system, the offsite portion of the PPS is capable of supplying required voltage to the interface with the onsite portions of the	3. Analyses of the as-built offsite portion of the PPS will be performed to evaluate the capability of each offsite power circuit to supply the voltage requirements at the interface with the onsite portion	3. A report exists and concludes that as-built offsite portion of the PPS, under normal steady state operation of the transmission system, is capable of supplying voltage at the interface with the

PPS that will support operation of safety-related loads during design basis operating modes.	of the PPS determined in DCD ITAAC 2.13.1-2, Item 9.	onsite portions of the PPS that will support operation of safety-related loads during design basis operating modes.
4. Under normal steady state operation of the transmission system, the offsite portion of the PPS is capable of supplying required frequency to the interface with the onsite portions of the PPS that will support operation of safety-related loads during design basis operating modes.	4. Analyses of the as-built offsite portion of the PPS will be performed to evaluate the capability of each offsite power circuit to supply the frequency requirements at the interface with the onsite portions of the PPS determined in DCD ITAAC 2.13.1-2, Item 9.	4. A report exists and concludes that as-built offsite portion of the PPS, under normal steady state operation of the transmission system, is capable of supplying required frequency at the interface with the onsite portions of the PPS that will support operation of safety-related loads during design basis operating modes.
5. The fault current contribution of the offsite portion of the PPS is compatible with the interrupting capability of the onsite short circuit interrupting devices.	5. Analyses of the as-built offsite portion of the PPS will be performed to evaluate the fault current contribution of each offsite power circuit at the interface with the onsite portions of the PPS.	5. A report exists and concludes the short circuit contribution of the as-built offsite portion of the PPS at the interface with the onsite portions of the PPS is compatible with the interrupting capability of the onsite fault current interrupting devices as determined in DCD ITAAC 2.13.1-2, Item 10.

4.5 Turbine Building ITAAC

Table 4-5 provides the site-specific turbine building (TB) ITAAC. The licensee shall perform and satisfy the ITAAC defined in Table 4-5 (from North Anna 3 COL Application Part 10, Table 2.4.15-1).

Table 4-5
ITAAC for the Turbine Building

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1. The site-specific seismic load demands for the Turbine Building structure are within acceptable limits to ensure that the structure is seismically adequate, using the same analysis methodology as a Seismic Category I structure, considering associated loads as described in DCD Tier 1 ITAAC Table 2.16.8-1, Item 1.	Perform site-specific SSI analysis, following the methodology specified for Seismic Category I structures in FSAR Section 3.7.2, to address ground motion exceedances and site-specific effects of subgrade properties. If the Turbine Building structure seismic load demands exceed the standard design seismic oads, perform a structural design evaluation of the Turbine Building n the same manner as for a Seismic Category I structure, ncluding the load combinations and the acceptance criteria, for the associated loads.	The Turbine Building structure seismic load demands obtained from the site-specific SSI analysis are acceptable if at least one of the following two criteria are satisfied: (1) the site-specific seismic loads are bounded by the standard design seismic oads used for the Turbine Building; or, (2) the results from the site-specific structural design evaluation demonstrate that the Turbine Building total stresses are bounded by the Code allowable stress imits for a Seismic Category I structure, for the associated loads.. Site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology are used in the SSI analysis.
2. Seismic SSSI of the non-Seismic Category I Turbine Building will not impair the ability of the adjacent Seismic Category I Reactor Building to perform its safety functions.	Perform site-specific SSSI analyses to evaluate seismic interaction between the Turbine Building and adjacent Seismic Category I Reactor Building, using methodology consistent with that used for the Seismic Category I structures.	Site-specific analyses conclude that there is no seismic SSSI of the non-Seismic Category I Turbine Building that impairs the ability of the adjacent Seismic Category I Reactor Building to perform its safety functions.

4.6 Radwaste Building ITAAC

Table 4-6 provides the site-specific radwaste building (RWB) ITAAC. The licensee shall perform and satisfy the ITAAC defined in Table 4-6 (from North Anna 3 COL Application Part 10, Table 2.4.16-1).

Table 4-6
ITAAC for the Radwaste Building

Design Commitment	Inspections, Tests, and	Acceptance Criteria
1. The site-specific seismic load demands for the Radwaste Building structure are within acceptable limits to ensure that the structure s seismically adequate, using the same analysis methodology as a Seismic Category I structure, considering associated oads as described in DCD Tier 1 ITAAC Table 2.16.9-1, Item 1. The SSI analysis uses site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology for Seismic Category I buildings.	Perform site-specific SSI analysis, following the methodology specified for Seismic Category I structures in FSAR Section 3.7.2, to address ground motion exceedances and site-specific effects of subgrade properties. If the Radwaste Building structure seismic load demands exceed the standard design seismic loads, perform a structural design evaluation of the Radwaste Building in the same manner as for a Seismic Category I structure, including the load combinations and the acceptance criteria, for the associated loads.	The Radwaste Building structure seismic load demands obtained from the site-specific SSI analysis for the Radwaste Building structure are acceptable if at least one of the following two criteria are satisfied: (1) the site-specific seismic loads are bounded by the standard design seismic loads used for the Radwaste Building; or, (2) the results from the site-specific structural evaluation demonstrate that the Radwaste Building total stresses are bounded by Code allowable stress limits that are the same as for a Seismic Category I structure, for the associated loads. Site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology are used in the SSI analysis.
2. The Radwaste Building has an exterior wall static pressure capacity of at least 3 psi.	Perform an analysis to determine the static wall pressure capacity of the exterior walls of the as-built Radwaste Building.	Results of the Radwaste Building analysis demonstrate that the exterior wall static pressure capacity s at least 3 psi.
3. Seismic SSSI of the non-Seismic Category I Radwaste Building will not impair the ability of the adjacent Seismic Category I Reactor Building to perform its safety functions.	Perform site-specific SSSI analyses to evaluate seismic interaction between the Radwaste Building and adjacent Seismic Category I Reactor Building, using methodology consistent with that used for the Seismic Category I structures.	Site-specific analyses conclude that there is no seismic SSSI of the non-Seismic Category I Radwaste Building that impairs the ability of the adjacent Seismic Category I Reactor Building to perform its safety functions.

4.7 Service Building ITAAC

Table 4-7 provides the site-specific service building (SB) ITAAC. The licensee shall perform and satisfy the ITAAC defined in Table 4-7 (from North Anna 3 COL Application Part 10, Table 2.4.17-1).

Table 4-7
ITAAC for the Service Building

Design Commitment	Inspections, Tests, and	Acceptance Criteria
1. The site-specific seismic load demands for the Service Building structure are within acceptable limits to ensure that the structure is seismically adequate, using the same analysis methodology as a Seismic Category I structure, considering associated loads as described in DCD Tier 1 ITAAC Table 2.16.10-1, Item 1. The SSI analysis uses site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology for Seismic Category I buildings.	Perform site-specific SSI analysis, following the methodology specified for Seismic Category I structures in FSAR Section 3.7.2, to address ground motion exceedances and site-specific effects of subgrade properties. If the Service Building structure seismic load demands exceed the standard design seismic loads, perform a structural design evaluation of the Service Building in the same manner as for a Seismic Category I structure, including the load combinations and the acceptance criteria, for the associated loads.	The Service Building structure seismic load demands obtained from the site-specific SSI analysis are acceptable if at least one of the following two criteria are satisfied: (1) the site-specific seismic loads are bounded by the standard design seismic loads used for the Service Building; or, (2) the results from the site-specific structural design evaluation demonstrate that the Service Building total stresses are bounded by Code allowable stress limits that are the same as for a Seismic Category I structure, for the associated loads. Site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology are used in the SSI analysis.
2. Seismic SSSI of the non-Seismic Category I Service Building will not impair the ability of the adjacent Seismic Category I Reactor Building, Control Building, Fuel Building, or FWSC to perform the safety functions	Perform site-specific SSSI analyses to evaluate seismic interaction between the Service Building and adjacent Seismic Category I Reactor Building, Control Building, Fuel Building, or FWSC, using methodology consistent with that used for the Seismic Category I structures.	Site-specific analyses conclude that there is no seismic SSSI of the non-Seismic Category I Service Building that impairs the ability of the adjacent Seismic Category I Reactor Building, Control Building, Fuel Building, or FWSC to perform the safety functions.

4.8 Ancillary Diesel Building ITAAC

Table 4-8 provides the site-specific ancillary diesel building (ADB) ITAAC. The licensee shall perform and satisfy the ITAAC defined in Table 4-8 (from North Anna 3 COL Application Part 10, Table 2.4.18-1).

Table 4-8
ITAAC for the Ancillary Diesel Building

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1 The site-specific seismic load demands for the Ancillary Diesel Building structure are within acceptable limits to ensure that the structure is seismically adequate, using the same analysis methodology as a Seismic Category I structure, considering associated loads as described in DCD Tier 1 ITAAC Table 2.16.11-1, Item 1.	Perform site-specific SSI analysis, following the methodology specified for Seismic Category I structures in FSAR Section 3.7.2, to address ground motion exceedances and site-specific effects of subgrade properties. If the Ancillary Diesel Building structure seismic load demands exceed the standard design seismic loads, perform a structural design evaluation of the Ancillary Diesel Building in the same manner as for a Seismic Category I structure, including the load combinations and the acceptance criteria, for the associated loads.	The Ancillary Diesel Building structure seismic load demands obtained from the site-specific SSI analysis are acceptable if at least one of the following two criteria are satisfied: (1) the site-specific seismic loads are bounded by the standard design seismic loads used for the Ancillary Diesel Building; or, (2) the results from the site-specific structural design evaluation demonstrate that the total stresses are bounded by Code allowable stress limits that are the same as for a Seismic Category I structure, for the associated oads.
The SSI analysis uses site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology for Seismic Category I buildings.		Site-specific foundation input response spectra (FIRS) developed using site-specific soil properties and FSAR Sections 2.5.2 and 3.7.1 methodology are used in the SSI analysis.
2. Seismic SSSI of the non-Seismic Category I Ancillary Diesel Building will not impair the ability of the adjacent Seismic Category I Fuel Building to perform its safety functions.	Perform site-specific SSSI analyses to evaluate seismic interaction between the Ancillary Diesel Building and adjacent Seismic Category I Fuel Building, using methodology consistent with that used for the Seismic Category I structures.	I Site-specific analyses conclude that there is no seismic SSSI of the non-Seismic Category I Ancillary Diesel Building that impairs the ability of the adjacent Seismic Category I Fuel Building to perform ts safety functions.

Appendix B

Chronology of the Combined License Application for North Anna 3

This appendix contains a chronological listing of routine licensing correspondence between the staff of the U.S. Nuclear Regulatory Commission (NRC) regarding the review of the North Anna 3 plant design under Docket No. 052-000017.

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
3/21/05	ML102990405	A-1 Dominions Early Site Permit Coastal Consistency Certification 3-05.	Letter	Dominion Dominion Resources Services, Inc	State of VA, Dept of Environmental Quality NRC/NRO	5200017
9/7/06	ML102990447	Attachment E-1 USACE's Jurisdictional Determination 09-06 08-08(2) 09-08 06-09 07-09.	Letter	US Dept of the Army	Dominion Nuclear North Anna, LLC NRC/NRO	5200017
11/21/06	ML102990407	A-2 DEQ's CZMA Response and Conditional Concurrence 11-06.	Letter	State of VA, Dept of Environmental Quality	Dominion Virginia Power NRC/NRO	5200017
8/20/07	ML083260727	North Anna COL SDEIS Chapter 8 Reference North Carolina General Assembly: Session Law 2007-397, Senate Bill 3.	- No Document Type Applies Congressional Correspondence	State of NC, General Assembly US HR (House of	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/11/07	ML082910714	Letter from Dominion to Virginia Department of Historic Resources Transmitting the Louis Berger Report for North Anna COL Application.	Letter	Dominion Resources Services, Inc	NRC/NRO State of VA, Dept of Historic Resources	5200017
12/14/07	ML083260818	North Anna COL SDEIS Chapter 8 Reference Virginia State Corporation Commission.	Letter	State of VA, State Corporation Commission	NRC/NRO State of VA, Office of the Governor State of VA, State Corporation Commission	5200017
1/17/08	ML080230507	North Anna, Unit 3, COL Application - Response to NRC Pre-application Quality Assurance (QA) Audit of North Anna COL Application Activities.	Letter License-Application for Combined License (COLA)	Dominion Generation	NRC/Document Control Desk NRC/NRO	5200017
1/17/08	ML080230503	North Anna, Unit 3, Combined License Application - Early Site Permit COL Action Item 13.6-1.	Letter	Dominion Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/28/08	ML080240154	Acceptance for Docketing of the Dominion Application for a Combined License for North Anna Unit 3.	Federal Register Notice Letter	NRC/NRO/D NRL/EPB1	Dominion Virginia Power	5200017
1/28/08	ML080240154	Acceptance for Docketing of the Dominion Application for a Combined License for North Anna Unit 3.	Federal Register Notice Letter	NRC/NRO/D NRL/EPB1	Dominion Virginia Power	5200017
1/29/08	ML080360349	Enclosure 2: Dominion Energy 01/29/08 Letter, with Virginia Department of Health (VDH) Emergency Response Plan Cross-Reference Matrix to NUREG-0654/FEMA-REP-1.	Letter	Dominion Energy Co	NRC/NSIR	5200017
1/29/08	ML080500254	North Anna, Unit 3 - Combined License Application, Virginia Department of Health (VDH) Emergency Response Plan Cross-Reference Matrix to NUREG-0654/FEMA-REP-1.	Letter	Dominion Virginia Power	NRC/NRO	5200017
2/7/08	ML080370365	North Anna Combined License Application Consultation.	Letter	NRC/NSIR/D SP/DDRSR/ RSPLB	US Dept of Homeland Security, Office of Infrastructu re Protection	5200017
2/8/08	ML080280187	Maintenance of Reference Materials at the Hanover Branch Library in Regards to the Review of the North Anna Combined License (COL) Application at the North Anna Site.	Letter	NRC/NRO/D SER	Hanover County, VA	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
2/8/08	ML080280218	Maintenance of Reference Materials at the Hanover Branch Library in Regards to the Review of the North Anna Combined License (COL) Application at the North Anna Site.	Letter	NRC/NRO/DSER	Orange County, VA	5200017
2/8/08	ML080280225	Maintenance of Reference Materials at the Hanover Branch Library in Regards to the Review of the North Anna Combined License (COL) Application at the North Anna Site.	Letter	NRC/NRO/DSER	Spotsylvania, VA, C. Melvin Snow Memorial Branch Library	5200017
2/8/08	ML080280208	Maintenance of Reference Materials at the Jefferson-Madison Regional Library in Regards to the Review of the North Anna Combined License (COL) Application at the North Anna Site.	Letter	NRC/NRO/DSER	Louisa County, VA, Public Library	5200017
2/8/08	ML080280221	Maintenance of Reference Materials at the Salem Church Library in Regards to the Review of the North Anna Combined License (COL) Application at the North Anna Site.	Letter	NRC/NRO/DSER/ETSB	Fredericksburg, VA, Salem Church Library	5200017
2/15/08	ML080220507	Letter: Request for Federal Emergency Management Agency (FEMA) Review of North Anna Unit 3 Combined License Application - Second Supplement to Application.	Letter	NRC/NSIR/DPR/DDEP/RIOB	US Federal Emergency Mgmt Agency (FEMA)	5200017
2/27/08	ML080570140	North Anna COL Application Technical Review Schedule.	Letter	NRC/NRO/DNRL/EPB1	Dominion	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
2/27/08	ML080600516	Response to USNRC Pre-Application Quality Assurance Audit of Grand Gulf and North Anna Combined License Application Activities.	Letter	Entergy Operations, Inc	NRC/NRO	5200017
2/29/08	ML080630373	Letter to Grecheck re: Federal Register Notice Regarding Notice of Hearing and Opportunity to Petition for Leave to Intervene - North Anna Unit 3.	Letter	NRC/NRO/DNRL	Dominion	5200017
2/29/08	ML080390307	Federal Register Notice Regarding Opportunity To Petition For Leave To Intervene - North Anna Unit 3.	Federal Register Notice	NRC/SECY	Dominion Nuclear North Anna, LLC	5200017
3/7/08	ML080580288	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to the Combined License Application for the North Anna Power Station.	Federal Register Notice Letter	NRC/NRO/DSER	Dominion Virginia Power	5200017
3/7/08	ML080580288	Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to the Combined License Application for the North Anna Power Station.	Federal Register Notice Letter	NRC/NRO/DSER	Dominion Virginia Power	5200017
3/12/08	ML080850798	Dominion Nuclear Power, LLC; North Anna Power Station Combined License Application; Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process.	Federal Register Notice	NRC/NRO/DSER		5200017
3/18/08	ML080660387	Request For Additional Information Process Revised For North Anna COL Application.	Letter	NRC/NRO/DNRL	Dominion	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
4/4/08	ML080720297	04/04/2008 - Letter from Richard A. Raione to Deanna Beacham of Virginia Council on Indians re: North Anna Power Station Combined License Application Review.	Letter	NRC/NRO/DSER/EPB2	Virginia Council on Indians	5200017
4/4/08	ML080710129	North Anna Power Station, Unit 3 Combined License Application Review (Letter to Virginia Department of Historic Resources).	Letter	NRC/NRO/DSER/EPB2	State of VA, Dept of Historic Resources	5200017
4/4/08	ML080780357	North Anna, Unit 3, Combined License Application Review.	Letter	NRC/NRO/DSER/EPB2	State of VA, Dept of Game & Inland Fisheries	5200017
4/4/08	ML080940415	North Anna, Unit 3, DHS Consultation Visit.	Letter	NRC/NSIR/DSP/DDRSR/RSPLB	Dominion	5200017
4/4/08	ML081620118	PNNL 04/04/08 Report (Draft TER 4-4-08) (via 04/04/08 Email): "Draft Technical Evaluation Report for the North Anna Unit 3 Project ETE Review," for North Anna Combined License (COL) Application.	E-Mail Letter	Battelle Memorial Institute, Pacific Northwest National Lab US Dept of Energy (DOE)	NRC/NRO	5200017
4/4/08	ML080920275	Request for Comments Concerning the North Anna Power Station, Unit 3 Combined License Application Review.	Letter	NRC/NRO/DSER/EPB2	- No Known Affiliation	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
4/4/08	ML080920298	Request for Comments on the North Anna Power Station, Unit 3 Combined License Application (Letter to L. Henry).	Letter	NRC/NRO/DSER/EPB2	- No Known Affiliation	5200017
4/4/08	ML080710278	Request for List of Protected Species Within the Area under Evaluation for the North Anna Power Station, Unit 3 Combined License Application.	Letter	NRC/NRO/DSER/EPB2	US Dept of Interior, Fish & Wildlife Service	5200017
4/4/08	ML080701146	Review of North Anna Power Station Combined License Application (Letter to D. Klima, ACHP Scoping).	Letter	NRC/NRO/DSER/EPB2	US Advisory Council On Historic Preservation	5200017
4/9/08	ML081000188	Supplement to Notice of Hearing and Opportunity to Petition for Leave to Intervene - North Anna, Unit 3.	Letter	NRC/NRO/DNRL/EPB1	Dominion	5200017
4/14/08	ML081000242	Federal Register Notice - Supplement to North Anna COL Application Notice of Hearing and Opportunity to Petition for Petition for Leave to Intervene.	Federal Register Notice	NRC/SECY		5200017
4/28/08	ML081190721	2008/04/28-Notice of Appearance of Louis A. Zeller.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environmental Defense League	NRC/ SECY	5200017
5/27/08	ML081440317	Federal Register Notice - Correction to Notice of Hearing re: North Anna COL Application.	Federal Register Notice	NRC/SECY		5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
6/9/08	ML081700158	North Anna, Unit 3, Transmittal of Interim Finding Report (Phase 1) of the Offsite Emergency Response Plans for the Combined License (COL) Application.	Letter	US Federal Emergency Mgmt Agency (FEMA)	NRC/NSIR /DPR	5200017
6/11/08	ML081630671	2008/06/11-Reply of the Blue Ridge Environmental Defense League to Dominion Virginia Power and NRC Staff Answers to Our Petition for Intervention and Request for Hearing.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environment al Defense League	NRC/ASLB P	5200017
6/18/08	ML081630583	Request for Additional Information Regarding the Environmental Review of the Combined License Application for the North Anna Power Station, Unit 3.	Letter Request for Additional Information (RAI)	NRC/NRO/D SER/EPB2	Dominion Virginia Power	5200017
6/26/08	ML081840266	North Anna, Unit 3, Combined License Application Transmittal of Inservice Testing (IST) Program Description - COLA FSAR Section 3.9.	Letter	Dominion Virginia Power	NRC/NRO	5200017
6/30/08	ML081820174	2008/06/30-Reply of the Blue Ridge Environmental Defense League to ASLBP Order Tentatively Scheduling Teleconference For Oral Argument.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environment al Defense League	NRC/ ASLBP	5200017
7/1/08	ML081830849	2008/07/01-Ex Parte E-mails Regarding Telephonic Oral Argument in ASLBP Adjudications.	Legal-Correspondence/ Miscellaneous	NRC/ASLBP	- No Known Affiliation	5200017
7/7/08	ML081900177	2008/07/07-Response to Ex Parte E-mails Regarding Teleconference, Part 2.	Legal-Correspondence/ Miscellaneous	NRC/ASLBP	- No Known Affiliation	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
7/14/08	ML081960065	US NRC North Anna Correction and Supplement FRN Emergency Publication Letter.	Letter	NRC/NRO/ DSER	US National Archives & Records Admin (NARA)	5200017
7/14/08	ML081920719	Supplement to Notice Of Intent to Prepare an Environmental Statement and Conduct Scoping Process for North Anna Unit 3 COL Application.	Federal Register Notice	NRC/NRO/D SER		5200017
7/17/08	ML082530148	Dominion Responses to Requests for Additional Information (RAIs) for the Environmental Review Regarding the North Anna COL Application.	- No Document Type Applies Letter License-Application for Combined License (COLA)	Dominion Energy, Inc Dominion Generation	NRC/Docu ment Control Desk NRC/NRO	5200017
7/17/08	ML082620236	Responses to the Environmental RAI's for the North Anna COLA Review.	Letter	Dominion Energy, Inc Dominion Generation	NRC/Docu ment Control Desk NRC/NRO	5200017
7/21/08	ML081960235	North Anna Combined License Application - Draft Technical Report for Review of the Evacuation Time Estimate (ETE).	Letter	NRC/NSIR/D PR/DDEP/RI OB	US Dept of Homeland Security US Federal Emergency Mgmt	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
					Agency (FEMA)	
7/25/08	ML081900047	North Anna Power Station Combined License Application Review (Letter to K. Mayne, US FWS-Gloucester).	Letter	NRC/NRO/DSER/EPB2	US Dept of Interior, Fish & Wildlife Service	5200017
7/25/08	ML081890449	Request for Comments Concerning North Anna, Unit 3, Combined License Application Review.	Letter	NRC/NRO/DSER/EPB2	Shawnee Tribe	5200017
8/1/08	ML082190839	North Anna, Unit 3, Transmittal of Response to Request for Supplemental Information regarding the COL Application Environmental Review.	Environmental Monitoring Report Letter	Dominion Virginia Power	NRC/NRO	5200017
8/14/08	ML082330069	North Anna, Unit 3, Combined License Application Plan for Responding to Requests for Additional Information on Emergency Planning Issues.	Letter	Dominion	NRC/NRO	5200017
8/25/08	ML082470307	North Anna COL Application (EP) FEMA 8-22-08, E-Mail And Interim Findings Report.	E-Mail Letter Report, Miscellaneous	NRC/NSIR/DPR/DDEP/LIB	NRC/NSIR/DPR/DDEP/LIB	5200017
8/25/08	ML082380725	2008/08/25-North Anna Power Station, Unit 3, Notifies the Licensing Board and the Parties of its Intent to Participate in This Proceeding as a Party With Respect to Admitted Contention One.	Legal-Correspondence/Miscellaneous	NRC/OGC	NRC/ASLBP	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
9/8/08	ML082520968	2008/09/08-Letter Informing Board of Agreements	Legal-Correspondence/ Miscellaneous	Dominion Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/ ASLBP	5200017
9/19/08	ML082680222	North Anna, Unit 3 - Combined License Application Environmental Report Supplemental Information.	Letter	DominionDominion Energy, IncDominion Generation	NRC/Document Control DeskNRC/ NRO	5200017
9/23/08	ML082730042	North Anna, Unit 3, Combined License Application, Evaluation of R-COLA Responses to NRC Requests for Information (RAIS) for Standard Applicability.	Letter	Dominion Energy, Inc Dominion Generation Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017
10/2/08	ML12082A062	North Anna, Unit 3 - Combined License Application Response to Site Audit - Request for Electronic Files.	Letter	Dominion Dominion Generation	NRC/NRO	5200017
10/10/08	ML082890417	North Anna, Unit 3 - Combined License Application Updated Evaluation of R-COLA Responses to NRC Requests for Information (RAIs) for Standard Applicability.	Letter	Dominion Energy, Inc Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/24/08	ML083080127	North Anna, Unit 3, COL, Response to FEMA Request for Additional Information re: Offsite Emergency Planning Activities.	Letter	Dominion Dominion Energy, Inc Dominion Generation Dominion Virginia Power	NRC/NRO US Dept of Homeland Security US Federal Emergency Mgmt Agency (FEMA)	5200017
11/4/08	ML083220171	Letter From Dominion to Virginia Department of Historic Resources Re: North Anna Power Station Project Update and Archaeological Survey (2008), VDHR File No.: 2000-1210.	Letter	Dominion Dominion Energy, Inc Dominion Generation	NRC/NRO State of VA, Dept of Historic Resources	5200017
11/6/08	ML083190134	Dominion Virginia Power, Notification of Planned Site Activities as Required by North Anna Early Site Permit.	Letter	Dominion Generation Dominion Virginia Power	NRC/NRO NRC/ RGN-II/ORA	5200017
11/18/08	ML083240076	2008/11/18-Intervenor's Request.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environmental Defense League Peoples Alliance for	NRC/ ASLBP	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
				Clean Energy		
11/24/08	ML082830751	Transmittal of Department of Homeland Security Consultation Report.	Letter	NRC/NRO/D NRL/NWE2	Dominion	5200017
12/12/08	ML090090113	North Anna, Unit 3 - Combined License Application - Submissions 2 and 3.	Letter	Dominion	NRC/NRO	5200017
12/12/08	ML083240722	Notice of Availability of the Draft Supplemental Environmental Impact Statement for North Anna Power Station Unit 3 Combined License.	Letter	NRC/NRO/D SER	Dominion	5200017
12/16/08	ML083240753	Letter Re: Notice of Availability to the US EPA of the Draft Supplemental Environmental Impact Statement for the North Anna Power Station, Unit 3 Combined License.	Letter	NRC/NRO/D SER	US Environmental Protection Agency,	5200017
12/16/08	ML083240627	North Anna Power Station, Unit 3 Draft Supplemental Environmental Impact Statement Federal Register Notice.	Federal Register Notice	NRC/NRO/D SER		5200017
12/22/08	ML083440644	Letter To Dominion - Re: Transfer of Early Site Permit ESP-003.	Letter	NRC/NRO/D NRL/NGE1	Dominion	5200017
1/15/09	ML090120457	Correction Comment Period for the Notice of Availability of the Draft SEIS for North Anna Power Station Unit 3 COL Federal Register Notice.	Federal Register Notice	NRC/NRO/D SER		5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/27/09	ML090140252	Notification of Issuance of the Draft Supplemental Environmental Impact Statement for the North Anna Power Station Unit 3, Letter to Ms. Deanna Beacham Virginia Council of Indians.	Letter	NRC/NRO/DSER/RAP1	Virginia Council on Indians	5200017
1/27/09	ML090150214	Request for Comments on the Draft SEIS for North Anna Power Station Unit 3 Combined License Application Review Letter to L Miranda, US FWS-Chesapeake Bay Office.	Letter	NRC/NRO/DSER/RAP1	US Dept of Interior, Fish & Wildlife Service	5200017
1/27/09	ML090150231	Request for Comments on the Draft SEIS for North Anna Power Station Unit 3 Combined License Application Review Letter to R Duncan, VDGIF.	Letter	NRC/NRO/DSER/RAP1	State of VA, Dept of Game & Inland Fisheries	5200017
1/27/09	ML090130279	Request for Comments on the Draft Supplemental Environmental Impact Statement for the North Anna Power Station Unit 3 Combined License Application Review Letter to ACHP, D. Klima.	Letter	NRC/NRO/DSER/RAP1	US Advisory Council On Historic Preservation	5200017
1/27/09	ML090130266	Request for Comments on the Draft Supplemental Environmental Impact Statement for the North Anna Power Station, Unit 3 Combined License Letter to US FWS- Virginia Field Office.	Letter	NRC/NRO/DSER/RAP1	State of VA, Fish and Wildlife Information Service	5200017
1/30/09	ML090140266	Notification of the Issuance of the Draft Supplemental Environmental Impact Statement for the North Anna Power Station Unit 3 Combined License Application Review.	Letter	NRC/NRO/DSER	State of VA, Dept of Historic Resources	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/30/09	ML090140270	Request for comments on the Draft Supplemental Environmental Impact Statement for the North Anna, Unit 3, Combined License.	Letter	NRC/NRO/DSER/RAP1	US Dept of the Army, Corps of Engineers	5200017
2/3/09	ML090360676	02/03/2009-Agenda for Public Meeting to Discuss the Draft Supplemental Environmental Impact Statement for North Anna Power Station, Unit 3 Combined License Application.	Federal Register Notice Meeting Agenda	NRC/NRO		5200017
2/4/09	ML091530468	North Anna, Unit 3 Combined License Application, Response to FEMA Request for Additional Information for Open Items.	E-Mail Letter	Dominion Energy, Inc Dominion Generation Dominion Virginia Power	NRC/NRO US Dept of Homeland Security US Federal Emergency Mgmt Agency (FEMA)	5200017
2/16/09	ML090570705	Dominion Virginia Power North Anna Unit 3 Combined License Application Reviewer's Aid Supporting COLA Revision.	Letter	Dominion Energy, IncDominion Generation	NRC/NRO	5200017
2/18/09	ML090540470	North Anna, Unit 3 - Combined License Application Updated Evaluation of R-COLA Responses to NRC Requests for Information (RAIS) for Standard Applicability.	Letter	Dominion	NRC/NRO	5200017
2/25/09	ML090560395	North Anna Unit 3 COLA Updated Review Schedule.	Letter	NRC/NRO/DNRL/NGE1	Dominion	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
			Schedule and Calendars			
3/11/09	ML093160798	VDEQ Letter DK Paylor to EPA Region 3, Dated March 11, 2009 Identifying Recommendations and Comments on Designations of Areas in Virginia under 2008 8-hour Ozone NAAQS.	Letter	State of VA, Dept of Environmental Quality	NRC/NRO US Environmental Protection Agency (EPA)	5200017
3/19/09	ML090830502	North Anna, Unit 3, Combined License Application, Comments on NUREG-1917, Draft Supplemental Environmental Impact Statement.	Graphics incl Charts and Tables Letter	Dominion	NRC/NRO	5200017
3/30/09	ML091100779	North Anna, Unit 3 Combined License Application, Transmittal of Security Plan, Revision 1.	Letter	Dominion	NRC/NRO	5200017
5/21/09	ML091540526	Submission 4 of the North Anna 3 Combined License Application (COLA).	Letter	Dominion Energy, Inc	NRC/NRO	5200017
6/3/09	ML090970680	Combined License Application Environmental Review Schedule for North Anna, Unit 3.	Letter	NRC/NRO/DSER	Dominion Virginia Power	5200017
6/5/09	ML091530573	Letter re: North Anna Combined License (COL) Application, Safety Evaluation Report (SER) With Open Items, Section 13.3 (Emergency Planning).	Letter	NRC/NSIR/DPR/DDEP	US Federal Emergency Mgmt Agency (FEMA)	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
6/17/09	ML091740714	North Anna, Unit 3 Combined License Application, Submittal of ESBWR Reactor Pressure Vessel Pressure-Temperature Cures Report.	Letter	Dominion	NRC/NRO	5200017
6/25/09	ML091760565	Safety Evaluation Reports with Open Items for Chapters 5, 9, 10, 11, 12, 13, and 16 Regarding the North Anna Combined License Application Review.	Letter	NRC/NRO/ DNRL/NGE1	Dominion Dominion Virginia Power	5200017
6/30/09	ML091750785	Request For Withholding Information From Public Disclosure - North Anna.	Letter Proprietary Information Review	NRC/NRO/ DNRL/NGE1	Dominion	5200017
7/20/09	ML092010218	Letter re. Safety Evaluation Report with Open Items for Chapter 14 Regarding the North Anna Combined License Application Review.	Letter	NRC/NRO/ DNRL/NGE1	Dominion	5200017
7/20/09	ML091520062	Recognition of the Pacific Northwest National Laboratory North Anna Unit 3 Environmental Review Team.	Letter	NRC/NRO/ DSER	Battelle Memorial Institute, Pacific Northwest National Lab	5200017
7/20/09	ML092010539	Safety Evaluation Report with Open Items for Chapter 3 Regarding the North Anna Combined License Application Review.	Letter	NRC/NRO/ DNRL/NGE1	Dominion	5200017
7/21/09	ML092020015	Safety Evaluation Report with Open Items for Chapter 2 Regarding the North Anna Combined License Application Review.	Letter	NRC/NRO/ DNRL	Dominion	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
7/29/09	ML092160526	North Anna, Unit 3, Combined License Application - Submission 5.	Letter	Dominion	NRC/NRO	5200017
9/15/09	ML092640120	North Anna Unit 3 Combined License Application Response to Request for Groundwater Model Input Files.	Letter	Dominion	NRC/NRO	5200017
9/25/09	ML092810030	North Anna Power Station Unit 3, Archaeological and Architectural Surveys (Proposed 500 kV Transmission Line -- Louisa, Spotsylvania, and Caroline Counties, Virginia) VDHR File No.: 2009-0430.	Letter	Dominion Virginia Power	NRC/NRO State of VA, Dept of Historic Resources	5200017
9/29/09	ML093160317	North Anna Power Station Unit 3- North Anna 3 Project Site, Construction Staging Area and North Anna to Ladysmith Transmission Line Corridor.	Letter	State of VA, Dept of Conservation & Recreation	Battelle Memorial Institute, Pacific Northwest National Lab NRC/NRO/ DSER	5200017
10/23/09	ML093030590	G20090625/EDATS: OEDO-2009-0662 - Mario V. Bonaca Ltr. re: NRC Staff's Safety Evaluation Report with Open Items Regarding the North Anna, Unit 3 Combined License Application	Letter	NRC/ACRS	NRC/EDO	5200017
10/29/09	ML093210500	Dominion and VDEQ IFIM Study-Final, November 2009.	Environmental Monitoring Report Letter	Dominion Dominion Resources Services, Inc	NRC/NRO/ DSER State of VA, Dept of Environmental Quality	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
11/4/09	ML093100111	North Anna, Unit 3 - Combined License Application re Cyber Security Plan.	Letter	Dominion Generation	NRC/NRO	5200017
11/9/09	ML110940610	VDHR Letter to Dominion 09 Nov. 2009 Re: Archaeological Report (June 2009) of New Property and Cultural Assessment (June 2009) of Heavy Haul Route.	Letter	State of VA, Dept of Historic Resources	Dominion Resources Services, Inc NRC/NRO	5200017
11/9/09	ML110960582	VDHR Letter to Dominion 09 Nov. 2009 RE: Archaeological Survey Ladysmith 500KV Transmission Line, Louisa, Spotsylvania and Caroline Counties.	Letter	State of VA, Dept of Historic Resources	Dominion Resources Services, Inc NRC/NRO	5200017
11/12/09	ML13323A640	North Anna, Small Whorled Pogonia Survey - NAPS Site - Williamsburg Environmental Group Project #4317B.	Letter	Williamsburg Environmental Group, Inc	AECOM, Inc NRC/NRO	5200017
11/16/09	ML13323A679	Habitat Survey for the Eplings HedgeNettle and Small Whorled Pogonia Blanton's Powerline Conservation Site - Williamsburg Environmental Group Project #4317A.	LetterMap	Williamsburg Environmental Group, Inc	AECOM, IncNRC/NRO	5200017
11/17/09	ML093240090	North Anna, Unit 3, Combined License Application, Request for Exemption from 10 CFR 50.71(e)(3) (iii).	Letter	Dominion Generation	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
11/18/09	ML093060286	G20090625/EDATS: OEDO-2009-0662 - Michael R. Johnson Ltr. re: NRC Staff's Safety Evaluation Report with Open Items Regarding the North Anna, Unit 3 Combined License Application.	Letter	NRC/NRO	NRC/ ACRS	5200017
11/20/09	ML093310297	North Anna, Unit 3, Combined License Application, Request for Extension to Response to Request for Additional Information Letter No. 041 (FSAR Chapters 3 and 5).	Letter	Dominion Generation	NRC/NRO	5200017
12/2/09	ML093240405	Federal Register Notice and Environmental Assessment and Finding of No Significant Impact Regarding Exemption From 50.71(e)(3)(iii) For North Anna Unit 3.	Federal Register Notice	NRC/NRO/D NRL/NGE1		5200017
12/7/09	ML093441405	FEMA, Submittal of Interim Finding Report for Reasonable Assurance for North Anna, Unit 3 COL, Submitted by Radiological Emergency Preparedness Program Staff From FEMA Region III Office.	Letter	US Dept of Homeland Security US Federal Emergency Mgmt Agency (FEMA)	NRC/NSIR /DPR	5200017
12/8/09	ML093370364	Courtesy Letter To Dominion Enclosing The Environmental Assessment and Finding of No Significant Impact Regarding Exemption From 10 CFR 50.71(e)(3)(iii).	Federal Register Notice Letter	NRC/NRO/D NRL/NGE1	Dominion Dominion Virginia Power	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
12/8/09	ML093370364	Courtesy Letter To Dominion Enclosing The Environmental Assessment and Finding of No Significant Impact Regarding Exemption From 10 CFR 50.71(e)(3)(iii).	Federal Register Notice Letter	NRC/NRO/D NRL/NGE1	Dominion Dominion Virginia Power	5200017
12/15/09	ML093491055	12/15/09 Letter to Honorable Thomas R. Carper Responding to his 10/15/09 Letter Regarding the U.S. NRC's Method for Reviewing New Nuclear Reactor Applications.	Letter Congressional Correspondence	NRC/OCA	US SEN, Comm on Environme nt & Public Works	5200017
12/16/09	ML093520624	North Anna, Unit 3 Combined License Application, Environmental Report Supplemental Information.	Environmental Report Letter	Dominion	NRC/NRO	5200017
12/22/09	ML093490864	Request For Withholding Information From Public Disclosure on Letter No. 41 For North Anna.	Letter Proprietary Information Review	NRC/NRO/D NRL/NGE1	Dominion	5200017
12/22/09	ML100350733	VDEQ Response to IFIM Submittal by Dominion, 12/09/09.	Letter	State of VA, Dept of Environment al Quality	Dominion Resources Services, Inc NRC/NRO	5200017
1/11/10	ML093370051	Federal Register Notice - North Anna COLA Exemption Granted From The Requirements of 10 CFR 50.71(e)(3)(iii).	Federal Register Notice	NRC/NRO/D NRL/NGE1	Dominion)	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
3/17/10	ML100260099	Final Supplemental Environmental Impact Statement for the North Anna Power Station, Unit 3 Combined License.	Letter	NRC/NRO/DSER	US Environmental Protection Agency (EPA)	5200017
3/17/10	ML100260529	Letter: Notice of Availability of the Final Supplemental Environmental Impact Statement for North Anna Power Station Unit 3 Combined License.	Letter	NRC/NRO/DSER	Dominion	5200017
3/17/10	ML100770548	Federal Register Notice, North Anna, Final SEIS	Federal Register Notice	NRC/NRO/DSER		5200017
3/17/10	ML100260708	FRN: Notice of Availability Federal Register Notice for Final Supplemental Environmental Impact Statement for the North Anna Power Station, Unit 3 Combined License.	Federal Register Notice	NRC/NRO/DSER		5200017
3/24/10	ML100880059	North Anna, Unit 3 Combined License Application, Letter of Intent to Resubmit Revised Cyber Security Plan.	Letter	Dominion Generation	NRC/NRO	5200017
3/26/10	ML13317C052	Dominion's Joint Permit Application Part 3 for Water Wetlands Permits for NAPS Unit 3, Attachment G Biological Monitoring 2009 Annual Report.	Annual Operating Report Environmental Monitoring Report Letter	Dominion	NRC/NRO/DNRL State of VA, Dept of Environmental Quality	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
3/29/10	ML100900136	North Anna, Unit 3, Combined License Application Quality Assurance Program Description Revision.	Letter Quality Assurance Program	Dominion Generation	NRC/NRO	5200017
4/7/10	ML100880231	North Anna Unit 3, Cyber-Security Plan Review Schedule For North Anna Unit 3 Combined License Application.	Letter	NRC/NRO/DNRL/NGE1	Dominion	5200017
5/18/10	ML101410207	North Anna, Unit 3, Combined License Application - Technology Change.	Letter	Dominion Virginia Power	NRC/NRO	5200017
6/1/10	ML101520734	2010/06/01-NRC Staff Letter to Board.	Legal-Correspondence/Miscellaneous	NRC/OGC	NRC/ASLBP	5200017
6/4/10	ML13323A700	North Anna, Small Whorled Pogonia Survey - NAPS Site - Williamsburg Environmental Group Project #4317B.	Letter	Williamsburg Environmental Group, Inc	AECOM, Inc NRC/NRO	5200017
6/25/10	ML13323A725	Habitat Survey for the Small Whorled Pogonia - Blanton's Powerline Conservation Site - Williamsburg Environmental Group Project#4317A.	LetterMap	Williamsburg Environmental Group, Inc	AECOM, IncNRC/NRO	5200017
6/28/10	ML102040697	Dominion Virginia Power North Anna Unit 3 Combined License Application - Submissions 6 And 7.	Letter	Dominion Energy, Inc Dominion Generation Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
6/28/10	ML102040334	North Anna Unit 3 COLA (Safeguards and Security Plans), Rev. 3 - Security	Letter License-Application for Combined License (COLA)	Dominion Old Dominion Electric Cooperative	NRC/NRO	5200017
6/28/10	ML101810355	North Anna, Unit 3 - Combined License Application Loss of Large Areas of the Plant Due to Explosions or Fire (LOLA) and Cyber Security Plan, Revision 1 (Part 8).	Letter	Dominion	NRC/NRO	5200017
6/28/10	ML101830015	North Anna, Unit 3, Combined License Application, Physical Security Plan, Revision 2 CAS/SAS Report, Revision 2 Supplement to US-APWR High Assurance Report, and Supplement to US-APWR Design Certification Physical Security Element Review (Part 8).	Letter	Dominion Energy, Inc Dominion Generation	NRC/NRO	5200017
7/1/10	ML101820626	2010/07/01-Dominion Letter to ASLB Notifying Judges that Revised COL Application was Submitted on 06/29/2010.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power Pillsbury, Winthrop, Shaw, Pittman, LLP Virginia Electric & Power Co (VEPCO)	NRC/ ASLBP	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
7/1/10	ML101820627	2010/07/01-Dominion Letter to NRC Transmtting Revised COL Application Submissions 6 and 7 for North Anna Unit 3.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017
7/19/10	ML12342A332	Epling's Hedge-nettle Survey - Blanton's Powerline Conservation Site - North Anna 3 - Corps of Engineers Permit No. 10-V1256/NAO-2534.	Letter Environmental Monitoring Report Map	Williamsburg Environmental Group, Inc	AECOM Environment NRC/NRO	5200017
7/26/10	ML102070596	2010/07/26-Request for Revised North Anna 3 COL Application.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environmental Defense League	NRC/ ASLBP	5200017
7/30/10	ML102110205	2010/07/30-Dominions Response to Blue Ridge Environmental Defense League's Letter Dated 07/26/2010 in which BREDL Claims that it did not Discover the Copy of Dominion's Amended COL Application that was Delivered on July 2, 2010 Until July 22, 2010.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/ ASLBP	5200017
8/4/10	ML111570144	Dominion's Joint Permit Application Part 1 for Water/Wetlands Permits for North Anna Unit 3 Vol 1 File 8 - Attachment B - Agency Correspondence.	LetterReport, Technical	EA Engineering, Science, & Technology	Dominion Virginia PowerNRC /NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
8/4/10	ML111570235	Dominion's Joint Permit Application Part 1 for Water/Wetlands Permits for North Anna Unit 3 Vol 2 File 4 - Attachment E1- Jurisdictional Determinations.	Letter Map Report, Technical	EA Engineering, Science, & Technology	Dominion Virginia Power NRC/NRO	5200017
8/4/10	ML111570241	Dominion's Joint Permit Application Part 1 for Water/Wetlands Permits for North Anna Unit 3 Vol 2 File 6 - Attachment E2 - Wetlands Delineation Reports.	Drawing Letter Report, Technical News Article	Dominion Virginia Power	NRC/NRO US Dept of the Army, Corps of Engineers	5200017
8/6/10	ML102180386	2010/08/06-NRC Staff Notification that Revision to North Anna Unit 3 COL Application is Available in the Agencywide Documents Access and Management System.	Legal-Correspondence/ Miscellaneous	NRC/OGC	NRC/ ASLBP	5200017
8/11/10	ML110940602	08/11/10 Letter From RW Kirchen to Dominion Resource Services, Inc Regarding Viewshed Impact Analysis For VDHR #088-0133 and #016-5042 Addendum to Architectural Survey of the Proposed North Anna - Ladysmith 500kV Transmission Line, Louisa, Spotsylvania..	Letter	State of VA, Dept of Historic Resources	Dominion Resources Services, Inc NRC/NRO	5200017
9/9/10	ML102570644	North Anna, Unit 3 - Response to Request for Electronic Files.	Letter	Dominion Dominion Energy, Inc	NRC/Document Control Desk NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
9/9/10	ML110530340	Project No. 6335-VA/NID No. VA83005, North Anna Hydroelectric Plant Increase in Lake Anna Level Associated with Proposed North Anna, Unit 3.	Letter	Dominion Energy, Inc Dominion Generation	NRC/ SECY	5200017
9/16/10	ML102500095	Letter to Dominion Updating the Status of the COL Environmental Review.	Letter	NRC/NRO/ DSER/RAP1	Dominion Resources Services, Inc	5200017
9/30/10	ML102990366	Letter from Dominion - North Anna Power Station Proposed Unit 3: Supplemental Coastal Zone Management Act Federal Consistency Certification.	Letter Report, Miscellaneous	Dominion Dominion Resources Services, Inc	State of VA, Dept of Environmental Quality NRC/NRO	5200017
10/27/10	ML103010277	North Anna, Unit 3, Combined License Application, Results of FSAR Chapter 8 RAI Review.	Letter	Dominion Energy, Inc Dominion Generation Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017
12/10/10	ML103430139	Library letter to Ms. Barbara Davison: Maintenance of Reference Materials at the Salem Church Library for the North Anna Power Station, Unit 3 Combined License Application.	Letter	NRC/NRO/DSER/RAP1	Fredericksburg, VA, Salem Church Library	5200017
12/10/10	ML103430125	Library letter to Ms. Chick-Gravel: Maintenance of Reference Materials at the C. Melvin Snow Memorial Library for the North Anna Power Station, Unit 3 combined License Application	Letter	NRC/NRO/DSER/RAP1	C. Melvin Snow Memorial Library	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
12/10/10	ML103430133	Library letter to Ms. Gail Ott: Maintenance of Reference Materials at the Jefferson-Madison Regional Library for the North Anna Power Station, Unit 3 Combined License Application.	Letter	NRC/NRO/DSER/RAP1	Jefferson-Madison Regional Library	5200017
12/10/10	ML103430130	Library letter to Ms. Katie Hill: Maintenance of Reference Materials at the Orange County Library for the North Anna Power Station, Unit 3 Combined License Application.	Letter	NRC/NRO/DSER/RAP1	Orange County, VA	5200017
12/10/10	ML103430148	Library Letter to Ms. Lisa Morgan: Maintenance of Reference Materials at the Hanover Branch Library for the North Anna Power Station, Unit 3 Combined License Application.	Letter	NRC/NRO/DSER/RAP1	Hanover County, VA	5200017
12/15/10	ML111540456	Dominion's Joint Permit Application Part 1 for Water/Wetlands Permits for North Anna Unit 3 Addendum 3.	Letter	Dominion Resources Services, Inc	NRC/NRO State of VA, Dept of Environmental Quality	5200017
12/16/10	ML103620342	North Anna, Unit 3, Combined License Application - Results of the Review of ESBR R-COLA RAI Responses.	Letter	Dominion Energy, Inc	NRC/NRO	5200017
12/16/10	ML103630544	North Anna, Unit 3, Combined License Application Response to Request for Electronic Files.	Letter	Dominion Energy, Inc	NRC/NRO	5200017
1/6/11	ML110080028	USACE Public Notice for Joint Application for Federal and State Permits Jan 6, 2011 - Dominion Virginia Power.	Letter	US Dept of the Army, Corps of Engineers	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/28/11	ML103160355	Letter to Mr. Eugene S. Grecheck: Notice of Intent to Prepare a Supplemental Environmental Impact Statement and Conduct Scoping Related to the Revision to the Combined License Application for the North Anna Power Station Unit 3.	Letter	NRC/NRO/DSER	Dominion Virginia Power	5200017
1/28/11	ML103160364	Federal Register Notice: North Anna Unit 3 COL Review Notice of Intent to Prepare a SEIS and Conduct Scoping Process.	Federal Register Notice	NRC/NRO/DSER		5200017
1/31/11	ML110530427	VDHR Letter to Dominion Energy, Inc 31 Jan 2011 Viewshed Impact Analysis Ladysmith Corridor.	Letter	State of VA, Dept of Historic Resources	Dominion Energy, Inc NRC/NRO	5200017
2/1/11	ML103490866	Reinitiation of Section 106 Process for North Anna Power Station, Unit 3 Supplemental Environmental Impact Statement.	Letter	NRC/NRO/DSER/RAP1	US Advisory Council On Historic Preservation	5200017
2/1/11	ML110040927	USFW Letter to Cindy Schultz: Request for Scoping Comments on North Anna Power Station Unit 3 Supplemental Environmental Impact Statement.	Letter	NRC/NRO/DSER/RAP1	US Dept of Interior, Fish & Wildlife Service	5200017
2/1/11	ML110030219	VDHR Letter to Mr. Roger Kirchen: Reinitiation of Section 106 Process for North Anna Power Station, Unit 3 Supplemental Environmental Impact Statement.	Letter	NRC/NRO/DSER/RAP1	State of VA, Dept of Historic Resources	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
2/7/11	ML111140002	76 FR 6638 Feb 7, 2011 Notice of Intent to Prepare a Supplemental Environmental Impact Statement and Conduct Scoping.	Federal Register Notice	NRC/NRO		5200017
2/7/11	ML110811255	76FR6638 North Anna Unit 3 Federal Register Notice of Intent to Prepare a Supplemental Environmental Impact Statement and Conduct Scoping Process.	Federal Register Notice	NRC/NRO		5200017
2/7/11	ML110811251	FR North Anna Unit 3 Federal Register Notice of Intent to Prepare a Supplemental Environmental Impact Statement and Conduct Scoping Process.	Federal Register Notice	NRC/NRO		5200017
2/28/11	ML110591118	Notice of Appearance for Marcia Carpentier on Behalf of the U.S. Nuclear Regulatory Commission Regarding North Anna, Unit 3.	Legal-Correspondence/ Miscellaneous	NRC/OGC	NRC/ ASLBP	5200017
3/10/11	ML110800627	2011/03/10 - Submittal of Concerning Environmental and Safety Reviews for North Anna, Unit 3.	Environmental Monitoring Report Letter	Friends of Lake Anna	NRC/NRO	5200017
3/10/11	ML110960721	VDHR Response (10 March 2011) to Scoping Letters for Supplemental Review (Request to Reinitiate Consultation).	Letter	State of VA, Dept of Historic Resources	NRC/ADM/ DAS/ RDEB NRC/NRO	5200017
3/14/11	ML110760408	North Anna, Unit 3 - Combined License Application Response to Request for Electronic Files.	Letter	Dominion Dominion Virginia Power	NRC/NRO	5200017

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3/31/11	ML110940006	North Anna COL Application Confirmation of Payment.	Letter	Dominion Virginia Electric & Power Co (VEPCO)	NRC/NRO NRC/Document Control Desk	5200017
5/12/11	ML11133A334	North Anna, Unit 3, SRP 08.02: Response to RAI Letter 54.	Letter	Dominion	NRC/NRO	5200017
5/16/11	ML111370769	Letter from VA Dept. of Environmental Quality to Dominion RE: Federal Consistency Certification Under CZMA for North Anna Unit 3 for USACE Permit and NRC COL.	Letter	State of VA, Dept of Environmental Quality	Dominion Virginia Power NRC/NRO/DSER/RAP1	5200017
5/23/11	ML111120429	Request for Additional Information Regarding the Environmental Review for the Combined License Application for North Anna Power Station Unit 3.	Letter	NRC/NRO/DSER/RAP1	Dominion Virginia Power	5200017
6/10/11	ML13233A065	06/11/2011 Ltr from R.M. Bisha, Dominion, to C. Cannella, USACE, Subject: NAPS-Joint Permit App Response to Corps request RAI-061011.	LetterOperating Plan	Dominion Resources Services, Inc Power EA Engineering, Science, & Technology	NRC/NRO US Dept of the Army, Corps of Engineers	5200017
6/10/11	ML12268A424	NAPS-Joint Permit App Response to Corps request RAI-061011.	Letter Map	Dominion Resources Services, Inc	NRC/NRO US Dept of the Army, Corps of Engineers	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
6/30/11	ML111310374	NRC Response to Virginia Departments of Environmental Quality Concerning Public Comments Received Related to Federal Consistency Certification (CZMA).	Letter	NRC/NRO/DSER/RAP1	State of VA, Dept of Environmental Quality	5200017
7/7/11	ML112020628	Dominion Virginia Power Letter to Virginia Dept of Historic Resources 07 July 2011 Large Component Transport Route.	Letter	Dominion Energy, Inc Dominion Generation	State of VA, Dept of Historic Resources NRC/NRO	5200017
7/25/11	ML11208B727	North Anna, Unit 3, Combined License Application, Probability of Missile Generation from Low Pressure Turbines for Model L54 (FSAR Chapter 10).	Letter	Dominion Virginia Power	NRC/NRO	5200017
7/29/11	ML112120007	VDHR Letter to Dominion 29 July 2011 Re: Terrestrial and Underwater Archaeological Survey of the Proposed Large Component Transport Route.	Letter	State of VA, Dept of Historic Resources	NRC/NRO	5200017
8/11/11	ML112220475	Final - Request for Additional Information Letter Number 80, RAI Number 5857, Related to Chapter 19 for the North Anna, Unit 3 Combined License Application.	Letter Request for Additional Information (RAI)	NRC/NRO/DNRL/NMIP	Dominion Virginia Power	5200017
9/1/11	ML14175A297	Dominion Virginia Power Letter to Virginia Dept of Historic Resources Regarding Summary of Consultations and Commitments related to North Anna Unit 3.	Letter	Dominion Resources Services, Inc	NRC/NRO State of VA, Dept of Historic Resources	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/17/11	ML11291A178	North Anna, Unit 3, Combined License Application Post ER Audit Follow Up - Cooling Water Use Diagram.	Drawing Letter	Dominion	NRC/NRO	5200017
12/5/11	ML12026A071	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
12/5/11	ML12026A489	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	License-Application for Combined License (COLA) Letter	Dominion	NRC/NRO	5200017
12/5/11	ML12027A017	North Anna, Unit 3, Combined License Application - Submissions 8 and 9.	Letter	Dominion	NRC/NRO	5200017
12/5/11	ML11342A028	North Anna, Unit 3, Combined License Application, Supplement to US-APWR High Assurance Evaluation Assessment and Supplement to US-APWR Design Certification Physical Security Element Review.	Letter	Dominion	NRC/NRO	5200017
12/12/11	ML11348A194	North Anna, Unit 3, Combined License Application 10 CFR 21 Notification of Impact of New Seismic Data on ESP Seismic Analyses.	Letter	Dominion	NRC/NRO	5200017

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12/15/11	ML11361A389	North Anna, Unit 3, Combined License Application Post ER Audit Follow Up - Request for MACCS Run Electronic Files.	Letter	Dominion	NRC/NRO	5200017
1/3/12	ML12005A125	North Anna, Unit 3 - Combined License Application, ESRP 2.7: Response to ER RAI Letter Dated May 23, 2011.	Letter	Dominion	NRC/NRO	5200017
2/13/12	ML12047A294	North Anna 3 Combined License Application Limited Seismic Closure Plan.	Letter	Dominion	NRC/NRO	5200017
2/14/12	ML120400088	Final Safety Analysis Report Section 6.4 Chemical Analysis Audit Plan, February 16, 2012, North Anna Unit 3 FSAR Application.	Audit Report Final Safety Analysis Report (FSAR)	NRC/NRO/D NRL/LB2		5200017
3/8/12	ML12090A199	North Anna, Unit 3, Combined License Application, Submissions 10 and 11.	Legal-Affidavit Letter	Dominion	NRC/NRO	5200017
4/9/12	ML12268A291	North Anna Unit 3 VDEQ Part III Permit Final 10-2001.	Letter	State of VA, Dept of Environment al Quality	Dominion Virginia Power NRC/NRO Virginia Electric & Power Co (VEPCO)	5200017

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5/16/12	ML12125A131	Request For Additional Information Concerning Implementation of Fukushima Near - Term Task Force Recommendations For North Anna 3 COLA.	Letter	NRC/NRO/ DNRL/LB2	Dominion Virginia Power	5200017
5/29/12	ML12151A302	North Anna Unit 3, Combined License Application, Seismic Closure Plan (SCP).	Letter Report, Miscellaneous	Dominion	NRC/NRO	5200017
6/19/12	ML12171A440	Update to Board and Parties on the Schedule for Dominion's Seismic Assessment.	Legal-Correspondence/ Miscellaneous	Dominion Pillsbury, Winthrop, Shaw, Pittman, LLP Dominion Virginia Power Virginia Electric & Power Co (VEPCO)	NRC/ ASLBP	5200017
7/10/12	ML12192A130	Letter to Commission Secretary re: Intervenors Filings in Dockets 52-018, 52-019 and 52-017.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environmental Defense League	NRC/ SECY	5200017
7/13/12	ML12195A000	Letter to the Atomic Safety and Licensing Board Panel regarding Dominion-Virginia Power North Anna Unit 3.	Legal-Correspondence/ Miscellaneous	Blue Ridge Environmental Defense League	NRC/ ASLBP	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
7/20/12	ML12208A008	North Anna, Unit 3, Combined License Application Revisions to FSAR Sections 2.5, 2.5.1 and 2.5.3.	Letter Final Safety Analysis Report (FSAR)	Dominion	NRC/NRO	5200017
8/3/12	ML12341A198	Small Whorled Pogonia Survey - North Anna Unit 3 - Blantons Powerline Conservation Site - Corps of Engineers Permit No. 10-V1256/NAO-2534.	Environmental Monitoring Report Letter Map Photograph	Williamsburg Environmental Group, Inc	Dominion Resources, Inc NRC/NRO	5200017
8/3/12	ML12341A194	Small Whorled Pogonia Survey North Anna Unit 3 - NAPS Site - Corps of Engineers Permit No. 10-V1256/NAAO-2534.	Environmental Monitoring Report Letter Map Photograph	Williamsburg Environmental Group, Inc	Dominion NRC/NRO	5200017
8/13/12	ML12227A679	North Anna, Unit 3 Combined License Application, Supplemental Response to RAI Letter 96, SRP Section 09.02.05 - Ultimate Heat Sink.	Letter	Dominion Energy, Inc Dominion Generation	NRC/Document Processing Center NRC/NRO	5200017
9/26/12	ML12271A286	North Anna Unit 3 Combined License Application (COLA) Impact of Seismic Changes on RAI Responses.	Letter	Dominion	NRC/NRO	5200017

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10/15/12	ML12341A044	Sensitive Joint Vetch Survey Mattaponi River - North Anna Unit 3 - Corps of Engineers Permit No. 10-V1256/NAO-2534.	Letter Report, Miscellaneous Photograph	Vanasse, Hangen, Brustlin, Inc	Dominion Resources Services, Inc EA Engineering, Science, & Technology NRC/NRO	5200017
10/24/12	ML12300A082	North Anna, Unit 3, Combined License Application, Seismic Closure Plan - Deferral.	Letter	Dominion	NRC/NRO	5200017
11/2/12	ML12341A035	Submittal of Threatened and Endangered Species Survey Reports for SAV and SJV - NA3 Project - Corps of Engineers Permit 10-V1256;NAO-2534.	Letter	Dominion Resources Services, Inc	NRC/NRO US Dept of the Army, Corps of Engineers	5200017
11/8/12	ML12318A077	North Anna, Unit 3 - Combined License Application - Proposed S-Cola Changes from Endorsed R-Cola RAI Responses.	Letter	Dominion	NRC/NRO	5200017
2/25/13	ML13058A049	North Anna Unit 3 Combined License Application, ESRP 2.4.1, 3.1: Response to ER RAI Letter.	Letter	Dominion	NRC/NRO	5200017
3/26/13	ML13087A198	North Anna Unit 3 Combined License Application, Seismic Closure Plan Deferral.	Letter	Dominion	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
4/1/13	ML13091A061	Notice of Appearance for L. Sheldon Clark on Behalf of the Nuclear Regulatory Commission in the Matter of North Anna, Unit 3.	Legal-Correspondence/ Miscellaneous	NRC/OGC	NRC/ ASLBP	5200017
4/25/13	ML13120A016	North Anna Unit 3 Combined License Application - Technology Change.	Letter	Dominion)	NRC/NRO	5200017
4/26/13	ML13116A409	Dominion Virginia Power Notification to Board and Parties that the Reactor Design Proposed for North Anna Unit 3 Will Revert to General Electric - Hitachi Nuclear Energy's ESBWR.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power Pillsbury, Winthrop, Shaw, Pittman, LLP Virginia Electric & Power Co (VEPCO)	NRC/ ASLBP	5200017
6/7/13	ML13158A330	Notice of Appearance for Ann N. Hove.	Legal-Correspondence/ Miscellaneous	NRC/OGC	NRC /ASLBP	5200017
6/25/13	ML13175A115	North Anna Power Station, Unit 3, Combined License Application - Review Schedule For Revised Application.	Letter	NRC/NRO/ DNRL	Dominion Virginia Power	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
7/31/13	ML13221A395	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
7/31/13	ML13225A738	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
7/31/13	ML13214A036	North Anna Unit 3 Combined License Application, Submittal of SGI Documents, Including Security Plan, Training & Qualification Plan, Safeguards Contingency Plan & Independent Spent Fuel Storage Installation Security Program, Rev. 4.	Letter	Dominion	NRC/NRO	5200017
7/31/13	ML13221A504	North Anna, Unit 3 - Combined License Application, Submissions 12 and 13.	Letter	Dominion	NRC/NRO	5200017
8/13/13	ML13228A013	North Anna, Unit 3, Combined License Application ESBWR Reactor Pressure Vessel Pressure-Temperature Limits Report.	Letter	Dominion	NRC/NRO	5200017
8/30/13	ML13247A788	Ltr to J.H. Peck, VA State Corporation Commission From: L.S. Booth and R.M. Blue, Dominion Resources Services, Inc. re: Dominion's Integrated Resource Plan and Transmittal Letter - Filed with VA State Corporation Commission on Aug 30, 2013.	Letter	Dominion Resources Services, IncDominion	State of VA, State Corporation Commission NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
8/30/13	ML13247A394	North Anna, Unit 3, Combined Licensed Application, Results of RAI Reviews.	Letter	Dominion	NRC/NRO	5200017
10/17/13	ML13294A123	North Anna Unit 3 Combined License Application Change in Executive Leadership.	Letter	Dominion	NRC/NRO	5200017
10/24/13	ML13301A019	Dominion Virginia Power North Anna Unit 3 Combined License Application Revised RAI Review Results.	Letter	Dominion	NRC/NRO	5200017
11/19/13	ML13294A499	Request for Withholding Information From Public Disclosure for North Anna, Unit 3 Combined License Application.	Letter Proprietary Information Review	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
11/27/13	ML13199A382	Letter - North Anna Unit 3 COL Supplement to the Biological Assessment.	Letter	NRC/NRO/ DNRL/EPB1	State of VA, Fish and Wildlife Information Service	5200017
12/6/13	ML13346A654	North Anna, Unit 3 - Combined License Application ESBWR Reactor Pressure Vessel Pressure-Temperature Limits Report.	Letter	Dominion	NRC/NRO	5200017
12/6/13	ML13346A647	North Anna, Unit 3, Combined License Application ESBWR Steam Turbine - Low Pressure Rotor Missile Generation Probability Analysis.	Letter	Dominion	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
12/18/13	ML14007A424	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
12/18/13	ML14007A645	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
12/18/13	ML13360A132	North Anna, Unit 3 - Combined License Application, December 2013 COLA Submittal: Transmittal of SGI Documents.	Letter	Dominion	NRC/NRO	5200017
12/18/13	ML14013A113	North Anna, Unit 3 Combined License Application Results of RAI Review.	Letter	Dominion	NRC/NRO	5200017
12/18/13	ML14007A541	North Anna, Unit 3, Combined License Application - Submissions 14 and 15.	LetterLicense-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
1/6/14	ML14006A286	Dominion Ltr re: Completion of Seismic Assessment.	Legal-Correspondence/ Miscellaneous	Dominion Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/ ASLBP	5200017

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1/15/14	ML14015A500	Letter from Dominion to ASLB re DVD.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/ ASLBP	5200017
2/3/14	ML14035A438	North Anna, Unit 3 Combined License Application, Change in Executive Leadership Update.	Letter	Dominion	NRC/NRO	5200017
2/6/14	ML14014A186	Request For Withholding Information From Public Disclosure For North Anna Unit 3 Combined License Application.	Letter Proprietary Information Review	NRC/NRO/D NRL/LB3	GE-Hitachi Nuclear Energy Americas, LLC	5200017
2/10/14	ML14043A035	North Anna, Unit 3 Combined License Application COLA Markups for Implementation of DCD Revision 10.	Final Safety Analysis Report (FSAR) Letter License-Application for Combined License (COLA)	Dominion Dominion Resources Services, Inc	NRC/NRO	5200017
2/12/14	ML14037A063	Quality Assurance Program Implementation Inspection of North Anna Nuclear Power Plant Unit 3 COL Application.	Letter	NRC/NRO/ DCIP/CEVB	Dominion Power Co (VEPCO)	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
3/19/14	ML14079A457	VDCR - Comments to the NAPS Unit 3 Supplement to the BA.	Letter	State of VA, Dept of Conservation & Recreation	NRC/NRO/ DNRL/ EPB1	5200017
3/31/14	ML14092A184	Notification of Interim Part 21 Report - Containment Loads Potentially Exceed Limits with High Suppression Pool Water Level in the ABWR Design.	Deficiency Report (per 10CFR50.55e and Part 21) Letter	GE-Hitachi Nuclear Energy Americas, LLC	NRC/NRR	5200017
4/7/14	ML14079A174	North Anna Power Station, Unit 3 Combined License Application - Review Schedule for Revised Application.	Letter	NRC/NRO/ DNRL	Virginia Electric & Power Co (VEPCO)	5200017
4/15/14	ML14101A098	IR 05200017-14-202, 03/24/2014 & 03/27/2014, Dominion Virgina Power.	Inspection Report Letter	NRC/NRO/ DCIP/CQAB	Dominion Virginia Power	5200017
4/17/14	ML14108A345	North Anna, Unit 3 - Combined License Application COLA Markups to Align with Fermi 3 February 2014 COLA Submission and DCD Revision 10 Update.	Letter	Dominion	NRC/NRO	5200017
4/30/14	ML14145A003	NAPS 3 COL Environmental Review - VDGIF Comments on Draft Supplement to the Biological Assessment.	Letter	State of VA, Dept of Game & Inland Fisheries	NRC/NRO/ DNRL/ EPB1	5200017
5/20/14	ML14143A126	North Anna, Unit 3 Combined License Application Markups to FSAR Sections 3.7 and 3.8 and COLA Part 10.	Final Safety Analysis Report (FSAR) Letter	Dominion	NRC/NRO	5200017

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6/24/14	ML14199A360	North Anna Unit 3, Combined License Application - Submissions 16 & 17.	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
7/14/14	ML14170A058	North Anna Power Station Mailing List Confirmation.	Letter	NRC/NRO/ DNRL/EPB2	Virginia Electric & Power Co (VEPCO)	5200017
7/31/14	ML14199A401	North Anna, Unit 3 Combined License Application Submissions 14 And 15 - Selection Of ESBWR Technology & Updated Evacuation Time Estimate (ETE).	Letter	NRC/NSIR/ DPR	US Federal Emergenc y Mgmt Agency (FEMA)	5200017
8/11/14	ML14225A020	North Anna, Unit 3 - Combined License Application Benchmarking of SASSI2010 MSM Results.	Letter	Dominion Dominion Resources, Inc	NRC/Docu ment Control Desk NRC/NRO	5200017
8/19/14	ML14238A018	North Anna, Unit 3 - Combined License Application Groundwater Flow Model Data Files.	Letter	Dominion Generation	NRC/Docu ment Control Desk NRC/NRO	5200017
9/3/14	ML14167A531	Documentation of Completion of the National Historic Preservation Act Section 106 Consultation for the North Anna Power Station, Unit 3 Combined License Review.	Letter	NRC/NRO/ DNRL/EPB2	State of VA, Dept of Historic Resources	5200017

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9/3/14	ML14255A019	North Anna - Confirmation of Payment for COL application.	Letter	Dominion Resources Services, Inc	NRC/NRO	5200017
9/16/14	ML14261A151	North Anna, Unit 3 - Combined License Application COLA Markups To Align With Fermi 3 Cola Changes.	Letter	Dominion Resources, Inc	NRC/NRO	5200017
9/30/14	ML14274A285	North Anna Unit 3, Combined License Application Clarification of RAI Review Results.	Letter	Dominion Power	NRC/NRO	5200017
10/3/14	ML16172A193	North Anna Unit 3 COL - Letter from Virginia Dept. of Historic Resources Regarding Closure of Section 106 Consultations.	Letter	State of VA, Dept of Historic Resources	NRC/NRO/ DNRL/EPB	5200017
10/10/14	ML14283A342	Notice of Withdrawal of Jody C. Martin.	Legal-Correspondence/ Miscellaneous	NRC/OGC	NRC/ ASLBP	5200017
10/17/14	ML14295A192	North Anna, Unit 3 - Combined License Application FSAR Section 2.4 Markup.	Final Safety Analysis Report (FSAR) Letter	Dominion Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017
10/17/14	ML14295A191	North Anna, Unit 3, Combined License Application Supplemental FSAR Markup To RAI 117.	Final Safety Analysis Report (FSAR)Letter	DominionDominion Resources, Inc	NRC/Document Control DeskNRC/ NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/22/14	ML14297A199	North Anna, Unit 3, Revised Combined License Application SEISMIC Closure Plan.	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
12/3/14	ML14338A822	North Anna, Unit 3 - Combined License Application Input Response Spectra, Acceleration Time Histories, and PSD Digital Data Using the EPRI 2013 GMM.	Letter	Dominion	NRC/NRO	5200017
1/22/15	ML14322B042	Letter to Mark Mitchell- Decision Related to a SEIS for Rev 3 of the COLA for NAPS 3.	Letter	NRC/NRO/ DNRL	Dominion Virginia Power	5200017
1/22/15	ML14322B043	FRN Notice of NRC Determination on US-APWR Supplement.	Federal Register Notice	NRC/NRO/ DNRL		5200017
1/23/15	ML15028A185	North Anna, Unit 3 Combined License Application COLA Markups to Align with Fermi 3, October 2014 COLA Submissions.	Letter	Dominion	NRC/NRO	5200017
2/12/15	ML15043A640	Change of Address - Lewis.	Legal-Correspondence/ Miscellaneous	Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/OCM	5200017
2/12/15	ML15043A641	Notice of Appearance - Walsh.	Legal-Correspondence/ Miscellaneous	Dominion Virginia Power Pillsbury, Winthrop, Shaw, Pittman, LLP	NRC/OCM	5200017

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2/23/15	ML15056A047	North Anna, Unit 3 - Combined License Application Submission of Revised Seismic RAI Responses and COLA Markups.	Letter	Dominion	NRC/NRO	5200017
3/30/15	ML15093A050	North Anna, Unit 3 - Combined License Application Transmittal Of Physical Security Plan, Revision 5.	Letter Security Plan	Dominion	NRC/NRO	5200017
4/14/15	ML15105A429	North Anna Unit 3 Combined License Application Transmittal Of Special Nuclear Material Physical Protection Program Description, Revision 1.	Letter	Dominion	NRC/NRO	5200017
5/5/15	ML15132A453	North Anna Unit 3 Combined License Application Semi-Annual Departures Report.	Annual Report Letter	Dominion	NRC/NRO	5200017
5/29/15	ML15177A076	North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
6/3/15	ML15170A175	North Anna, Unit 3 Combined License Application Oscillator Report.	Letter	Dominion	NRC/NRO	5200017
6/30/15	ML15195A302	North Anna, Unit 3 - Submission of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
7/28/15	ML15222A239	North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Letter	Dominion Resources, Inc	NRC/NRO	5200017
7/31/15	ML15222A240	North Anna, Unit 3 - Combined License Application Submission of Revised Seismic RAI Responses and COLA Markups.	Letter	Dominion Resources, Inc	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
8/17/15	ML15238B281	North Anna Unit 3 Combined License Application Revised Seismic Technical Report.	Letter	Dominion Resources, Inc	NRC/NRO	5200017
8/31/15	ML15266A056	Dominion Virginia Power North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Legal-Affidavit Letter License-Application for Combined License (COLA) Report, Technical	Dominion Virginia Power	k NRC/NRO	5200017
9/4/15	ML15253A233	Dominion Virginia Power North Anna Unit 3 Combined License Application Groundwater Monitoring.	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
9/15/15	ML15013A499	Letter - North Anna Power Station, Unit 3, Combined License Application - Review Schedule For Revised Application.	Letter	NRC/NRO/DNRL NRC/NRO/DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
9/23/15	ML15268A039	North Anna, Unit 3 - Request for Exemption From 10 CFR 50.71(e)(3)(iii).	Letter	Dominion	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/21/15	ML15295A388	North Anna, Unit 3 - Combined License Application, Submission Schedule for Seismic Audit-Related Documents.	Letter	Dominion	NRC/NRO	5200017
10/30/15	ML15362A005	North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
11/3/15	ML15310A034	North Anna, Unit 3 - Semi-Annual Departures Report.	Letter	Dominion	NRC/NRO	5200017
11/13/15	ML15322A287	North Anna - COL Application Confirmation of Payment.	Letter	Dominion	NRC/NRO	5200017
11/20/15	ML15296A324	North Anna Power Station, Unit 3, Combined License Application - Exemption from the Requirements of Title 10 of the Code of Federal Regulations Part 50 Section 71(e)(3)(iii).	Letter	NRC/NRO/DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
11/20/15	ML15296A326	North Anna 3 Exemption Issuance FRN.	Federal Register Notice	NRC/NRO/DNRL		5200017
11/30/15	ML15342A127	North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
12/16/15	ML15357A306	North Anna, Unit 3 - Combined License Application Submission of Seismic Technical Reports.	Letter	Dominion Resources, Inc	NRC/NRO	5200017
12/16/15	ML15364A384	North Anna, Unit 3 - Combined License Application, Submission of Revised Seismic RAI Responses and COLA Markups.	Letter	Dominion	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/14/16	ML16022A112	North Anna, Unit 3 - Combined License Application, Submission of Seismic Technical Reports.	Legal-Affidavit Letter	Dominion	NRC/NRO	5200017
2/2/16	ML16042A287	North Anna, Unit 3 - Submission of Seismic Information.	Letter Response to Request for Additional Information (RAI)	Dominion Generation	NRC/NRO	5200017
2/16/16	ML16317A001	Dominion Letter to USACE - 2016 TE Surveys Waiver Request.	Letter	Dominion Resources Services, Inc	US Dept of the Army, Corps of Engineers	5200017
2/16/16	ML16055A123	North Anna, Unit 3 - Combined License Application, Pages From FSAR Sections 2.0 and 2.4.	Final Safety Analysis Report (FSAR) Letter	Dominion	NRC/NRO	5200017
2/25/16	ML16060A262	North Anna, Unit 3 Combined License Application Submission of Seismic Technical Reports.	Letter License-Application for Combined License (COLA) Report, Technical	Dominion	NRC/NRO	5200017
2/29/16	ML16333A405	USACE Letter to Dominion Approving 2016 Survey Waiver.	Letter	US Dept of the Army, Corps of Engineers, Norfolk District	Dominion Virginia Power	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
3/7/16	ML16061A561	Letter - Audit Plan For North Anna, Unit 3, Combined License Application Site Specific Seismic Category I Structures (TAC No. RP7614) - Audit No. 2.	Audit Plan Letter	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
3/11/16	ML16076A268	North Anna, Unit 3 Combined License Application Submittal of Revision to Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
3/18/16	ML16077A204	Letter - U. S. Nuclear Regulatory Commission Plan For North Anna Unit 3, Combined License Application Site Specific Seismic Fuel Audit.	Letter	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
3/28/16	ML16097A196	North Anna, Unit 3 - Combined License Application, Submission of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
4/4/16	ML16082A211	Letter to National Marine Fisheries Service Submitting the Biological Assessment for North Anna Power Station Unit 3.	Letter	NRC/NRO/D NRL/EPB	US Dept of Commerce , National Marine Fisheries Service	5200017
4/20/16	ML16054A813	Letter - Federal Register Notification Of The Availability of the Combined License Application For North Anna Unit 3 In Accordance with 10 CFR 50.43(a)(3) Requirements.	Federal Register Notice Letter	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
4/20/16	ML16064A507	Notice of Availability Of The Combined License Application For North Anna Unit 3 In Accordance With Title 10 Of the Code Of Federal Regulations 10 C.F.R. 50.43.	Letter	NRC/NRO/ DNRL/LB3	State of NC, Utilities Commission	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
4/20/16	ML16064A508	Notification of the Availability of The Combined License Application For North Anna Unit 3 In Accordance With Title 10 of the code of Federal Regulations 10 C.F.R 50.43.	Federal Register Notice Letter	NRC/NRO/ DNRL/LB3	State of VA, State Corporation Commission	5200017
4/20/16	ML16064A506	Notification of the Availability of the Combined License Application For The North Anna, Unit 3, in Accordance with Title 10 Of the Code of Federal Regulations 10. C.F.R. 50.43.	Letter	NRC/NRO/ DNRL/LB3	US Federal Energy Regulatory Commission	5200017
4/20/16	ML16054A813	Letter - Federal Register Notification Of The Availability of the Combined License Application For North Anna Unit 3 In Accordance with 10 CFR 50.43(a)(3) Requirements.	Federal Register Notice Letter	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017
4/20/16	ML16050A150	Memo - Notice of Availability Of Combined License Application [Docket No. 52-017; NRC-2008-0066](1).	Federal Register Notice Memoranda	NRC/NRO/ DNRL/LB3	NRC/ADM/ DAS/ RADB	5200017
4/20/16	ML16064A508	Notification of the Availability of The Combined License Application For North Anna Unit 3 In Accordance With Title 10 of the code of Federal Regulations 10 C.F.R 50.43.	Federal Register Notice Letter	NRC/NRO/ DNRL/LB3	State of VA, State Corporation Commission	5200017
4/21/16	ML16050A154	Notice of Availablity Of Combined License Application [Docket. 052-17; NRC-2008-0066] (1).	Federal Register Notice	NRC/NRO/ DNRL/LB3		5200017
4/27/16	ML16050A149	Memo - Notice of Availability of Combined License Application [Docket No. 52-017; NRC-2008-0066]	Federal Register Notice Memoranda	NRC/NRO/ DNRL/LB3	NRC/ADM/ DAS/RAD B	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
4/27/16	ML16050A153	Notice of Availability Of Combined License Application [Docket No. 52-017; NRC-2008-0066](2).	Federal Register Notice	NRC/NRO/ DNRL/LB3		5200017
5/4/16	ML16050A156	Memo - Notice of Availablity of Combined License Application [Docket No. 52-017; NRC-2008-0066] (3).	Federal Register Notice Memoranda	NRC/NRO/ DNRL/LB3	NRC/ADM/ DAS/ RADB	5200017
5/4/16	ML16050A152	Notice of Availability of Combined License Application [Docket No. 52-017; NRC-2008-0066](3).	Federal Register NoticeMemorand a	NRC/NRO/ DNRL/LB3		5200017
5/9/16	ML16148A048	Dominion Virginia Power North Anna Unit 3 Combined License Application Submission Of Seismic Technical Reports.	Letter	Dominion	NRC/NRO	5200017
5/11/16	ML16050A151	Notice of Availability of Combined License Application [Docket No. 52-017; NRC-2008-0066](4).	Federal Register Notice	NRC/NRO/ DNRL/LB3		5200017
5/18/16	ML16146A789	North Anna, Unit 3 Combined License Application, Submission of Revised Seismic RAI Responses and COLA Markups.	Letter Response to Request for Additional Information (RAI)	Dominion	NRC/NRO	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
5/19/16	ML16146A277	Dominion Virginia Power North Anna, Unit 3 Combined License Application Submission of RAI Response and Technical Reports.	Letter License-Application for Combined License (COLA) Response to Request for Additional Information (RAI)	Dominion	NRC/NRO	5200017
5/19/16	ML16146A169	North Anna - COL Application Confirmation of Payment.	Letter	Virginia Electric & Power Co (VEPCO)	NRC/NRO	5200017
5/25/16	ML16153A387	North Anna, Unit 3 Combined License Application, Submission of Corrected Public Version of Report 003N0526.	Letter	Dominion	NRC/NRO	5200017
6/8/16	ML16155A374	Letter - Request for Withholding Information From Public Disclosure for Dominion Virginia Power NA316014.	Letter Proprietary Information Review	NRC/NRO/ DNRL/LB3	Dominion Virginia Power	5200017
6/14/16	ML16070A066	Letter - North Ann 3, Combined License Application - Advanced Final Safety Evaluation For Chapter 19 "Probabilistic Risk Assessment And Severe Accidents."	Letter	NRC/NRO/ DNRL/LB3	Virginia Electric & Power Co (VEPCO)	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
6/22/16	ML16218A028	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	Letter License-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
6/22/16	ML16207A121	North Anna Unit 3 COLA (Safeguards and Security Plans) - Security	LetterLicense-Application for Combined License (COLA)	Dominion	NRC/NRO	5200017
6/22/16	ML16208A322	North Anna, Unit 3 Combined License Application - Submissions 18 and 19.	Letter	Dominion Virginia Power	NRC/NRO	5200017
6/22/16	ML16179A198	North Anna, Unit 3 Combined License Application, June 2016 COLA Submittal: Transmittal of SGI Documents.	Letter License-Application for Combined License (COLA)	Dominion Virginia Power	NRC/NRO	5200017
7/25/16	ML16211A181	Dominion Virginia Power North Anna Unit 3 Submittal of Bat Survey Report.	Letter	Dominion Virginia Power	NRC/NRO	5200017
8/16/16	ML16215A394	Federal Register Notice Regarding the ACRS ESBWR Subcommittee Meeting, September 23, 2016.	Federal Register Notice	NRC/ACRS		5200017
8/31/16	ML16231A066	Letter - North Anna Power Station, Unit 3, Combined License Application - Review Schedule For Revised Application.	Letter Schedule and Calendars	NRC/NRO/ DNRL	Virginia Electric & Power Co (VEPCO)	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
10/12/16	ML16293A580	Dominion Virginia Power North Anna, Unit 3 Combined License Application Response to RAI ENV-03.	Letter Response to Request for Additional Information (RAI)	Dominion Virginia Power	NRC/NRO	5200017
11/3/16	ML16319A265	National Marine Fisheries Service - Response to NRC Biological Assessment for North Anna Unit 3 COL Review.	Letter	US Dept of Commerce, National Marine Fisheries Service	NRC/NRO/ DNRL/LB3	5200017
11/28/16	ML16333A396	USACE Letter - Federal Lead Agency Designation NRC, November 28, 2016.	Letter	US Dept of the Army, Corps of Engineers, Norfolk District	NRC/NRO/ DNRL/EPB	5200017
12/16/16	ML16355A182	North Anna, Unit 3 Combined License Application Semi-Annual Departures Report.	Letter	Dominion Resources, Inc Dominion Virginia Power	NRC/Document Control Desk NRC/NRO	5200017
12/22/16	ML16340A261	LTR-16-00545-1 - Response To Dennis C. Bley Report On the Safety Aspects of Dominion Virginia Power Combined License Application for North Anna Unit 3	Letter	NRC/EDO	NRC/ ACRS	5200017

Document Date	Accession Number	Title	Document Type	Author Affiliation	Addressee Affiliation	Docket Number
1/12/17	ML17010A192	Letter - Final Safety Evaluation Report For The North Anna Unit 3 Combined License Application	Letter NRO Safety Evaluation Report (SER)-Delayed	NRC/NRO /DNRL NRC/NRO/ DNRL/LB3	Dominion	5200017

Appendix C Electronic Request for Additional Information Database

The following notes pertain to the table on the proceeding pages:

- The request for additional information (RAI) question numbers were assigned based on the section of the Standard Review Plan (SRP) that was associated with the question (e.g., question 02.01.02-1 was generated based on the staff's review of the application against Section 2.1.2 of the SRP).
- The NRC letter number is a unique number that was assigned to the letter that transmitted the RAIs to the applicant.
- The applicant's responses to security-related and sensitive information questions (e.g., physical security) are not publically available

Question Number	NRC Letter No.	System RAI No.	FSER Chapter	RAI Accession Number	RAI Response Date	Response Accession Number
01.05-1	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-1	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-2	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-2	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-3	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-3	102	6529	FSER Chapter 1	ML12177A435	12/18/13	ML14013A113
01.05-4	156	8074	FSER Chapter 1	ML15224B630	9/15/10	ML15288A072
01.05-5	157	8417	FSER Chapter 1	ML16012A520	1/28/16	ML16034A053
01-1	28	1078	FSER Chapter 1	ML082340933	8/8/10	ML082880100
01-2	28	1078	FSER Chapter 1	ML082340933	8/8/10	ML082880100
01-3	34	2225	FSER Chapter 1	ML090840271	6/17/09	ML091700117
01-4	38	2829	FSER Chapter 1	ML091550016	9/25/09	ML092730455
01-5	138	7696	FSER Chapter 1	ML14303A727	12/3/14	ML14338A782
01-6	158	8616	FSER Chapter 1	ML16139A590	6/9/16	ML16168A027
02.01.02-1	17	475	FSER Chapter 2	ML081970390	8/28/08	ML082460847
02.02.03-1	25	477	FSER Chapter 2	ML082250417	10/20/08	ML082980061
02.02.03-10	129	7546	FSER Chapter 2	ML14283A550	2/16/15	ML15051A288
02.02.03-10	129	7546	FSER Chapter 2	ML14283A550	9/3/14	ML14251A060
02.02.03-2	25	477	FSER Chapter 2	ML082250417	12/29/08	ML083660043
02.02.03-3	25	477	FSER Chapter 2	ML082250417	12/29/08	ML083660043
02.02.03-4	25	477	FSER Chapter 2	ML082250417	10/20/08	ML082980061
02.02.03-5	33	2234	FSER Chapter 2	ML090680312	5/27/09	ML091490217
02.02.03-6	33	2235	FSER Chapter 2	ML090680312	5/27/09	ML091490217
02.02.03-7	34	2322	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.02.03-8	50	5210	FSER Chapter 2	ML110110613	12/18/13	ML14013A112

Question Number	NRC Letter No.	System RAI No.	FSER Chapter	RAI Accession Number	RAI Response Date	Response Accession Number
02.02.03-8	50	5210	FSER Chapter 2	ML110110613	1/10/11	ML110110613
02.02.03-9	50	5210	FSER Chapter 2	ML110110613	1/10/11	ML110110613
02.03.01-1	17	464	FSER Chapter 2	ML081970390	8/28/08	ML082460847
02.03.01-2	17	464	FSER Chapter 2	ML081970390	8/28/08	ML082460847
02.03.01-3	17	464	FSER Chapter 2	ML081970390	8/28/08	ML082460847
02.03.01-4	30	1264	FSER Chapter 2	ML082940356	12/3/08	ML083460148
02.03.01-5	49	5182	FSER Chapter 2	ML110140131	1/10/11	ML110140131
02.03.01-6	71	5732	FSER Chapter 2	ML11139A472	6/16/11	ML11172A056
02.03.02-1	2	55	FSER Chapter 2	ML080920571	4/25/08	ML081260212
02.03.02-2	17	465	FSER Chapter 2	ML081970390	8/28/08	ML082460847
02.03.02-3	49	5183	FSER Chapter 2	ML110140131	1/10/11	ML110140131
02.03.04-1	3	56	FSER Chapter 2	ML080930282	5/12/08	ML081350595
02.03.04-2	49	5184	FSER Chapter 2	ML110140131	1/10/11	ML110140131
02.03.05-1	17	609	FSER Chapter 2	ML081970390	10/17/08	ML082980134
02.03.05-2	19	466	FSER Chapter 2	ML082030183	10/17/08	ML082980134
02.03.05-3	19	466	FSER Chapter 2	ML082030183	10/17/08	ML082980134
02.03.05-4	49	5185	FSER Chapter 2	ML110140131	1/10/11	ML110140131
02.03.05-5	133	7660	FSER Chapter 2	ML14283A554	10/17/14	ML14295A659
02.04.02-1	28	1079	FSER Chapter 2	ML082340933	9/16/08	ML082680033
02.04.02-10	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-11	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-12	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-13	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-14	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-15	151	7708	FSER Chapter 2	ML14345B075	1/19/15	ML15022A199
02.04.02-15	151	7708	FSER Chapter 2	ML14345B075	6/12/15	ML15170A101
02.04.02-2	33	2233	FSER Chapter 2	ML090680312	5/27/09	ML091490217
02.04.02-3	33	2233	FSER Chapter 2	ML090680312	5/27/09	ML091490217
02.04.02-4	40	3370	FSER Chapter 2	ML092090567	9/25/09	ML092730453
02.04.02-5	40	3370	FSER Chapter 2	ML092090567	9/25/09	ML092730453
02.04.02-6	40	3370	FSER Chapter 2	ML092090567	9/25/09	ML092730453
02.04.02-7	40	3370	FSER Chapter 2	ML092090567	9/25/09	ML092730453
02.04.02-8	63	5574	FSER Chapter 2	ML110970719	5/3/11	ML11124A154
02.04.02-9	63	5574	FSER Chapter 2	ML110970719	5/3/11	ML11124A155
02.04.12-1	24	877	FSER Chapter 2	ML082210547	9/19/08	ML082730233
02.04.12-1	24	877	FSER Chapter 2	ML082210547	12/18/13	ML14013A112
02.04.12-2	34	2248	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.04.12-2	34	2248	FSER Chapter 2	ML090840271	12/18/13	ML14013A112
02.04.12-3	103	6565	FSER Chapter 2	ML12187A743	10/23/12	ML12307A196

Question Number	NRC Letter No.	System RAI No.	FSER Chapter	RAI Accession Number	RAI Response Date	Response Accession Number
02.04.12-4	148	7710	FSER Chapter 2	ML14325A831	1/8/15	ML15009A237
02.04.13-1	26	882	FSER Chapter 2	ML082320133	10/2/08	ML082810405
02.04.13-2	26	882	FSER Chapter 2	ML082320133	10/2/08	ML082810405
02.04.13-3	26	882	FSER Chapter 2	ML082320133	10/2/08	ML082810405
02.04.13-4	34	2249	FSER Chapter 2	ML090840271	7/29/09	ML092150961
02.05.01-1	116	7477	FSER Chapter 2	ML14112A156	5/21/14	ML14143A239
02.05.01-2	116	7477	FSER Chapter 2	ML14112A156	5/21/14	ML14143A239
02.05.01-3	116	7477	FSER Chapter 2	ML14112A156	6/23/14	ML14177A441
02.05.01-4	116	7477	FSER Chapter 2	ML14112A156	6/10/14	ML14162A436
02.05.01-5	116	7477	FSER Chapter 2	ML14112A156	6/10/14	ML14162A436
02.05.01-5	116	7477	FSER Chapter 2	ML14112A156	6/23/14	ML14177A441
02.05.01-6	116	7477	FSER Chapter 2	ML14112A156	6/23/14	ML14177A441
02.05.01-7	116	7477	FSER Chapter 2	ML14112A156	6/23/14	ML14177A441
02.05.01-8	132	7642	FSER Chapter 2	ML14283A557	9/30/14	ML14274A303
02.05.02-1	53	5198	FSER Chapter 2	ML110270358	3/22/11	ML110880254
02.05.02-2	53	5199	FSER Chapter 2	ML110340012	1/28/11	ML110340012
02.05.02-2	53	5199	FSER Chapter 2	ML110340012	12/18/13	ML14013A112
02.05.02-3	68	5693	FSER Chapter 2	ML11241A058	8/25/11	ML11241A058
02.05.02-3	68	5693	FSER Chapter 2	ML11241A058	2/23/15	ML15062A459
02.05.02-3	68	5693	FSER Chapter 2	ML11241A058	12/18/13	ML14013A112
02.05.02-4	88	6032	FSER Chapter 2	ML11305A261	2/17/12	ML12048A096
02.05.02-5	94	6220	FSER Chapter 2	ML12018A478	2/17/12	ML12048A096
02.05.02-6	115	7472	FSER Chapter 2	ML14098A297	2/27/15	ML15124A005
02.05.02-6	115	7472	FSER Chapter 2	ML14098A297	2/23/15	ML15062A459
02.05.02-6	115	7472	FSER Chapter 2	ML14098A297	5/9/14	ML14140A087
02.05.02-7	115	7473	FSER Chapter 2	ML14098A297	5/9/14	ML14140A087
02.05.02-7	115	7473	FSER Chapter 2	ML14098A297	5/29/14	ML14150A439
02.05.04-1		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-10		293	FSER Chapter 2	ML081710161	8/4/08	ML082200626
02.05.04-11		293	FSER Chapter 2	ML081710161	8/4/08	ML082200626
02.05.04-12	34	2395	FSER Chapter 2	ML090840271	8/20/09	ML092360773
02.05.04-13	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-14	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-15	34	2395	FSER Chapter 2	ML090840271	8/20/09	ML092360773
02.05.04-16	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-17	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-18	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-19	34	2395	FSER Chapter 2	ML090840271	6/17/09	ML091700117
02.05.04-2		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558

Question Number	NRC Letter No.	System RAI No.	FSER Chapter	RAI Accession Number	RAI Response Date	Response Accession Number
02.05.04-20	42	3760	FSER Chapter 2	ML092610350	11/4/09	ML093100109
02.05.04-21	42	3760	FSER Chapter 2	ML092610350	11/4/09	ML093100109
02.05.04-22	59	5386	FSER Chapter 2	ML110680412	4/4/11	ML110950474
02.05.04-23	59	5386	FSER Chapter 2	ML110680412	3/7/11	ML110680412
02.05.04-24	59	5386	FSER Chapter 2	ML110680412	4/4/11	ML110950474
02.05.04-25	82	5941	FSER Chapter 2	ML12013A447	10/20/11	ML11297A046
02.05.04-26	157	8459	FSER Chapter 2	ML16012A520	2/2/16	ML16042A247
02.05.04-3		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-4		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-5		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-6		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-7		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.04-8		233	FSER Chapter 2	ML081690661	1/12/09	ML090140351
02.05.04-9		233	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.05-1	10	235	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.05-2	10	235	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.05-3	10	235	FSER Chapter 2	ML081690661	7/14/08	ML082050558
02.05.05-4	115	7468	FSER Chapter 2	ML14098A297	5/9/14	ML14140A087
03.02.01-1	23	731	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-2	23	730	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-3	23	729	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-3	23	729	FSER Chapter 3	ML082190780	8/30/13	ML13247A394
03.02.01-4	23	728	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-5	23	727	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-6	23	725	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.01-7	41	3572	FSER Chapter 3	ML092360286	12/9/09	ML093490251
03.02.02-1	23	734	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.02-1	23	734	FSER Chapter 3	ML082190780	8/30/13	ML13247A394
03.02.02-2	23	733	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.02.02-3	23	732	FSER Chapter 3	ML082190780	9/17/08	ML082661075
03.03.01-1	51	5138	FSER Chapter 3	ML103560108	2/18/11	ML110550457
03.03.01-1	51	5138	FSER Chapter 3	ML103560108	8/30/13	ML13247A394
03.05.01.04-1	114	7471	FSER Chapter 3	ML14092A573	4/29/14	ML14120A239
03.05.01.04-2	126	7533	FSER Chapter 3	ML14169A655	7/28/14	ML14210A378
03.05.01.04-3	126	7533	FSER Chapter 3	ML14169A655	11/25/14	ML14337A116
03.05.01.05-1	25	608	FSER Chapter 3	ML082250417	9/26/08	ML082750076
03.05.01.06-1	51	5214	FSER Chapter 3	ML110550457	2/18/11	ML110550457
03.05.01.06-1	51	5214	FSER Chapter 3	ML110550457	8/30/13	ML13247A394
03.07.01-1	14	43	FSER Chapter 3	ML081780731	8/12/08	ML082260375

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03.07.01-1	14	43	FSER Chapter 3	ML081780731	12/18/13	ML14013A113
03.07.01-10	121	7520	FSER Chapter 3	ML14156A451	7/18/14	ML14204A459
03.07.01-11	121	7520	FSER Chapter 3	ML14156A451	7/18/14	ML14204A459
03.07.01-11	121	7520	FSER Chapter 3	ML14156A451	8/22/14	ML14239A541
03.07.01-11	121	7520	FSER Chapter 3	ML14156A451	8/22/14	ML14239A541
03.07.01-11	121	7520	FSER Chapter 3	ML14156A451	2/23/15	ML15062A459
03.07.01-11	121	7520	FSER Chapter 3	ML14156A451	7/31/15	ML15222A294
03.07.01-12	121	7520	FSER Chapter 3	ML14156A451	2/23/15	ML15062A459
03.07.01-12	121	7520	FSER Chapter 3	ML14156A451	10/13/14	ML14288A505
03.07.01-12	121	7520	FSER Chapter 3	ML14156A451	7/18/14	ML14204A459
03.07.01-2	37	2454	FSER Chapter 3	ML091480213	12/18/13	ML14013A113
03.07.01-2	37	2545	FSER Chapter 3	ML091480213	12/18/13	ML14013A113
03.07.01-3	64	5544	FSER Chapter 3	ML110970720	12/18/13	ML14013A112
03.07.01-3	64	5544	FSER Chapter 3	ML110970720 ML14013A112	12/18/13	ML14013A112
03.07.01-3	64	5544	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.01-4	64	5544	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.01-5	81	5942	FSER Chapter 3	ML12013A446	5/31/12	ML12157A347
03.07.01-6	81	5942	FSER Chapter 3	ML12013A446	2/08/12	ML12047A293
03.07.01-7	121	7520	FSER Chapter 3	ML14156A451	7/03/14	ML14202A385
03.07.01-7	121	7520	FSER Chapter 3	ML14156A451	2/23/15	ML15062A459
03.07.01-7	121	7520	FSER Chapter 3	ML14156A451	7/31/15	ML15222A294
03.07.01-8	121	7520	FSER Chapter 3	ML14156A451	2/23/15	ML15062A459
03.07.01-8	121	7520	FSER Chapter 3	ML14156A451	7/03/14	ML14202A385
03.07.01-8	121	7520	FSER Chapter 3	ML14156A451	8/22/14	ML14239A541
03.07.01-8	121	7520	FSER Chapter 3	ML14156A451	8/22/14	ML14239A541
03.07.01-9	121	7520	FSER Chapter 3	ML14156A451	7/18/14	ML14204A459
03.07.02-1	14	47	FSER Chapter 3	ML081780731	10/08/08	ML082840763
03.07.02-1	14	47	FSER Chapter 3	ML081780731	12/18/13	ML14013A112
03.07.02-10	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-10	123	7536	FSER Chapter 3	ML14156A460	7/31/15	ML15222A294
03.07.02-11	123	7536	FSER Chapter 3	ML14156A460	8/11/14	ML14225A019
03.07.02-11	123	7536	FSER Chapter 3	ML14156A460	2/23/15	ML15062A459
03.07.02-12	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-13	123	7536	FSER Chapter 3	ML14156A460	7/31/15	ML15222A294
03.07.02-14	123	7536	FSER Chapter 3	ML14156A460	7/31/15	ML15222A294
03.07.02-15	123	7536	FSER Chapter 3	ML14156A460	7/31/15	ML15222A294
03.07.02-15	123	7536	FSER Chapter 3	ML14156A460	7/18/14	ML14204A459
03.07.02-16	123	7536	FSER Chapter 3	ML14156A460	7/31/15	ML15222A294

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03.07.02-17	123	7536	FSER Chapter 3	ML14156A460	5/18/16	ML16146A791
03.07.02-17	123	7536	FSER Chapter 3	ML14156A460	12/16/15	ML15364A384
03.07.02-18	123	7536	FSER Chapter 3	ML14156A460	12/16/15	ML15364A384
03.07.02-19	123	7536	FSER Chapter 3	ML14156A460	12/16/15	ML15364A384
03.07.02-19	123	7536	FSER Chapter 3	ML14156A460	5/18/16	ML16146A791
03.07.02-19	123	7536	FSER Chapter 3	ML14156A460	8/11/14	ML14225A019
03.07.02-2	64	5546	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.02-2	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-20	123	7536	FSER Chapter 3	ML14156A460	12/16/15	ML15364A384
03.07.02-21	123	7536	FSER Chapter 3	ML14156A460	12/16/15	ML15364A384
03.07.02-22	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-23	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-23	123	7536	FSER Chapter 3	ML14156A460	8/11/14	ML14225A019
03.07.02-24	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-25	123	7536	FSER Chapter 3	ML14156A460	7/03/14	ML14202A385
03.07.02-26	154	7810	FSER Chapter 3	ML15055A085	7/31/15	ML15222A294
03.07.02-3	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-3	64	5546	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.02-4	64	5546	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.02-4	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-5	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-5	64	5546	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.02-6	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-6	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-7	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-7	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-8	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-8	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-9	64	5546	FSER Chapter 3	ML110970720	12/18/13	ML14013A113
03.07.02-9	64	5546	FSER Chapter 3	ML110970720	8/22/11	ML11236A130
03.07.03-1	122	7535	FSER Chapter 3	ML14156A456	7/18/14	ML14204A459
03.07.04-1	83	5939	FSER Chapter 3	ML11230B383	10/12/11	ML11287A070
03.07.04-1	83	5939	FSER Chapter 3	ML11230B383	12/18/13	ML14013A113
03.07.04-2	115	7474	FSER Chapter 3	ML14098A297	5/9/14	ML14140A087
03.07.04-2	115	7474	FSER Chapter 3	ML14098A297	5/9/14	ML14140A087
03.07.04-3	134	7654	FSER Chapter 3	ML14288A724	11/19/14	ML14337A117
03.08.04-1	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-1	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-10	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113

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03.08.04-10	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-11	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-11	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-12	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-12	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-13	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-13	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-14	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-14	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-15	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-15	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-16	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-16	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-17	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-17	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-18	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-18	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-19	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-19	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-2	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-2	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-20	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-20	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-21	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-21	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-22	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-22	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-23	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-23	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-24	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-24	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-25	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-25	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-26	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-26	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-27	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-27	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-28	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-28	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113

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03.08.04-29	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-29	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-3	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-3	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-30	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-30	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-31	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-31	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-32	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-32	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-33	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-33	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-34	101	6418	FSER Chapter 3	ML12142A401	12/18/13	ML14013A113
03.08.04-34	101	6418	FSER Chapter 3	ML12142A401	12/18/13	ML14013A113
03.08.04-35	101	6418	FSER Chapter 3	ML12142A401	12/18/13	ML14013A113
03.08.04-35	101	6418	FSER Chapter 3	ML12142A401	12/18/13	ML14013A113
03.08.04-37	124	7537	FSER Chapter 3	ML14156A463	12/16/15	ML15364A384
03.08.04-38	124	7537	FSER Chapter 3	ML14156A463	7/3/14	ML14202A385
03.08.04-4	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-4	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-5	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-5	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-6	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-6	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-7	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-7	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-8	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-8	74	5604	FSER Chapter 3	ML11180A026	8/25/11	ML11241A067
03.08.04-9	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.04-9	74	5604	FSER Chapter 3	ML11180A026	12/18/13	ML14013A113
03.08.05-1	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113
03.08.05-1	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113
03.08.05-2	75	5605	FSER Chapter 3	ML11180A025	8/15/11	ML11229A164
03.08.05-2	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113
03.08.05-3	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113
03.08.05-3	75	5605	FSER Chapter 3	ML11180A025	8/15/11	ML11229A164
03.08.05-4	75	5605	FSER Chapter 3	ML11180A025	8/15/11	ML11229A164
03.08.05-4	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113
03.08.05-5	75	5605	FSER Chapter 3	ML11180A025	12/18/13	ML14013A113

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03.08.05-5	75	5605	FSER Chapter 3	ML11180A025	8/15/11	ML11229A164
03.08.05-6	125	7538	FSER Chapter 3	ML14156A466	7/31/15	ML15222A294
03.08.05-7	125	7538	FSER Chapter 3	ML14156A466	8/11/14	ML14225A019
03.08.05-7	125	7538	FSER Chapter 3	ML14156A466	12/16/15	ML15364A384
03.08.05-7	125	7538	FSER Chapter 3	ML14156A466	5/18/16	ML16146A791
03.09.02-1	26	677	FSER Chapter 3	ML082320133	10/2/08	ML082810405
03.09.02-2	26	681	FSER Chapter 3	ML082140136	10/2/08	ML082810405
03.09.02-3	128	7552	FSER Chapter 3	ML14175A526	8/1/14	ML14217A472
03.09.03-1	19	647	FSER Chapter 3	ML082030183	9/3/08	ML082520378
03.09.03-2	19	647	FSER Chapter 3	ML082030183	9/3/08	ML082520378
03.09.06-1	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-2	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-3	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-4	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-5	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-6	22	747	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.09.06-7	22	747	FSER Chapter 3	ML110880251	3/22/11	ML110880251
03.09.06-7	61	5496	FSER Chapter 3	ML110880251	8/30/11	ML13247A394
03.09.06-8	61	5496	FSER Chapter 3	ML110880251	12/18/13	ML14013A113
03.09.06-8	61	5496	FSER Chapter 3	ML110880251	3/22/11	ML110880251
03.09.06-9	61	5496	FSER Chapter 3	ML110880251	8/30/13	ML13247A394
03.10-1	37	2848	FSER Chapter 3	ML091480213	10/28/09	ML093030298
03.10-1	37	2848	FSER Chapter 3	ML091480213	12/18/13	ML14013A113
03.11-10	62	5547	FSER Chapter 3	ML110821287	8/30/13	ML13247A394
03.11-10	62	5547	FSER Chapter 3	ML110821287	4/13/11	ML11104A060
03.11-2	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-3	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-4	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-5	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-6	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-7	22	748	FSER Chapter 3	ML082140136	9/11/08	ML082730754
03.11-8	44	748	FSER Chapter 3	ML093230304	2/4/10	ML100470588
03.11-9	62	5547	FSER Chapter 3	ML110821287	4/13/11	ML11104A060
03.11-9	62	5547	FSER Chapter 3	ML110821287	8/30/13	ML13247A394
03.12-1	51	5119	FSER Chapter 3	ML103560108	1/10/11	ML110120445
03.12-1	51	5119	FSER Chapter 3	ML103560108	12/18/13	ML14013A113
03.12-2	113	7414	FSER Chapter 3	ML14041A452	3/6/14	ML14070A210
04.02-1	130	7580	FSER Chapter 4	ML14283A563	5/19/16	ML16146A547
04.02-1	130	7580	FSER Chapter 4	ML14283A563	12/16/15	ML15364A384

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05.02.01.01-1	21	479	FSER Chapter 5	ML082110133	9/11/08	ML082610417
05.02.01.02-1	21	480	FSER Chapter 5	ML082110133	9/11/08	ML082610417
05.02.01.02-2	21	480	FSER Chapter 5	ML082110133	9/11/08	ML082610417
05.02.04-1	14	30	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.02.04-2	14	30	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.02.04-3	14	30	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.02.04-4	14	30	FSER Chapter 5	Ml081780731	8/12/08	ML082260375
05.02.04-5	14	30	FSER Chapter 5	Ml081780731	8/12/08	ML082260375
05.02.04-6	14	30	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.02.04-7	14	30	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.02.05-1	12	370	FSER Chapter 5	ML081780731	8/12/08	ML082260375
05.03.01-1	19	654	FSER Chapter 5	ML081750645	8/7/08	ML082240134
05.03.02-1	37	2803	FSER Chapter 5	ML082030183	9/3/08	ML082520378
05.03.02-2	41	3508	FSER Chapter 5	ML091480213	8/24/09	ML092390079
05.03.02-3	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-4	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-5	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-6	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-7	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-8	41	3508	FSER Chapter 5	ML092360286	12/15/09	ML093490251
05.03.02-9	107	6893	FSER Chapter 5	ML13018A171	3/25/13	ML13084A093
05.03.03			FSER Chapter 5	ML082320133	10/2/08	ML082810405
06.02.01-1	6	332	FSER Chapter 6	ML081580132	12/18/08	ML083570596
06.02.04-1	6	220	FSER Chapter 6	ML081580132	7/14/08	ML082050559
06.02.04-2	30	1231	FSER Chapter 6	ML082940356	12/3/08	ML083460148
06.04-1	70	5669	FSER Chapter 6	ML11132A205	6/13/11	ML11172A282
06.04-2	70	5669	FSER Chapter 6	ML11132A205	6/13/11	ML11172A282
06.04-3	70	5669	FSER Chapter 6	ML11132A205	7/18/11	ML11201A331
06.04-4	70	5669	FSER Chapter 6	ML11132A205	6/13/11	ML11172A282
06.04-5	70	5669	FSER Chapter 6	ML11132A205	7/18/11	ML11201A331
06.04-6	87	5953	FSER Chapter 6	ML11286A342	12/12/11	ML11348A193
06.04-7	87	6054	FSER Chapter 6	ML11286A342	12/12/11	ML11348A193
06.04-8	150	7745	FSER Chapter 6	ML14344A107	2/3/15	ML15035A523
08.02-1	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-10	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-11	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-12	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-13	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-14	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400

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08.02-14	9	178	FSER Chapter 8	ML081650433	12/18/13	ML14013A112
08.02-15	9	178	FSER Chapter 8	ML081650433	12/18/13	ML14013A112
08.02-15	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-16	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-17	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-18	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-19	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-2	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-20	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-21	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-22	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-23	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-24	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-25	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-26	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-27	16	664	FSER Chapter 8	ML081910316	11/19/08	ML083260325
08.02-28	16	664	FSER Chapter 8	ML081910316	11/19/08	ML083260325
08.02-29	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-3	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-30	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-31	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-32	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-33	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-34	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-35	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-36	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-37	29	1207	FSER Chapter 8	ML082900201	12/1/08	ML083390401
08.02-38	32	1871	FSER Chapter 8	ML090490579	3/18/09	ML090790310
08.02-39	32	1871	FSER Chapter 8	ML090490579	4/6/09	ML090960537
08.02-4	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-40	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-41	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-42	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-43	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-44	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-45	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-46	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-47	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-48	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095

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08.02-49	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-5	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-50	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-51	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-52	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-53	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-54	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-54	54	5181	FSER Chapter 8	ML110341688	12/18/13	ML14013A112
08.02-55	54	5181	FSER Chapter 8	ML110341688	5/12/11	ML11133A334
08.02-56	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-57	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-58	54	5181	FSER Chapter 8	ML110341688	3/17/11	ML110800095
08.02-59	66	5645	FSER Chapter 8	ML111040640	5/17/11	ML11147A176
08.02-59	66	5645	FSER Chapter 8	ML111040640	12/18/13	ML14013A112
08.02-6	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-60	78	5832	FSER Chapter 8	ML11195A365	10/27/11	ML11304A034
08.02-61	78	5832	FSER Chapter 8	ML11195A365	9/16/11	ML11264A130
08.02-62	78	5832	FSER Chapter 8	ML11195A365	9/16/11	ML11264A130
08.02-63	78	5832	FSER Chapter 8	ML11195A365	9/16/11	ML11264A130
08.02-64	78	5832	FSER Chapter 8	ML11195A365	9/16/11	ML11264A130
08.02-65	78	5832	FSER Chapter 8	ML11195A365	9/16/11	ML11264A130
08.02-7	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-8	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.02-9	9	178	FSER Chapter 8	ML081650433	7/28/08	ML082170400
08.03.02-1	11	179	FSER Chapter 8	ML081710161	8/4/08	ML082200626
08.03.02-2	11	179	FSER Chapter 8	ML081710161	8/4/08	ML082200626
09.01.04-1	13	509	FSER Chapter 9	ML081760334	8/4/08	ML082200545
09.01.04-2	13	509	FSER Chapter 9	ML081760334	8/4/08	ML082200545
09.01.05-1	13	508	FSER Chapter 9	ML081760334	8/4/08	ML082200545
09.01.05-2	13	508	FSER Chapter 9	ML081760334	8/4/08	ML082200545
09.02.01-2		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-3		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-3		363	FSER Chapter 9	ML081970390	12/18/13	ML14013A113
09.02.01-4		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-5		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-6		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-7		363	FSER Chapter 9	ML081970390	8/28/08	ML082460847
09.02.01-8	36	2693	FSER Chapter 9	ML091910257	7/8/09	ML091910257
09.02.01-9	36	2693	FSER Chapter 9	ML091910257	7/8/09	ML091910257

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09.02.02-1	65	5578	FSER Chapter 9	ML111040639	5/6/11	ML11131A029
09.02.02-1	65	5578	FSER Chapter 9	ML111040639	12/18/13	ML14013A113
09.02.04-1	65	5404	FSER Chapter 9	ML111040639	5/6/11	ML11131A029
09.02.04-1	65	5404	FSER Chapter 9	ML111040639	12/18/13	ML14013A113
09.02.04-2	139	7670	FSER Chapter 9	ML14318A552	1/8/15	ML15009A235
09.02.05-1	11	360	FSER Chapter 9	ML081710161	8/4/08	ML082200626
09.02.05-10	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-10	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-10	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-11	99	6402	FSER Chapter 9	ML12129A573	8/25/12	ML12354A360
09.02.05-11	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-11	99	6402	FSER Chapter 9	ML12129A573	12/19/12	ML12354A360
09.02.05-12	99	6402	FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.02.05-12	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-13	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-13	99	6402	FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.02.05-14	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-14	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-2	96	6198	FSER Chapter 9	ML12059A630	12/18/13	ML14013A113
09.02.05-2	96	6198	FSER Chapter 9	ML12059A630	4/13/12	ML12108A017
09.02.05-2	96	6198	FSER Chapter 9	ML12059A630	8/14/12	ML12227A679
09.02.05-3	99	6402	FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-3	99	6402	FSER Chapter 9	ML12129A573	2/15/13	ML13046A093
09.02.05-4	99		FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.02.05-4	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-5	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-5	99		FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.02.05-6	99		FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.02.05-6	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-7	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-7	99		FSER Chapter 9	ML12129A573	12/19/12	Ml12354A360
09.02.05-8	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-9	99		FSER Chapter 9	ML12129A573	12/18/13	ML14013A113
09.02.05-9	99		FSER Chapter 9	ML12129A573	8/30/12	ML122480120
09.03.02-1	7		FSER Chapter 9	ML081640399	7/23/08	ML082140231
09.03.04-1	65		FSER Chapter 9	ML111040639	6/9/11	ML11165A035
09.03.04-1	65		FSER Chapter 9	ML111040639	12/18/13	ML14013A113
09.04.05-1	72		FSER Chapter 9	ML11180A028	7/7/11	ML11192A041
09.04.05-8	100	6262	FSER Chapter 9	ML12129A574	1/7/13	ML13008A672

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09.05.01-1	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-1	8	199	FSER Chapter 9	ML081630351	12/18/13	ML14013A113
09.05.01-10	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-11	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-12	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-13	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-14	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-15	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-16	20	781	FSER Chapter 9	ML082100346	9/4/08	ML082530448
09.05.01-17	20	781	FSER Chapter 9	ML082100346	9/4/08	ML082530448
09.05.01-18	20	781	FSER Chapter 9	ML082100346	9/4/08	ML082530448
09.05.01-19	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-19	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-2	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-20	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-20	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-21	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-22	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-22	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-23	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-23	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-23	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-24	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-24	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-25	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-25	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-26	58	5342	FSER Chapter 9	ML110400769	3/7/11	ML110680411
09.05.01-26	58	5342	FSER Chapter 9	ML110400769	12/18/13	ML14013A113
09.05.01-3	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-4	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.01-5	8	199	FSER Chapter 9	ML081630351	7/23/08	ML082140230
09.05.04-8	36	2468	FSER Chapter 9	ML091260337	8/3/09	ML092180975
10.02.03-1	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-2	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-3	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-4	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-5	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-6	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.02.03-7	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935

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10.02.03-8	73	5811	FSER Chapter 10	ML11180A027	7/25/11	ML11208B935
10.03.06-1	6	119	FSER Chapter 10	ML081580132	7/14/08	ML082050559
10.03.06-2	6	119	FSER Chapter 10	ML081580132	7/14/08	ML082050559
10.04.05-1	12	361	FSER Chapter 10	ML081750645	8/7/08	ML082240134
10.04.05-2	12	362	FSER Chapter 10	ML081750645	8/7/08	ML082240134
11.02-1	4	124	FSER Chapter 11	ML081410065	6/30/08	ML081900515
11.02-2	7	143	FSER Chapter 11	ML081640399	7/23/08	ML082140231
11.02-3	67	5447	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.02-4	67	5447	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.02-5	67	5447	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.02-6	67	5447	FSER Chapter 11	ML11123A286	8/16/11	ML11229A809
11.02-7	67	5447	FSER Chapter 11	ML11123A286	8/16/11	ML11229A809
11.02-8	144	7689	FSER Chapter 11	ML14318A620	1/8/15	ML15009A235
11.02-9	145	7697	FSER Chapter 11	ML14318A702	1/8/15	ML15009A235
11.02-9	145	7697	FSER Chapter 11	ML14318A702	7/28/15	ML15212A763
11.03-1	7	312	FSER Chapter 11	ML081640399	7/23/08	ML082140231
11.03-2	30	1011	FSER Chapter 11	ML082940356	12/3/08	ML083460148
11.03-3	67	5448	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.03-4	67	5448	FSER Chapter 11	ML11123A286	8/16/11	ML11229A809
11.03-5	67	5448	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.04-1	4	125	FSER Chapter 11	ML081410065	6/30/08	ML081900515
11.04-10	77	5639	FSER Chapter 11	ML11145A130	7/18/11	ML11201A332
11.04-11	86	5913	FSER Chapter 11	ML11277A242	11/7/11	ML11314A046
11.04-12	149	7701	FSER Chapter 11	ML14344A105	1/20/15	ML15022A198
11.04-2	7	145	FSER Chapter 11	ML081640399	7/23/08	ML082140231
11.04-3	20	341	FSER Chapter 11	ML082100346	5/21/09	ML091540526
11.04-4	32	2120	FSER Chapter 11	ML090490579	3/18/09	ML090790310
11.04-5	67	5449	FSER Chapter 11	ML11123A286	6/9/11	ML11167A149
11.04-6	76	5461	FSER Chapter 11	ML11180A024	7/18/11	ML11201A330
11.04-7	76	5461	FSER Chapter 11	ML11180A024	7/18/11	ML11201A330
11.04-8	76	5461	FSER Chapter 11	ML11180A024	7/18/11	ML11201A330
11.04-9	77	5639	FSER Chapter 11	ML11145A130	7/18/11	ML11201A332
11.05-1		127	FSER Chapter 11	ML081410065	6/30/08	ML081900515
11.05-2	4	142	FSER Chapter 11	ML081410065	6/30/08	ML081900515
11.05-3	7	314	FSER Chapter 11	ML081640399	7/23/08	ML082140231
11.05-4	26	763	FSER Chapter 11	ML082320133	10/2/08	ML082810405
11.05-5	32	2121	FSER Chapter 11	ML090490579	3/18/09	ML090790310
12.01-3	27		FSER Chapter 12	ML082340072	10/3/08	ML082810344
12.02-1	1		FSER Chapter 12	ML080790715	4/27/08	ML081220710

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12.02-10	25		FSER Chapter 12	ML082250417	10/17/08	ML082980134
12.02-11	30		FSER Chapter 12	ML082940356	12/3/08	ML083460148
12.02-12	30		FSER Chapter 12	ML082940356	12/3/08	ML083460148
12.02-13	33		FSER Chapter 12	ML090680312	5/27/09	ML091490217
12.02-14	90	5784	FSER Chapter 12	ML11314A264	12/14/11	ML11354A127
12.02-15	90	5784	FSER Chapter 12	ML11314A264	12/14/11	ML11354A127
12.02-16	90	5980	FSER Chapter 12	ML11314A264	12/14/11	ML11354A127
12.02-18	131	7557	FSER Chapter 12	ML14283A559	8/26/14	ML14241A467
12.02-19	131	7556	FSER Chapter 12	ML14283A559	8/26/14	ML14241A467
12.02-2	11	196	FSER Chapter 12	ML081710161	8/4/08	ML082200626
12.02-20	135	7676	FSER Chapter 12	ML14302A007	12/3/14	ML14338A782
12.02-20	135	7676	FSER Chapter 12	ML14302A007	8/31/15	ML15245A229
12.02-21	146	7703	FSER Chapter 12	ML14318A677	1/8/15	ML15009A235
12.02-21	146	7703	FSER Chapter 12	ML14318A677	8/17/15	ML15230A619
12.02-22	147	7704	FSER Chapter 12	ML14318A652	8/17/15	ML15230A619
12.02-22	147	7704	FSER Chapter 12	ML14318A652	1/8/15	ML15009A235
12.02-3	16	413	FSER Chapter 12	ML081910316	8/21/08	ML082390834
12.02-4	24	859	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.02-5	24	859	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.02-6	24	859	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.02-7	24	859	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.02-8	24	859	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.02-9	24	860	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.03-12.04-1		861	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.03-12.04-10		1658	FSER Chapter 12	ML090120830	2/10/09	ML090430159
12.03-12.04-11		1658	FSER Chapter 12	ML090120830	2/10/09	ML090430159
12.03-12.04-12		2692	FSER Chapter 12	ML091480213	8/24/09	ML092390079
12.03-12.04-13		4008	FSER Chapter 12	ML093230304	2/4/10	ML100470588
12.03-12.04-14		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-15		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-16		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-17		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-18		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-19		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-2		861	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.03-12.04-20		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-21		5977	FSER Chapter 12	ML11318A315	4/10/12	ML12103A102
12.03-12.04-22		5786	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-23		5786	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264

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12.03-12.04-24		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-25		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-26		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-27		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-28		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-29		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-3		861	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.03-12.04-30		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-31		5972	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-32		5976	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-33		5976	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-34		5976	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-35		5976	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-36		5979	FSER Chapter 12	ML11318A329	1/23/12	ML12025A264
12.03-12.04-4		861	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.03-12.04-5		870	FSER Chapter 12	ML082340072	10/3/08	ML082810344
12.03-12.04-6		870	FSER Chapter 12	ML082340072	10/3/08	ML082810344
12.03-12.04-7		870	FSER Chapter 12	ML082340072	10/3/08	ML082810344
12.03-12.04-8		884	FSER Chapter 12	ML082340072	10/3/08	ML082810344
12.03-12.04-9		1355	FSER Chapter 12	ML082940356	12/3/08	ML083460148
12.03-51	136	7682	FSER Chapter 12	ML14329B372	1/8/15	ML15009A236
12.03-52	136	7682	FSER Chapter 12	ML14329B372	1/23/15	ML15028A184
12.03-53	136	7682	FSER Chapter 12	ML14329B372	1/23/15	ML15028A184
12.03-54	136	7682	FSER Chapter 12	ML14329B372	1/8/15	ML15009A236
12.03-55	140	7677	FSER Chapter 12	ML14318A573	6/30/15	ML15187A050
12.03-55	140	7677	FSER Chapter 12	ML14318A573	1/8/15	ML15009A235
12.03-56	141	7679	FSER Chapter 12	ML14318A575	1/18/15	ML15009A235
12.03-57	142	7680	FSER Chapter 12	ML14318A596	1/8/15	ML15009A235
12.03-58	136	7682	FSER Chapter 12	ML14329B372	1/8/15	ML15009A236
12.05-1	24	874	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.05-2	24	874	FSER Chapter 12	ML082210547	9/19/08	ML082730233
12.05-3	24	874	FSER Chapter 12	ML082210547	9/19/08	ML082730233
13.01.01-1	21	686	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.01-2	21	685	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.01-3	21	684	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.01-4	21	683	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.01-5	21	682	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.01-6	21	673	FSER Chapter 13	ML082110133	9/11/08	ML082610417
02-13.01.03-1	11	200	FSER Chapter 13	ML081710161	9/11/08	ML082610417

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13.01.02-13.01.03-2	21	699	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.02-13.01.03-3	21	687	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.02-13.01.03-4	21	678	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.01.02-13.01.03-5	32	2026	FSER Chapter 13	ML090490579	3/18/09	ML090790310
13.01.02-13.01.03-6	32	2027	FSER Chapter 13	ML090490579	3/18/09	ML090790310
13.02.01-1	21	657	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.02.02-1	21	708	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.03-2	18	438	FSER Chapter 13	ML082000593	10/6/08	ML082830168
13.03-3	31	1816	FSER Chapter 13	ML090120830	2/10/09	ML092730454
13.03-4	31	2400	FSER Chapter 13	ML091260337	8/3/09	ML092180975
13.03-5	36	2400	FSER Chapter 13	ML091260337	8/3/09	ML092180975
13.03-6	36	2400	FSER Chapter 13	ML091260337	8/3/09	ML092180975
13.03-7	36	2400	FSER Chapter 13	ML091260337	3/8/09	ML092180975
13.03-8	36	2400	FSER Chapter 13	ML091260337	8/3/09	ML092180975
13.03-9	118	7483	FSER Chapter 13	ML14125A460	5/19/14	ML14141A016
13.04-1	84	5906	FSER Chapter 13	ML11230B384	10/12/11	ML11287A069
13.04-2	84	5906	FSER Chapter 13	ML11230B384	10/12/11	ML11287A069
13.04-3	137	7683	FSER Chapter 13	ML14303A726	12/3/14	ML14338A782
13.05.02.01-1		284	FSER Chapter 13	ML081640399	7/23/08	ML082140231
13.05.02.01-2		697	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.05.02.01-3		697	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.05.02.01-4		697	FSER Chapter 13	ML082110133	9/11/08	ML082610417
13.06.01-1		3249	FSER Chapter 13	ML091900067	8/17/09	ML092380164
13.06.01-10	39	3243	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-11	39	3243	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-12	39	3243	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-13	39	3240	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-14	39	3240	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-15	39	3240	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-16	39	3240	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-17	39	3239	FSER Chapter 13	ML091900067	8/24/09	ML092380164
13.06.01-18	39	3239	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-19	39	3239	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-2	39	3246	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-20	39	3204	FSER Chapter 13	ML091900067	8/24/09	ML092380164
13.06.01-21	39	3205	FSER Chapter 13	ML091900067	8/24/09	ML092380164

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13.06.01-22	39	3205	FSER Chapter 13	ML091900067	8/24/09	ML092380164
13.06.01-23	39	3242	FSER Chapter 13	ML091900067	8/24/09	ML092380161
13.06.01-24	39	3241	FSER Chapter 13	ML091900067	8/24/09	ML092380596
13.06.01-25	39	3241	FSER Chapter 13	ML091900067	8/24/09	ML092380164
13.06.01-26	39	3241	FSER Chapter 13	ML091900067	8/24/09	ML092380164
13.06.01-27	39	3235	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-28	39	3235	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-29	39	3235	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-3	39	3247	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-30	39	3235	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-30	39	3235	FSER Chapter 13	ML091900067	12/18/13	ML14013A112
13.06.01-31	39	3793	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-32	43	3766	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-33	43	3766	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-34	43	3766	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-35	43	3771	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-35	43	3771	FSER Chapter 13	ML092730215	10/8/14	ML14287A288
13.06.01-36	43	3770	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-37	43	3770	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-38	43	3769	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-39	43	3769	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-4	43	3247	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-40	39	3769	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-41	43	3769	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-42	43	3765	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-43	43	3765	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-44	43	3768	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-45	43	3768	FSER Chapter 13	ML092730215	11/19/09	ML093270043
13.06.01-46	43	4461	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-47	45	4461	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-48	45	4461	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-49	45	4520	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-5	45	3245	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-50	39	4520	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-51	45	4520	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-52	45	4575	FSER Chapter 13	ML101020051	6/10/10	ML101650530
13.06.01-53	45	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-54	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-54	89	6008	FSER Chapter 13	ML11313A108	8/30/12	ML12257A285

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13.06.01-55	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-56	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-57	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-58	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11356A074
13.06.01-59	89	6008	FSER Chapter 13	ML11313A108	12/16/11	ML11354A126
13.06.01-6	89	3245	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06.01-60	39	6282	FSER Chapter 13	ML12047A410	4/17/12	ML12114A294
13.06.01-61	95	6282	FSER Chapter 13	ML12047A410	4/17/12	ML12114A294
13.06.01-62	95	6282	FSER Chapter 13	ML12047A410	4/17/12	ML12114A294
13.06.01-63	95	7309	FSER Chapter 13	ML14126A406	5/29/14	ML14155A421
13.06.01-64	119	7309	FSER Chapter 13	ML14126A406	5/29/14	ML14155A338
13.06-1	119	3248	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06-10	39	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-11	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-12	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-13	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-13	55	5232	FSER Chapter 13	ML110390706	8/30/12	ML12257A285
13.06-14	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-15	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-16	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-16	55	5232	FSER Chapter 13	ML110390706	8/30/12	ML12257A285
13.06-17	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-18	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-19	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-2	55	3248	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06-20	39	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-21	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-22	55	5232	FSER Chapter 13	ML110390706	8/3/11	ML11221A338
13.06-23	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-24	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-25	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-26	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-27	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-28	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-29	55	5232	FSER Chapter 13	ML110390706	3/22/11	ML110880252
13.06-3	55	3248	FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06-30	39	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-30	55	5232	FSER Chapter 13	ML110390706	12/18/13	ML14013A114
13.06-31	55	5232	FSER Chapter 13	ML110390706	5/26/11	ML11151A197

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13.06-32	55		FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.06-32	55		FSER Chapter 13	ML110390706	12/18/13	ML14013A112
13.06-33	55		FSER Chapter 13	ML110390706	8/3/11	ML11221A338
13.06-4	55		FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06-5	39		FSER Chapter 13	ML091900067	8/17/09	ML092310489
13.06-6	39		FSER Chapter 13	Ml092090567	9/29/09	ML092730453
13.06-7	40		FSER Chapter 13	Ml092090567	9/29/09	ML092730453
13.06-8	40		FSER Chapter 13	Ml092090567	9/29/09	ML092730453
13.06-9	40		FSER Chapter 13	ML110390706	5/26/11	ML11151A197
13.07-1	55		FSER Chapter 13	ML103560107	1/18/11	ML110270303
13.07-2	52		FSER Chapter 13	ML103560107	1/18/11	ML110270303
14.02-1	52		FSER Chapter 14	ML081580132	7/14/08	ML082050559
14.02-10	20		FSER Chapter 14	ML090120830	2/10/09	ML090430159
14.02-11	31		FSER Chapter 14	ML110110032	1/6/11	ML110110032
14.02-12	48		FSER Chapter 14	ML110110032	1/6/11	ML110110032
14.03.10-1	48	441	FSER Chapter 14	ML082000593	10/6/08	ML082830168
16-1	18	1451	FSER Chapter 16	ML082900201	12/1/08	ML083390401
16-1	29	1451	FSER Chapter 16	ML082900201	7/31/14	ML13221A221
17.04-1	29	184	FSER Chapter 17	ML081560048	7/14/08	ML082140803
17.06-1		183	FSER Chapter 17	ML081560048	7/14/08	ML082140803
17.5-1		333	FSER Chapter 17	ML081760334	8/4/08	ML082200545
17.5-10	57	5230	FSER Chapter 17	ML110630198	3/1/11	ML110630198
19.02-1	127	7547	FSER Chapter 19	ML14175A522	12/16/15	ML15364A384
19.03-1	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-10	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-11	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-12	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-13	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-14	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-15	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-16	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-17	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-18	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-19	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-2	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-20	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-21	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-22	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-23	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236

Question Number	NRC Letter No.	System RAI No.	FSER Chapter	RAI Accession Number	RAI Response Date	Response Accession Number
19.03-24	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-25	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-26	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-27	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-28	80	5857	FSER Chapter 19	ML112220475	9/8/11	ML112550031
19.03-3	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-4	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-5	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-6	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-7	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-8	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19.03-9	56	5283	FSER Chapter 19	ML110200458	3/14/11	ML110760236
19-1	5		FSER Chapter 19	ML081560048	7/14/08	ML082140803
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

November 15, 2016

The Honorable Stephen G. Burns
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REPORT ON THE SAFETY ASPECTS OF DOMINION VIRGINIA POWER COMBINED LICENSE APPLICATION FOR NORTH ANNA UNIT 3

Dear Chairman Burns:

During the 638th meeting of the Advisory Committee on Reactor Safeguards (ACRS), November 3-5, 2016, we reviewed the NRC staff's advanced final safety evaluation report (SER) for the Dominion Virginia Power (Dominion or the applicant) combined license application (COLA) for North Anna Unit 3. Dominion proposes to construct and operate an Economic Simplified Boiling Water Reactor (ESBWR) on the site of their two operating nuclear units, North Anna Units 1 and 2. In October 2010, we completed our safety review of the General Electric-Hitachi (GEH) application for certification of its ESBWR passive nuclear power plant design and concurred with the staff's recommendation to certify that design. In April 2014, we found the revised analysis procedure for the structural and functional integrity of the ESBWR steam dryer to be acceptable.

Our ESBWR Subcommittee held an informational briefing on September 22, 2016, and a subcommittee meeting on October 20, 2016, to review the North Anna Unit 3 COLA and the staff's advanced final SER. During our meetings, we met with representatives of the staff, Dominion and its vendors, and the public. We also had the benefit of the documents referenced. This letter fulfills the requirement of 10 CFR 52.87 that the ACRS report on those portions of the application that concern safety.

CONCLUSIONS AND RECOMMENDATION

1 There is reasonable assurance that North Anna Unit 3 can be built and operated without undue risk to the health and safety of the public. The COLA for North Anna Unit 3 should be approved.

2 Site-specific departures and exemptions from the ESBWR design control document (DCD), including those in the areas of seismic design and analysis, electrical power distribution system, liquid effluent discharge, and design for hurricane wind generated missiles, are acceptable and should be approved.

3. There is reasonable assurance that the ESBWR design and the North Anna Unit 3 site satisfy the requirements resulting from the Fukushima Near-Term Task Force recommendations.

BACKGROUND

On November 26, 2007, Dominion submitted an application to the NRC for a combined license (COL) to construct and operate a GEH ESBWR at the North Anna site pursuant to 10 CFR Part 52, “Licenses, Certification, and Approvals for Nuclear Power Plants.” The application incorporated, by reference, the ESBWR DCD and an early site permit (ESP) for the North Anna site which was issued based on a site safety analysis report.

The ESBWR nuclear reactor design is a 4,500 megawatt thermal reactor that uses natural circulation flow within the vessel under normal operation and has passive safety features. This reactor is identified as North Anna Unit 3 and will be located on Dominion’s existing North Anna site in Louisa County, Virginia, approximately 40 miles north northwest of Richmond, Virginia. There are two existing Westinghouse pressurized water reactors, North Anna Units 1 and 2, in operation at the site, as well as an independent spent fuel storage installation. North Anna Unit 3 will be located adjacent to and generally west of the existing units.

In June 2010, Dominion revised its application to instead reference the United States Advanced Pressurized Water Reactor technology for North Anna Unit 3, but then reverted to the ESBWR reactor technology in April 2013.

On June 24, 2014, Dominion submitted a revised application that followed the design centered review approach (DCRA), based on the DTE Electric Company Fermi 3 COLA, which referenced the codified version of the ESBWR design certification rule contained in 10 CFR Part 52, Appendix E, “Design Certification Rule for the ESBWR Design.” The DCRA allows the staff to perform one technical review and reach a decision for a reference COLA (RCOLA) addressing issues outside the scope of the design certification, and to use that review and decision to support subsequent COLAs. The first COLA submitted for NRC staff review for a certified design is designated as the RCOLA, and subsequent applications are designated as subsequent COLAs (SCOLAs).

The final SER for the Fermi 3 COLA documents the staff’s review of both standard and site-specific information and is the first complete SER for a COLA in the ESBWR design center. To ensure that the staff’s findings on standard content documented in the final SER for the Fermi 3 COLA are equally applicable to the North Anna Unit 3 COLA, the staff undertook the following reviews:

- The staff compared the North Anna Unit 3 COL final safety analysis report (FSAR), Revision 8, to the Fermi 3 COL FSAR, Revision 8. In performing this comparison, the staff considered changes to the Fermi 3 COL FSAR (and other parts of the COLA, as applicable) resulting from requests for additional information (RAIs) and open and confirmatory items identified in the Fermi 3 SER with open items.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation (the Fermi 3 final SER) were acceptable for North Anna Unit 3.

- The staff verified that the site-specific differences between Fermi 3 and North Anna Unit 3 sites are adequately addressed.

DISCUSSION

Site Characteristics

Site characteristics include potential hazards in proximity of the plant, as well as meteorology, hydrology, geology, seismology, and geotechnical parameters. An applicant must identify these characteristics and demonstrate that they, along with site-related design parameters specified in the ESP, are bounded by the site parameters for the certified design, or justify departures or exemptions where applicable. The staff reviewed the North Anna Unit 3 COLA, the referenced ESBWR DCD, and the North Anna Unit 3 ESP, to ensure that the combination of the information in these documents appropriately represents the complete scope of information relating to site characteristics. The staff concluded that the applicant has provided sufficient information and that, except as discussed under Departures and Exemptions below, the North Anna Unit 3 site characteristics are bounded by the requirements of the ESBWR DCD.

Departures and Exceptions from the ESBWR DCD

Ground Response Spectra for Seismic Structural Loads and Floor Response Spectra

The site-specific ground motion response spectra and foundation input response spectra for North Anna Unit 3 exceed the DCD certified seismic design response spectra. In the current application, Dominion revised its seismic hazard characterization using the methods prescribed in NUREG-2115. The updated North Anna Unit 3 probabilistic seismic hazard analysis using the Central and Eastern U.S. seismic source characterization model considers an updated catalog of earthquakes potentially affecting the site and incorporates the most recent ground motion model (Electric Power Research Institute, 2013) to develop uniform hazard response spectra; i.e. response spectra associated with specific annual exceedance frequencies).

The probabilistic seismic hazard analysis considered the magnitude 5.8 2011 Mineral, Virginia earthquake, which occurred approximately 11 miles southwest of the North Anna site and was one of the largest magnitude earthquakes instrumentally recorded in eastern North America. Despite its magnitude, the CEUS SSC model found the Mineral earthquake to have an insignificant effect on the resulting seismic source characterization for the site. Indeed, the resulting acceleration response spectra being used for the seismic design of North Anna Unit 3 demonstrates substantial margins relative to the accelerations measured at the North Anna site during the Mineral earthquake. The applicant also considered the potential for surface faulting, and the stability of surface materials and foundations at the site.

The uniform hazard response spectra at $1x10^{-4}$ and $1x10^{-5}$ per year exceedance frequencies were further analyzed to address transmission of the seismic waves through the site-specific geologic columns above hard rock, for determination of the ground motion response spectra and the foundation input response spectra for the seismic category I structures: reactor building/fuel building, control building and fire water support complex. These spectra were input to detailed structural models of each building to determine seismic load demands on the structures as well as in-structure response spectra (ISRS) for analysis of systems and components.

Since the updated seismic load demands exceed those based on the certified seismic design response spectra at some frequencies, the two spectra were bounded. Bounding spectra were then combined with standard design non-seismic loads in the same analysis models used for the standard design to determine their acceptability. The analyses confirmed the adequacy of the seismic category 1 structures. No changes were required to DCD concrete structures such as slab and wall thickness, although some minor structural modifications were required to some steel components to withstand the higher loads.

Interaction with non-seismic category I structures was also considered. Inspection, test, and analysis acceptance criteria are included for those buildings to verify that the as-built structures meet applicable acceptance standards under the higher, site-specific loads. Site-specific ISRS that exceed standard design ISRS will be used for seismic design and qualification of North Anna Unit 3 equipment and components.

The staff confirmed that the North Anna Unit 3 seismic design methodology for plant structures, systems, and components is acceptable. Their review included an independent geological assessment of the Mineral earthquake, which concluded that the applicant's assessment was sufficient. Staff experts, including geologists, also evaluated the behavior of a previously discovered fault, commonly referred to as fault "a", near the North Anna site. This is a geologically old structure, i.e., at least one million years old, and the staff determined it was not a potential seismic source. There was no evidence of rupture or deformation of fault "a" as a result of the Mineral earthquake. The staff performed an independent probabilistic seismic hazard analysis and confirmed the applicant's site amplification and ground motion response spectra calculations.

The review concluded that sufficient information has been provided to satisfy NRC regulations and guidance in the seismic area and, with identified changes, the ESBWR standard design is adequate to meet the site-specific seismic demand. Thus, the applicant resolved all COL items and license conditions in the seismic area.

Electrical Power Distribution System

The applicant has proposed two departures and an exemption to the certified design information.

One departure pertains to the use of Dominion transmission system standards for switchyard surge protection. Those standards are proposed in lieu of specific elements of an IEEE standard that is endorsed by Regulatory Guide 1.204, which is cited in Tier 2 of the DCD. The staff reviewed this departure and concluded that the applicant's measures provide equivalent protection.

The other departure and its associated DCD Tier 1 exemption pertain to a change in the configuration of the normal preferred power supply from the North Anna switchyard. The change introduces an intermediate switchyard that contains additional equipment not included in the certified design: three single-phase 500kV / 230kV transformers, a 500kV isolation circuit breaker, and three motor-operated disconnects. This configuration incorporates unit auxiliary transformers and reserve auxiliary transformers that have the same design specifications and voltage ratings. To better understand the potential risk significance of this change, we examined the relevant portions of the electric power system models and analyses in the design certification probabilistic risk assessment (PRA).

Failures of the additional equipment in the intermediate switchyard will increase the frequency for loss of normal preferred power to the unit auxiliary transformers, compared to the switchyard-related power failures that are evaluated in the design certification PRA. Depending on the specific failure modes, those failures may also functionally prevent recovery of normal preferred power from the 500kV switchyard during the nominal PRA mission time. It is not likely that equipment failures in the intermediate switchyard will directly affect availability of the 230kV alternate preferred power supply to the reserve auxiliary transformers. Nonetheless, the site-specific design will result in an increase in risk, compared to that evaluated for the certified design. The amount of that increase will be better understood when the final design is analyzed more completely in the North Anna Unit 3 site-specific PRA that will be performed prior to initial fuel load. Based on our comparative assessment, we have reasonable assurance that the increase will be small and that switchyard-related failures of normal preferred power will remain a small contribution to overall plant risk. Therefore, the proposed departure and exemption are acceptable.

Liquid Radioactive Waste Effluent Discharge Piping Flow Path

The North Anna Unit 3 COLA proposes an alternate flow path for routing of liquid radioactive waste effluent discharges to the environment that does not use the cooling tower blowdown line as specified in the DCD. This departure simplifies design and construction of the cooling tower blowdown line since it will not need to be designed with special features required for lines that contain liquid radioactive waste. Since the changes involve differences from both Tier 1 and Tier 2 portions of the DCD, they constitute both an exemption and a departure. The staff evaluated the radioactive waste discharge piping exemption/departure, and concluded that it is acceptable.

Design of Structures for Hurricane Wind Generated Missiles

The staff evaluated the exemption to the ESBWR DCD for the effects of hurricane-generated missiles. The staff requested that the applicant address site-specific hurricane missiles based on Regulatory Guide 1.221. In response, the applicant demonstrated that all seismic Category I structures are bounded by the DCD tornado missiles (330 mph wind speed). Some equipment subject to regulatory treatment of non-safety systems (RTNSS) is housed in non-seismic Category I structures, which are not designed for tornado-generated missiles. The DCD hurricane wind speed does not bound the Regulatory Guide 1.221 hurricane wind speeds at the North Anna site (140 mph). Therefore, this exemption modifies the DCD to specify that RTNSS structures will be designed to the most limiting hurricane-generated missile, either from the DCD or site-specific value calculated from Regulatory Guide 1.221. The staff finds that this exemption is acceptable.

Fukushima Requirements

In 2011, the Fukushima Near-Term Task Force issued a series of recommendations for improving nuclear power plant safety in the U.S. following the Fukushima earthquake and tsunami. Recommendations applicable to the North Anna Unit 3 COLA are: 4.2, Mitigation of Beyond-Design-Basis External Events, 7.1, Reliable Spent Fuel Pool Instrumentation, and 9.3, Emergency Preparedness Staffing and Communications.

Dominion incorporated information related to mitigating strategies for beyond-design-basis external events from the Fermi 3 RCOLA into the North Anna Unit 3 COLA. The staff reviewed this information and found the Fermi 3 COL standard content to be directly applicable to North Anna Unit 3. The staff provided a license condition with the same provisions as the comparable license condition for Fermi 3 that reflects the same mitigating strategies. This license condition requires the applicant to have developed an overall plan of mitigating strategies 180 days before the date scheduled for initial fuel load and to fully implement the strategies and guidance required in the license condition before fuel load.

The applicant addressed spent fuel pool instrumentation in the North Anna Unit 3 COLA. In subsequent RAI responses, Dominion described spent fuel pool level instrument design features that ensure reliable indication of the water level in the spent fuel pool and buffer pools. The staff reviewed the Dominion submittal on this topic and found that it is consistent with the Fermi 3 RCOLA final SER. Therefore, the North Anna Unit 3 supplemental information on reliable spent fuel pool level instrumentation is acceptable. A license condition was imposed which verifies that the programmatic aspects of the Fukushima-related reliable spent fuel pool instrumentation Order are completed and implemented prior to initial fuel loading.

The Fukushima accident highlighted the need to better determine the levels of plant and offsite staffing needed to respond to a multi-unit event. Additionally, there is a need to ensure that communication equipment has adequate power to coordinate the response to an event during an extended loss of AC power. The applicant proposed and the staff accepted a license condition related to communications and staffing for emergency planning actions identical to that imposed at Fermi 3. The proposed license condition ensures that communications and staffing will be adequate for emergency planning operations.

We concur that the applicant’s submittals and associated license conditions adequately address the applicable Fukushima Near-Term Task Force recommendations.

SUMMARY

There is reasonable assurance that North Anna Unit 3 can be built and operated without undue risk to the health and safety of the public. The North Anna Unit 3 COLA should be approved.

Sincerely,

/RA/

Dennis C. Bley
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, "Advanced Final Safety Evaluation Report for North Anna Unit 3 Combined Operating License Application," (ML16095A218, ML16146A703, ML16203A355, ML16166A244, ML15092A729, ML15188A423, ML14056A093, 15343A123, ML16221A428, ML14218A747, ML338A139, ML348A042, ML15352A312, ML15176A443, ML15020A230, ML14128A045, ML15092A730, ML14063A491, ML16256A255, ML15338A212).

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