River Bend Station

Unit 3

Combined

License

Application

Part 2: Final Safety Analysis Report

Revision 0

September 2008

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ACRONYMS AND ABBREVIATIONS

Terms	Definitions
ABWR	Advanced Boiling Water Reactor
ACAR	Aluminum Conductor Alloy Reinforced
ACSR	Aluminum Conductor Steel Reinforced
ADA	American Disability Act
AE	Architect/Engineer
AHS	Auxiliary Heat Sink
ALARA	As Low as Reasonably Achievable
ALOHA	Areal Locations of Hazardous Atmospheres
AMI	Applied Meteorology, Incorporated
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANSS	Advanced National Seismic System
Applicant	Entergy Operations, Inc. (EOI)
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATV	All-Terrain Vehicle
AWWA	American Water Works Association
BEC	Bechtel
bgs	Below Ground Surface

BP	Before Present
B&PVC	Boiler and Pressure Vessel Code
BR	Baton Rouge
BPT	Brownian Passage Time
BTP	Branch Technical Position
B&V	Black & Veatch
BWR	Boiling Water Reactor
CAV	Cumulative Absolute Velocity
CAOC	Constant Axial Offset Control
CB	Control Building
CBG	Census Block Group
CC	Coefficient of Consolidation
CDI	Conceptual-Design Information
CE	Energy Correction Factor
CEO	Chief Executive Officer
CEUS	Central and Eastern United States
CH	Fat Clay
CIRC	Circulating Water System
CIV	Containment Isolation Valve
CL	Lean Clay
CLAS	Coastal Lowlands Aquifer System
CMT	Centroid-Moment-Tensor
CN	Overburden Correction Factor
CN	Curve Number

CO	Carbon Monoxide
COC	Chain of Custody
COL	Combined Operating License
COLA	Combined License Application
COOP	Cooperative Observation Program
cov	Coefficient of Variation
CPT	Cone Penetration Test
CPT	Cone Penetrometer Test
Cr	Coefficient of Recompression
CR	Compression Ratio
CRHA	Control Room Habitability Area
CRHAVS	Control Room Heating, Ventilating, and Air Conditioning Subsystem
CRHAVS	Control Room Habitability Area Ventilating Subsystem
CRR	Cyclic Resistance Ratio
CSR	Cyclic Stress Ratio
CSDRS	Certified Seismic Design Response Spectra
CSS	Cyclic Simple Shear
CST	Condensate Storage Tank
CS&TS	Condensate Storage and Transfer System
CU	Consolidated-Undrained
CWS	Circulating Water System
DAM	Dames & Moore
DB	Dry-Bulb
DBA	Design Basis Accident

DBT	Design-Basis Tornado
DC	Design Certification
DCD	Design Control Document
DE	Deaggregation Earthquake
DEM	Digital Elevation Model
DF	Design Factor
D-RAP	Design Reliability Assurance Program
E	Estimated
EAB	Exclusion Area Boundary
EAI	Entergy Arkansas, Inc.
ECCS	Emergency Core Cooling System
EES	Entergy Electric System
EF	Enhanced Fujita
EFU	Emergency Filter Unit
EGC	Exelon Generation Company
EGSL	Entergy Gulf States Louisiana, L.L.C.
EHS	Extra-High Strength
ELL	Entergy Louisiana, LLC
Emb	Expected Estimate of Body-Wave Magnitude
EMI	Entergy Mississippi, Inc.
ENO	Entergy New Orleans, Inc.
ENS	Emergency Notification System
Entergy	Entergy Corporation
EOF	Emergency Operations Facility

EOI	Entergy Operations, Inc.
EOP	Emergency Operating Procedure
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
EPRI-SOG	Electric Power Research Institute and Seismic Owners Group
EPZ	Emergency Planning Zone
EQD	Environmental Qualification Document
EQD	Equipment Qualification Document
ESBWR	Economic Simplified Boiling Water Reactor
ESP	Early Site Permit
EST	Earth Science Team
ETE	Evacuation Time Estimate
ETR	Energy Transfer Ratio
ETSZ	East Tennessee Seismic Zone
FAA	Federal Aviation Administration
FAPCS	Fuel and Auxiliary Pool Cooling System
FBVS	Fuel Building HVAC System
FE	Finite Element
FEMA	Federal Emergency Management Agency
FFD	Fitness for Duty
FHA	Fire Hazards Analysis
FHA	Fuel Handling Accident
FIRS	Foundation Input Response Spectra
FOS	Factor of Safety

FP	Fire Protection
FPS	Fire Protection System
fs	Sleeve Friction
FSAR	Final Safety Analysis Report
FWLB	Feedwater Line Break
FWSC	Fire Water Service Complex
Ga	Billion Years
GB	Grants Bayou
GCSZ	Gulf Coastal Source Zone
GDC	General Design Criteria
GEH	GE-Hitachi Nuclear Energy Americas LLC
GEOVision	GEOVision Geophysical Services, Inc.
GGNS	Grand Gulf Nuclear Station
GG&S	Geotechnical, Geological, and Seismological
GIS	Geographic Information System
GMRS	Ground-Motion Response Spectra
GMS	Groundwater Modeling System
GPS	Global Positioning System
GTG	Generic Technical Guidelines
GWG	Generic Writer's Guide
HCLPF	High Confidence Low Probability of Failure
HF	High-Frequency
HFE	Human Factors Engineering
HMR	Hydrometeorological Report

HP	High-Pressure
HR	Hydrometeorological Report
HSI	Human System Interface
HUSWO	Hourly United States Weather Observations
HVAC	Heating, Ventilating, and Air Conditioning
HWC	Hydrogen Water Chemistry
HWCS	Hydrogen Water Chemistry System
I&C	Instrumentation and Controls
ICF	Indirect Cost Factor
IC/PCC	Isolation Condenser/Passive Containment Cooling
IDLH	Immediately Dangerous to Life or Health
IE	Inspection and Enforcement
IEEE	Institute of Electrical and Electronics Engineers
IMCOM	Installation Management Command
ISFSI	Independent Spent Fuel Storage Installation
ISFSI	Interim Spent Fuel Storage Initiative
ISI	In-Service Inspection
ISI/IST	In-Service Inspection/In-Service Testing
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
JFDs	Joint Frequency Distributions
JPM	Job Performance Measure
JRTC	Joint Readiness Training Center
Ko	Coefficient of Earth Pressure at Rest
LAW	Law Engineering

LCD	Local Climatological Data
LCOs	Limiting Conditions for Operations
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife & Fisheries
LERs	Licensee Event Reports
LF	Low Frequency
LFL	Lower Flammability Limit
LGS	Louisiana Geological Survey
LLD	Lower Limit of Detection
LLNL	Lawrence Livermore National Laboratory
LLW	Low Level Waste
LNG	Liquefied Natural Gas
LOCA	Loss-of-Coolant Accident
LP	Low-Pressure
LPMS	Lock Performance Monitoring System
LPZ	Low Population Zone
LST	Local Standard Time
LSU	Louisiana State University
LWMS	Liquid Waste Management System
M	Moment Magnitude
Ma	Million Years
mb	Body-Wave Magnitude

mb*	Adjusted Body-Wave Magnitude
MCR	Main Control Room
MCR	Maximum Continuous Rating
MCSAP	Motor Carrier Safety Assistance Program
MCWB	Mean Coincident Wet-Bulb
MDCT	Mechanical Draft Cooling Tower
MEAS	Mississippi Embayment Aquifer System
MEI	Maximally Exposed Individual
MHW	Mean High Water
MLE	Maximum Likelihood Estimate
MM	Modified Mercalli
Mmax	Maximum Magnitude
MMI	Modified Mercalli Intensity
MOST	Method of Splitting Tsunami
MOV	Motor-Operated Valve
MP&C	Materials, Procurement, and Contracts
MR	Maintenance Rule
MR	Mississippi River
MRAA	Mississippi River Alluvial Aquifer
MS	Surface-Wave Magnitude
MSF	Magnitude Scaling Factor
MSIV	Main Steam Isolation Valve
msl	Mean Sea Level
MSLB	Main Steam Line Break

MSS	Multispectral Scanner
MSW	Shear-Wave Magnitude
MWS	Makeup Water System
NACE	National Association of Corrosion Engineers
NAS	Naval Air Station
NCDC	National Climatic Data Center
NCEER	National Center for Earthquake Engineering Research
ND	Not Detected
NDCT	Natural Draft Cooling Tower
NDE	Nondestructive Examination
NEI	Nuclear Energy Institute
NEIC	National Earthquake Information Center
NESC	National Electrical Safety Code
NFDC	National Flight Data Center
NFPA	National Fire Protection Association
NGA	Next Generation Attenuation
NGDC	National Geophysical Data Center
NGS	National Geodetic Survey
NGVD	National Geodetic Vertical Datum
NHC	National Hurricane Center
NMSZ	New Madrid Seismic Zone
NN	New Madrid North
NO2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration

NOS	National Ocean Service
NP	Non-Plastic
NPHS	Normal Power Heat Sink
NRC	Nuclear Regulatory Commission
NS	New Madrid South
NSA	Nuclear Safety Assurance
NT	Not Tested
NWS	National Weather Service
OBE	Operational Basis Earthquake
OCR	Overconsolidation Ratios
ODCM	Offsite Dose Calculation Manual
OHLHS	Overhead Heavy Load Handling Systems
OJT	On-the-Job Training
OLNC	On-Line Noble ChemTM
OSC	Operational Support Center
OSHA	Occupational Safety and Health Act
P	Compression
PA	Protected Area
PAP	Primary Access Point
Pc	Preconsolidation Stress
Pc	'Preconsolidation Pressures
PCCS	Passive Containment Cooling System
PCP	Process Control Program
PD	Probability of Detection

PDF	Project Design Flood
PDI	Palmer Drought Index
PEER	Pacific Earthquake Engineering Research
PGA	Peak Ground Acceleration
PGP	Procedures Generation Package
PI	Plasticity Index
PIP	Plant Investment Protection
PIV	Pressure Isolation Valve
PM	Particulate Matter
PMEL	Pacific Marine Environmental Laboratory
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMWP	Probable Maximum Winter Precipitation
POV	Power-Operated Valve
PRA	Probabilistic Risk Assessment
PSA	Probabilistic Safety Assessment
PSHA	Probabilistic Seismic Hazard Analysis
PSI	Pre-Service Inspection
PSI	Professional Service Industries, Inc.
PSI/ISI	Preservice Inspection/In-Service Inspection
PSO	Phosphinosuccinic Oligomer
PS&O	Planning, Scheduling, and Outages
PSW	Plant Service Water
PSWS	Plant Service Water System

P/T	Pressure and Temperature
PWR	Pressurized Water Reactor
PWS	Potable Water System
QA	Quality Assurance
QAPD	Quality Assurance Program Description
qc	Cone Tip Resistance
QC	Quality Control
RADTRAD	RADionuclide Transport Removal and Dose
radwaste	Radioactive Waste
RAP	Reliability Assurance Program
RASA	Regional Aquifer-System Analysis
RAT	Reserve Auxiliary Transformer
RBS	River Bend Station
RC	Resonant Column
RCCWS	Reactor Component Cooling Water System
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
RCTS	Resonant Column and Torsional Shear
rd	Stress Reduction Factor
RE	Reference Earthquake
REDOX	Oxidation and Reduction Potential
REMP	Radiological Effluents Monitoring Program
Rf	Friction Ratio
RF	Reelfoot Fault

R/FB	Reactor/Fuel Building
RG	Regulatory Guide
RHR	Residual Heat Removal
RM	River Mile
RND	Rondout Associates
RO	Reactor Operator
ROW	Right-of-Way
RP	Radiation Protection
RPT	Radiation Protection Technician
RR	Recompression Ratio
RTNSS	Regulatory Treatment of Non-Safety Systems
RW	Radwaste Building
RWCU	Reactor Water Cleanup
S	Shear
SACTI	Seasonal/Annual Cooling Tower Impact Prediction Code
SAMSON	Solar and Meteorological Surface Observation Network
SAT	Systematic Approach to Training
SBO	Station Blackout
SCS	Soil Conservation Service
SDWIS	Safe Drinking Water Information System
SEI	Structural Engineering Institute
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SEUSSN	Southeastern U.S. Seismic Network

SIFT	Short-Term Inundation Forecasting for Tsunamis
SIS	System Impact Study
SITC	Standard International Trade Classification
SO2	Sulfur Dioxide
SO4	Sulfate
SOG	Seismic Owners Group
SONRIS	Strategic Online Natural Resources Information System
SPF	Standard Project Flood
SPR	Single Point Resistance
SPT	Standard Penetration Test
SQD	Sample Quality Designation
SRCC	Southern Regional Climate Center
SRO	Senior Reactor Operator
SRP	Standard Review Plan
SS	Site-Specific
SSAR	Site Safety Analysis Report
SSC	Structures, Systems, and Components
SSE	Safe Shutdown Earthquake
SSE	Safe Shutdown Event
SSHAC	Senior Seismic Hazard Advisory Committee
SSI	Soil Structure Interaction
STA	Shift Technical Advisor
STAR	Stability Array
STP	South Texas Project

STPNOC	STP Nuclear Operating Company
SUNSI	Sensitive Unclassified Non-Safeguards Information
SWDS	Sanitary Waste Discharge System
SWS	Station Water System
TAC	Total Annual Cost
TB	Turbine Building
TCCWS	Turbine Component Cooling Water System
TE	Equivalent Period of Completeness
TEDE	Total Effective Dose Equivalent
TESS	Transportation and Environmental Safety Section
3-D	Three Dimensions
TIMED	Transportation Infrastructure Model for Economic Development
TIP	Trial Implementation Program
TLDs	Thermoluminescent Dosimeters
TP	Technical Paper
TRI	Toxic Release Inventory
TSC	Technical Support Center
TSO	Transmission System Operator
TVA	Tennessee Valley Authority
2-D	Two Dimensions
UAT	Unit Auxiliary Transformer
UFL	Upper Flammability Limit
UFSAR	Updated Final Safety Analysis Report
UHRS	Uniform Hazard Response Spectra

UHS	Ultimate Heat Sink
UL	Underwriters Laboratories
UMR	Upper Mississippi River
UPS	United Parcel Service
USACE	U.S. Army Corps of Engineers
USAR	Updated Safety Analysis Report
USGS	U.S. Geological Survey
UTA	Upland Terrance Aquifer
UTM	Universal Transverse Mercator
UU	Unconsolidated-Undrained
Veq	Equivalent Uniform Shear Wave Velocity
V/H	Vertical-to-Horizontal
VS	Shear Wave Velocity
V&V	Verification and Validation
WB	Wet-Bulb
WC	West Creek
WCC	Woodward-Clyde Consultants
WCSC	Waterborne Commerce Statistics Center
WFP	West Feliciana Parish
WGC	Weston Geophysical
WUS	Western United States

CHAPTER 1 INTRODUCTION AND GENERAL DESCRIPTION OF THE PLANT

1.1 INTRODUCTION

This section of the Economic Simplified Boiling Water Reactor (ESBWR) Design Control Document (DCD), i.e., the referenced DCD, is incorporated by reference with the following departures and/or supplements.

1.1.1 FORMAT AND CONTENT

1.1.1.1 10 CFR 52 and Regulatory Guide 1.206

RBS SUP 1.1-1 This Final Safety Analysis Report (FSAR) was developed to comply with the content requirements of 10 CFR 52.79, and to the extent feasible, the content and format guidance contained in Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)." See Table 1.9-201, Conformance With the FSAR Content Guidance in RG 1.206. If the information requested by RG 1.206 is not needed (e.g., because it is already provided in the DCD or is located elsewhere in the FSAR), the table specifies the location of the information.

Section C.III.6 of RG 1.206 addresses referencing a design certification (DC) application rather than a certified design. The existing DC rules (10 CFR 52 appendices) require that a Combined Operating License Application (COLA) that references a certified design include a plant-specific DCD containing the same type of information and using the same organization and numbering as the generic DCD for the ESBWR design, as modified and supplemented by the applicant's exemptions and departures. Consistent with this guidance and the expected approval of the ESBWR DCD, the organization and numbering of this FSAR follows the organization and numbering of the generic DCD for the ESBWR design as modified and supplemented by exemptions and departures. Where necessary to present additional information, new sections were added following the logical structure of the ESBWR generic DCD.

1.1.1.2 Standard Review Plan

As required by 10 CFR 52.79(a)(41), an evaluation of the facility for conformance with the acceptance criteria contained in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants LWR Edition," in effect 6 months prior to submittal of the COLA was performed. This evaluation determined that this FSAR contains no unacceptable deviations from the acceptance criteria given in the applicable portions of the Standard Review Plan (SRP). Where necessary, Table 1.9-201, Conformance with Standard Review Plan, provides a summary of any differences from the SRP acceptance criteria, along with a justification for an exception to a criterion or a Branch Technical

Position (BTP); or the table identifies the applicable FSAR section(s) that addresses a difference.

1.1.1.3 Tables and Figures

Tabulations of data are designated "tables." Each is identified by the section number followed by a number (for example, Table 1.9-204 would be an FSAR table in Section 1.9). The use of the "200" series for FSAR table numbers distinguishes FSAR tables from DCD tables. If a table from the DCD is referenced in the FSAR text, it is denoted as such, for example "DCD Table 4.1-1." If a table from the DCD was revised for use in the FSAR, the original DCD table number was appended with an "R"; for example, if DCD "Table 4.2-1" was revised, it would have become "Table 4.2-1R." Tables are located at the end of the section immediately following the text.

Drawings, pictures, sketches, curves, graphs, and engineering diagrams identified as "figures" are numbered using the section number followed by a number, (for example, Figure 2.1-201 would be an FSAR figure in Section 2.1.) The use of the "200" series for FSAR figure numbers distinguishes FSAR figures from DCD figures. If a figure from the DCD is referenced in the FSAR text, it is denoted as such; for example "DCD Figure 4.1-1." If a figure from the DCD was revised for use in the FSAR, the original DCD figure number was appended with an "R"; for example, if DCD "Figure 4.2-1" was revised, it would have become "Figure 4.2-1R." Figures are located at the end of the applicable section following the tables.

1.1.1.4 Numbering of Pages

Text pages are numbered sequentially within each chapter (for example, Page 1-4 is the fourth page of Chapter 1).

1.1.1.5 Proprietary and Security-Related Sensitive Unclassified Non-Safeguards Information (SUNSI)

RBS SUP 1.1-2 Proprietary information and SUNSI covers a range of information for which the loss, misuse, modification, or unauthorized access can reasonably be foreseen to harm the public interest, the commercial or financial interests of an entity or individual to whom the information pertains, the conduct of the U.S. Nuclear Regulatory Commission (NRC) and federal programs, or the personal privacy of individuals. This classification includes security-related information which, if released, could cause harm to the public interest as it could be useful, or could reasonably be expected to be useful, to a terrorist in a potential attack. To protect SUNSI, it is not included in the public version of the FSAR. SUNSI that was needed at the time of COL application/approval was supplied in a separate part of the COLA. FSAR sections that rely on restricted information contain references to the appropriate location in the COLA. SUNSI included in the non-public version of the FSAR is appropriately indicated.

1.1.1.6 Acronyms

RBS SUP 1.1-3 The FSAR front matter contains a supplemental list of acronyms used in the FSAR text for acronyms not identified in the DCD chapter acronym list. In addition to the supplemental list of acronyms, acronyms are defined at their first occurrence in FSAR chapter text.

1.1.1.7 Incorporation by Reference

RBS SUP 1.1-4 10 CFR 52.79 states in part that, "The final safety analysis report need not contain information or analyses submitted to the Commission in connection with the design certification, provided, however, that the final safety analysis report must either include or incorporate by reference the standard design certification final safety analysis report and must contain, in addition to the information and analyses otherwise required, information sufficient to demonstrate that the site characteristics fall within the site parameters specified in the design certification." Therefore, because this COLA references the ESBWR DC application, the FSAR incorporates by reference the ESBWR DCD with certain departures (see Subsection 1.1.1.8) and supplemental information (see Subsection 1.1.1.9). References in this FSAR to the DCD should be understood to mean the ESBWR DCD, Tier 2, submitted by GE-Hitachi Nuclear Energy Americas LLC (GEH), as Revision 4.

1.1.1.8 Departures from the Standard Design Certification (or Application)

RBS SUP 1.1-5 A departure is a plant-specific "deviation" from design information in a standard DC rule or, consistent with Section C.III.6 of RG 1.206, from design information in a DC application.

10 CFR 52 clarifies that Tier 2 information in a standard DC rule does not include conceptual design information (CDI) and per Section C.III.6 of RG 1.206, Tier 2 information in a standard DC application does not include CDI. Therefore, replacement or revision of CDI does not constitute a departure. Additionally, information addressing combined license (COL) information/holder items and supplemental information (see Subsection 1.1.1.9) that does not change the intent or meaning of the ESBWR DCD text is not considered a departure from the ESBWR DCD.

1.1.1.9 Supplements

RBS SUP 1.1-6 Supplements fall into one of the following categories (see Table 1.1-201 for definitions of categories unless noted otherwise):

- COL Item.
- CDI.
- Supplemental Information (see definition below).

Supplemental information is FSAR information that includes information not related to COL Items, departures, variances, conceptual design, or permit conditions (see Table 1.1-201 for definition of terms); or is information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the DCD.

1.1.1.10 Left Margin Annotations

STD SUP 1.1-3 FSAR sections are annotated in the left margin with information that identifies 1) the reason the information is being provided and, as applicable, 2) whether the information is standard (identical) for any ESBWR application, or specific to the COLA for a particular plant.

The annotations and their definitions are listed in Table 1.1-201.

1.1.1.11 Tense

Because this FSAR is a licensing basis document that will control plant design and operations after the COL is issued, the FSAR is generally written in the present tense. Thus, plant design and configuration are described in the present tense although the plant is not yet built. Similarly, programs, procedures, and organizational matters are generally described in the present tense although such descriptions may not yet be implemented. Accordingly, the use of the present tense in this FSAR should be understood as describing the plant, programs and procedures, and organization as they will exist when in place, and not as a representation that they are already in place.

1.1.2 GENERAL DESCRIPTION

1.1.2.1 ESBWR Standard Plant Scope

RBS CDI Replace the last sentence with the following.

The orientation of the principal plant structures for Unit 3 is shown in Figure 1.1-201.

RBS SUP 1.1-7 The ESBWR standard plant scope is discussed in DCD Subsection 1.1.2.1. In addition to the buildings and structures within the scope of the ESBWR standard plant, the plant includes an intake structure for plant makeup water, normal power heat sink and auxiliary heat sink cooling towers, a sewage treatment plant, water treatment facilities, storage tanks for water and fuel oil, a switchyard and other site support systems and structures necessary to support the operation and maintenance of the facility.

1.1.2.2 Type of License Request

Add the following to the end of this section.

This application by Entergy Operations, Inc. on behalf of itself; Entergy Gulf States Louisiana, L.L.C. and Entergy Louisiana LLC is for a combined construction permit and operating license, i.e., COL under Section 103 of the Atomic Energy Act, for the second nuclear power plant to be located on the existing River Bend Station (RBS) site near St. Francisville, Louisiana. This COLA references a DC application for an ESBWR (consistent with Section C.III.6 of RG 1.206). The second unit is designated RBS Unit 3.

1.1.2.4 Description of Location

Add the following to the end of this section.

RBS SUP 1.1-8 The approximate center of the location of the power block area of the new facility is N820595 and E3280625 in the NAD 83 Louisiana South State Plane coordinate system.

1.1.2.7 Rated Core Thermal Power

RBS COL 1.1-1-A Replace the last three sentences of this section with the following.

GEH is responsible for the design of the Turbine Island for the ESBWR Standard Plant to be deployed at the RBS site (Unit 3).

The design of the Unit 3 plant auxiliaries has not been finalized at the time of COLA submittal; therefore, confirmation of the net electrical output could not be made. This information will be supplied, as required, in an FSAR update following selection of the architect-engineer and completion of necessary plant design. However, Unit 3 will utilize a single ESBWR Standard Plant; therefore, no departures from the ESBWR Standard Plant's estimated gross electrical output, estimated net electrical output, or rated thermal power level are anticipated.

Unit 3 utilizes a single ESBWR Standard Plant and no site-specific environmental parameter was identified that results in a deviation from the thermal output of the standard plant.

1.1.2.8 Schedule

RBS SUP 1.1-9 Construction and startup schedules will be provided after issuance of the COL.

1.1.3 COL UNIT-SPECIFIC INFORMATION

1.1-1-A ESTABLISHED RATED ELECTRICAL OUTPUT

RBS COL 1.1-1-A This COL Item is addressed in Subsection 1.1.2.7.

**Table 1.1-201 (Sheet 1 of 2)
Left Margin Annotations**

STD SUP 1.1-5

FSAR Component	Margin Annotation	Definition and Use
Standard Departure	STD DEP X.Y.Z -#	FSAR information that departs from the generic DCD and is common for all parallel applicants; i.e., the departure and discussion of the departure are identical for all applicants of the ESBWR technology. Each Standard Departure is numbered based on the applicable section down to the X.Y.Z level, e.g.: STD DEP 9.2-1, or STD DEP 9.2.1-1.
Plant-Specific Departure	(PLANT) DEP X.Y.Z-#	FSAR information that departs from the generic DCD and is plant-specific; i.e., the departure and discussion of the departure are not identical for all applicants of the ESBWR technology. Each Plant-Specific Departure is numbered based on the applicable section down to the X.Y.Z level, e.g.: NAPS DEP 9.2-1, or NAPS DEP 9.2.1-1.
Standard COL Item	STD COL X.Y-#-A or STD COL X.Y-#-H	FSAR information that addresses a DCD COL Item that is common for all parallel applicants; i.e., the response to and discussion of the DCD COL Item are identical for all applicants of the ESBWR technology. Each Standard COL Item is numbered as identified in ESBWR DCD Table 1.10-1. The -A refers to a COL Applicant item while the -H refers to a COL Holder item.
Plant-Specific COL Item	(PLANT) COL X.Y-#-A or (PLANT) COL X.y-#-H	FSAR information that addresses a DCD COL Item that is plant-specific; i.e., the response to the COL Item is not a Standard COL Item for parallel applicants. Each Plant-Specific COL Item is numbered as identified in the ESBWR DCD (see STD COL above).

Table 1.1-201 (Sheet 2 of 2)
Left Margin Annotations

	FSAR Component	Margin Annotation	Definition and Use
STD SUP 1.1-5	Standard Conceptual Design Information	STD CDI	A Conceptual Design Information designation is used to identify FSAR information that replaces Conceptual Design Information in the DCD, in whole or in part. Replacement and supplemental Conceptual Design Information is generally plant-specific; however, for conceptual design that is generic for all applications, the annotation for standard (STD) is used, STD CDI.
STD SUP 1.1-3	Plant Specific Conceptual Design Information	(PLANT) CDI	A Conceptual Design Information designation is used to identify FSAR information that replaces Conceptual Design Information in the DCD, in whole or in part. Plant specific replacement and supplemental Conceptual Design Information uses the annotation (PLANT) CDI, e.g., NAPS CDI.
	Standard Supplemental Information	STD SUP X.Y-#	Supplemental FSAR information that is identical for all parallel applicants; i.e., the supplemental information is identical for all applicants of the ESBWR technology. Each Standard Supplemental Information designation is numbered based on applicable section down to the X.Y level, e.g., STD SUP 10.4-1.
	Plant-Specific Supplemental Information	(PLANT) SUP X.Y-#	Supplemental FSAR information that is plant-specific (not standard). Each Plant-Specific Supplemental Information designation is numbered based on applicable section down to the X.Y level, e.g., NAPS SUP 10.4-1.
	Design Control Document	DCD	Information in the DCD that is provided in the FSAR as determined necessary to aid in FSAR contextual clarity.

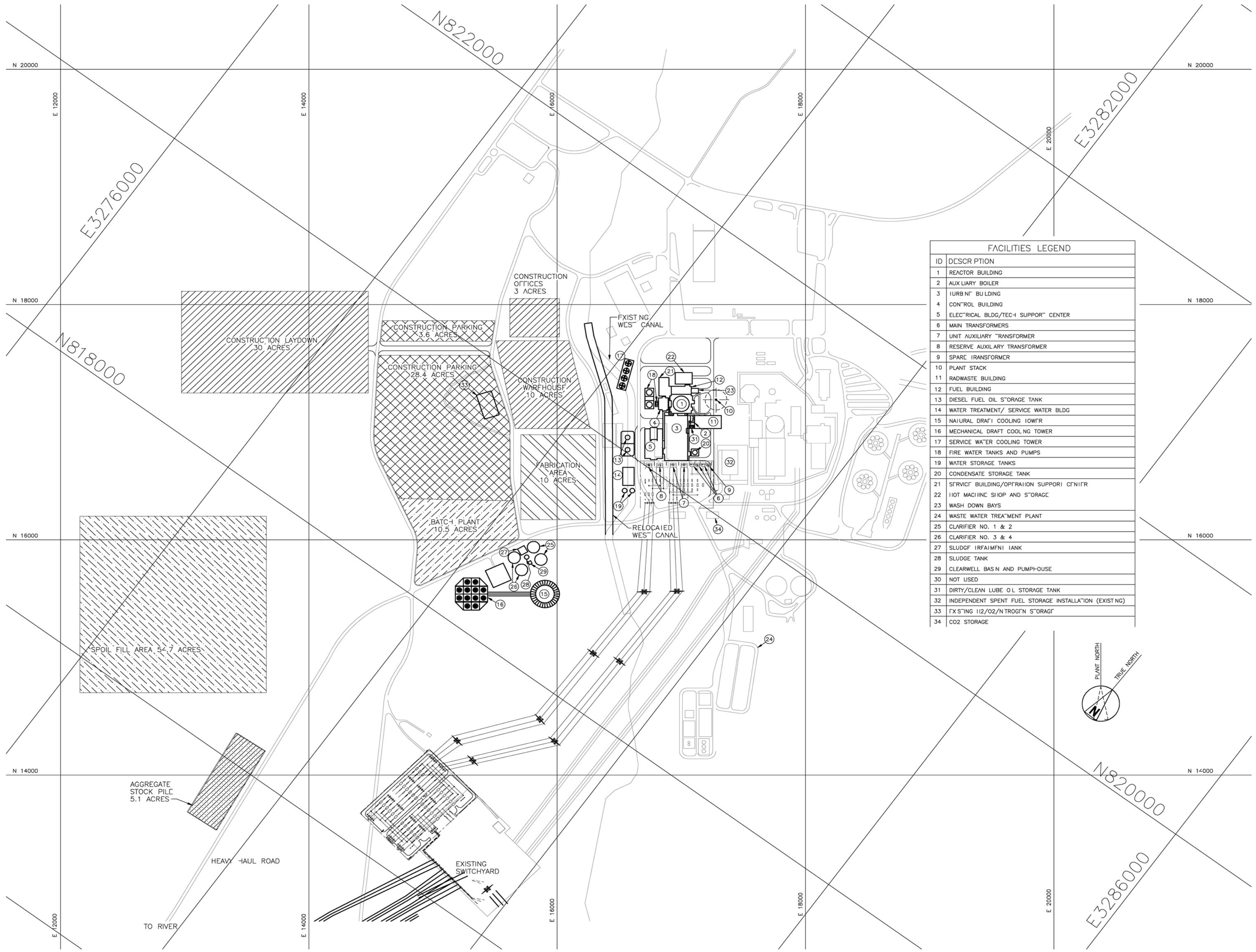

Figure 1.1-201. Site Arrangement

1.2 GENERAL PLANT DESCRIPTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

1.2.2.11.4 Main Turbine

Delete the second sentence of the first paragraph and replace the first sentence of the first paragraph with the following.

STD CDI The main turbine has one high-pressure (HP) turbine and three low-pressure (LP) turbines.

1.2.2.11.7 Main Condenser

Delete the second sentence of the third paragraph and replace the first sentence of the third paragraph with the following.

STD CDI The main condenser is a multi-pressure, triple-shell unit.

1.2.2.12.1 Makeup Water System

Replace second paragraph with the following.

RBS CDI Clarified, filtered river water is supplied to the MWS by the Station Water System. Prior to transfer to the demineralized water storage tank, the clarified water is processed through a vendor-supplied mobile water treatment system.

1.2.2.12.6 Oxygen Injection System

Replace the second sentence of the first paragraph with the following.

RBS CDI Oxygen is supplied from the Unit 1 cryogenic skid.

1.2.2.12.13 Hydrogen Water Chemistry System

Replace the existing text with the following.

STD CDI The HWC system consists of hydrogen and oxygen supply systems to inject hydrogen in the feedwater and oxygen in the offgas, plus monitoring systems to track the effectiveness of the system.

1.2.2.12.15 Zinc Injection System

Replace this section with the following.

STD CDI The Zinc Injection System is not utilized.

1.2.2.12.16 Freeze Protection

Replace this section with the following.

STD CDI Freeze protection is incorporated at the individual system level using insulation and heat tracing for all external tanks and piping that may freeze during winter weather.

1.2.2.16.10 Other Building Structures

Replace the third paragraph with the following.

RBS CDI Other facilities include the Service Building, the Water Treatment Building, Administration Building, Training Center, Sewage Treatment Plant, warehouse, and hot machine shop. These are all of conventional size and design, and in some cases may be shared with Unit 1.

1.2.2.19 Modular Construction Techniques and Plans

STD SUP 1.2-1 To the extent practical, modular construction techniques that have been applied during ABWR construction projects will be adapted and/or modified for use during ESBWR construction. Modularization reviews will be performed to develop a plan for bringing the ABWR experience into the ESBWR. Once completed, the results of the modularization reviews will be used as guidance to develop the detailed design of the areas affected by modularization.

1.3 COMPARISON TABLES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following to the end of this section.

RBS COL 1.3-1-A There are no updates to DCD Table 1.3-1 based on unit-specific information.

1.3.1 COL UNIT-SPECIFIC INFORMATION

1.3-1-A UPDATE TABLE 1.3-1

RBS COL 1.3-1-A This COL item is addressed in Section 1.3.

1.4 IDENTIFICATION OF AGENTS AND CONTRACTORS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

1.4.1 RBS UNIT 3 PROJECT

RBS SUP 1.4-1 Unit 3 is owned by Entergy Gulf States Louisiana, L.L.C. Unit 3 is operated by Entergy Operations, Inc. Entergy Gulf States Louisiana, L.L.C. and Entergy Operations, Inc. are wholly owned subsidiaries of Entergy Corporation (Entergy). Entergy has more than 30 years of experience in the design, construction, and operation of nuclear generating stations. Entergy operates 12 reactors in several states. Entergy has managed several major construction projects including steam generator replacements, pressurizer replacements, turbine upgrades, dry fuel storage project, and major control systems upgrades in addition to the initial construction of Arkansas Nuclear One, Waterford 3, and Grand Gulf Unit 1.

In addition to operating the plant, Entergy Operations, Inc. is responsible for the following coordination of the licensing activity:

- Assurance through quality assurance audits of the proper implementation and compliance of the quality program.
- Assurance of the proper implementation and execution of the supplier inspection program.

1.4.2 ARCHITECT-ENGINEER

RBS SUP 1.4-2 The architect-engineer for the site-specific systems and structures outside the scope of the reactor vendor for the construction phase of the project had not been chosen at the time of COLA submittal; this information will be supplied in an FSAR update following selection of the architect-engineer.

1.4.3 NUCLEAR STEAM SUPPLY SYSTEM

RBS SUP 1.4-3 GEH is responsible for developing the complete standard plant for the ESBWR necessary to obtain a design certification (DC) from the NRC, supporting preparation of the COLA, and activities to support deployment of the ESBWR on the RBS site. GEH, established in June 2007 to serve the global nuclear industry, is a business alliance of GE's and Hitachi's respective nuclear businesses.

DCD Table 1.4-1 lists the commercial nuclear reactors that were completed by GE or are under construction by GEH. For 50 years, GE provided advanced technology for nuclear energy and developed breakthrough light water technology in the mid-1950s: the boiling water reactor (BWR). Since then, GE developed nine evolutions of BWR technology, including the first operational advanced light water design in the world, the ABWR, and culminating in its latest generation of design, the ESBWR. All of GE's nuclear technology has been transferred to GEH. There are 67 plants operating worldwide utilizing GEH designs with an operating capacity of more than 59 GW, including 36 BWR plants in North America.

Further information describing GEH's design scope is discussed in DCD Subsection 1.1.2.1.

1.4.4 CONSTRUCTION OF THE TURBINE ISLAND AND THE NUCLEAR ISLAND

The contractors for the construction of the turbine island and the nuclear island have not yet been selected. The turbine island and the nuclear island together represent the power block. The contractor for the construction of the turbine island will be responsible for the erection and the delivery of the turbine building, the electric building, and the contents of each building. The contractor for the construction of the nuclear island will be responsible for the erection and the delivery of the reactor and fuel buildings, the control building, the hot machine shop, the radwaste building, and the contents of each building. Each contractor will be selected based on its historical work in the nuclear industry, ongoing nuclear business, ability to deliver integrated engineering and construction services, and available resources.

1.4.4.1 Turbine Generator Vendor

GEH has the overall responsibility for the design, fabrication, and delivery of the entire turbine island, including the turbine generator system, for the standard GE ESBWR single unit plant; Unit 3 is a standard ESBWR single unit plant. Various subcontractors may support GEH in the design, fabrication, and delivery of the turbine generator.

1.4.5 CONSULTANTS

1.4.5.1 Black & Veatch Corporation (B&V)

RBS SUP 1.4-4 B&V, under contract to Entergy, served as primary contractor for development of the COLA, supplying engineering support, conceptual design, environmental impact assessments, and project management. B&V, based in Overland Park, Kansas, is an engineering, environmental, technical, construction services, and management services firm providing a broad range of professional services to private and government sector clients throughout the world since 1915. B&V's

nuclear activities date back to the closing years of World War II, with early work including extensive service to the Atomic Energy Commission in the development of facilities at Los Alamos, New Mexico. More recent activities include the Interim Spent Fuel Storage Initiative (ISFSI) Dry Cask Storage Project at Cooper Nuclear Station, the Advanced Boiling Water Reactor (ABWR) Design Certification Program, Lungmen Nuclear Project in Taiwan, and the U.S. Department of Energy's 2010 initiative for the deployment of new nuclear plants in the United States.

1.4.5.2 Geomatrix

RBS SUP 1.4-5 Geomatrix performed geologic mapping and characterization of seismic sources and performed seismic sensitivity analyses for the COLA. It also provided support for COLA preparation. Geomatrix is a diversified technical consulting and engineering firm with offices throughout North America and with affiliates throughout the world. Formed in 1984, Geomatrix has a professional staff of more than 450 engineers, scientists, and technical experts. Industries represented among their clients include oil and gas, petrochemicals, food, agriculture, financial services, real estate development, and the legal community. Geomatrix conducted geologic investigations for the proposed underground repository for permanent disposal of high-level nuclear waste at Yucca Mountain. The investigations included detailed paleoseismic investigations of the Quaternary faults in the site area; photogeologic interpretation of aerial photographs and remote sensing imagery; interpretation of geophysical data; detailed geologic mapping; exploratory trenching; age-dating of geologic materials to assess the nature, age, and tectonic evolution of the late Cenozoic faulting in the Yucca Mountain area; and development of a probabilistic seismic hazard model to estimate the probability for earthquake ground motions and the co-seismic fault rupture at the site. Geomatrix has also performed work for Clinton Power Station and San Onofre Nuclear Generating Station.

1.4.5.3 Professional Service Industries, Inc. (PSI)

RBS SUP 1.4-6 PSI performed geotechnical field investigations and laboratory testing in support of Chapter 2. The effort included performing standard penetration tests; obtaining core samples; performing cone pentrometer tests, cross-hole seismic tests, and laboratory tests of soil samples; installing groundwater observation wells; and preparing data reports. Distinguished as a leader in environmental consulting, geotechnical engineering, and construction testing services, PSI is nationally recognized in several disciplines including: construction services, materials testing, roof consulting, and asbestos management. PSI is one of North America's largest consulting engineering firms and has been providing services to business and industry for more than 100 years.

1.4.5.4 GEOVision Geophysical Services, Inc. (GEOVision)

RBS SUP 1.4-7 GEOVision performed site characterization to support COLA preparation. GEOVision is a small California corporation offering state-of-the-art geophysical services using the most modern techniques and instrumentation to provide cost-effective solutions to engineering and environmental problems. Since 1995, GEOVision has specialized in the application of geophysics to engineering and environmental problems, emphasizing the use of non-invasive methods of investigations. It has provided site characterization services for numerous nuclear sites throughout the United States as well as other facilities such as the Space-Based Laser Facility and the National Ignition Facility.

1.4.5.5 Additional Consultants

RBS SUP 1.4-8 Additional consultants may be utilized during construction, for startup and operational phases of the Unit 3 project, and for activities not within the scope of the reactor vendor that had not been chosen at the time of COLA submittal. This information will be supplied in an FSAR update following selection of the architect-engineer.

1.5 REQUIREMENTS FOR FURTHER TECHNICAL INFORMATION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

1.6 MATERIAL INCORPORATED BY REFERENCE

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following paragraph to the end of this section.

RBS SUP 1.6-1 Table 1.6-201 lists topical reports not included in DCD Section 1.6 that are incorporated in whole or in part by reference in the FSAR.

RBS SUP 1.6-1

Table 1.6-201
Referenced Topical Reports

Report No.	Title	Section No.
NEI 03-01	Industry Guidelines for Nuclear Power Plant access Authorization Programs, Revision 1	13.7
NEI 03-12, Appendix F	Nuclear Energy Institute, "New Plant Security Program," NEI 03-12, Appendix F, Revision 2, September 2007	13.6
NEI 06-06	Nuclear Energy Institute, "Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites," NEI 06-06, Revision 1, September 2007	13.7
NEI 06-13-A	Nuclear Energy Institute, "Technical Report on a Template for an Industry Training Program Description," NEI 06-13-A, Revision 0, October 2006	13BB
NEI 06-14A	Nuclear Energy Institute, "Quality Assurance Program Description," NEI 06-14A, Revision 4, July 2007	17.5
NEI 07-01	Methodology for Development of Emergency Action Levels Advanced Passive Light Water Reactors, Revision 0, September 2007.	Table 1.9-202
NEI 07-02	Nuclear Energy Institute, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," NEI 07-02, Revision 3, September 2007	17.6
NEI 07-03	Nuclear Energy Institute, "Generic FSAR Template Guidance for Radiation Protection Program Description," NEI 07-03, Revision 3, October 2007	12BB
NEI 07-08	Nuclear Energy Institute, "Generic FSAR Template Guidance for Ensuring That Occupation Radiation Exposures Are As Low As Reasonably Achievable (ALARA)," NEI 07-08, Revision 0, September 2007	12AA
NEI 07-09	Nuclear Energy Institute, "Generic FSAR Template Guidance for Off-Site Dose Calculation Manual (ODCM) Program Description," NEI 07-09, Revision 0, September 2007	11.5
NEI 07-10	Nuclear Energy Institute, "Generic FSAR Template Guidance for Process Control Program (PCP) Description," NEI 07-10, Revision 1, October 2007	11.4

1.7 DRAWINGS AND OTHER DETAILED INFORMATION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following paragraph to the end of this section.

STD COL 1.7-1-H The final P&IDs used for construction will be available upon completion of the final design configuration. Design changes that result in revisions to the simplified diagrams will be incorporated in subsequent updates to the FSAR.

1.7.1 ELECTRICAL AND INSTRUMENTATION AND CONTROL DRAWINGS

Replace the last sentence in this section with the following.

RBS SUP 1.7-1 DCD Table 1.7-2 and Table 1.7-201 provide a summary of the electrical system configuration drawings found throughout the DCD and FSAR, respectively.

1.7.2 PIPING AND INSTRUMENTATION DRAWINGS

Replace the last sentence in this section with the following.

RBS SUP 1.7-2 DCD Table 1.7-3 and Table 1.7-202 provide a summary of the mechanical system configuration drawings found throughout the DCD and FSAR, respectively.

1.7.4 COL INFORMATION

1.7-1-H Final Design Configuration Confirmation

STD COL 1.7-1-H This COL item is addressed in Section 1.7.

RBS SUP 1.7-1

Table 1.7-201
Summary of Electrical System Configuration Drawings

FSAR Figure No.	Title
8.2-201	Entergy Gulf States Louisiana Electrical System Map
8.2-202	On-Site Power System One-Line Diagram
8.2-203	Switchyard Plan
8.2-204	Transformer Area Plan

RBS SUP 1.7-2

Table 1.7-202
Summary of Mechanical System Configuration Drawings

FSAR Figure No.	Title
9.2-201	Potable Water System Simplified Diagram
9.2-202	Sanitary Waste Discharge System Simplified Diagram
9.2-203	Station Water System Simplified Diagram
9.5-201	Fire Protection System Yard Main Loop
10.4-201	Circ Condenser Inlet and Outlet Including Ball Cleaning Subsystem
10.4-202	Circ Mechanical Draft Cooling Tower
10.4-203	Circ Natural Draft Cooling Tower and Pump Pit
10.4-204	Circulating Water Blowdown

1.8 INTERFACES FOR STANDARD DESIGNS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

1.8.2 IDENTIFICATION OF BOP INTERFACES

Add the following paragraph after the first paragraph of this section.

STD CDI

The significant interface requirements for those systems that are beyond the scope of the DCD are identified in DCD Tier 1.

Delete the second sentence of the second paragraph of this section.

RBS SUP 1.8-1

1.8.3 VERIFICATION OF SITE PARAMETERS

Chapter 2 provides information demonstrating that the site characteristics fall within the ESBWR site parameters specified in the referenced certified design.

RBS SUP 1.8-2

1.8.4 COL INFORMATION ITEMS AND PERMIT CONDITIONS

Section 1.10 identifies specific FSAR sections that address the COL information items from the referenced certified design and COL Action Items.

RBS SUP 1.8-3

1.8.5 GENERIC CHANGES AND DEPARTURES FROM THE REFERENCED CERTIFIED DESIGN

Plant-specific departures from the referenced certified design are listed in Table 1.8-201, along with the section of the FSAR in which each is discussed. These departures are described and evaluated in Part 7 of the COLA. There are no generic changes from the referenced certified design.

RBS SUP 1.8-4

1.8.6 CONCEPTUAL DESIGN INFORMATION

The referenced DCD includes the Conceptual Design Information (CDI) for certain systems, or portions of systems, that are outside the scope of the standard plant design. Table 1.8-202 identifies systems for which either the CDI in the DCD is adopted as the actual system design information, or the CDI in the DCD is replaced with site-specific design information, along with cross-references to

FSAR sections where the CDI is treated. Where there are differences between the conceptual design and the actual design, these differences have been evaluated. The evaluations have concluded that there are no impacts on the safety evaluations provided in the referenced certified design.

RBS SUP 1.8-5

1.8.7 PROBABILISTIC RISK ASSESSMENT (PRA)

Site- and plant-specific information, including site meteorological data and site-specific population distribution, plant-specific design information that replaced CDI described in the DCD, and the departures listed in Subsection 1.8.5, were reviewed with respect to the DC PRA. The conclusion, which is documented in Section 19.5, is that there is no significant change from the certified design PRA.

RBS SUP 1.8-3

Table 1.8-201
Departures from the Referenced Certified Design

Number	Subject	FSAR Section
RBS DEP 2.0-1	Seismic Spectra Exceedance	Table 2.0-201 Figure 2.0-201 Figure 2.0-202 Subsection 3.7.1.1.4
RBS DEP 2.0-2	Minimum Shear Wave Velocity	Table 2.0-201 Subsection 2.5.2.6.4
RBS DEP 2.5-1	Settlement	Table 2.0-201 Subsection 2.5.4.10.4
RBS DEP 9.4-1	Heating, Ventilation, and Air Conditioning Exhaust Points	Table 2.0-201 Subsection 2.3.5.1 Subsection 9.4.2 Subsection 9.4.3 Subsection 9.4.4 Subsection 9.4.6 Subsection 11.3 Subsection 11.3.2 Subsection 12.2.2.2
RBS DEP 12.2-1	Annual Airborne Releases	Table 2.0-201 Subsection 11.1.2 Subsection 12.2.2.2

RBS SUP 1.8-5

Table 1.8-202 (Sheet 1 of 5)
Conceptual Design Information

Item in DCD	CDI in DCD Adopted as Actual Design	CDI in DCD Replaced with Actual Design	Evaluation	FSAR Section
1.1.2.1 ESBWR Standard Plant Scope Figure 1.1-1 ESBWR Standard Plant General Site Plan		X	Site plan general site plan provided.	1.1.2.1 Figure 1.1-201
1.2.2.11.4 Main Turbine	X		Conceptual turbine type selected as site-specific design.	1.2.2.11.4
1.2.2.11.7 Main Condenser	X		Conceptual condenser type selected as site-specific design.	1.2.2.11.7
1.2.2.12.1 Makeup Water System		X	Source of water is clarified, filtered river water; prior to transfer to demineralized water storage tank, clarified water is processed with vendor-supplied mobile water treatment system.	1.2.2.12.1
1.2.2.12.6 Oxygen Injection System		X	Oxygen is supplied from the Unit 1 cryogenic skid.	1.2.2.12.6

RBS SUP 1.8-5

Table 1.8-202 (Sheet 2 of 5)
Conceptual Design Information

Item in DCD	CDI in DCD Adopted as Actual Design	CDI in DCD Replaced with Actual Design	Evaluation	FSAR Section
1.2.2.12.13 Hydrogen Water Chemistry Table 3.2-1 P73 Note 9.3.9 Hydrogen Water Chemistry		X	Hydrogen water chemistry option utilized.	1.2.2.12.13 Table 3.2-1 9.3.9
1.2.2.12.15 Zinc Injection System Table 3.2-1 P74 Note 9.3.11 Zinc Injection System		X	Zinc Injection System is not utilized.	1.2.2.12.15 Table 3.2-1 9.3.11
1.2.2.12.16 Freeze Protection		X	Freeze protection incorporated for external tanks and piping that may freeze during winter weather.	1.2.2.12.16
1.2.2.16.10 Other Building Structures		X	Site-specific buildings specified.	1.2.2.16.10
1.8.2 Identification of BOP Interfaces	X		Not applicable.	1.8.2
Appendix 3A Seismic Soil-Structure Interaction Analysis		X	Site-specific geotechnical data described in Chapter 2.	Appendix 3A Chapter 2

RBS SUP 1.8-5

Table 1.8-202 (Sheet 3 of 5)
Conceptual Design Information

Item in DCD	CDI in DCD Adopted as Actual Design	CDI in DCD Replaced with Actual Design	Evaluation	FSAR Section
Appendix 3A.2 ESBWR Standard Site Plan		X	Site-specific general site plan provided.	Section 3A.2 Figure 1.1-201
6.2.5.2 Containment Inerting System Figure 6.2-29		X	Location of Nitrogen Storage Tank Skid is included in Table 2.2-201.	6.2.5.2 Table 2.2-201
9.2.1 Plant Service Water Table 9.2-2 Figure 9.2-1	Figure 9.2-1	X	Site-specific system description and design characteristics described.	9.2.1 Table 9.2-201
9.2.3 Makeup Water System Table 9.2-9		X	Site-specific system description and design characteristics described.	9.2.3 Table 9.2-202
9.2.4 Potable and Sanitary Water Systems		X	Site-specific system description and design characteristics described.	9.2.4 Table 9.2-203 Figure 9.2-201 Figure 9.2-202

RBS SUP 1.8-5

Table 1.8-202 (Sheet 4 of 5)
Conceptual Design Information

Item in DCD	CDI in DCD Adopted as Actual Design	CDI in DCD Replaced with Actual Design	Evaluation	FSAR Section
9.2.10 Station Water System		X	Site-specific system description and design characteristics described.	9.2.10 Table 9.2-204 Figure 9.2-203
9.3.9 Hydrogen Water Chemistry System		X	Site-specific system description and design characteristics described.	9.3.9
10.4.5 Circulating Water System		X	Site-specific system description and design characteristics described.	10.4.5 Table 10.4-3R Table 10.4-201 Figure 10.4-201 Figure 10.4-202 Figure 10.4-203 Figure 10.4-204
11.2 Liquid Waste Management System	X		Conceptual design for liquid waste management selected as site-specific design.	11.2

RBS SUP 1.8-5

Table 1.8-202 (Sheet 5 of 5)
Conceptual Design Information

Item in DCD	CDI in DCD Adopted as Actual Design	CDI in DCD Replaced with Actual Design	Evaluation	FSAR Section
11.4 Solid Waste Management System	X		Conceptual design for solid waste management selected as site-specific design.	11.4

1.9 CONFORMANCE WITH STANDARD REVIEW PLAN AND APPLICABILITY OF CODES AND STANDARDS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

1.9.1 CONFORMANCE WITH STANDARD REVIEW PLAN

Add the following paragraph at the end of this section.

RBS COL 1.9-3-A Table 1.9-201 evaluates conformance with the SRP sections and BTPs in effect 6 months prior to the submittal of the COLA. Table 1.9-201 does not re-address conformance with the SRP for those portions of the facility design included in the referenced certified design.

In the table, the term "Conforms" means that no exception is being taken to the guidance in the SRP section/acceptance criteria as they apply to site-specific design information, operational aspects of the facility, or siting information in the FSAR. The term "Not applicable" means that the SRP section/acceptance criteria do not apply to the ESBWR or Unit 3. Any differences with the SRP acceptance criteria are identified and justified, with references to the applicable FSAR section(s) that address the difference, as necessary.

1.9.2 APPLICABILITY TO REGULATORY CRITERIA

Add the following paragraphs at the end of this section.

RBS COL 1.9-3-A **Division 1, 4, 5, and 8 Regulatory Guides**

Table 1.9-202 evaluates conformance with Division 1, 4, 5, and 8 Regulatory Guides in effect 6 months prior to the submittal of the COLA. Each issued Division 1 Regulatory Guide is evaluated. Issued Division 4, 5, and 8 Regulatory Guides identified in the SRP, Regulatory Guide 1.206, or DCD Table 1.9-21 as COL responsibility, are also evaluated. (Conformance with Division 4 Regulatory Guides is also addressed in ER Chapter 1.) Table 1.9-202 does not re-address conformance with Regulatory Guides for those portions of the facility design included in the referenced certified design.

In the table, the term "Conforms" means that no exception is being taken to the guidance in the regulatory positions as they apply to site-specific design information, operational aspects of the facility, or siting information in the FSAR. The term "Not applicable" means that the regulatory positions do not apply to the ESBWR or Unit 3.

Regulatory Guide 1.206

Table 1.9-203 evaluates conformance with the FSAR content guidance in Regulatory Guide 1.206. Where necessary, the table identifies the FSAR section where the required information is provided. In the table, the term "Conforms" means that the information called for in Regulatory Guide 1.206 is either: 1) already addressed in the DCD or 2) addressed by adding new information beyond that contained in the DCD. The term "Not applicable" means that the information called for in Regulatory Guide 1.206 does not apply to the ESBWR or Unit 3.

Table 1.9-203 evaluates conformance with Regulatory Guide 1.206, Section C.III.1, "Information Needed for a Combined License Application Referencing a Certified Design," and Section C.I, "Standard Format and Content of Combined License Applications for Nuclear Power Plants-Light-Water Reactor Edition," were also evaluated, as applicable, if portions of these sections were referenced or identified in Regulatory Guide 1.206, or Section C.III.1.

Industrial Codes and Standards

RBS SUP 1.9-1 Table 1.9-204 identifies the Industrial Codes and Standards that are applicable to those portions of the Unit 3 design that are beyond the scope of the DCD, and to the operational aspects of the facility.

1.9.3 APPLICABILITY OF EXPERIENCE INFORMATION

Add the following after the first sentence of the section.

STD SUP 1.9-2 Table 1.9-205 lists NUREG and NUREG/CR reports cited in the FSAR.

Add the following paragraph at the end of this section.

Table 1.9-205 addresses operational experience information, as described in applicable NUREG reports, for those portions of the Unit 3 design and operation that are beyond the scope of the 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.

1.9.4 COL INFORMATION

1.9-3-A SRP and Regulatory Guide Applicability

RBS COL 1.9-3-A This COL Item is addressed in Subsections 1.9.1 and 1.9.2.

RBS COL 1.9-3-A

**Table 1.9-201 (Sheet 1 of 53)
Conformance with Standard Review Plan**

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
1	Introduction and Interfaces	Initial Issuance	Mar-07	No Specific Acceptance Criteria	Conforms
2.0	Site Characteristics and Site Parameters	Initial Issuance	Mar-07	II.2, II.4, II.5	Not applicable
				II.1, II.3	Conforms
2.1.1	Site Location and Description	Rev. 3	Mar-07	II.1, II.2	Conforms
2.1.2	Exclusion Area Authority and Control	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
2.1.3	Population Distribution	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
2.2.1 - 2.2.2	Identification of Potential Hazards in Site Vicinity	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
2.2.3	Evaluation of Potential Accidents	Rev. 3	Mar-07	II.1, II.2	Conforms
2.3.1	Regional Climatology	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9	Conforms
2.3.2	Local Meteorology	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
2.3.3	On-Site Meteorological Measurements Programs	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
2.3.4	Short-Term Atmospheric Dispersion Estimates for Accident Releases	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
2.3.5	Long-Term Atmospheric Dispersion Estimates for Routine Releases	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
2.4.1	Hydrologic Description	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
2.4.2	Floods	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10	Conforms
2.4.3	Probable Maximum Flood (PMF) on Streams and Rivers	Rev. 4	Mar-07	II.1, II.2, II.3	Conforms
2.4.4	Potential Dam Failures	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
2.4.5	Probable Maximum Surge and Seiche Flooding	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
2.4.6	Probable Maximum Tsunami Hazards	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
2.4.7	Ice Effects	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
2.4.8	Cooling Water Canals and Reservoirs	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
2.4.9	Channel Diversions	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
2.4.10	Flooding Protection Requirements	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
2.4.11	Low Water Considerations	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
2.4.12	Groundwater	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
2.4.13	Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
2.4.14	Technical Specifications and Emergency Operation Requirements	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
2.5.1	Basic Geologic and Seismic Information	Rev. 4	Mar-07	II.1, II.2	Conforms
2.5.2	Vibratory Ground Motion	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
2.5.3	Surface Faulting	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
2.5.4	Stability of Subsurface Materials and Foundations	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.6, II.7, II.8, II.9, II.10, II.11	Conforms
				II.5	Exception. Backfill sources will be identified and backfill properties will be verified prior to construction.
				II.12	Exception. Evaluation of the effectiveness of foundation improvement measures will be performed prior to construction.
2.5.5	Stability of Slopes	Rev. 3	Mar-07	II. Section 2.5.5.1, II. Section 2.5.5.2, II. Section 2.5.5.3, II. Section 2.5.5.4	Conforms
3.2.1	Seismic Classification	Rev. 2	Mar-07	II.1	Conforms
3.2.2	System Quality Group Classification	Rev. 2	Mar-07	II.1	Conforms
3.3.1	Wind Loadings	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
3.3.2	Tornado Loadings	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
3.4.1	Internal Flood Protection for Onsite Equipment Failures	Rev. 3	Mar-07	II.1, II.2	Conforms
3.4.2	Analysis Procedures	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
3.5.1.1	Internally Generated Missiles (Outside Containment)	Rev. 3	Mar-07	II.1, II.2	Conforms
3.5.1.2	Internally Generated Missiles (Inside Containment)	Rev. 3	Mar-07	II.1, II.2	Conforms
3.5.1.3	Turbine Missiles	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
3.5.1.4	Missiles Generated by Tornadoes and Extreme Winds	Rev. 3	Mar-07	II.1, II.2	Conforms
3.5.1.5	Site Proximity Missiles (Except Aircraft)	Rev. 4	Mar-07	II.1, II.2	Conforms
3.5.1.6	Aircraft Hazards	Rev. 3	Mar-07	II.1, II.2	Conforms
3.5.2	Structures, Systems, and Components to be Protected from Externally Generated Missiles	Rev. 3	Mar-07		Conforms
3.5.3	Barrier Design Procedures	Rev. 3	Mar-07	II.1, II.2	Conforms
3.6.1	Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
3.6.2	Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping	Rev. 2	Mar-07	II.1, II.2, II.3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
3.6.3	Leak Before Break Evaluation Procedures	Rev. 1	Mar-07	II.1, II.2	Not applicable. ESBWR design does not rely on a Leak Before Break Evaluation.
3.7.1	Seismic Design Parameters	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
3.7.2	Seismic System Analysis	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14	Conforms
3.7.3	Seismic Subsystem Analysis	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14	Conforms
3.7.4	Seismic Instrumentation	Rev. 2	Mar-07	II.1, II.2	Conforms
3.8.1	Concrete Containment	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
3.8.2	Steel Containment	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
3.8.3	Concrete and Steel Internal Structures of Steel or Concrete Containments	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
3.8.4	Other Seismic Category I Structures	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
3.8.5	Foundations	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
3.9.1	Special Topics for Mechanical Components	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
3.9.2	Dynamic Testing and Analysis of Systems, Structures, and Components	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
3.9.3	ASME Code Class 1, 2, and 3 Components, and Component Supports, and Core Support Structures	Rev. 2	Mar-07	II.1, II.2, II.3	Conforms
3.9.4	Control Rod Drive Systems	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
3.9.5	Reactor Pressure Vessel Internals	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
3.9.6	Functional Design, Qualification, and In-Service Testing Programs for Pumps, Valves, and Dynamic Restraints	Rev. 3	Mar-07	II.1, II.3, II.4, II.5, II.6	Conforms
				II.2	Not applicable. There are no safety-related pumps.
3.9.7	Risk-Informed In-Service Testing	Rev. 0	Aug-98	II.A, II.B	Not applicable. Risk-informed in-service testing is not being used.
3.9.8	Risk-Informed In-Service Inspection of Piping	Rev. 0	Sep-03	II.1, II.2, II.3	Not applicable. Risk-informed in-service inspection of piping is not being used.
3.10	Seismic and Dynamic Qualification of Mechanical and Electrical Equipment	Rev. 3	Mar-07	II.1, II.2, II.3, II.5	Conforms
				II.4, II.6	Conforms
3.11	Environmental Qualification of Mechanical and Electrical Equipment	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14, II.15	Conforms
				II.16	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
3.12	ASME Code Class 1, 2, and 3 Piping Systems, Piping Components and their Associated Supports	Initial Issuance	Mar-07	II.A, II.B, II.C, II.D	Conforms
3.13	Threaded Fasteners - ASME Code Class 1, 2, and 3	Initial Issuance	Mar-07	II.1, II.2	Conforms
BTP 3-1	Classification of Main Steam Components Other than the Reactor Coolant Pressure Boundary for BWR Plants	Rev. 2	Mar-07		Conforms
BTP 3-2	Classification of BWR/6 Main Steam and Feedwater Components Other than the Reactor Coolant Pressure Boundary	Rev. 2	Mar-07		Conforms
BTP 3-3	Protection Against Postulated Piping Failures in Fluid Systems Outside Containment	Rev. 3	Mar-07		Conforms
BTP 3-4	Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment	Rev. 2	Mar-07		Conforms
4.2	Fuel System Design	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
4.3	Nuclear Design	Rev. 3	Mar-07	II.1, II.2, II.4	Conforms
				II.3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
4.4	Thermal and Hydraulic Design	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.8, II.9, II.10	Conforms
				II.7	Not applicable
4.5.1	Control Rod Drive Structural Materials	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
4.5.2	Reactor Internal and Core Support Structure Materials	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
4.6	Functional Design of Control Rod Drive System	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
BTP 4-1	Westinghouse Constant Axial Offset Control (CAOC)	Rev. 3	Mar-07		Not applicable to the ESBWR
5.2.1.1	Compliance with the Codes and Standards Rule, 10 CFR 50.55a	Rev. 3	Mar-07	RG 1.26	Conforms
5.2.1.2	Applicable Code Cases	Rev. 3	Mar-07	RG 1.84, RG 1.147, RG 1.192	Conforms
5.2.2	Overpressure Protection	Rev. 3	Mar-07	II.1, II.2, II.5, II.6, II.7	Conforms
				II.3, II.4	Not applicable to the ESBWR
5.2.3	Reactor Coolant Pressure Boundary Materials	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms. Acceptance Criterion II.3 is addressed in DCD Section 3.9.3.9.
5.2.4	Reactor Coolant Pressure Boundary In-Service Inspection and Testing	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11	Conforms
5.2.5	Reactor Coolant Pressure Boundary Leakage Detection	Rev. 2	Mar-07	II.1, II.2	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
5.3.1	Reactor Vessel Materials	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
5.3.2	Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock	Rev. 2	Mar-07	II.1, II.2, II.3	Conforms
5.3.3	Reactor Vessel Integrity	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
5.4	Reactor Coolant System Component and Subsystem Design	Rev. 2	Mar-07		Conforms
5.4.1.1	Pump Flywheel Integrity (PWR)	Rev. 2	Mar-07		Not applicable to the ESBWR
5.4.2.1	Steam Generator Materials	Rev. 3	Mar-07		Not applicable to the ESBWR
5.4.2.2	Steam Generator Program	Rev. 2	Mar-07		Not applicable to the ESBWR
5.4.6	Reactor Core Isolation Cooling System (BWR)	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10	Conforms
5.4.7	Residual Heat Removal (RHR) System	Rev. 4	Mar-07	II.1, II.2, II.3, II.4	Conforms
5.4.8	Reactor Water Cleanup System (BWR)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
5.4.11	Pressurizer Relief Tank	Rev. 3	Mar-07		Not applicable to the ESBWR
5.4.12	Reactor Coolant System High Point Vents	Rev. 1	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14	Conforms
5.4.13	Isolation Condenser System (BWR)	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 5-1	Monitoring of Secondary Side Water Chemistry in PWR Steam Generators	Rev. 3	Mar-07		Not applicable to the ESBWR
BTP 5-2	Overpressurization Protection of Pressurized-Water Reactors While Operating at Low Temperatures	Rev. 3	Mar-07		Not applicable to the ESBWR
BTP 5-3	Fracture Toughness Requirements	Rev. 3	Mar-07		Conforms
BTP 5-4	Design Requirements of the Residual Heat Removal System	Rev. 3	Mar-07		Not applicable to ESBWR
6.1.1	Engineered Safety Features Materials	Rev. 2	Mar-07	II.1, II.2, II.3, II.4	Conforms
6.1.2	Protective Coating Systems (Paints) - Organic Materials	Rev. 3	Mar-07	II.1	Conforms
6.2.1	Containment Functional Design	Rev. 3	Mar-07		Conforms
6.2.1.1.A	PWR Dry Containments, Including Subatmospheric Containments	Rev. 3	Mar-07		Not applicable to the ESBWR
6.2.1.1.B	Ice Condenser Containments	Draft Rev. 3	Jun-96		Not applicable to the ESBWR
6.2.1.1.C	Pressure-Suppression Type BWR Containments	Rev. 7	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11	Conforms
6.2.1.2	Subcompartment Analysis	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
6.2.1.3	Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents (LOCAs)	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
6.2.1.4	Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures	Rev. 2	Mar-07		Not applicable to the ESBWR
6.2.1.5	Minimum Containment Pressure Analysis for Emergency Core Cooling System Performance Capability Studies	Rev. 3	Mar-07		Not applicable to the ESBWR
6.2.2	Containment Heat Removal Systems	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8	Conforms
6.2.3	Secondary Containment Functional Design	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms. See DCD Table 1.9-20.
6.2.4	Containment Isolation System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14, II.15, II.16, II.17, II.18, II.19, II.20, II.21, II.22	Conforms
6.2.5	Combustible Gas Control in Containment	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9	Conforms
6.2.6	Containment Leakage Testing	Rev. 3	Mar-07		Conforms
6.2.7	Fracture Prevention of Containment Pressure Boundary	Rev. 1	Mar-07	II.1, II.2	Conforms
6.3	Emergency Core Cooling System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.6, II.7, II.8, II.10	Conforms
				II.5, II.9	Not applicable

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
6.4	Control Room Habitability System	Rev. 3	Mar-07	II.1, II.2, II.4, II.5, II.6	Conforms
				II.3	Exception: For differential pressure testing of the control room, the periodic verification interval of every 18 months in Acceptance Criteria II.3.a through II.3.c is increased to every 24 months to accommodate the ESBWR's 2-year operating cycle. The frequencies for testing the CR HVAC system are defined by Technical Specifications 3.7.2 and 5.5.12 of the referenced certified design.
				II.7	Exception: SRP states that self-contained breathing apparatus for the control room personnel should be on hand. DCD 6.4.1.1 states that CRHA habitability requirements are satisfied without the need for individual breathing apparatus and/or special clothing.
6.5.1	ESF Atmosphere Cleanup Systems	Rev. 3	Mar-07		Conforms. Surveillances, testing, and maintenance guidelines for the CRHAVS are addressed in Technical Specifications 3.7.2, 5.5.12, and 5.5.13, Maintenance Rule requirements in Section 17.6, and procedure requirements in Section 13.5.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
6.5.2	Containment Spray as a Fission Product Cleanup System	Rev. 4	Mar-07		Not applicable. See DCD Table 1.9-20.
6.5.3	Fission Product Control Systems and Structures	Rev. 3	Mar-07	II.1, II.2, (there is no II.3)	Conforms
				II.4	Not applicable. Drywell spray function is not credited in DCD Chapter 15 dose analysis.
6.5.4	Ice Condenser as a Fission Product Cleanup System	Draft Rev. 4	Jun-96		Not applicable to the ESBWR
6.5.5	Pressure Suppression Pool as a Fission Product Cleanup System	Rev. 1	Mar-07	II.1, II.2	Conforms. Refer to DCD Table 1.9-20.
				II.3	Not applicable
6.6	In-Service Inspection and Testing of Class 2 and 3 Components	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11	Conforms
6.7	Main Steam Isolation Valve Leakage Control System (BWR)	Draft Rev. 3	Jun-96		Not applicable
BTP 6-1	pH for Emergency Coolant Water for Pressurized Water Reactors	Initial Issuance	Mar-07		Not applicable to the ESBWR
BTP 6-2	Minimum Containment Pressure Model for PWR ECCS Performance Evaluation	Rev. 3	Mar-07		Not applicable to the ESBWR
BTP 6-3	Determination of Bypass Leakage Paths in Dual Containment Plants	Rev. 3	Mar-07		Conforms. Refer to DCD Table 1.9-20.
BTP 6-4	Containment Purging During Normal Plant Operations	Rev. 3	Mar-07		Conforms. Refer to TS SR 3.6.1.3.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 6-5	Currently the Responsibility of Reactor Systems Piping from the RWST (or BWST) and Containment Sump(s) to the Safety Injection Pumps	Rev. 3	Mar-07		Not applicable
7.0	Instrumentation and Controls - Overview of Review Process	Rev. 5	Mar-07		Conforms
Appendix 7.0-A	Review Process for Digital Instrumentation and Control Systems	Rev. 5	Mar-07		Conforms
7.1	Instrumentation and Controls - Introduction	Rev. 5	Mar-07	II.1, II.2, II.3	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
7.1-T	Table 7-1 Regulatory Requirements, Acceptance Criteria, and Guidelines for Instrumentation and Control Systems Important to Safety	Rev. 5	Mar-07		Conforms
Appendix 7.1-A	Acceptance Criteria and Guidelines for Instrumentation and Controls Systems Important to Safety	Rev. 5	Mar-07	1, 2, 3, 4, 5	Conforms
Appendix 7.1-B	Guidance for Evaluation of Conformance to IEEE Std 279	Rev. 5	Mar-07		Conforms
Appendix 7.1-C	Guidance for Evaluation of Conformance to IEEE Std 603	Rev. 5	Mar-07		Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
Appendix 7.1-D	Guidance for Evaluation of the Application of IEEE Std 7-4.3.2	Initial Issuance	Mar-07	SRM to SECY 93-087 II.Q	Conforms
7.2	Reactor Trip System	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, SRM to SECY 93-087 II.Q	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.3	Engineered Safety Features Systems	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, SRM to SECY 93-087 II.Q	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.4	Safe Shutdown Systems	Rev. 5	Mar-07	II.1, II.2, II.3	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.5	Information Systems Important to Safety	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, II.5, SRM to SECY 93-087 II.Q	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.6	Interlock Systems Important to Safety	Rev. 5	Mar-07	II.1, II.2, II.3	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.7	Control Systems	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, SRM to SECY 93-087 II.Q	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
7.8	Diverse Instrumentation and Control Systems	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, SRM to SECY 93-087 II.Q	Conforms. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
7.9	Data Communication Systems	Rev. 5	Mar-07	II.1, II.2, II.3	Conforms. Addressed in DCD Section 7.1. Procedures addressed in Section 13.5. Technical Specifications addressed in Chapter 16. ITAAC addressed in COLA Part 10.
Appendix 7-A	General Agenda, Station Site Visits (formerly Appendix 7-B)	Rev. 5	Mar-07		Not applicable. Provides guidance to the NRC to conduct site visits.
Appendix 7-B	Acronyms, Abbreviations, and Glossary (formerly Appendix 7-C)	Rev. 5	Mar-07		Conforms
BTP 7-1	Guidance on Isolation of Low-Pressure Systems from the High-Pressure Reactor Coolant System	Rev. 5	Mar-07		Conforms
BTP 7-2	Guidance on Requirements of Motor-Operated Valves in the Emergency Core Cooling System Accumulator Lines	Rev. 5	Mar-07		Not applicable to the ESBWR
BTP 7-3	Guidance on Protection System Trip Point Changes for Operation with Reactor Coolant Pumps Out of Service	Rev. 5	Mar-07		Not applicable to the ESBWR

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 7-4	Guidance on Design Criteria for Auxiliary Feedwater Systems	Rev. 5	Mar-07		Not applicable to the ESBWR
BTP 7-5	Guidance on Spurious Withdrawals of Single Control Rods in Pressurized Water Reactors	Rev. 5	Mar-07		Not applicable to the ESBWR
BTP 7-6	Guidance on Design of Instrumentation and Controls Provided to Accomplish Changeover from Injection to Recirculation Mode	Rev. 5	Mar-07		Not applicable. ESBWR does not use recirculation pumps or active ECCS pumps.
HICB-7	Not Used				Not used
BTP 7-8	Guidance for Application of Regulatory Guide 1.22	Rev. 5	Mar-07		Conforms. Chapter 16 addresses Technical Specifications.
BTP 7-9	Guidance on Requirements for Reactor Protection System Anticipatory Trips	Rev. 5	Mar-07		Conforms
BTP 7-10	Guidance on Application of Regulatory Guide 1.97	Rev. 5	Mar-07		Conforms. Section 13.5 addresses procedures.
BTP 7-11	Guidance on Application and Qualification of Isolation Devices	Rev. 5	Mar-07		Conforms
BTP 7-12	Guidance on Establishing and Maintaining Instrument Setpoints	Rev. 5	Mar-07		Conforms. Section 13.5 addresses procedures.
BTP 7-13	Guidance on Cross-Calibration of Protection System Resistance Temperature Detectors	Rev. 5	Mar-07		Not applicable. RTDs are not used in the ESBWR protection systems.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 7-14	Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems	Rev. 5	Mar-07		Conforms
HCIB-15	Not Used				Not used
BTP 7-16	Withdrawn				Withdrawn
BTP 7-17	Guidance on Self-Test and Surveillance Test Provisions	Rev. 5	Mar-07		Conforms. Section 13.5 addresses procedures. Chapter 16 addresses Technical Specifications.
BTP 7-18	Guidance on the Use of Programmable Logic Controllers in Digital Computer-Based Instrumentation and Control Systems	Rev. 5	Mar-07		Conforms. Section 13.5 addresses procedures.
BTP 7-19	Guidance for Evaluation of Diversity and Defense-in-Depth in Digital Computer-Based Instrumentation and Control Systems	Rev. 5	Mar-07		Conforms
HCIB-20	Not Used				Not used
BTP 7-21	Guidance on Digital Computer Real-Time Performance	Rev. 5	Mar-07		Conforms
8.1	Electric Power - Introduction	Rev. 3	Mar-07		Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
8.2	Off-Site Power System	Rev. 4	Mar-07	II.4, II.5, II.8	Conforms
				II.1, II.2, II.3, II.6, II.7	Not applicable. ESBWR is a passive design and does not rely on off-site power.
8.3.1	AC Power Systems (On-site)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4.A, II.4.C, II.4.D, II.4.E, II.4.F, II.4.H, II.4.J, II.5, II.6, II.7, II.10	Conforms
				II.4.B, II.4.I	Not applicable. The ESBWR diesel generators are not safety-related.
				II.4.G, II.8	Not applicable. The ESBWR diesel generators are not safety-related, nor is AC power needed to achieve safe shutdown.
				II.9	Conforms. Addressed in DCD 17.4 and Section 17.6.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
8.3.2	DC Power Systems (On-site)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.7, II.8, II.9, II.10	Conforms
				II.5, II.6	Not applicable. Addressed in DCD Sections 8.3.2.1.1 and 8.3.2.2.2.
				II.11	Not applicable. The ESBWR is designed to shutdown safely without reliance on offsite or diesel-generator-derived AC power for 72 hours, which exceeds station blackout requirements.
				II.12	Conforms. Addressed in Section 17.6.
				II.13	Conforms. Addressed in Section 17.6.
8.4	Station Blackout	Initial Issuance	Mar-07	II.1, II.2	Conforms. Addressed in DCD Section 15.5.5.
				II.3	Not applicable. On-site Class 1E Emergency AC power sources are not required for ESBWR safe shutdown.
				II.4, II.5	Conforms. Addressed in Section 17.6.
Appendix 8-A	General Agenda, Station Site Visits	Rev. 1	Mar-07		Not applicable. Provides guidance to NRC to conduct site visits.
BTP 8-1	Requirements on Motor-Operated Valves in the ECCS Accumulator Lines	Rev. 3	Mar-07		Not applicable. The ESBWR does not have any safety-related motor-operated valves.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 8-2	Use of Diesel-Generator Sets for Peaking	Rev. 3	Mar-07		Not applicable. The ESBWR will not use the nonsafety-related diesel generators as peaking units.
BTP 8-3	Stability of Off-Site Power Systems	Rev. 3	Mar-07		Conforms - Stability studies investigating worst case loss of off-site generation were performed
BTP 8-4	Application of the Single Failure Criterion to Manually-Controlled, Electrically-Operated Valves	Rev. 3	Mar-07		Not applicable. The ESBWR does not use any manually operated valves to mitigate an accident.
BTP 8-5	Supplemental Guidance for Bypass and Inoperable Status Indication for Engineered Safety Features Systems	Rev. 3	Mar-07		Not applicable. The ESBWR does not rely on safety-related AC power systems. However, refer to DCD Table 7.1-1 for conformance to RG 1.47 and BISI for all safety-related systems.
BTP 8-6	Adequacy of Station Electric Distribution System Voltages	Rev. 3	Mar-07		Not Applicable - The use of batteries/ inverters in the supply arrangement of the ESBWR Class 1E buses results in independence from off-site power with respect to the voltage on the 1E buses.
BTP 8-7	Criteria for Alarms and Indications Associated with Diesel-Generator Unit Bypassed and Inoperable Status	Rev. 3	Mar-07		Not applicable. The ESBWR does not use safety-related diesel generators.
9.1.1	Criticality Safety of Fresh and Spent Fuel Storage and Handling	Rev. 3	Mar-07	II.1	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
9.1.2	New and Spent Fuel Storage	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
9.1.3	Spent Fuel Pool Cooling and Cleanup System	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
				II.8	Conforms. EP-ITAAC are addressed in COLA Part 10.
9.1.4	Light Load Handling System (Related to Refueling)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.1.5	Overhead Heavy Load Handling Systems	Rev. 1	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.2.1	Station Service Water System	Rev. 5	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
9.2.2	Reactor Auxiliary Cooling Water Systems	Rev. 4	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
9.2.3	Demineralized Water Makeup System				SRP withdrawn
9.2.4	Potable and Sanitary Water Systems	Rev. 3	Mar-07	II.1.A, II.1.B, II.1.C	Conforms
9.2.5	Ultimate Heat Sink	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
9.2.6	Condensate Storage Facilities	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
9.3.1	Compressed Air System	Rev. 2	Mar-07	II.1, II.2, II.3, II.4	Conforms. Instrument Air is addressed in DCD Section 9.3.6, Service Air is addressed in DCD Section 9.3.7, and High-Pressure Nitrogen Supply System is addressed in DCD Section 9.3.8.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
9.3.2	Process and Post-accident Sampling Systems	Rev. 3	Mar-07	II.1, II.3, II.4	Conforms
				II.2	Exception. Technical Specifications do not require analyses. Subsection 9.3.2 addresses actions required to qualify process sampling for taking radioactive samples without having a specific post-accident sampling system. Analyses and frequencies of process systems are addressed in plant operating procedures.
9.3.3	Equipment and Floor Drainage System	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
9.3.4	Chemical and Volume Control System (PWR) (Including Boron Recovery System)	Rev. 3	Mar-07		Not applicable to the ESBWR
9.3.5	Standby Liquid Control System (BWR)	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
9.4.1	Control Room Area Ventilation System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms. Section 9.4 was evaluated against these criteria.
9.4.2	Spent Fuel Pool Area Ventilation System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.4.3	Auxiliary and Radwaste Area Ventilation System	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms. Section 9.4 was evaluated against these criteria.
9.4.4	Turbine Area Ventilation System	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
9.4.5	Engineered Safety Feature Ventilation System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
9.5.1	Fire Protection Program	Rev. 5	Mar-07	II.1, II.2, II.4	Not applicable. See DCD Table 1.9-21.
				II.3, II.5, II.6	Conforms
				II.7	Exception: The elements of the Fire Protection Program required to be operational prior to receipt of new fuel are those elements necessary to protect buildings storing new fuel and adjacent fire areas that could affect the fuel storage area. Other required elements of the Fire Protection Program will be fully operational prior to initial fuel loading. Refer to Section 13.4.
9.5.2	Communications Systems	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.14	Conforms
9.5.3	Lighting Systems	Rev. 3	Mar-07	II.1, II.2, II.3, II.4	Conforms
9.5.4	Emergency Diesel Engine Fuel Oil Storage and Transfer System	Rev. 3	Mar-07		Not applicable to the ESBWR
9.5.5	Emergency Diesel Engine Cooling Water System	Rev. 3	Mar-07		Not applicable to the ESBWR
9.5.6	Emergency Diesel Engine Starting System	Rev. 3	Mar-07		Not applicable to the ESBWR

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
9.5.7	Emergency Diesel Engine Lubrication System	Rev. 3	Mar-07		Not applicable to the ESBWR
9.5.8	Emergency Diesel Engine Combustion Air Intake and Exhaust System	Rev. 3	Mar-07		Not applicable to the ESBWR
10.2	Turbine Generator	Rev. 3	Mar-07	II.1.A, II.1.B	Conforms
				II.1.C	Exception: The TGS has the capability to permit periodic testing of all components important to safety while the unit is at or above rated speed. In DCD Section 10.2.2.7, a list of components that may be tested with the unit at load is provided. However, some load reduction may be necessary before testing main stop and control valves, and intermediate stop and intercept valves (see DCD Section 10.2.3.7). Overspeed trip testing is performed at speed levels greater than or equal to rated speed with no electrical load. Thus, not all components are capable of being tested at rated load as required in the corresponding Acceptance Criterion. (continued)

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
10.2	Turbine Generator (continued)				
				II.1.C (continued)	Load reduction for turbine valve testing is common in the existing fleet of power reactors and is considered acceptable. Testing at turbine loads below the rated load condition is considered an acceptable means of confirming that equipment relied on to prevent turbine overspeed related failures is available and capable of providing required functions. Further, component redundancies, as described in DCD Section 10.2.2.4, ensure that a single failure of any of the above valves important to safety will not disable the function of the overspeed protection system.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
10.2	Turbine Generator (continued)			II.2.A	Exception: In-service inspection of main steam and reheat valves is discussed in DCD Sections 10.2.2.7 and 10.2.3.7. The first disassembly and visual inspection of all main stop valves, main control valves, intermediate stop valves, and intercept valves are performed within the first three refueling shutdowns. However, the interval for subsequent inspections may be extended beyond the SRP interval of 3-1/3 years to an interval consistent with applicable industry guidance, subject to the requirements of the turbine missile probability analysis. The inspection interval may not exceed the requirements or assumptions in the turbine missile probability analysis. Further, inspection intervals are only extended if there are no significant findings in the initial (baseline) inspections. Thus, with the above provisions, extending the inspection interval beyond the SRP interval is considered acceptable.
				II.2.B, II.3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
10.2.3	Turbine Rotor Integrity	Rev. 2	Mar-07	II.1, II.2	Conforms
				II.3.A	Exception - DCD Section 10.2.3.5 states that, "Forgings are rough-machined with minimum stock allowance prior to heat treatment." This statement meets the intent of the corresponding SRP Acceptance Criterion. The exception to the Acceptance Criterion is introduced with the reference to welded rotors. The GE N1R steam turbine selected for this site utilizes integral forgings in the rotor design and fabrication. Although other manufacturers produce welded rotors, the GE N1R rotor is not a welded rotor design and does not utilize welding to construct the base rotor. Flaws in the forging may be repaired by welding and other means, but only after heat treatment. Thus, the intent of this Acceptance Criterion is met.
				II.3.B, II.3.C, II.3.D, II.4, II.5	Conforms
10.3	Main Steam Supply System	Rev. 4	Mar-07	II.1, II.2, II.3, II.5, II.6, II.7, II.8	Conforms
				II.4	Not applicable to the ESBWR
10.3.6	Steam and Feedwater System Materials	Rev. 3	Mar-07	II.1, II.2	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
10.4.1	Main Condensers	Rev. 3	Mar-07	II.1	Conforms
10.4.2	Main Condenser Evacuation System	Rev. 3	Mar-07	II.1	Conforms
10.4.3	Turbine Gland Sealing System	Rev. 3	Mar-07		Conforms
10.4.4	Turbine Bypass System	Rev. 3	Mar-07	II.1, II.2, II.3	Conforms
10.4.5	Circulating Water System	Rev. 3	Mar-07	II.1	Conforms
10.4.6	Condensate Cleanup System	Rev. 3	Mar-07	II.1	Conforms
				II.2	Not applicable to the ESBWR

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
10.4.7	Condensate and Feedwater System	Rev. 4	Mar-07	II.1, II.2.B, II.3, II.4, II.5, II.6	Conforms
				II.2.A	Not applicable to the ESBWR
				II.7	Exception: This SRP acceptance criterion states that guidance for acceptable FAC inspection programs "is found in (NRC) Generic Letter 89-08 and in EPRI NP-3944." EPRI document NSAC-202L, Rev. 2, supersedes EPRI NP-3944 and is therefore referenced in place of EPRI NP-3944 in DCD Section 6.6.7, for guidance regarding FAC (erosion corrosion) monitoring and related inspection programs. The more recent document, EPRI NSAC-202L, utilizes more extensive industry experience and improved inspection methods and modeling. The substitution of EPRI NSAC-202L, Rev. 2, in place of EPRI NP-3944 is therefore acceptable.
				II.8	Conforms. Addressed in DCD Sections 3.9.3, 5.2.4, and 10.4.7, and DCD Tables 1.9-22 and 1.11-1.
10.4.8	Steam Generator Blowdown System (PWR)	Rev. 3	Mar-07		Not applicable to the ESBWR
10.4.9	Auxiliary Feedwater System (PWR)	Rev. 3	Mar-07		Not applicable to the ESBWR

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 10-1	Design Guidelines for Auxiliary Feedwater System Pump Drive and Power Supply Diversity for Pressurized Water Reactor Plants	Rev. 3	Mar-07		Not applicable to the ESBWR
BTP 10-2	Design Guidelines for Avoiding Water Hammers in Steam Generators	Rev. 4	Mar-07		Not applicable to the ESBWR
11.1	Source Terms	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.6, II.7, II.8, II.9	Conforms. Addressed in DCD Section 12.2 and in FSAR Section 12.2.
				II.5	Conforms. Addressed in Section 11.2 and 11.3.
11.2	Liquid Waste Management System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms. Addressed in DCD Sections 11.2 and 12.2, and in FSAR Sections 11.2 and 12.2.
				II.6	Not applicable. Applies to ESP applications.
11.3	Gaseous Waste Management System	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms. Addressed in DCD Sections 11.3 and 12.2, and in FSAR Sections 11.2 and 12.2.
				II.8	Not applicable. Applies to ESP applications.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
11.4	Solid Waste Management System	Rev. 3	Mar-07	II.1, II.2, II.5, II.7, II.8, II.9, II.14	Conforms
				II.3, II.4, II.6, II.11. II.12, II.13	Conforms (addressed in DCD Section 11.4 and in FSAR Section 11.4; for Acceptance Criterion II.13, this is also addressed in Section 11.5) with the following exception: RG 1.206, Section 13.4 includes the PCP as an operational program, and only requires a program description in the COLA and a milestone for full program implementation. The FSAR provides a description of the PCP, along with the implementation milestone. Procedures for handling waste will be developed once the PCP is implemented.
				II.10	Not applicable. There is no temporary on-site storage facility.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
11.5	Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems	Rev. 4	Mar-07	II.1, II.2	Addressed in DCD Section 11.5.2.
				II.3, II.4, II.5	Conforms (addressed in DCD Sections 11.5.2 and 11.5.3, and in Section 11.5) with the following exception: RG 1.206, Section 13.4 includes the ODCM (including the SREC) and PCP as operational programs, and only requires program descriptions in the COLA and milestones for full program implementation. The FSAR provides descriptions of the PCP and ODCM along with implementation milestones.
				II.6	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
BTP 11-3	Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants	Rev. 3	Mar-07	B.1,B.3, B.5	Conforms
				B.2, B.4	Conforms (addressed in DCD Section 11.4 and in FSAR Section 11.4; for Acceptance Criterion II.13, this is also addressed in Section 11.5) with the following exception: RG 1.206, Section 13.4 includes the PCP as an operational program, and only requires a program description in the COLA and a milestone for full program implementation. The FSAR provides a description of the PCP, along with the implementation milestone. Procedures for handling waste will be developed once the PCP is implemented.
BTP 11-5	Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure	Rev. 3	Mar-07		Conforms. Addressed in DCD Section 11.3.
BTP 11-6	Postulated Radioactive Releases Due to Liquid-Containing Tank Failures	Rev. 3	Mar-07		Conforms. Addressed in DCD Subsection 15.3.16 and in FSAR Section 2.4.13.
12.1	Assuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable	Rev. 3	Mar-07	II.1, II.2. II.3, II.4	Conforms. Addressed in Section 13.2, and Appendices 12AA and 12BB.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
12.2	Radiation Sources	Rev. 3	Mar-07	II.1	Not applicable. Acceptance criterion cites RG 1.3. SRP states RG 1.3 is applicable to license holders issued prior to January 10, 1997. COL Applicant is not a license holder.
				II.2	Not applicable to the ESBWR
				II.3	Conforms. Addressed in DCD Sections 12.3 and 15.4 and in FSAR Section 6.4.
				II.4	Conforms. Addressed in DCD Section 12.3.
				II.5	Conforms
				II.6	Conforms. Addressed in DCD Sections 1A and 12.2.
				II.7	Conforms. Addressed in DCD Section 12.2.
12.3–12.4	Radiation Protection Design Features	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
12.5	Operational Radiation Protection Program	Rev. 3	Mar-07	II.1	Conforms with the following exceptions: 1) NUREG-0731 is not active and is not utilized; 2) RG 8.8 specifies the use of RG 1.16. Reporting per C.1.b(2) and C.1.b(3) of RG 1.16 is no longer required.
				II.2.A, II.2.B, II.2.C, II.2.D, II.2.E.i, II.2.E.ii, II.2.E.iii, II.2.E.iv, II.2.F, II.2.G, II.2.H, II.4	Conforms
				II.2.E.v	Conforms with the following exception: NUREG-1736 states that RGs 8.20, 8.26, and 8.32 are outdated and recommends use of the methods in RG 8.9, Rev. 1. Therefore, the methods identified in RG 8.9, Rev. 1 will be used in place of those in RGs 8.20, 8.26, and 8.32.
				II.3	Conforms with the following exceptions: 1) RG 8.25 is not applicable to power stations; 2) NUREG-1736 states that RGs 8.20, 8.26, and 8.32 are outdated and recommends use of the methods in RG 8.9, Rev. 1.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.1.1	Management and Technical Support Organization	Rev. 5	Mar-07	II.1.A, B, D, II.2.A.i through II.2.A.v	Conforms. Addressed in Sections 13.1 and 14.2.
				II.1.C	Exception: Design and construction responsibilities are not defined in numbers. The experience requirements of corporate staff are set by corporate policy and not provided in detail; however, the experience level of Entergy, as discussed in Section 13.1 and Appendix 13AA, in the area of nuclear plant development, construction, and management establishes that Entergy has the necessary capability and staff to ensure that design and construction of the facility will be performed in an acceptable manner.
				II.2.A.vi, II.2.A.vii	Conforms. Addressed in Sections 13.1 and 14.2.
				II.2.A.viii	Not applicable. Only applies to applicants whose applications were pending as of February 16, 1982.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.1.2 - 13.1.3	Operating Organization	Rev. 6	Mar-07	General 1	Exception: SRP requires operational, on-site technical support, and maintenance groups to be under the direction and supervision of a plant manager. Entergy has organized much of its technical support with direct reporting to off-site/corporate organizations and dotted line reporting to the site executive in charge of plant management. This applies to such groups as training, security, emergency preparedness, QA, licensing, and projects.
				General 2, General 3	Conforms
				General 4	Not applicable. There are no requests for exemptions from the requirements of 10 CFR 50.54(m).

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
				II.1.A, II.1.B	Conforms with the following exception: Quality assurance is in accordance with the QAPD. QA requirements as they apply to the operating organization and on-site review are described in the QAPD. Responsibilities and authorities of operating personnel conform to the guidance of ANSI/ANS-3.2-1994 (R1999). Rules of practice, fire protection, RG 1.8 and TMI item I.C.3 are addressed in Section 13.1.
				II.1.A.i through II.1.A.v, II.1.C, II.1.E, II.1.F, II.1.G	Conforms
				II.1.D	Not applicable
				II.1.H	Conforms. Addressed in Section 13.2.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.2.1	Reactor Operator Requalification Program: Reactor Operator Training	Rev. 3	Mar-07	II.1.A.i	Conforms. Addressed in Section 13.1.
				II.1.A.ii, II.1.A.iii, II.1.A.v, II.1.B, II.1.D, II.1.E	Conforms
				II.1.A.iv	Conforms. Addressed in Sections 13.1, 13.2, and 17.5.
				II.1.A.vi	Conforms. Addressed in DCD Chapter 18.
				II.1.A.vii	Exception: The COLA incorporates by reference approved industry template NEI 06-13, which does not address compliance with NUREG-1021.
				II.1.C	Exception: This item states that "formal segments of the initial licensed operator training program should be substantially complete when the preoperational program test begins." Appendix13BB (via NEI 06-13) commits to a similar state of readiness: "Before initial fuel loading, the number of persons trained in preparation for RO and SRO licensing examinations will be sufficient to meet regulatory requirements, with allowances for examination contingencies and without the need for planned overtime."

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.2.2	Non-Licensed Plant Staff Training	Rev. 3	Mar-07	II.1, II.2, II.3, II.4, II.5, II.7, II.8, II.9	Conforms
				II.6	Exception. This item states that "formal segments of the initial training program should be substantially complete when the pre-operational test program begins." Appendix13BB (via NEI 06-13) commits to a similar state of readiness: "Before initial fuel loading, sufficient plant staff will be trained to provide for safe plant operations."
				II.10	Conforms. Addressed in DCD Section 9.5.1.
				II.11	Conforms. Addressed in Sections 13.2 and 13.4
13.3	Emergency Planning	Rev. 3	Mar-07	II.1, II.2,	Conforms. Addressed in Section 13.4, COLA Part 5, and COLA Part 10.
				II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II.11, II.12, II.13, II.17, II.18, II.27, II.28, II.29, II.30	Conforms. Addressed in COLA Part 5.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
				II.14	Not applicable. Allows NRC to issue a license when applicant asserts that noncompliance with off-site EP requirements is because state or local government has declined to participate in emergency planning.
				II.15, II.16, II.19, II.20, II.21	Not applicable. Only applies to ESP applications.
				II.22	Not applicable. Only applies to design certification applications.
				II.23	Conforms. Addressed in COLA Part 10.
				II.24	Conforms: Emergency Planning ITAAC were developed using SECY 05-0197 and were tailored to the specific reactor design and emergency planning program requirements.
				II.25	Conforms. Addressed in DCD Section 13.3 and COLA Part 5. The EOF will be used for Unit 3.
				II.26	Conforms. Reviewed under SRPs 7.5 and 18.2.
				II.31	Conforms. Addressed in Section 13.4.
13.4	Operational Programs	Rev. 3	Mar-07		Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.5.1.1	Administrative Procedures - General	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.6, II.7	Conforms
				II.5	Conforms with the following exception: Section 13.5 conforms to the updated version of ANSI/ANS-3.2-1994 (R1999).
				II.8	Section 13.5 and DCD Section 18.9 discuss conformance with NUREG-0711
				II.9, II.10, II.12, II.13, II.14, II.15, II.16, II.17, II.18, II.19, II.20	Conforms
				II.11	Conforms with the following exception: Section 13.5 conforms to the updated version of ANSI/ANS-3.2-1994 (R1999).
13.5.2.1	Operating and Emergency Operating Procedures	Rev. 2	Mar-07	II.1	Conforms
				II.2.A, II.2.B	Conforms
				II.2.C	Section 13.5 and DCD Section 18.9 discuss conformance with NUREG-0711
				II.2.D, II.2.E, II.2.H, II.2.I	Conforms.
				II.2.F, II.2.G	Conforms with the following exception: Section 13.5 conforms to the updated version of ANSI/ANS-3.2-1994 (R1999).

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Conformance with Standard Review Plan

SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
13.6	Physical Security	Rev. 3	Mar-07		Addressed in COLA Part 8.
13.6.1	Physical Security - Combined License Review Responsibilities	Initial Issuance	Mar-07		Addressed in COLA Part 8.
13.6.2	Physical Security - Design Certification	Initial Issuance	Mar-07		Not applicable. Applies to design certification applications.
13.6.3	Physical Security - Early Site Permit	Initial Issuance	Mar-07		Not applicable. Applies to ESP applications.
14.2	Initial Plant Test Program - Design Certification and New License Applicants	Rev. 3	Mar-07	1A, 1B, 1C, 2A, COL/OL Applicants: 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 4A, 4B, 5A, 5B, 6A, 6C	Conforms
				5C	Not applicable. No first-of-a-kind features utilized in the facility.
				5D	Not applicable. No test exceptions have been identified.
				6B	Not applicable. FSAR references a certified design.
				DC Applicants: 3A, 3B, 3C, 3D, 4A, 6A, 6B, 6C	Not applicable. Applies to DC applicants.
14.2.1	Generic Guidelines for Extended Power Uprate Testing Programs	Initial Issuance	Aug-06		Not applicable. Applies to power uprates.
14.3	Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2	Conforms
14.3.1	[Reserved]	[Reserved]	Mar-07		Not used

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
14.3.2	Structural and Systems Engineering - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II.9, II.10, II. 11	Conforms
14.3.3	Piping Systems and Components - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2.A, II.2.B, II.2.C, II.2.D, II.2.E	Conforms
14.3.4	Reactor Systems - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
14.3.5	Instrumentation and Controls - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
14.3.6	Electrical Systems - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	Class 1E Equipment: II.1, II.2, II.3, II.4, II.5 Other Electrical Equipment Important to Safety: II.1, II.2, II.3, II.4, II.5	Conforms
14.3.7	Plant Systems - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7, II.8, II. 9	Conforms
14.3.8	Radiation Protection - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3	Conforms
14.3.9	Human Factors Engineering - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5, II.6	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
14.3.10	Emergency Planning - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2	Conforms
14.3.11	Containment Systems - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1, II.2, II.3, II.4, II.5	Conforms
14.3.12	Physical Security Hardware - Inspections, Tests, Analyses, and Acceptance Criteria	Initial Issuance	Mar-07	II.1	Conforms. The security ITAAC are generic and included in the referenced certified design. No site-specific security ITAAC are required.
15	Introduction - Transient and Accident Analyses	Rev. 3	Mar-07	I.1, I.2, 1.3, I.4, I.5, I.6	Conforms
15.0.1	Radiological Consequence Analyses Using Alternative Source Terms	Rev. 0	Jul-00	V	Conforms
15.0.2	Review of Transient and Accident Analysis Method	Rev. 0	Dec-05	II.1, II.2, II.3, II.4, II.5, II.6	Conforms
15.0.3	Design Basis Accident Radiological Consequences of Analyses for Advanced Light-Water Reactors	Initial Issuance	Mar-07		Not applicable to the ESBWR. For radiological analysis, the DCD utilized previously issued SRPs. This SRP was not issued at the time of DCD submittal.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
15.1.1 – 15.1.4	Decrease in Feedwater Temperature, Increase in Feedwater Flow, Increase in Steam Flow, and Inadvertent Opening of a Steam Generator Relief or Safety Valve	Rev. 2	Mar-07	II.1, II.2, II.3, II.4, II.5, 1, 2, 3, 4	Conforms
15.1.5	Steam System Piping Failures Inside and Outside of Containment (PWR)	Rev. 3	Mar-07		Not applicable to the ESBWR
15.1.5.A	Radiological Consequences of Main Steam Line Failures Outside Containment of a PWR				Not applicable to the ESBWR
15.2.1 – 15.2.5	Loss of External Load; Turbine Trip; Loss of Condenser Vacuum; Closure of Main Steam Isolation Valve (BWR); and Steam Pressure Regulator Failure (Closed)	Rev. 2	Mar-07	1A, 1B, 1C, 1D, 2A, 2B, 2D, 2E, 2F, 3A, 3B, 3C, 3D	Conforms
				2C	Not applicable. This is not an event of moderate frequency.
15.2.6	Loss of Nonemergency AC Power to the Station Auxiliaries	Rev. 2	Mar-07	II.1, II.2, II.4, II.5, II.5B, II.5C, II.5D	Conforms
				II.3	Not applicable. This is not an event of moderate frequency.
				II.5A	Not applicable. There are no RCS loops in the ESBWR.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
15.2.7	Loss of Normal Feedwater Flow	Rev. 2	Mar-07	1A, 1B, 1C, 1D, 2A, 2B, 2D, 2E, 2F, 3A, 3B, 3C, 3D	Conforms
				2C	Not applicable. This is not an event of moderate frequency.
15.2.8	Feedwater System Pipe Breaks Inside and Outside Containment (PWR)	Rev. 2	Mar-07		Not applicable to the ESBWR
15.3.1–15.3.2	Loss of Forced Reactor Coolant Flow Including Trip of Pump Motor and Flow Controller Malfunctions	Rev. 2	Mar-07		Not applicable to the ESBWR
15.3.3–15.3.4	Reactor Coolant Pump Rotor Seizure and Reactor Coolant Pump Shaft Break	Rev. 3	Mar-07		Not applicable to the ESBWR
15.4.1	Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power Startup Condition	Rev. 3	Mar-07	1A, 1C	Conforms
				1B	Not applicable to the ESBWR
15.4.2	Uncontrolled Control Rod Assembly Withdrawal at Power	Rev. 3	Mar-07	1A, 1C	Conforms
				1B	Not applicable to the ESBWR
15.4.3	Control Rod Misoperation (System Malfunction or Operator Error)	Rev. 3	Mar-07	1, 2, 3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
15.4.4 - 15.4.5	Startup of an Inactive Loop or Recirculation Loop at an Incorrect Temperature, and Flow Controller Malfunction Causing an Increase in BWR Core Flow Rate	Rev. 2	Mar-07	A, B, D, E, F, 1, 2, 3, 4	Conforms
				C	Not applicable. This is not an event of moderate frequency.
15.4.6	Inadvertent Decrease in Boron Concentration in the Reactor Coolant System (PWR)	Rev. 2	Mar-07		Not applicable to the ESBWR
15.4.7	Inadvertent Loading and Operation of a Fuel Assembly in an Improper Position	Rev. 2	Mar-07	1, 2	Conforms
15.4.8	Spectrum of Rod Ejection Accidents (PWR)	Rev. 3	Mar-07		Not applicable to the ESBWR
15.4.8.A	Radiological Consequences of a Control Rod Ejection Accident (PWR)				Not applicable to the ESBWR
15.4.9	Spectrum of Rod Drop Accidents (BWR)	Rev. 3	Mar-07	1, 2, 3	Conforms. Postulated events are not applicable to the ESBWR.
15.4.9.A	Radiological Consequences of Control Rod Drop Accident (BWR)	Rev. 2	Jul-81		Conforms. Postulated control rod drop events are not applicable to the ESBWR.
15.5.1 – 15.5.2	Inadvertent Operation of ECCS and Chemical and Volume Control System Malfunction that Increases Reactor Coolant Inventory	Rev. 2	Mar-07	1, 2, 3	Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
15.6.1	Inadvertent Opening of a PWR Pressurizer Pressure Relief Valve or a BWR Pressure Relief Valve	Rev. 2	Mar-07	1, 2, 3, A, B, C, D	Conforms
15.6.2	Radiological Consequences of the Failure of Small Lines Carrying Primary Coolant Outside Containment	Rev. 2	Jul-81	II.1, II.2	Conforms
15.6.3	Radiological Consequences of Steam Generator Tube Failure				Not applicable to the ESBWR
15.6.4	Radiological Consequences of Main Steam Line Failure Outside Containment (BWR)	Rev. 2	Jul-81	II.1, II.2, II.3	Conforms
				II.4	Conforms. Addressed in TS 3.4.3.
15.6.5	Loss-of-Coolant Accidents Resulting From Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary	Rev. 3	Mar-07	II.1A, II.1B, II.1C, II.1D, II.1.E, II.2, II.3	Conforms.
15.6.5.A	Radiological Consequences of a Design Basis Loss-of-Coolant Accident Including Containment Leakage Contribution	Rev. 1	Jul-81		Not Applicable. Reference DCD Table 1.9-20.
15.6.5.B	Radiological Consequences of a Design Basis Loss-of-Coolant Accident: Leakage from Engineered Safety Feature Components Outside Containment	Rev. 1	Jul-81		Not Applicable. Reference DCD Table 1.9-20.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
15.6.5.D	Radiological Consequences of a Design Basis Loss-of-Coolant Accident: Leakage From Main Steam Isolation Valve Leakage Control System (BWR)	Rev. 1	Jul-81		Not Applicable. Reference DCD Table 1.9-20.
15.7.3	Postulated Radioactive Releases Due to Liquid-Containing Tank Failures			1, 2	Conforms
15.7.4	Radiological Consequences of Fuel Handling Accidents	Rev. 2	Jul-81	II.1, II.2, II.3, II.4, II.5	Conforms. Radiological assumptions superseded by SRP 15.0.1.
15.7.5	Spent Fuel Cask Drop Accidents	Rev. 2	Jul-81	II.1, II.2, II.3, II.4, II.5	Conforms. Because a spent fuel cask drop exceeding 30 ft. (9.2 m) is not postulated (DCD Section 15.4.10.1), per SRP 15.7.5, a design basis radiological analysis is not required. Therefore, the acceptance criteria do not apply even though the SRP does.
15.8	Anticipated Transients Without Scram	Rev. 2	Mar-07	1A	Not applicable. ESBWR does not have recirculation pumps.
				1B, 1C, 1D, 1E	Conforms
				1F	Conforms
15.9	Boiling Water Reactor Stability	Initial Issuance	Mar-07	1, 2, 3, 4A, 4B, 5, 6, 7, 9A, 9B, 9C, 10, 11	Conforms
				8, 9D	Conforms
16	Technical Specifications	Rev. 2	Mar-07		Conforms

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
16.1	Risk-Informed Decision Making: Technical Specifications	Rev. 1	Mar-07		Not applicable
17.1	Quality Assurance During the Design and Construction Phases	Rev. 2	Jul-81		Not applicable. RG 1.206 refers the COL applicant to Section 17.5 for the format and content of a QA Program for design and construction of new plants.
17.2	Quality Assurance During the Operations Phase	Rev. 2	Jul-81		Not applicable. RG 1.206 refers the COL applicant to Section 17.5 for the format and content of a QA Program for design and construction of new plants.
17.3	Quality Assurance Program Description	Rev. 0	Aug-90		Not applicable. RG 1.206 refers the COL applicant to Section 17.5 for the format and content of a QA Program for design and construction of new plants.
17.4	Reliability Assurance Program (RAP)	Initial Issuance	Mar-07	II.B.1, II.B.2, II.B.3, II.B.4, II.B.5, II.B.6, II.B.7, II.B.8, II.B.9	Conforms. Addressed in DCD Section 17.4 and FSAR Sections 17.5 and 17.6.
17.5	Quality Assurance Program Description - Design Certification, Early Site Permit and New License Applicants	Initial Issuance	Mar-07	II.A, II.B, II.C, II.D., II.E, II.F, II.G, II.H, II.I, II.J, II.K, II.L, II.M, II.N, II.O, II.P, II.Q, II.R, II.S, II.T, II.U, II.V,	Conforms
				II.W Option II	Conforms. Option II chosen. IRC is discussed in QAPD.

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SRP Section	Title	Rev	Date	Specific Acceptance Criteria	Evaluation
17.6	Maintenance Rule	Initial Issuance	Mar-07	II.1, II.2	Conforms
18	Human Factors Engineering	Rev. 2	Mar-07	II.A	Conforms
				II.B, II.C	Not applicable. These acceptance criteria apply to changes to existing plants.
19.0	Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors	Rev. 2	Jun-07	II.1, II.2, II.3, II.4, II.5, II.6, II.7	Conforms
				II.8, II.9	Not applicable. Only applies to Westinghouse AP 600 design.
19.1	Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities	Rev. 2	Jun-07		Not applicable. There are no plans for risk-informed activities.
19.2	Review of Risk Information Used to Support Permanent Plant-Specific Changes to the Licensing Basis: General Guidelines	Rev. 0	Jun-07		Not applicable. There are no plans for risk-informed applications.

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Table 1.9-202 (Sheet 1 of 23)
Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.1	Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps	Rev. 0	Nov-70	General	Not applicable
1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors	Rev. 2	Jun-74	General	Not applicable. Regulatory Guide 1.183 is used.
1.4	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors	Rev. 2	Jun-74	General	Not applicable
1.5	Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors	Rev. 0	Mar-71	General	Not applicable. Regulatory Guide 1.183 is used.
1.6	Independence Between Redundant Standby (On-site) Power Sources and Between Their Distribution Systems	Rev. 0	Mar-71	D.1, D.3	Conforms
1.7	Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident	Rev. 3	Mar-07	General	Conforms
1.8	Qualification and Training of Personnel for Nuclear Power Plants	Rev. 3	May-00	C.1 C.2	Conforms. Conforms, except experience requirements cannot be met prior to operations as described in Appendix 13BB (Subsection 13BB.1.1.3).
1.9	Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants	Rev. 4	Mar-07	General	Not applicable

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Table 1.9-202 (Sheet 2 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.11	Instrument Lines Penetrating Primary Reactor Containment (Safety Guide 11) Supplement to Safety Guide 11, Backfitting Considerations	Rev. 0	Feb-72	C.1, C.2, E	Conforms
1.12	Nuclear Power Plant Instrumentation for Earthquakes	Rev. 2	Mar-97	C.1, C.2, C.4 – C.7 C.3, C.8	Conforms Conforms. The seismic monitoring program, including the necessary test and operating procedures, will be implemented prior to receipt of fuel on-site.
1.13	Spent Fuel Storage Facility Design Basis	Rev. 2	Mar-07	General	Conforms
1.14	Reactor Coolant Pump Flywheel Integrity	Rev. 1	Aug-75	General	Not applicable
1.16	Reporting of Operating Information - Appendix A Technical Specifications	Rev. 4	Aug-75	General	Conforms
1.20	Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing	Rev. 3	Mar-07	C.1 C.2 C.3	Conforms. Not applicable. Unit 3 does not have prototype reactor internals. Conforms. Subsection 3.9.2.4 describes that the vibration assessment program will be completed 1 year after the time of application.
1.21	Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants	Rev. 1	Jun-74	General	Conforms. Subsections 11.4.2.3 (NEI 07-10) and 11.5.4.5 (NEI 07-09) provide descriptions of the PCP and ODCM, respectively. Implementation milestones are provided in Section 13.4.
1.22	Periodic Testing of Protection System Actuation Functions	Rev. 0	Feb-72	General	Conforms. Operational program implementation is described in Section 13.4.

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Table 1.9-202 (Sheet 3 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.23	Meteorological Monitoring Programs For Nuclear Power Plants	Rev. 1	Mar-07	General	Exception: The Regulatory Guide in part requires that sensors should be located at a distance of at least 10 times the height of any nearby obstruction if the height of the obstruction exceeds one-half the height of the wind measurement. This criterion is met for all structures except the natural draft cooling tower. An alternative method for evaluating the wake effects for a hyperbolically-shaped structure is provided in Subsection 2.3.2, and it is demonstrated that the natural draft cooling tower will not adversely affect measurements made at the primary meteorological tower.
1.24	Assumptions Used for Evaluating the Potential Radiological Consequences of a Pressurized Water Reactor Radioactive Gas Storage Tank Failure	Rev. 0	Mar-72	All	Not applicable
1.25	Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors	Rev. 0	Mar-72	General	Not applicable. Regulatory Guide 1.183 is used.
1.26	Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants	Rev. 4	Mar-07	All	Exception. The QAPD is based on NEI 06-14A, which invokes Revision 3 of Regulatory Guide 1.26 (the same revision utilized by the DCD).
		Rev. 3	Feb-76	All	Conforms with the following exception: The QAPD incorporates the exception taken to Regulatory Guide 1.26 in the ESBWR DCD Table 1.9-21b.

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Table 1.9-202 (Sheet 4 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.27	Ultimate Heat Sink for Nuclear Power Plants	Rev. 2	Jan-76	General	The UHS is within the scope of the referenced certified design and is addressed in DCD Section 9.2.5.
1.28	Quality Assurance Program Requirements (Design and Construction)	Rev. 3	Aug-85	General	Exception: The QAPD identified in Section 17.5 addresses a QA program based on the newer NQA-1-1994, as provided for in SRP 17.5.
1.29	Seismic Design Classification	Rev. 4	Mar-07	General	Exception. The QAPD is based on NEI 06-14A, which invokes Revision 3 of Regulatory Guide 1.29 (the same revision utilized by the DCD).
		Rev. 3	Sept-78	All	Conforms with the following exception: The QAPD incorporates the exception taken to Regulatory Guide 1.29 in the ESBWR DCD Table 1.9-21b.
1.30	Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment	Rev. 0	Aug-72	General	Exception: The QAPD identified in Section 17.5 addresses a QA program based on a newer NQA-1-1994, as discussed in SRP 17.5.
1.31	Control of Ferrite Content in Stainless Steel Weld Metal	Rev. 3	Apr-78	General	Conforms. Operational program implementation is described in Section 13.4.
1.32	Criteria for Power Systems for Nuclear Power Plants	Rev. 3	Mar-04	General	Exception - The design of off-site power meets the intent of Regulatory Guide1.32 with respect to separation and redundancy, but is neither safety-related nor provided with safety-related power supplies. The design is described in Subsections 8.2.1.1, 8.2.1.2.1.1, and 8.2.1.2.1.2.
1.33	Quality Assurance Program Requirements (Operation)	Rev. 2	Feb-78	C.1	Conforms with the following exception: For procedures, Regulatory Guide 1.33 is utilized; however, ANSI/ ANS-3.2-1994 (R1999) is used as guidance instead of the 1976 version endorsed by Regulatory Guide 1.33.

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Table 1.9-202 (Sheet 5 of 23)
Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
				C.2, C.3, C.4, C.5	Not applicable. The QAPD identified in Section 17.5 follows NQA-1 rather than the older standards referenced in Regulatory Guide 1.33.
1.34	Control of Electroslag Weld Properties	Rev. 0	Dec-72	General	Conforms. Operational program implementation is described in Section 13.4.
1.35	In-Service Inspection of Ungrouted Tendons in Prestressed Concrete Containments	Rev. 3	Jul-90	General	Not applicable
1.35.1	Determining Prestressing for Inspection of Prestressed Concrete Containments	Rev. 0	Jul-90	General	Not applicable
1.36	Nonmetalic Thermal Insulation for Austenitic Stainless Steel	Rev. 0	Feb-73	General	Conforms. Operational program implementation is described in Section 13.4.
1.37	Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants	Rev. 1	Mar-07	General	Conforms
1.38	Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants	Rev. 2	May-77	General	Exception. Section 17.5 identifies equivalent quality assurance standards.
1.39	Housekeeping Requirements for Water-Cooled Nuclear Power Plants	Rev. 2	Sep-77	General	Exception. Section 17.5 identifies equivalent quality assurance standards.
1.40	Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants	Rev. 0	Mar-73	General	Not applicable
1.41	Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments	Rev. 0	Mar-73	General	Conforms with the following exception: There are no safety-related DGs for ESBWR.

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.43	Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components	Rev. 0	May-73	General	Conforms
1.44	Control of the Use of Sensitized Stainless Steel	Rev. 0	May-73	General	Conforms. Operational program implementation is described in Section 13.4.
1.45	Reactor Coolant Pressure Boundary Leakage Detection Systems	Rev. 0	May-73	General	Conforms. Operational program implementation is described in Section 13.4.
1.47	Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems	Rev. 0	May-73	General	Conforms. Operational program implementation is described in Section 13.4.
1.50	Control of Preheat Temperature for Welding of Low-Alloy Steel	Rev. 0	May-73	General	Conforms. Operational program implementation is described in Section 13.4.
1.52	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	Rev. 3	Jun-01	General	Conforms
1.53	Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems	Rev. 2	Nov-03	General	Conforms
1.54	Service Level I, II, and III Protective Coatings Applied to Nuclear Power Plants	Rev. 1	Jul-00	General	Conforms with the following exceptions: Not applicable to small size equipment as described in DCD Section 6.1.2.1.
1.56	Maintenance of Water Purity in Boiling Water Reactors	Rev. 1	Jul-78	General	Conforms
1.57	Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components	Rev. 1	Mar-07	General	Conforms
1.59	Design Basis Floods for Nuclear Power Plant (Errata Published 7/30/80)	Rev. 2	Aug-77	General	Conforms
1.60	Design Response for Seismic Design of Nuclear Power Plants	Rev. 1	Dec-73	General	Conforms

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Table 1.9-202 (Sheet 7 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.61	Damping Values for Seismic Design of Nuclear Power Plants	Rev. 1	Mar-07	General	Conforms
1.62	Manual Initiation of Protective Actions	Rev. 0	Oct-73	General	Conforms
1.63	Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants	Rev. 3	Feb-87	General	Conforms
1.65	Materials and Inspections for Reactor Vessel Closure Studs	Rev. 0	Oct-73	General	Conforms
1.68	Initial Test Programs for Water-Cooled Nuclear Power Plants	Rev. 3	Mar-07	General	Conforms
1.68.1	Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants	Rev. 1	Jan-77	General	Conforms
1.68.2	Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants	Rev. 1	Jul-78	General	Conforms
1.68.3	Preoperational Testing of Instrument and Control Air Systems	Rev. 0	Apr-82	General	Conforms
1.69	Concrete Radiation Shields for Nuclear Power Plants	Rev. 0	Dec-73	General	Conforms
1.70	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants LWR Edition	Rev. 3	Nov-78	--	Not applicable. Regulatory Guide 1.206 is used. Refer to Table 1.9-203.
1.71	Welder Qualification for Areas of Limited Accessibility	Rev. 1	Mar-07	General	Conforms. Operational program implementation is described in Section 13.4.
1.72	Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin	Rev. 2	Nov-78	General	Not applicable
1.73	Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants	Rev. 0	Jan-74	General	Conforms
1.75	Criteria for Independence of Electrical Safety Systems	Rev. 3	Feb-05	General	Conforms

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Table 1.9-202 (Sheet 8 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.76	Design Basis Tornado for Nuclear Power Plants	Rev. 1	Mar-07	General	Conforms
1.77	Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors	Rev. 0	May-74	General	Not applicable
1.78	Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release	Rev. 1	Dec-01	General	Conforms
1.79	Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors	Rev. 1	Sep-75	General	Not applicable
1.81	Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants	Rev. 1	Jan-75	General	Not applicable
1.82	Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident	Rev. 3	Nov-03	General	Conforms
1.83	Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes	Rev. 1	Jul-75	General	Not applicable
1.84	Design, Fabrication, and Materials Code Case Acceptability, ASME Section III	Rev. 34	Oct-07	General	Conforms
1.86	Termination of Operating Licenses for Nuclear Reactors	Rev. 0	Jun-74	General	This Regulatory Guide is outside the scope of the FSAR
1.87	Guidance for Construction of Class 1 Components in Elevated-Temperature Reactors (Supplement to ASME Section III Code Cases 1592, 1593, 1594, 1595, and 1596)	Rev. 1	Jun-75	General	Not applicable
1.89	Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants	Rev. 1	Jun-84	General	Conforms. Source terms from Regulatory Guide 1.183 used.

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Table 1.9-202 (Sheet 9 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.90	Inservice Inspection of Prestressed Concrete Containment Structures with Grouted Tendons	Rev. 1	Aug-77	General	Not applicable
1.91	Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants	Rev. 1	Feb-78	General	Conforms
1.92	Combining Modal Responses and Spatial Components in Seismic Response Analysis	Rev. 2	Jul-06	General	Conforms
1.93	Availability of Electric Power Sources	Rev. 0	Dec-74	C.5	Conforms. Only DC portion is applicable.
1.94	Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants	Rev. 1	Apr-76	General	Exception. Section 17.5 identifies equivalent QA standards in NQA-1, Subpart 2.5.
1.96	Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants	Rev. 1	Jun-76	General	Not applicable
1.97	Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants	Rev. 4	Jun-06	General	Conforms. Operational program implementation is described in Section 13.4.
1.98	Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor	Rev. 0	Mar-76	General	Not applicable. Superseded by BTP 11-5.
1.99	Radiation Embrittlement of Reactor Vessel Materials	Rev. 2	May-88	General	Conforms. Operational program implementation is described in Section 13.4.
1.100	Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants	Rev. 2	Jun-88	General	Conforms
1.101	Emergency Response Planning and Preparedness for Nuclear Power Reactors	Rev. 5	Jun-05	General	Not applicable (See Rev. 3 discussion)

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.101		Rev. 3	Aug-05	General	Conforms with the following exception: The EP for Unit 3 utilizes Rev. 3 of Regulatory Guide 1.101, which endorses Rev. 1 of NUREG-0654/FEMA-REP-1, however, the EP utilizes NEI 07-01, Rev. 0 for EALs instead of Appendix 1 of NUREG-0654/FEMA-REP-1 (NEI 07-01 has not been endorsed by the NRC via revision to Regulatory Guide 1.101 at this time). Regulatory Guide 1.101 Rev. 4 is not used because it endorses NEI 99-01 as an alternative to Appendix 1 of NUREG 0654/FEMA-REP-1 regarding EALs; the EP utilizes NEI 07-01. Regulatory Guide 1.101 Rev. 5 is not applicable since it addresses co-located licensees.
1.102	Flood Protection for Nuclear Power Plants	Rev. 1	Sep-76	General	Conforms
1.105	Setpoints For Safety-Related Instrumentation	Rev. 3	Dec-99	General	Conforms. Operational program implementation is described in Section 13.4.
1.106	Thermal Overload Protection for Electric Motors on Motor-Operated Valves	Rev. 1	Feb-77	General	Not applicable
1.107	Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures	Rev. 1	Feb-77	General	Not applicable
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	Rev. 1	Oct-77	General	Conforms
1.110	Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors	Rev. 0	Mar-76	General	Conforms

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Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.111	Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors	Rev. 1	Jul-77	General	Conforms
1.112	Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors	Rev. 1	Mar-07	General	Not Applicable. BWR-GALE code is used in DCD Section 12.2.2.1 for gaseous releases (NUREG-0016), and in DCD Section 12.2.2.3 for liquid releases.
1.113	Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I	Rev. 1	Apr-77	General	Conforms with the following exception: Methodology for liquid release, utilized in Subsection 12.2.2.4, Liquid Doses Off-Site, is based on Regulatory Guide 1.109.
1.114	Guidance to Operators at the Controls and to Senior Operators in the Control Room of a Nuclear Power Unit	Rev. 2	May-89	General	Conforms
1.115	Protection Against Low-Trajectory Turbine Missiles	Rev. 1	Jul-77	General	Conforms
1.116	Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems	Rev. 0	May-77	General	Exception: Section 17.5 identifies equivalent QA standards in NQA-1, Subpart 2.8.
1.117	Tornado Design Classification	Rev. 1	Apr-78	General	Conforms
1.118	Periodic Testing of Electric Power and Protection Systems	Rev. 3	Apr-95	General	Conforms
1.121	Bases for Plugging Degraded PWR Steam Generator Tubes	Rev. 0	Aug-76	General	Not applicable
1.122	Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components	Rev. 1	Feb-78	General	Conforms

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Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.124	Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports	Rev. 2	Feb-07	General	Conforms
1.125	Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants	Rev. 1	Oct-78	General	Conforms
1.126	An Acceptable Model and Related Statistical Methods for the Analysis of Fuel Densification	Rev. 1	Mar-78	General	Conforms
1.127	Inspection of Water-Control Structures Associated with Nuclear Power Plants	Rev. 1	Mar-78	General	Conforms
1.128	Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants	Rev. 2	Feb-07	General	Not applicable. Does not apply to ESBWR VRLA batteries.
1.129	Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants	Rev. 2	Feb-07	General	Not applicable. Does not apply to ESBWR VRLA batteries.
1.130	Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports	Rev. 2	Mar-07	General	Conforms
1.131	Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants	Rev. 0	Aug-77	General	Conforms
1.132	Site Investigations for Foundations of Nuclear Power Plants	Rev. 2	Oct-03	General	Conforms.
1.133	Loose-Part Detection Program for the Primary System of Light-Water-Cooled Reactors	Rev. 1	May-81	General	Not applicable
1.134	Medical Evaluation of Licensed Personnel for Nuclear Power Plants	Rev. 3	Mar-98	General	Conforms. Although Regulatory Guide 1.134 is not specifically identified in the FSAR, equivalent requirements for medical evaluations for licensed personnel are embedded in policies and procedures of operations and training departments.

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Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.135	Normal Water Level and Discharge at Nuclear Power Plants	Rev. 0	Sep-77	General	Conforms
1.136	Design Limits, Combinations, Materials, Construction, and Testing of Concrete Containments	Rev. 3	Mar-07	General	Conforms
1.137	Fuel-Oil Systems for Standby Diesel Generators	Rev. 1	Oct-79	General	Not applicable
1.138	Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants	Rev. 2	Dec-03	C.1.1 - C.1.2.3, C.2.1 - C.2.3, C.3, C.4.1, C.4.2, C.4.3, C.4.4, C.4.5, C.5.1 - C.5.3, C.6.1, C.6.3	Conforms
				C.6.2	Exception. Cyclic Triaxial Tests were not performed. Torsional shear testing was performed instead as part of a combined resonant column/torsional shear test. Special procedures were used for dynamic soil property testing that combines laboratory resonant column/torsional shear tests because no published standard methods exist.
				C.7	Not applicable. RBS is considered a soft soil site.
1.139	Guidance for Residual Heat Removal	Rev. 0	May-78	General	Conforms
1.140	Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants	Rev. 2	Jun-01	General	Conforms. Operational program implementation is described in Section 13.4.
1.141	Containment Isolation Provisions for Fluid Systems	Rev. 0	Apr-78	General	Conforms
1.142	Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)	Rev. 2	Nov-01	General	Conforms

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.143	Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants	Rev. 2	Nov-01	General	Conforms. Operational program implementation is described in Section 13.4.
1.145	Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants	Rev. 1	Nov-82	General	Conforms
1.147	In-Service Inspection Code Case Acceptability, ASME Section XI, Division 1	Rev. 15	Oct-07	General	Conforms. Operational program implementation is described in Section 13.4.
1.148	Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants	Rev. 0	Mar-81	General	Conforms
1.149	Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations	Rev. 3	Oct-01	General	Conforms
1.150	Ultrasonic Testing of Reactor Vessel Welds During Pre-Service and In-Service Examinations	Rev. 1	Feb-83	General	Conforms. Operational program implementation is described in Section 13.4.
1.151	Instrument Sensing Lines	Rev. 0	Jul-83	General	Conforms. Operational program implementation is described in Section 13.4.
1.152	Criteria for Use of Computers in Safety Systems of Nuclear Power Plants	Rev. 2	Jan-06	General	Conforms. Operational program implementation is described in Section 13.4.
1.153	Criteria for Safety Systems	Rev. 1	Jun-96	General	Conforms
1.154	Format and Content of Plant-Specific Pressurized Thermal Shock Safety Analysis Reports for Pressurized Water Reactors	Rev. 0	Jan-87	General	Not applicable
1.155	Station Blackout	Rev. 0	Aug-88	General	Conforms, except no emergency AC power is required for the ESBWR. Only the coping analysis is applicable. Operational program implementation is described in Section 13.4.

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.156	Environmental Qualification of Connection Assemblies for Nuclear Power Plants	Rev. 0	Nov-87	General	Conforms
1.157	Best-Estimate Calculations of Emergency Core Cooling System Performance	Rev. 0	May-89	General	Conforms
1.158	Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants	Rev. 0	Feb-89	General	Conforms
1.159	Assuring the Availability of Funds for Decommissioning Nuclear Reactors	Rev. 1	Oct-03	General	Conforms. The amount of funds for decommissioning and the method of financial assurance is described in COLA Part 1.
1.160	Monitoring the Effectiveness of Maintenance at Nuclear Power Plants	Rev. 2	Mar-97	General	Conforms. Operational program implementation is described in Section 13.4. Maintenance Rule activities are addressed in Section 17.6.
1.161	Evaluation of Reactor Pressure Vessels with Charpy Upper-Shelf Energy Less Than 50 Ft.-Lb.	Rev. 0	Jun-95	General	Not applicable
1.162	Format and Content of Report for Thermal Annealing of Reactor Pressure Vessels	Rev. 0	Feb-96	General	This Regulatory Guide is outside the scope of the FSAR.
1.163	Performance-Based Containment Leak-Test Program	Rev. 0	Sep-95	General	Conforms
1.165	Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion	Rev. 0	Mar-97	General	Conforms
1.166	Pre-Earthquake Planning and Immediate Nuclear Power Plant Operator Postearthquake Actions	Rev. 0	Mar-97	General	Conforms. The seismic monitoring program, including the necessary test and operating procedures, will be implemented prior to receipt of fuel on-site.
1.167	Restart of a Nuclear Power Plant Shut Down by a Seismic Event	Rev. 0	Mar-97	General	Not applicable

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.168	Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 1	Feb-04	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.169	Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 0	Sep-87	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.170	Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 0	Sep-97	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.171	Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 0	Sep-97	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.172	Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 0	Sep-97	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.173	Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants	Rev. 0	Sep-97	General	Conforms. Procedures addressed in Section 13.5. ITAAC addressed in COLA Part 10.
1.174	An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis	Rev. 1	Nov-02	General	Not applicable. The approach described in this Regulatory Guide is not being used.
1.175	An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing	Rev. 0	Aug-98	General	Not applicable. Risk informed in-service testing is not being used.
1.176	An Approach for Plant-Specific, Risk-Informed Decisionmaking: Graded Quality Assurance	Rev. 0	Aug-98	General	Not applicable. A risk-based graded QA program is not being used.
1.177	An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications	Rev. 0	Aug-98	General	Not applicable. Risk informed Technical Specifications are not being used.

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Table 1.9-202 (Sheet 17 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.178	An Approach for Plant-Specific Risk-Informed Decisionmaking: In-Service Inspection of Piping	Rev. 0	Sep-98	General	Not applicable. Risk informed in-service inspection is not being used.
1.179	Standard Format and Content of License Termination Plans for Nuclear Power Reactors	Rev. 0	Jan-99	General	This Regulatory Guide is outside the scope of the FSAR.
1.180	Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems	Rev. 1	Oct-03	General	Conforms
1.181	Content of the Updated Final Safety Analysis Report in Accordance with 10 CFR 50.71(e)	Rev. 0	Sep-99	General	Conforms
1.182	Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants	Rev. 0	May-00	General	Conforms
1.183	Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors	Rev. 0	Jul-00	General	Conforms
1.184	Decommissioning of Nuclear Power Reactors	Rev. 0	Jul-00	General	Not applicable. The Regulatory Guide provides guidance on how to conduct decommissioning activities.
1.185	Standard Format and Content for Post-Shutdown Decommissioning Activities Report	Rev. 0	Jul-00	General	This Regulatory Guide is outside the scope of the FSAR.
1.186	Guidance and Examples for Identifying 10 CFR 50.2 Design Bases	Rev. 0	Oct-00	General	This Regulatory Guide is outside the scope of the FSAR.
1.187	Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments	Rev. 0	Nov-00	General	Conforms
1.188	Standard Format and Content for Applications to Renew Nuclear Power Plant Operating Licenses	Rev. 1	Sep-05	General	Not applicable. This Regulatory Guide is outside the scope of the FSAR.

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Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.189	Fire Protection for Nuclear Power Plants	Rev. 1	Mar-07	General	Conforms with the following exception. Section C.1.1 of the Regulatory Guide states, in part, that the licensee should assign overall responsibility for the FPP to a person who has management control over all organizations involved in fire protection activities. The organization described in Section 13.1 shows separate reporting chains for the fire protection staff and the fire brigade (operations department) up to the level of the CNO.
1.190	Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence	Rev. 0	Mar-01	General	Conforms. The reactor vessel material surveillance program is described in Subsection 5.3.1.8. Implementation of the program is described in Section 13.4.
1.191	Fire Protection Program for Nuclear Power Plants During Decommissioning and Permanent Shutdown	Rev. 0	May-01	General	Not applicable. This Regulatory Guide is outside the scope of the FSAR.
1.192	Operation and Maintenance Code Case Acceptability, ASME OM Code	Rev. 0	Jun-03	General	Conforms. Operational program implementation is described in Section 13.4.
1.193	ASME Code Cases Not Approved for Use	Rev. 2	Oct-07	General	Conforms
1.194	Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants	Rev. 0	Jun-03	General	Conforms
1.195	Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Reactors	Rev. 0	May-03	General	Not applicable. Regulatory Guide 1.183 is used.
1.196	Control Room Habitability at Light-Water Nuclear Power Reactors	Rev. 1	Jan-07	General	Conforms
1.197	Demonstrating Control Room Envelope Integrity at Nuclear Power Plant Reactors	Rev. 0	May-03	General	Conforms

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Table 1.9-202 (Sheet 19 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.198	Procedures and Criteria for Assessing Seismic Soil Liquefaction At Nuclear Power Plant Sites	Rev. 0	Nov-03	General	Conforms
1.199	Anchoring Components and Structural Supports in Concrete	Rev. 0	Nov-03	General	Conforms
1.200	An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities	Rev. 1	Jan-07	General	Not applicable
1.201	Guidelines for Categorizing Structures, Systems, and Components in Nuclear Power Plants According to Their Safety Significance	Rev. 1	May-06	General	Not applicable
1.202	Standard Format and Content of Decommissioning Cost Estimates for Nuclear Power Reactors	Rev. 0	Feb-05	General	Not applicable. The Regulatory Guide provides guidance for submitting decommissioning cost estimates to NRC prior to license termination.
1.203	Transient and Accident Analysis Methods	Rev. 0	Dec-05	General	Conforms
1.204	Guidelines for Lightning Protection of Nuclear Power Plants	Rev. 0	Nov-05	General	Conforms. Operational program implementation is described in Section 13.4.
1.205	Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants	Rev. 0	May-06	General	Not applicable. Risk-informed, performance-based fire protection is not used.
1.206	Combined License Applications for Nuclear Power Plants (LWR Edition)	Rev. 0	Jun-07	General	See Table 1.9-203.
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	Rev. 0	Mar-07	General	Conforms

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Table 1.9-202 (Sheet 20 of 23) Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
1.208	A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion	Rev. 0	Mar-07	C.1.1, C.1.1.1 - C.1.1.4, C.1.2, C.1.4, C.1.5, C.2.1 - C.2.3, C.2.3.1, C.3, C.3.1 - C.3.5, C.4.0 - C.4.3, C.5.1 - C.5.4	Conforms
				C.1.3	Not applicable. Construction not yet in progress.
				C.2.3.2	Not applicable. Site not in Western US.
				C.2.3.3	Not applicable. No subduction zones in region.
1.209	Guidelines for Environmental Qualification of Safety-Related, Computer-Based Instrumentation and Control Systems in Nuclear Power Plants	Rev. 0	Mar-07	General	Conforms
4.7	General Site Suitability Criteria for Nuclear Power Stations	Rev. 2	Apr-98	General	Conforms
4.15	Quality Assurance for Radiological Monitoring Programs (Inception Through Normal Operations to License Termination) – Effluent Streams and the Environment	Rev. 1	Feb-79	General	Conforms. Subsection 11.5.4.5 (NEI 07-09) provides a description of the ODCM. The implementation milestone is provided in Section 13.4.
5.44	Perimeter Intrusion Alarm Systems	Rev. 3	Oct-97	General	Conforms to one test option as discussed in the Regulatory Guide defined by a plant station procedure.
5.62	Reporting of Safeguards Events	Rev. 1	Nov-87	General	Not applicable. Reportability of Safeguards Events is in accordance with 10 CFR 73 Appendix G.
5.66	Access Authorization Program for Nuclear Power Plants	Rev. 0	Jun-91	General	Not applicable. NEI 03-01, Revision 1, April 2004 is used.
8.1	Radiation Symbol	Rev. 0	Feb-73	General	Conforms. The facility utilizes standard radiation symbols.

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Table 1.9-202 (Sheet 21 of 23)
Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
8.2	Guide for Administrative Practices in Radiation Monitoring	Rev. 0	Feb-73	General	Conforms. Operational program implementation is described in Section 13.4.
8.4	Direct-Reading and Indirect-Reading Pocket Dosimeters	Rev. 0	Feb-73	General	Conforms. Operational program implementation is described in Section 13.4.
8.5	Criticality and Other Interior Evacuation Signals	Rev. 1	Mar-81	General	Conforms. Operational program implementation is described in Section 13.4.
8.6	Standard Test Procedure for Geiger-Muller Counters	Rev. 0	May-73	General	Conforms. Operational program implementation is described in Section 13.4.
8.7	Instructions for Recording and Reporting Occupational Radiation Exposure Data	Rev. 2	Nov-05	General	Conforms. Operational program implementation is described in Section 13.4.
8.8	Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable	Rev. 3	Jun-78	General	Conforms. Operational program implementation is described in Section 13.4.
8.9	Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program	Rev. 1	Jul-93	General	Conforms. Operational program implementation is described in Section 13.4.
8.10	Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable	Rev. 1-R	May-77	General	Conforms. Operational program implementation is described in Section 13.4.
8.11	Applications of Bioassay for Uranium	Rev. 0	Jun-74	General	Not applicable. Regulatory Guide 8.11 has been superseded by Regulatory Guide 8.9, Rev 1.
8.13	Instruction Concerning Prenatal Radiation Exposure	Rev. 3	Jun-99	General	Conforms. Operational program implementation is described in Section 13.4.
8.15	Acceptable Programs for Respiratory Protection	Rev. 1	Oct-99	General	Conforms. Operational program implementation is described in Section 13.4.
8.19	Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants – Design Stage Man-Rem Estimates	Rev. 1	Jun-79	General	Conforms

Table 1.9-202 (Sheet 22 of 23) Conformance with Regulatory Guides

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Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
8.20	Applications of Bioassay for I-125 and I-131	Rev. 1	Sep-79	General	Exception. Per NUREG-1736, Regulatory Guide 8.20 is outdated. Regulatory Guide 8.9 is used. Operational program implementation is described in Section 13.4.
8.25	Air Sampling in the Workplace	Rev. 1	Jun-92	General	Not applicable
8.26	Applications of Bioassay for Fission and Activation Products	Rev. 0	Sep-80	General	Exception. Per NUREG-1736, Regulatory Guide 8.20 is outdated. Regulatory Guide 8.9 is used. Operational program implementation is described in Section 13.4.
8.27	Radiation Protection Training for Personnel at Light-Water-Cooled Nuclear Power Plants	Rev. 0	Mar-81	General	Conforms. Operational program implementation is described in Section 13.4.
8.28	Audible-Alarm Dosimeters	Rev. 0	Jul-81	General	Conforms. Operational program implementation is described in Section 13.4.
8.29	Instruction Concerning Risks from Occupational Radiation Exposure	Rev. 1	Feb-96	General	Conforms. Operational program implementation is described in Section 13.4.
8.32	Criteria for Establishing a Tritium Bioassay Program	Rev. 0	Jul-88	General	Exception. Per NUREG-1736, Regulatory Guide 8.20 is outdated. Regulatory Guide 8.9 is used. Operational program implementation is described in Section 13.4.
8.33	Quality Management Program	Rev. 0	Oct-91	General	Not applicable to nuclear power plants. Regulatory Guide 8.33 applies to nuclear medicine.
8.34	Monitoring Criteria and Methods to Calculate Occupational Radiation Doses	Rev. 0	Jul-92	General	Conforms. Operational program implementation is described in Section 13.4.
8.35	Planned Special Exposures	Rev. 0	Jun-92	General	Conforms. Operational program implementation is described in Section 13.4.
8.36	Radiation Dose to the Embryo/Fetus	Rev. 0	Jul-92	General	Conforms. Operational program implementation is described in Section 13.4.

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Table 1.9-202 (Sheet 23 of 23)
Conformance with Regulatory Guides

Regulatory Guide Number	Title	Revision	Date	Regulatory Guide Position	Evaluation
8.38	Control of Access to High and Very High Radiation Areas of Nuclear Plants	Rev. 1	May-06	General	Conforms. Operational program implementation is described in Section 13.4.

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Table 1.9-203 (Sheet 1 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 1	Introduction and General Description of the Plant	Conforms
C.III.1 1.1	Introduction	Conforms with the following exception: the design of the plant auxiliaries had not been finalized at the time of COLA submittal; therefore, confirmation of net electrical output could not be made.
C.III.1 1.2	General Plant Description	Conforms. Addressed in Subsection 1.2.2.19 and Section 2.0, Figure 1.1-201, and DCD Figures 1.2-1 through 1.2-33.
C.III.1 1.3	Comparisons with Other Facilities	Conforms
C.III.1C.III.1 1.4	Identification of Agents and Contractors	Conforms with the following exceptions: the architect-engineer and consultants to be utilized during construction, startup, and operation had not been chosen at the time of COLA submittal.
C.III.1 1.5	Requirements for Further Technical Information	Conforms
C.III.1 1.6	Material Referenced	Conforms
C.III.1 1.7	Drawings and Other Detailed Information	Conforms
C.III.1 1.8	Site and Plant Design Interfaces and Conceptual Design Information	Conforms. There are no generic changes from the DCD; however, there is one departure from the DCD as discussed in COLA Part 7.
C. III.2 1.9	Conformance with Regulatory Criteria	Conforms
C.III.1 2.1.1	Site Location and Description	Conforms
C.III.1 2.1.2.1	Authority	Conforms
C.III.1 2.1.2.2	Control of Activities Unrelated to Plant Operation	Conforms
C.III.1 2.1.2.3	Arrangements for Traffic Control	Conforms
C.III.1 2.1.2.4	Abandonment or Relocation of Roads	Conforms
C.III.1 2.1.3	Population Distribution	Conforms
C.III.1 2.2	Nearby Industrial, Transportation, and Military Facilities	Conforms
C.III.1 2.3.1	Regional Climatology	Conforms

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Table 1.9-203 (Sheet 2 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 2.3.2	Local Meteorology	Conforms
C.III.1 2.3.3	On-Site Meteorological Measurements Program	Conforms
C.III.1 2.3.4	Short-Term Atmospheric Dispersion Estimates for Accident Releases	Conforms
C.III.1 2.3.5	Long-Term Atmospheric Dispersion Estimates for Routine Releases	Conforms
C.III.1 2.4.1	Hydrologic Description	Conforms
C.III.1 2.4.2	Floods	Conforms
C.III.1 2.4.3	Probable Maximum Flood (PMF) on Streams and Rivers	Conforms
C.III.1 2.4.4	Potential Dam Failures	Conforms
C.III.1 2.4.5	Probable Maximum Surge and Seiche Flooding	Conforms
C.III.1 2.4.6	Probable Maximum Tsunami Hazards	Conforms
C.III.1 2.4.7	Ice Effects	Conforms.
C.III.1 2.4.8	Cooling Water Canals and Reservoirs	Conforms
C.III.1 2.4.9	Channel Diversions	Conforms
C.III.1 2.4.10	Flooding Protection Requirements	Conforms. There are no safety-related SSCs that are not part of the DC facility.
C.III.1 2.4.11	Low Water Considerations	Conforms
C.III.1 2.4.12.1	Description and On-Site Use	Conforms
C.III.1 2.4.12.2	Sources	Conforms
C.III.1 2.4.12.3	Subsurface Pathways	Conforms
C.III.1 2.4.12.4	Monitoring or Safeguard Requirements	Not applicable. An operational monitoring program is not required.
C.III.1 2.4.12.5	Site Characteristics for Subsurface Hydrostatic Loading	Conforms
C.III.1 2.4.13	Accidental Release of Radioactive Liquid Effluent in Ground and Surface Waters	Conforms
C.III.1 2.4.14	Technical Specifications and Emergency Operation Requirements	Conforms
C.III.1 2.5.1	Basic Geologic and Seismic Information	Conforms

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Table 1.9-203 (Sheet 3 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 2.5.2	Vibratory Ground Motion	Conforms
C.III.1 2.5.3	Surface Faulting	Conforms
C.III.1 2.5.4.1	Geologic Features	Conforms
C.III.1 2.5.4.2	Properties of Subsurface Materials	Conforms
C.III.1 2.5.4.3	Foundation Interfaces	Conforms
C.III.1 2.5.4.4	Geophysical Surveys	Conforms
C.III.1 2.5.4.5	Excavations and Backfill	Conforms with the following exception: Sources of backfill have not been identified. Backfill properties will be verified prior to construction.
C.III.1 2.5.4.6	Groundwater Conditions	Conforms
C.III.1 2.5.4.7	Response of Soil and Rock to Dynamic Loading	Conforms
C.III.1 2.5.4.8	Liquefaction Potential	Conforms
C.III.1 2.5.4.9	Earthquake Site Characteristics	Conforms
C.III.1 2.5.4.10	Static Stability	Conforms
C.III.1 2.5.4.11	Design Criteria	Conforms
C.III.1 2.5.4.12	Techniques to Improve Subsurface Conditions	Conforms
C.III.1 2.5.5	Stability of Slopes	Conforms
C.III.1 3.1	Conformance with NRC General Design Criteria	Conforms. Conformance with the NRC's criteria to 10 CFR 50, Appendix A, is described in DCD Section 3.1 and the applicable DCD system sections.
C.III.1 3.2.1	Seismic Classification	Conforms. There are no additional safety-related or RTNSS SSCs subject to seismic classification beyond those addressed in the DCD. There are no SSCs outside the referenced certified design that are required to be designed for an OBE.
C.III.1 3.2.2	System Quality Group Classification	Conforms. There are no additional safety-related or RTNSS SSCs subject to system quality group classification beyond those addressed in the DCD.

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Table 1.9-203 (Sheet 4 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.3.1 (1)	Wind Loadings	Conforms. There are no safety-related SSCs outside the scope of the certified design. Nonsafety-related facility SSCs that are not included in the referenced certified design meet the requirements of DCD Sections 3.3.1.3 and 3.3.2.3.
C.III.1 3.3.1 (2)	Wind Loadings	Conforms
C.III.1 3.3.2	Tornado Loadings	Conforms. There are no safety-related SSCs outside the scope of the certified design. Nonsafety-related facility SSCs that are not included in the referenced certified design meet the requirements of DCD Sections 3.3.1.3 and 3.3.2.3.
C.III.1 3.4.1	Internal Flood Protection	Conforms. There are no SSCs outside the scope of the referenced certified design that require internal flood protection whose failure could prevent a safe shutdown of the plant or result in the uncontrolled release of significant radioactivity.
C.III.1 3.4.2	Analysis Procedures	Conforms. There are no Seismic Category I structures outside the scope of the referenced certified design.
C.III.1 3.5.1.1	Internally Generated Missiles (Outside Containment)	Conforms. There are no SSCs outside the scope of the referenced certified design that are required to be protected against damage from internally generated missiles.
C.III.1 3.5.1.2	Internally Generated Missiles (Inside Containment)	Conforms
C.III.1 3.5.1.3	Turbine Missiles	Conforms. Addressed in DCD Section 10.2.3.8 and FSAR Subsection 10.2.3.8.
C.III.1 3.5.1.4	Missiles Generated by Tornadoes and Extreme Winds	Conforms. Table 2.0-201 demonstrates that the site-specific tornado characteristics are bounded by the parameters assumed in the DCD. DCD Section 3.5.1.4 indicates that resistance to missiles is independent of site topography.
C.III.1 3.5.1.5	Site Proximity Missiles (Except Aircraft)	Conforms
C.III.1 3.5.1.6	Aircraft Hazards	Conforms
C.III.1 3.5.2	Structures, Systems, and Components To Be Protected from Externally Generated Missiles	Conforms. There are no SSCs outside the scope of the referenced certified design that are required to be protected from externally generated missiles.
C.III.1 3.5.3	Barrier Design Procedures	Conforms. There are no SSCs that require reanalysis for tornado, extreme wind, or site proximity missile impact or for aircraft impact.

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Table 1.9-203 (Sheet 5 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.6	Protection against Dynamic Effects Associated with the Postulated Rupture of Piping	Conforms
C.III.1 3.6.1	Plant Design for Protection against Postulated Piping Failures in Fluid systems Outside of Containment	Conforms
C.III.1 3.6.2	Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping	Conforms
C.III.1 3.6.3	Leak-Before-Break Evaluation Procedures	Not applicable. ESBWR design does not rely on a Leak-Before-Break Evaluation.
C.III.1 3.7.1	Seismic Design Parameters	Conforms. Addressed in DCD Sections 3.7 and 3.7.1.
C.III.1 3.7.1.1	Design Ground Motion	Conforms. Addressed in DCD Section 3.7.1.1 and FSAR Subsection 5.3.1.8.
C.III.1 3.7.1.1.1	Design Ground Motion Response Spectra	Conforms with the following exception: There is a departure for an exceedance below 0.23 Hz for horizontal spectra and 0.15 Hz for vertical spectra, which is evaluated in Subsection 3.7.1.1.4 and COLA Part 7.
C.III.1 3.7.1.1.2	Design Ground Motion Time History	Exception. The site-specific earthquake ground motion time history is not developed to match the GMRS/FIRS because the CSDRS are confirmed adequate (Subsection 3.7.1.1.4). Also, Approach 3 of NUREG/CR-6728 was used to develop FIRS at the various foundation levels.
C.III.1 3.7.1.2	Percentage of Critical Damping Values	Conforms
C.III.1 3.7.1.3	Supporting Media for Seismic Category I Structures	Conforms. Addressed in DCD Section 3.7.1.3 and FSAR Subsection 2.5.4.
C.III.1 3.7.2	Seismic System Analysis	Conforms. Addressed in DCD Section 3.7.2.
C.III.1 3.7.2.1	Seismic Analysis Methods	Conforms
C.III.1 3.7.2.2	Natural Frequencies and Responses	Conforms. Addressed in DCD Section 3.7.2.2.
C.III.1 3.7.2.3	Procedures Used for Analytical Modeling	Conforms
C.III.1 3.7.2.4	Soil/Structure Interaction	Conforms. Addressed in DCD Section 3.7.2.4 and Appendix 3A and FSAR Subsection 2.5.4.
C.III.1 3.7.2.5	Development of Floor Response Spectra	Conforms. Addressed in DCD Section 3.7.2.5.
C.III.1 3.7.2.6	Three Components of Earthquake Motion	Conforms
C.III.1 3.7.2.7	Combination of Modal Responses	Conforms

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Table 1.9-203 (Sheet 6 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.7.2.8	Interaction of Nonseismic Category I Structures with Seismic Category I Structures	Conforms. There are no Seismic Category I structures outside the scope of the referenced certified design. In lieu of providing the plant-specific distances between structures and the heights of structures, the distance and height requirements for Non-Seismic Category I structures are addressed in DCD Section 3.7.2.8.
C.III.1 3.7.2.9	Effects of Parameter Variations on Floor Response Spectra	Conforms. Addressed in DCD Section 3.7.2.9.
C.III.1 3.7.2.10	Use of Constant Vertical Static Factors	Conforms
C.III.1 3.7.2.11	Method Used to Account for Torsional Effects	Conforms
C.III.1 3.7.2.12	Comparison of Responses	Conforms. Addressed in DCD Section 3.7.2.12.
C.III.1 3.7.2.13	Methods for Seismic Analysis of Dams	Not applicable. There are no Seismic Category I dams in the ESBWR design per DCD Section 3.7.3.14.
C.III.1 3.7.2.14	Determination of Dynamic Stability of Seismic Category I Structures	Conforms. Addressed in DCD Sections 3.7.2.14 and 3.8.5.5.
C.III.1 3.7.2.15	Analysis Procedure for Damping	Conforms
C.III.1 3.7.3.1	Seismic Analysis Methods	Conforms
C.III.1 3.7.3.2	Procedures Used for Analytical Modeling	Conforms
C.III.1 3.7.3.3	Analysis Procedure for Damping	Conforms
C.III.1 3.7.3.4	Three Components of Earthquake Motion	Conforms
C.III.1 3.7.3.5	Combination of Modal Responses	Conforms. Addressed in DCD Section 3.7.3.7.
C.III.1 3.7.3.6	Use of Constant Vertical Static Factors	Conforms
C.III.1 3.7.3.7	Buried Seismic Category I Piping, Conduits, and Tunnels	Conforms. Addressed in DCD Section 3.7.3.13.
C.III.1 3.7.3.8	Methods for Seismic Analysis of Seismic Category I Concrete Dams	Not applicable. There are no Seismic Category I dams for Unit 3.
C.III.1 3.7.3.9	Methods for Seismic Analysis of Aboveground Tanks	Conforms. Addressed in DCD Section 3.7.3.15.
C.III.1 3.7.4	Seismic Instrumentation	Conforms
C.III.1 3.8.1	Concrete Containment	Conforms
C.III.1 3.8.2	Steel Containment	Conforms
C.III.1 3.8.3	Concrete and Steel Internal Structures of Steel or Concrete Containments	Conforms
C.III.1 3.8.4	Other Seismic Category I Structures	Conforms. There are no Seismic Category I structures that are outside the scope of the DCD.
C.III.1 3.8.5	Foundations	Conforms

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Table 1.9-203 (Sheet 7 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.9.1	Special Topics for Mechanical Components	Conforms. There are no Seismic Category I components or supports beyond those evaluated in the reference certified design.
C.III.1 3.9.1.1	Design Transients	Conforms. There are no Seismic Category I components or supports beyond those evaluated in the reference certified design.
C.III.1 3.9.1.2	Computer Programs Used in Analysis	Conforms. There are no Seismic Category I components or supports beyond those evaluated in the reference certified design.
C.III.1 3.9.1.3	Experimental Stress Analysis	Conforms. There are no Seismic Category I components or supports beyond those evaluated in the reference certified design.
C.III.1 3.9.1.4	Considerations for the Evaluation of the Faulted Condition	Conforms. There are no Seismic Category I components or supports beyond those evaluated in the reference certified design.
C.III.1 3.9.2	Dynamic Testing and Analysis of Systems, Components, and Equipment	Conforms. There are no systems outside the scope of the referenced certified design that require dynamic testing and analysis.
C.III.1 3.9.2.1	Piping Vibration, Thermal Expansion, and Dynamic Effects	Conforms. There are no ASME Code Class 1, 2, and 3 systems; other high-energy piping systems inside Seismic Category I structures; high-energy portions of systems for which failure could reduce the functioning of any Seismic Category I plant feature to an unacceptable level; or Seismic Category I portions of moderate-energy piping systems located outside containment outside the scope of the referenced certified design.
C.III.1 3.9.2.2	Seismic Analysis and Qualification of Seismic Category I Mechanical Equipment	Conforms
C.III.1 3.9.2.3	Dynamic Response Analysis of Reactor Internals Under Operational Flow Transients and Steady-State Conditions	Conforms. There are no ESBWR pressure vessel internals that the referenced certified design does not cover.
C.III.1 3.9.2.4	Preoperational Flow-Induced Vibration Testing of Reactor Internals	Conforms. There are no BWR pressure vessel internals that the referenced certified design does not cover. DCD Sections 3.9.2.3 and 3.9.2.4 adequately cover the analysis of potential adverse flow effects that could impact BWR vessel internals.
C.III.1 3.9.2.5	Dynamic System Analysis of the Reactor Internals Under Faulted Condition	Conforms. Addressed in DCD Section 3.9.3.1 and Table 3.9-2.

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Table 1.9-203 (Sheet 8 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.9.2.6	Correlations of Reactor Internals Vibration Tests with the Analytical Results	Conforms. Addressed in DCD Section 3.9.2.6.
C.III.1 3.9.3	ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures	Conforms. There are no pressure-retaining components or component supports designed or constructed in accordance with ASME Code Class 1, 2, or 3, or GDC 1,2,4,14, or 15, beyond those evaluated in the referenced certified design.
C.III.1 3.9.4	Control Rod Drive Systems	Conforms
C.III.1 3.9.5.1	Design Arrangements	Conforms
C.III.1 3.9.5.2	Loading Conditions	Conforms
C.III.1 3.9.5.3	Design Bases	Conforms
C.III.1 3.9.5.4	BWR Reactor Pressure Vessel Internals Including Steam Dryer	Conforms. There are no reactor pressure vessel internals (including the steam dryer) or other main steam system components that are not covered by the referenced certified design. The reactor is classified as non-prototype.
C.III.1 3.9.6.1	Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints	Conforms. There is no safety-related equipment beyond the scope of the referenced certified design.
C.III.1 3.9.6.2	In-Service Testing Program for Pumps	Not applicable. There are no safety-related pumps.
C.III.1 3.9.6.3	In-Service Testing Program for Valves	Conforms. Addressed in DCD Section 3.9.6; the list of valves included in the IST program is provided in Table 3.9-8. IST Program test procedures and schedules are addressed in Technical Specifications 5.5.5. Justification for cold shutdown and refueling outage test schedules is addressed in DCD Section 3.9.6 and Table 3.9-8. The implementation milestones for the IST and MOV Programs are addressed in Section 13.4.
C.III.1 3.9.6.3.1	In-Service Testing Program for Motor-Operated Valves (MOVs)	Conforms. Addressed in DCD Section 3.9.6.
C.III.1 3.9.6.3.2	In-Service Testing Program for Power-Operated Valves (POVs) Other Than MOVs	Conforms. Addressed in DCD Section 3.9.6.
C.III.1 3.9.6.3.3	In-Service Testing Program for Check Valves	Conforms. Addressed in DCD Section 3.9.6.
C.III.1 3.9.6.3.4	Pressure Isolation Valve (PIV) Leak Testing	Not applicable. The ESBWR plant does not have any PIVs.
C.III.1 3.9.6.3.5	Containment Isolation Valve (CIV) Leak Testing	Conforms
C.III.1 3.9.6.3.6	In-Service Testing Program for Safety and Relief Valves	Conforms. Addressed in DCD Table 3.9-8.

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Table 1.9-203 (Sheet 9 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.9.6.3.7	In-Service Testing Program for Manually Operated Valves	Conforms. Addressed in DCD Table 3.9-8.
C.III.1 3.9.6.3.8	In-Service Testing Program for Explosively Activated Valves	Conforms. Addressed in DCD Table 3.9-8.
C.III.1 3.9.6.4	In-Service Testing Program for Dynamic Restraints	Conforms with the following exception: A plant-specific snubber table will be prepared in conjunction with closure of ITAAC Table 3.1-1.
C.III.1 3.9.6.5	Relief Requests and Alternative Authorizations to ASME OM Code	Conforms
C.III.1 3.10.1	Seismic Qualification Criteria	Conforms. There is no seismic or dynamic qualification required for equipment that is outside the scope of the referenced certified design.
C.III.1 3.10.2	Methods and Procedures for Qualifying Mechanical and Electrical Equipment and Instrumentation	Conforms
C.III.1 3.10.3	Methods and Procedures of Analysis or Testing of Supports of Mechanical and Electrical Equipment and Instrumentation	Conforms
C.III.1 3.10.4	Test and Analyses Results and Experience Database	Conforms
C.III.1 3.11	Environmental Qualification of Mechanical and Electrical Equipment	Conforms. There is no other equipment beyond that which has been evaluated in the referenced certified design.
C.III.1 3.11.1	Equipment Location and Environmental Conditions	Conforms
C.III.1 3.11.2	Qualification Tests and Analysis	Conforms
C.III.1 3.11.3	Qualification Test Results	Conforms
C.III.1 3.11.4	Loss of Ventilation	Conforms
C.III.1 3.11.5	Estimated Chemical and Radiation Environment	Conforms
C.III.1 3.11.6	Qualification of Mechanical Equipment	Conforms
C.III.1 3.12.1	Introduction	Conforms
C.III.1 3.12.2	Codes and Standards	Conforms. Addressed in DCD Sections 3.2, 3.6, 3.7, and Chapters 5 and 14.
C.III.1 3.12.3	Piping Analysis Methods	Conforms. Addressed in DCD Sections 3.7.2.2 and 3.7.3.9.
C.III.1 3.12.3.1	Experimental Stress Analyses	Conforms. Addressed in DCD Section 3.9.1.3.
C.III.1 3.12.3.2	Modal Response Spectrum Method	Conforms. Addressed in DCD Section 3.7.2.1.
C.III.1 3.12.3.3	Response Spectra Method (or Independent Support Motion Method)	Conforms. Addressed in DCD Section 3.7.2.1.2.
C.III.1 3.12.3.4	Time History Method	Conforms. Addressed in DCD Section 3.7.2.1.1.

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Table 1.9-203 (Sheet 10 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 3.12.3.5	Inelastic Analyses Method	Not Applicable. Per DCD Section 3.9.1.4 (Inelastic Analyses Methods), except for pipe whip restraints, inelastic analyses methods are not used in the ESBWR piping design and analysis.
C.III.1 3.12.3.6	Small-Bore Piping Method	Conforms. Addressed in DCD Section 3.7.3.16.
C.III.1 3.12.3.7	Nonseismic/Seismic Interaction (II/I)	Conforms with the following exception: The location and distance between piping systems will be established as part of the completion of ITAAC Table 3.1-1.
C.III.1 3.12.3.8	Seismic Category I Buried Piping	Not Applicable. Per DCD Section 3.7.3.13, there is no buried Seismic Category I piping.
C.III.1 3.12.4	Piping Modeling Technique	Conforms. Addressed in DCD Section 3.7.3.3.1 and Appendix 3D for the PISYS computer code.
C.III.1 3.12.4.1	Computer Codes	Conforms. Addressed in DCD Appendix 3D.
C.III.1 3.12.4.2	Dynamic Piping Model	Conforms. Addressed in DCD Section 3.7.3.3.1.
C.III.1 3.12.4.3	Piping Benchmark Program	Conforms. Addressed in DCD Appendix 3D.
C.III.1 3.12.4.4	Decoupling Criteria	Conforms. Addressed in DCD Sections 3.7.2.3 and 3.7.3.16.
C.III.1 3.12.5.1	Seismic Input Envelope vs. Site-Specific Spectra	Conforms. Addressed in DCD Section 3.7.1.
C.III.1 3.12.5.2	Design Transients	Conforms. Addressed in DCD Section 3.9.1.1 and DCD Table 3.9-1.
C.III.1 3.12.5.3	Loadings and Load Combination	Conforms. Addressed in DCD Section 3.9.1.1 and DCD Table 3.9-8.
C.III.1 3.12.5.4	Damping Values	Conforms. Addressed in DCD Section 3.7.1.2 and DCD Table 3.7-1.
C.III.1 3.12.5.5	Combination of Modal Responses	Conforms. Addressed in DCD Section 3.7.3.7.
C.III.1 3.12.5.6	High-Frequency Modes	Conforms. Addressed in DCD Sections 3.7.1.1 and 3.7.1.2.
C.III.1 3.12.5.7	Fatigue Evaluation of ASME Code Class 1 Piping	Conforms. Addressed in DCD Section 3.9.3.4 and DCD Table 3.9-8.
C.III.1 3.12.5.8	Fatigue Evaluation of ASME Code Class 2 and 3 Piping	Conforms. Addressed in DCD Section 3.9.
C.III.1 3.12.5.9	Thermal Oscillations in Piping Connected to the Reactor Coolant System	Conforms

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Section		Section Title	Conformance Evaluation
C.III.1	3.12.5.10	Thermal Stratification	Conforms. Addressed in DCD Section 3.9.2.1.2.
C.III.1	3.12.5.11	Safety Relief Valve Design, Installation, and Testing	Conforms. Addressed in DCD Figures 5.2-3 and 5.4-3, and DCD Table 3.9-8.
C.III.1	3.12.5.12	Functional Capability	Conforms. Addressed in DCD Table 3.9-2, Note 13, and DCD Chapters 5 and 6.
C.III.1	3.12.5.13	Combination of Inertial and Seismic Anchor Motion Effects	Conforms. Addressed in DCD Section 3.7.3.9.
C.III.1	3.12.5.14	Operating-Basis Earthquake as a Design Load	Not applicable. The SSE establishes the design load for the ESBWR.
C.III.1	3.12.5.15	Welded Attachments	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.5.16	Modal Damping for Composite Structures	Conforms. Addressed in DCD Section 3.7.2.13.
C.III.1	3.12.5.17	Minimum Temperature for Thermal Analyses	Conforms. Addressed in DCD Sections 3.9.1.1 and 3.9.3.1.
C.III.1	3.12.5.18	Intersystem Loss-of-Coolant Accident	Conforms. Addressed in DCD Appendix 3K.
C.III.1	3.12.5.19	Effects of Environment on Fatigue Design	Conforms. Addressed in DCD Section 3.9.3.4. The reference in Regulatory Guide 1.206 to 1.76 appears to be in error, and should have referenced 1.207.
C.III.1	3.12.6.1	Applicable Codes	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.6.2	Jurisdictional Boundaries	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.6.3	Loads and Load Combinations	Conforms. Addressed in DCD Section 3.9 and DCD Appendix 3B.
C.III.1	3.12.6.4	Pipe Support Baseplate and Anchor Bolt Design	Conforms. Addressed in DCD Section 3.9.3.7.
C.III.1	3.12.6.5	Use of Energy Absorbers and Limit Stops	Conforms. Addressed in DCD Section 3.9.3.7.
C.III.1	3.12.6.6	Use of Snubbers	Conforms. Addressed in DCD Section 3.9.3.7.1(3).
C.III.1	3.12.6.7	Pipe Support Stiffnesses	Conforms. Addressed in DCD Section 3.7.3.3.1.
C.III.1	3.12.6.8	Seismic Self-Weight Excitation	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.6.9	Design of Supplementary Steel	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.6.10	Consideration of Friction Forces	Conforms. Addressed in DCD Section 3.9.3.7.1(5).
C.III.1	3.12.6.11	Pipe Support Gaps and Clearances	Conforms. Addressed in DCD Section 3.9.3.7.1.
C.III.1	3.12.6.12	Instrumentation Line Support Criteria	Conforms. Addressed in DCD Section 3.9.3.7.1.

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Section	Section Title	Conformance Evaluation
C.III.1 3.12.6.13	Pipe Deflection Limits	Conforms. Addressed in DCD Section 3.9.2.1.1 and Chapter 14.
C.III.1 3.13	Threaded Fasteners – ASME code Class 1, 2, and 3	Conforms
C.III.1 3.13.1.1	Materials Selection	Conforms
C.III.1 3.13.1.2	Special Materials fabrication Processes and Special Controls	Conforms
C.III.1 3.13.1.3	Fracture Toughness Requirements for Threaded Fasteners Made of Ferritic Materials	Conforms
C.III.1 3.13.1.5	Certified Material Test Reports	Conforms
C.III.1 3.13.2	Inservice Inspection Requirements	Conforms
C.III.1 4.1	Reactor: Summary Description	Conforms
C.III.1 4.2	Fuel System Design	Conforms
C.III.1 4.3	Nuclear Design	Conforms
C.III.1 4.4	Thermal and Hydraulic Design	Conforms
C.III.1 4.5.1	Control Rod Drive Structural Materials	Conforms
C.III.1 4.5.2	Reactor Internal and Core Support Materials	Conforms
C.III.1 4.6	Functional Design of Reactivity Control System	Conforms
C.III.1 5.1	Reactor Coolant and Connecting Systems: Summary Description	Conforms
C.III.1 5.2.1	Compliance with ASME Codes and Code Cases	Conforms
C.III.1 5.2.2.1	Design Bases	Conforms
C.III.1 5.2.2.2	Design Evaluation	Conforms
C.III.1 5.2.2.3	Piping and Instrumentation Diagrams	Conforms
C.III.1 5.2.2.4	Equipment and Component Description	Conforms
C.III.1 5.2.2.5	Mounting of Pressure-Relief Devices	Conforms
C.III.1 5.2.2.6	Applicable Codes and Classification	Conforms
C.III.1 5.2.2.7	Material Specification	Conforms
C.III.1 5.2.2.8	Process Instrumentation	Conforms

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Section	Section Title	Conformance Evaluation
C.III.1 5.2.2.9	System Reliability	Conforms
C.III.1 5.2.2.10	Testing and Inspection	Conforms. Addressed in DCD Section 5.2.2.4, and in Section 3.9 and Chapter 14.
C.III.1 5.2.3.1	Material Specifications	Conforms
C.III.1 5.2.3.2	Compatibility with Reactor Coolant	Conforms. Addressed in DCD Section 5.2.3.
C.III.1 5.2.3.3	Fabrication and Processing of Ferritic Materials	Conforms
C.III.1 5.2.3.4	Fabrication and Processing of Austenitic Stainless Steels	Conforms
C.III.1 5.2.3.5	Prevention of Primary Water Stress-Corrosion Cracking for Nickel-Based Alloys (PWRs only)	Not applicable. Applies only to PWRs.
C.III.1 5.2.3.6	Threaded Fasteners	Conforms. Addressed in DCD Section 3.9.3.9.
C.III.1 5.2.4.1	In-Service Inspection and Testing Program	Conforms. Addressed in DCD Section 5.2.4 and in FSAR Section 5.2.4.
C.III.1 5.2.4.2	Pre-Service Inspection and Testing Program	Conforms. Addressed in DCD Section 5.2.4.
C.III.1 5.2.5	Reactor Coolant Pressure Boundary Leakage Detection	Conforms
C.III.1 5.3.1.1	Material Specifications	Conforms
C.III.1 5.3.1.2	Special Processes Used for Manufacturing and Fabrication	Conforms
C.III.1 5.3.1.3	Special Methods for Nondestructive Examination	Conforms
C.III.1 5.3.1.4	Special Controls for Ferritic and Austenitic Stainless Steels	Conforms
C.III.1 5.3.1.5	Fracture Toughness	Conforms
C.III.1 5.3.1.6	Material Surveillance	Conforms. Addressed in DCD Section 5.3.1.6 and FSAR Subsection 5.3.1.8.
C.I.1 5.3.1.7	Reactor Vessel Fasteners	Although Regulatory Position C.III.1 provides a Section Number 5.3.1.7; there is no specific direction provided for COL applicants. A review of Regulatory Position C.I Section 5.3.17 was performed, and the information requested is provided in the DCD Section 5.3.1.7.
C.III.1 5.3.2.1	Limit Curves	Conforms

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Section	Section Title	Conformance Evaluation
C.III.1 5.3.2.2	Operating Procedures	Conforms. Addressed in DCD Sections 5.3.2.1, 5.3.2.2, and 5.3.3.6, and FSAR Subsection 5.3.3.6.
C.III.1 5.3.2.3	Pressurized Thermal Shock (PWRs only)	Not applicable. Applies only to PWRs.
C.III.1 5.3.2.4	Upper-Shelf Energy	Conforms
C.III.1 5.3.3	Reactor Vessel Integrity	Conforms. Identification of a specific manufacturer is not required.
C.III.1 5.3.3.1	Design	Conforms
C.III.1 5.3.3.2	Materials of Construction	Conforms
C.III.1 5.3.3.3	Fabrication Methods	Conforms
C.III.1 5.3.3.4	Inspection Requirements	Conforms. Addressed in DCD Section 5.3.3.4.
C.III.1 5.3.3.5	Shipment and Installation	Conforms. Addressed in DCD Section 5.3.3.5.
C.III.1 5.3.3.6	Operating Conditions	Conforms. Addressed in DCD Section 5.3.3.6 and FSAR Subsection 5.3.3.6.
C.III.1 5.3.3.7	Inservice Surveillance	Conforms. Addressed in DCD Section 5.3.3.7.
C.III.1 5.3.3.8	Threaded Fasteners	Conforms. Addressed in DCD Section 3.9.3.9 and FSAR Section 3.13.
C.III.1 5.4.1	Reactor Coolant Pumps or Circulation Pumps (BWR)	Conforms
C.III.1 5.4.1.1	Pump Flywheel Integrity (PWR)	Not applicable. Applies only to PWRs.
C.III.1 5.4.2	Steam Generators (PWR)	Not applicable. Applies only to PWRs.
C.III.1 5.4.3	Reactor Coolant System Piping and Valves	Conforms
C.III.1 5.4.4	Main Steamline Flow Restrictions	Conforms
C.III.1 5.4.5	Pressurizer	Not applicable. Applies only to PWRs.
C.III.1 5.4.6	Reactor Core Isolation Cooling System (BWRs)/Isolation Condenser System (ESBWR)	Conforms
C.III.1 5.4.7	Residual Heat Removal System/Passive Residual Heat Removal System (Advanced Light-Water Reactor/Shutdown Cooling Mode of the Reactor Water Cleanup System (ESBWR)	Conforms

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Section	Section Title	Conformance Evaluation
C.III.1 5.4.8	Reactor Water Cleanup System (BWR)/ Reactor Water Cleanup/Shutdown Cooling System (ESBWR)	Conforms
C.III.1 5.4.9	Reactor Coolant System Pressure Relief Devices/Reactor Coolant Depressurization Systems	Conforms
C.III.1 5.4.10	Reactor Coolant System Component Supports	Conforms
C.III.1 5.4.11	Pressurizer Relief Discharge System (PWRs only)	Not applicable. Applies only to PWRs.
C.III.1 5.4.12	Reactor Coolant System High-Point Vents	Conforms
C.III.1 5.4.13	Main Steamline, Feedwater, and Auxiliary Feedwater Piping	Conforms
C.III.1 6.1	Engineered Safety Features: Engineered Safety Feature Materials	Conforms. Addressed in DCD Section 6.1.
C.III.1 6.1.1.1	Materials Selection and Fabrication	Conforms
C.III.1 6.1.1.2	Composition and Compatibility of Core Cooling Coolants and Containment Sprays	Conforms. Addressed in DCD Sections 5.2.3.2, 5.4.8, 9.3.10, 5.2.3.4.1, 6.1.1.3.4, 9.1.3, 6.1.1.4, and 6.1.2.
C.III.1 6.1.2	Organic Materials	Exception. The information requested by the Regulatory Guide is not available at this time, but commitments and a milestone for completing COL Item 6.1.3-1-A, which pertains to this guidance, are addressed in Subsection 6.1.2.3.
C.III.1 6.2	Containment Systems	Conforms
C.III.1 6.2.1	Containment Functional Design	Conforms
C.III.1 6.2.2	Containment Heat Removal Systems	Conforms
C.III.1 6.2.3	Secondary Containment Functional Design	Not applicable. The ESBWR plant does not have a secondary containment.
C.III.1 6.2.4	Containment Isolation System	Conforms.
C.III.1 6.2.5	Combustible Gas Control in Containment	Conforms.
C.III.1 6.2.6	Containment Leakage Testing	Conforms. Addressed in DCD Sections 6.2.6.1 through 6.2.6.5, and in FSAR Section 13.4. Special testing requirements in Regulatory Guide 1.206, Section C.III.1, Section 6.2.6.5 are not applicable to the ESBWR.
C.III.1 6.2.7	Fracture Prevention of Containment Pressure Vessel	Conforms

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Section	Section Title	Conformance Evaluation
C.III 6.3	Emergency Core Cooling System	Conforms. There are no aspects of the site-specific design that affect the LOCA analyses in the DCD.
C.III.1 6.4	Habitability Systems	Conforms
C.III.1 6.5	Fission Product Removal and Control Systems	Conforms
C.III.1 6.6	In-Service Inspection of Class 2 and 3 Components	Conforms. Addressed in DCD Section 6.6 and in FSAR Subsection 6.6.10.3.
C.III.1 6.6.1	Components Subject to Examination	Conforms
C.III.1 6.6.2	Accessibility	Conforms
C.III.1 6.6.3	Examination Techniques and Procedures	Conforms. Addressed in DCD Section 6.6.3.2. There are no special examination techniques required to meet the ASME Code.
C.III.1 6.6.4	Inspection Intervals	Conforms. Addressed in DCD Section 6.6.4.
C.III.1 6.6.5	Examination Categories and Requirements	Conforms. Addressed in DCD Section 6.6.3.1.
C.III.1 6.6.6	Evaluation of Examination Results	Conforms (addressed in DCD Section 6.6.5), except that RG 1.206 references ASME Code Sections IWC-4000 and IWD-4000 for Class 2 and Class 3, respectively, whereas DCD Section 6.6.5 references IWA-4000. Later editions of ASME Code Section XI do not contain Sections IWC-4000 and IWD-4000, only IWA-4000. Therefore, the intent of the Regulatory Guide is met.
C.III.1 6.6.7	System Pressure Tests	Conforms. Addressed in DCD Section 6.6.6.
C.III.1 6.6.8	Augmented In-Service Inspection to Protect against Postulated Piping Failures	Conforms. Addressed in DCD Section 6.6.7.
C.III.1 6.7	Main Steamline Isolation Valve Leakage Control Steam (BWRs)	Not applicable to the ESBWR.
C.III.1 7	Instrumentation and Controls	Conforms. Addressed in DCD Chapter 7, Tier 1, and design-related ITAAC (DAC). There are no departures from the referenced certified design.
C.III.1 7.1	Introduction	Conforms. There is no safety-related instrumentation, control, or supporting system that has not been addressed in the referenced certified design or other parts of the COL application.

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Section	Section Title	Conformance Evaluation
C.III.1 7.2	Reactor Trip System	Conforms. There is no reactor trip system instrumentation, control, or supporting system that has not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.3	Engineered Safety Features Systems	Conforms. There are no ESF systems I&C or supporting systems that have not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.4	Systems Required for Safe Shutdown	Conforms. There are no safe-shutdown systems I&C or supporting systems that have not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.5	Information Systems Important to Safety	Conforms. There are no information systems important to safety that have not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.6	Interlock Systems Important to Safety	Conforms. There are no interlock systems important to safety that have not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.7	Control Systems Not Required for Safety	Conforms. There is no control system instrumentation or supporting system that has not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.8	Diverse Instrumentation and Control Systems	Conforms. There is no diverse I&C system that has not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 7.9	Data Communication Systems	Conforms. There are no data communication systems that have not been addressed in the referenced certified design or other parts of the COL application.
C.III.1 8	Electrical Power	Conforms
C.III.1 8.1	Introduction	Conforms. There are no safety-related or RTNSS on-site AC or DC loads that are added to the referenced certified design. There are no safety-related or RTNSS electrical systems that are beyond the scope of the referenced certified design.

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Section	Section Title	Conformance Evaluation
C.III.1 8.2.1	Description	Conforms (as it relates to passive designs). Addressed in Subsections 8.2.1, 8.2.2 and 8.2.3; Table 8.2-201; Figures 8.2-202, 8.2-203, and 8.2-204; and DCD Section 8.2.3.
C.III.1 8.2.2	Analysis	Conforms (as it relates to BWRs and passive designs). Addressed in Section 8.2.2.
C.III.1 8.3.1.1	AC Power Systems: Description	Conforms. Addressed in DCD Section 8.3.1 and in FSAR Subsection 8.3.1.1.
C.III.1 8.3.1.2	Analysis	Not applicable. Does not request information for passive designs.
C.III.1 8.3.1.3	Electrical Power System Calculations and Distribution System Studies for AC Systems	Conforms
C.III.1 8.3.2.1	DC Power Systems: Description	Not applicable. Does not request information for passive designs.
C.III.1 8.3.2.2	Analysis	Not applicable. Does not request information for passive designs.
C.III.1 8.3.2.3	Electrical Power System Calculations and Distribution System Studies for DC Systems	Conforms
C.III.1 8.4.1(1)	Station Blackout: Description	Not applicable. Does not request information for passive designs.
C.III.1 8.4.1(2)		Not applicable. Does not request information for passive designs.
C.III.1 8.4.1(3)		Conforms. Addressed in Subsection 8.3.2.1.1.
C.III.1 8.4.1(4)		Conforms. Addressed in Subsection 8.3.2.1.1.
C.III.1 8.4.2	Analysis	Not applicable. Does not request information for passive designs.
C.III.1 9.1.1	Fuel Storage and Handling: Criticality Safety of Fresh and Spent Fuel Storage and Handling	Conforms. Addressed in DCD Sections 9.1.1 and 9.1.2.
C.III.1 9.1.2	New and Spent Fuel Storage	Conforms. Addressed in DCD Section 9.1.2.
C.III.1 9.1.3	Spent Fuel Pool Cooling and Cleanup System	Conforms. Addressed in DCD Section 9.1.3.
C.III.1 9.1.4	Light Load Handling System (Related to Refueling)	Conforms
C.III.1 9.1.5	Overhead Heavy Load Handling System	Conforms. Addressed in DCD Section 9.1.5.5 and in Subsection 9.1.4 and 9.1.5.

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Section	Section Title	Conformance Evaluation
C.III.1 9.2.1	Station Service Water System (Open, Raw Water Cooling Systems)	Conforms. Addressed in DCD Section 9.2.1 and FSAR Subsection 9.2.1. FSAR Subsection 9.2.1.2 supplies information on the site-specific PSWS heat sink and provisions to preclude corrosion and fouling.
C.III.1 9.2.2	Cooling System for Reactor Auxiliaries (Closed Cooling Water Systems)	Conforms
C.III.1 9.2 (for DCD Section 9.2.3)	Makeup Water System	Conforms. Design Bases, Safety Evaluation, Inspection and Testing Requirements, and Instrumentation are addressed in DCD Section 9.2.3. System Description is addressed in Subsection 9.2.3.
C.III.1 9.2.4	Potable and Sanitary Water Systems	Conforms
C.III.1 9.2.5	Ultimate Heat Sink	The design of the UHS is within the scope of the referenced certified design, and inspection and testing requirements are addressed in DCD Section 9.2.5.
C.III.1 9.2.6	Condensate Storage Facilities	Conforms. There are no safety-related or RTNSS condensate storage facilities outside the scope of the referenced certified design that are sources of water for residual heat removal or sources of coolant inventory makeup for safety-related systems.
C.III.1 9.2 9.2.7	Chilled Water System	Conforms. Addressed in DCD Section 9.2.7.
C.III.1 9.2 9.2.8	Turbine Component Cooling Water System	Conforms. Addressed in DCD Section 9.2.8.
C.III.1 9.2 9.2.10	Station Water System	Conforms. Design Bases, Safety Evaluation, Inspection and Testing Requirements, and Instrumentation are addressed in DCD Section 9.2.10. System Description is addressed in Subsection 9.2.10.
C.III.1 9.3	Process Auxiliaries	Conforms. Hydrogen Water Chemistry is addressed in Subsection 9.3.9, Oxygen Injection System is addressed in Subsection 9.3.10, Zinc Injection System is addressed in Subsection 9.3.11, and Auxiliary Boiler System is addressed in DCD Section 9.3.12.
C.III.1 9.3 1	Compressed Air Systems	Conforms. Instrument Air is addressed in DCD Section 9.3.6, Service Air is addressed in DCD Section 9.3.7, and High-Pressure Nitrogen Supply System is addressed in DCD Section 9.3.8.

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Section	Section Title	Conformance Evaluation
C.III.1 9.3.2	Process and Postaccident Sampling Systems	Conforms
C.III.1 9.3.3	Equipment and Floor Drain System	Conforms. Addressed in DCD Section 9.3.3.
C.III.1 9.3.4	Chemical and Volume Control System (PWRs) (Including Boron Recovery System)	Not applicable. Applies only to PWRs.
C.III.1 9.3.5	Standby Liquid Control System	Conforms
C.III.1 9.4	Air Conditioning, Heating, Cooling, and Ventilation Systems	Conforms. Reactor Building HVAC System is addressed in DCD Section 9.4.6; Electric Building Heating, Ventilation, and Air Conditioning System is addressed in DCD Section 9.4.7; and Drywell Cooling System is addressed in DCD Section 9.4.8.
C.III.1 9.4.1	Control Room Area Ventilation System	Conforms
C.III.1 9.4.2	Spent Fuel Pool Area Ventilation Systems	Conforms
C.III.1 9.4.3	Auxiliary and Radwaste Area Ventilation System	Conforms
C.III.1 9.4.4	Turbine Building Area Ventilation System	Conforms
C.III.1 9.4.5	Engineered Safety Feature Ventilation System	Conforms
C.III.I 9.5.1	Fire Protection Program	Conforms
C.III.1 9.5.1.1(1)		Conforms
C.III.1 9.5.1.1(2)		Conforms
C.III.1 9.5.1.1(3)		Conforms. Addressed in Section 1.7.
C.III.1 9.5.1.1(4)		Conforms. Will be completed in accordance with the milestones in Section 13.4.
C.III.1 9.5.1.1(5)		Conforms. Will be completed in accordance with the milestones in Section 13.4.
C.III.1 9.5.1.1(6)		Conforms
C.III.1 9.5.1.1(7)		Conforms. Will be completed in accordance with the milestones in Section 13.4.
C.III.1 9.5.1.1(8)		Conforms

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Section	Section Title	Conformance Evaluation
C.III.1 9.5.1.1(9)		Conforms. Addressed in DCD Sections 9.5.1.15 and 14.3, and in FSAR Section 13.4.
C.III.1 9.5.2	Communication System	Conforms. Addressed in DCD Section 9.5.2 and in FSAR Subsection 9.5.2.
C.III.1 9.5.3	Lighting System	Conforms. Addressed in DCD Section 9.5.3.
C.III.1 9.5.4	Diesel Generator Fuel Oil Storage and Transfer Systems	Conforms. Addressed in DCD Section 9.5.4 and in FSAR Subsection 9.5.4.
C.III.1 9.5.5	Diesel Generator Cooling Water Systems	Conforms. Addressed in DCD Section 9.5.5.
C.III.1 9.5.6	Diesel Generator Starting Systems	Conforms. Addressed in DCD Section 9.5.6.
C.III.1 9.5.7	Diesel Generator Lubrication Systems	Conforms. Addressed in DCD Section 9.5.7.
C.III.1 9.5.8	Diesel Generator Combustion Air Intake and Exhaust System	Conforms. Addressed in DCD Section 9.5.8.
C.III.1 10.1	Steam and Power Conversion: Introduction	Conforms. There are no principal design features of the steam and power conversion system that are outside the scope of the referenced certified design.
C.III.1 10.2.1 (1)	Design Bases	Conforms. Addressed in DCD Section 10.2.1.
C.III.1 10.2.1 (2)	Design Bases	Conforms. Addressed in DCD Section 10.2.2.
C.III.1 10.2.1 (3)	Design Bases	Conforms. Addressed in DCD Sections 3.5.1, 3.5.3, 3.6, and 10.2.4, and DCD Figure 3.5-2.
C.III.1 10.2.2 (1)	Description	Conforms. Addressed in DCD Sections 10.2.2, 10.2.3, and DCD Figures 1.2-12 to 1.2-20, 3.5-2, and 10.1-1.
C.III.1 10.2.2 (2)	Description	Conforms. Addressed in DCD Sections 10.2.2 and 10.2.3.
C.III.1 10.2.2 (3)	Description	Conforms. Addressed in DCD Section 10.2.2 and DCD Figures 10.2-1, 10.2-2, and 10.2-3.
C.III.1 10.2.2 (4)	Description	Conforms. Addressed in DCD Sections 10.2.3 and 14.2.8.
C.III.1 10.2.2 (5)	Description	Conforms. Addressed in DCD Sections 12.2.1, 12.2.3, 12.4.4, Table 12.2-23 and DCD Figures 12.3-12 to 12.3-18 and 12.3-32 to 12.3-38.
C.III.1 10.2.2 (6)	Description	Conforms. Addressed in DCD Sections 3.6, 10.2.2, and 10.2.4.

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Section	Section Title	Conformance Evaluation
C.III.1 10.2.3 (1)	Turbine Rotor Integrity	Conforms. Addressed in DCD Section 10.2.3 and FSAR Subsection 10.2.3.
C.III.1 10.2.3 (2)	Turbine Rotor Integrity	Conforms. Addressed in DCD Section 10.2.3 and FSAR Subsection 10.2.3.
C.III.1 10.2.3 (3)	Turbine Rotor Integrity	Conforms. Addressed in DCD Section 10.2.3 and FSAR Subsection 10.2.3.
C.III.1 10.2.3 (4)	Turbine Rotor Integrity	Conforms. Addressed in DCD Section 10.2.3 and FSAR Subsection 10.2.3.
C.III.1 10.2.3 (5)	Turbine Rotor Integrity	Conforms. Addressed in DCD Sections 10.2.2 and 10.2.3, and FSAR FSAR Subsection 10.2.3.
C.III.1 10.3	Main Steam Supply System	Conforms. Addressed in DCD Section 10.3.
C.III.1 10.3.1 (1)	Design Bases	Conforms. Addressed in DCD Section 10.3.1.
C.III.1 10.3.1 (2)	Design Bases	Conforms. Addressed in DCD Section 10.3.
C.III.1 10.3.1 (3)	Design Bases	Conforms. Addressed in DCD Sections 10.3.2 and 10.3.3.
C.III.1 10.3.1 (4)	Design Bases	Conforms. Addressed in DCD Section 10.3.
C.III.1 10.3.1 (5)	Design Bases	Conforms. Addressed in DCD Section 10.3.3.
C.III.1 10.3.1 (6)	Design Bases	Conforms. Addressed in DCD Section 10.3.
C.III.1 10.3.2	Description	Conforms. Addressed in DCD Section 10.3.3.
C.III.1 10.3.3	Evaluation	Conforms. Addressed in DCD Section 10.3.
C.III.1 10.3.4	Inspection and Testing Requirements	Conforms. Addressed in DCD Section 10.3.4.
C.III.1 10.3.5	Water Chemistry (PWR Only)	Not applicable. Only applies to PWRs.
C.III.1 10.3.6 (1)	Steam and Feedwater System Materials	Conforms. Addressed in DCD Section 10.3.6.
C.III.1 10.3.6 (2)	Steam and Feedwater System Materials	Conforms. Addressed in DCD Sections 6.6 and 10.3.4.
C.III.1 10.3.6 (3)	Steam and Feedwater System Materials	Not applicable. DCD Section 10.3.6 states that there are no austenitic stainless steels in the steam and feedwater system piping.
C.III.1 10.3.6 (4)	Steam and Feedwater System Materials	Not Applicable. DCD Section 10.3.6 states that there are no austenitic stainless steels in the ASME Code Section III Class 1 and 2 portions of steam and feedwater piping.
C.III.1 10.3.6 (5)	Steam and Feedwater System Materials	Conforms. Addressed in DCD Section 10.3.

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Section	Section Title	Conformance Evaluation
C.III.1 10.3.6 (6)	Steam and Feedwater System Materials	Not applicable. Additional information is not required.
C.III.1 10.4	Other Features of the Steam and Power Conversion System	Conforms
C.III.1 10.4.1	Main Condensers	Conforms. Sampling points for detection are discussed in DCD Section 10.4.1.5.4. Although sodium content and sampling for sodium content is not specifically mentioned in DCD Section 10.4.1, monitoring condensate for an increase in conductivity is considered an acceptable means to detect condenser tube leakage. A table of key parameters and associated action levels is provided as Table 10.4-201. Alarm set points are established to provide an indication of abnormal chemistry conditions prior to reaching a recommended action level.
C.III.1 10.4.2	Main Condenser Evacuation System	Conforms. There are no design features of the main condenser evacuation system that are outside the scope of the referenced certified design.
C.III.1 10.4.3 (1)	Turbine Gland Sealing System	Conforms. Addressed in DCD Section 10.4.3.
C.III.1 10.4.3 (2)		Conforms with the following exception: for the operational phase, the QA program is described in Chapter 17, and is based on NQA-1, rather than RG 1.33.
C.III.1 10.4.4 (1)	Turbine Bypass System	Conforms. The turbine bypass system is consistent with the referenced certified design.
C.III.1 10.4.5 (1)	Circulating Water System	Conforms
C.III.1 10.4.5 (2)		Not applicable. The circulating water system does not interface with the UHS.
C.III.1 10.4.6 (1)	Condensate Cleanup System	Conforms
C.III.1 10.4.6 (2)		Conforms. Addressed in DCD Sections 10.4.1, 10.4.6, and 5.2.3; DCD Table 5.2-5; and in Table 10.4-201.
C.III.1 10.4.6 (3)		Conforms.
C.III.1 10.4.6 (4)		Not applicable. Only applies to PWRs.
C.III.1 10.4.7 (1)	Condensate and Feedwater Systems	Not applicable. Only applies to PWRs.
C.III.1 10.4.7 (2)		Conforms. Addressed in DCD Sections 1.2.2 and 5.2.4, and DCD Tables 1.9-22 and 1.11-1.
C.III.1 10.4.7 (3)		Not applicable. The condensate and feedwater systems are consistent with the referenced certified design.
C.III.1 10.4.8	Steam Generator Blowdown System (PWR)	Not applicable. Only applies to PWRs.

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Section	Section Title	Conformance Evaluation
C.III.1 10.4.9	Auxiliary Feedwater System (PWR)	Not applicable. Only applies to PWRs.
C,III.1 11.1	Source Terms	Conforms
C.III.1 11.2.1(1)	Liquid Waste Management Systems: Design Bases	Conforms. Addressed in DCD Section 11.2 and in FSAR Section 11.2.
C.III.1 11.2.1(2)	Design Bases	Conforms. Addressed in DCD Section 11.2.
C.III.1 11.2.1(3)	Design Bases	Conforms. Addressed in DCD Section 11.2.1 and DCD Table 11.2-3. Conformance with Regulatory Guide 1.140 is addressed in DCD Section 9.4.3.
C.III.1 11.2.1(4)	Design Bases	Conforms. Addressed in DCD Section 9.4.3.
C.III.1 11.2.1(5)	Design Bases	Conforms. Addressed in DCD Sections 11.2.3 and 15.3.16, and in FSAR Section 2.4.13.
C.III.1 11.2.1(6)	Design Bases	Conforms. Quality Assurance Program requirements are addressed in Chapter 17.
C.III.1 11.2.1(7)	Design Bases	Conforms. Addressed in DCD Section 11.2.4.
C.III.1 11.2.1(8)	Design Bases	Conforms
C.III.1 11.2.1(9)	Design Bases	Conforms. Addressed in DCD Section 11.2.2 and in FSAR Section 11.2.
C.III.1 11.2.2(1)	System Description	Conforms. Addressed in DCD Section 11.2.2.
C.III.1 11.2.2(2)	System Description	Conforms. Addressed in DCD Section 11.2.2.
C.III.1 11.2.2(3)	System Description	Conforms. Addressed in DCD Section 11.2.2.
C.III.1 11.2.2(4)	System Description	Conforms. Addressed in DCD Section 11.2.2.
C.III.1 11.2.3(1)	Radioactive Effluent Releases	Conforms. Addressed in DCD Sections 11.2 and 12.2, and in FSAR Section 12.2.
C.III.1 11.2.3(2)	Radioactive Effluent Releases	Conforms. Addressed in DCD Sections 11.2 and 12.2, and in FSAR Section 12.2.
C.III.1 11.3.1(1)	Gaseous Waste Management Systems: Design Bases	Addressed in DCD Section 11.3. Conforms with the following exception: No discussion is provided regarding the capability of and requirements for using portable processing equipment for refueling outages.

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Table 1.9-203 (Sheet 25 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 11.3.1(2)	Design Bases	Conforms. Addressed in DCD Section 11.3.
C.III.1 11.3.1(3)	Design Bases	Conforms. Addressed in DCD Section 11.3.
C.III.1 11.3.1(4)	Design Bases	Conforms. Quality Assurance Program requirements are addressed in Chapter 17.
C.III.1 11.3.1(5)	Design Bases	Conforms. Addressed in DCD Section 11.3.5.
C.III.1 11.3.1(6)	Design Bases	Conforms. Addressed in DCD Section 12.6 and in FSAR Section 12.6.
C.III.1 11.3.1(7)	Design Bases	Conforms. Addressed in DCD Section 11.3.
C.III.1 11.3.2(1)	System Description	Conforms. Addressed in DCD Section 11.3.2.
C.III.1 11.3.2(2)	System Description	Conforms. Addressed in DCD Section 11.3.2.
C.III.1 11.3.2(3)	System Description	Conforms. Addressed in DCD Section 11.3.2.
C.III.1 11.3.2(4)	System Description	Conforms. Addressed in DCD Sections 11.3.2, 11.3.3, and 9.4.
C.III.1 11.3.3	Radioactive Effluent Releases	Conforms. Addressed in DCD Sections 11.3 and 12.2, and in FSAR Section 12.2.
C.III.1 11.4.1(1)	Solid Waste Management System: Design Bases	Conforms. Addressed in DCD Section 11.4 and in FSAR Section 11.4.
C.III.1 11.4.1(2)	Design Bases	Conforms. Addressed in DCD Section 11.4 and in FSAR Section 11.4.
C.III.1 11.4.1(3)	Design Bases	Conforms. Addressed in DCD Section 11.4 and in FSAR Section 11.4.
C.III.1 11.4.1(4)	Design Bases	Conforms. Addressed in DCD Section 11.4 and in FSAR Sections 11.4, 13.5, and 17.5.
C.III.1 11.4.1(5)	Design Bases	Conforms. Addressed in DCD Section 11.4 and in FSAR Section 11.4.
C.III.1 11.4.1(6)	Design Bases	Conforms.
C.III.1 11.4.1(7)	Design Bases	Conforms. Addressed in DCD Section 11.4.

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Section	Section Title	Conformance Evaluation
C.III.1 11.4.2(1)	System Description	Addressed in DCD Section 11.4 and in FSAR Section 11.4. Conforms with the following exception: The FSAR provides a description of the PCP. Detailed waste packaging methodologies will be provided in the PCP. The implementation milestone is provided in Section 13.4.
C.III.1 11.4.2(2)	System Description	Addressed in DCD Section 11.4 and FSAR Section 11.4. Conforms with the following exception: The FSAR provides a description of the PCP. Detailed waste packaging methodologies will be provided in the PCP. The implementation milestone is provided in Section 13.4.
C.III.1 11.4.2(3)	System Description	Addressed in DCD Section 11.4 and in FSAR Section 11.4. Conforms with the following exception: The FSAR provides a description of the PCP. Detailed waste packaging methodologies will be provided in the PCP. The implementation milestone is provided in Section 13.4. There are no temporary on-site storage facilities.
C.III.1 11.4.2 (4)	System Description	Conforms. Addressed in DCD Section 11.4.
C.III.1 11.4.3 (1)	Radioactive Effluent Releases	Addressed in DCD Section 11.4 and in FSAR Section 11.4. Conforms with the following exception: The FSAR provides a description of the PCP. Detailed waste packaging methodologies will be provided in the PCP. The implementation milestone is provided in Section 13.4.
C.III.1 11.4.3 (2)	Radioactive Effluent Releases	Conforms. Addressed in DCD Sections 3.1 and 11.4.
C.III.1 11.4.3 (3)	Radioactive Effluent Releases	Conforms. Addressed in DCD Section 12.2.
C.III.1 11.5.1	Process and Effluent Radiological Monitoring and Sampling Systems: Design Bases	Conforms
C.III.1 11.5.2(1)	System Description	Conforms. Addressed in DCD Section 11.5.
C.III.1 11.5.2 (2)	System Description	Conforms with the following exception: Section 11.5 provides a description of the ODCM. The implementation milestone is provided in Section 13.4.
C.III.1 11.5.2 (3)	System Description	Conforms with the following exception: Section 11.5 and TS Chapter 5 provide a description of the radiological effluent controls. The implementation milestone is provided in Section 13.4.

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Section	Section Title	Conformance Evaluation
C.III.1 11.5.2 (4)	System Description	Conforms with the following exception: FSAR Section 11.5 and TS Chapter 5 provide a description of the REMP. The implementation milestone is provided in Section 13.4.
C.III.1 11.5.2 (5)	System Description	Conforms. Addressed in DCD Sections 3.1 and 11.5.
C.III.1 11.5.2 (6)	System Description	Conforms
C.III.1 11.5.2 (7)	System Description	Conforms
C.III.1 11.5.3	Effluent Monitoring and Sampling	Conforms
C.III.1 11.5.4	Process Monitoring and Sampling	Conforms
C.III.1 12.1.1	Policy Considerations	Conforms. Addressed in Sections 12.1 and 12.5.
C.III.1 12.1.2	Design Considerations	Conforms. Addressed in Section 12.5.
C.III.1 12.1.3	Operational Considerations	Conforms. Addressed in Sections 12.1 and 12.5.
C.III.1 12.2.1	Contained Sources	Conforms
C.III.1 12.2.2	Airborne Radioactive Material Sources	Conforms
C.III.1 12.3.1	Facility Design Features	Conforms
C.III.1 12.3.2	Shielding	Conforms
C.III.1 12.3.3	Ventilation	Conforms. Addressed in DCD Sections 9.4.1 and 12.3.
C.III.1 12.3.4	Area Radiation and Airborne Radioactivity Monitoring Instrumentation	Conforms
C.III.1 12.3.5	Dose Assessment	Conforms. Addressed in DCD Section 12.4 and in FSAR Section 12.4.
C.III.1 12.4	Dose Assessment	Conforms
C.III.1 12.5 (1) (a)	Operational Radiation Protection Program: Organization	Conforms. Addressed in Sections 12.5 and 13.1.
C.III.1 12.5 (1) (b)	Facilities	Conforms
C.III.1 12.5 (1) (c)	Instrumentation and Equipment	Conforms
C.III.1 12.5 (1) (d)	Procedures	Conforms

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Section	Section Title	Conformance Evaluation
C.III.1 12.5 (1) (e)	Training	Conforms. Addressed in Sections 12.5 and 13.2.
C.III.1 12.5 (2)		Conforms. Addressed in DCD Section 12.3.
C.III.1 12.5 (3)		Conforms. Addressed in Sections 12.5, 13.1, and 13.4.
C.III.1 12.5 (4)		Conforms. Addressed in Section 13.4.
C.III.1 12.5, last paragraph		Conforms. Addressed in Sections 12.5, 13.1, 13.2, and 13.5.
C.III.1 12.5.1	Organization	Conforms. Addressed in Sections 12.5 and 13.1.
C.III.1 12.5.2	Equipment, Instrumentation, and Facilities	Conforms
C.III.1 12.5.3	Procedures	Conforms. Addressed in Sections 12.5, 13.2, 13.5, and 17.5.
C.III.1 13.1.1(1)	Organizational Structure of Applicant: Management and Technical Support Organization	Conforms. Addressed in Sections 13.1 and 14.2.
C.III.1 13.1.1(2)		Conforms
C.III.1 13.1.1(3)		Conforms
C.III.1 13.1.1(4)		Conforms
C.III.1 13.1.1(5)		Conforms
C.III.1 13.1.1(6)		Conforms
C.III.1 13.1.1(7)		Conforms. Addressed in Sections 13.1 and 14.2.
C.III.1 13.1.1.1	Design, Construction, and Operating Responsibilities	Conforms
C.III.1 13.1.1.2	Organizational Arrangement	Conforms. (Unit 3 is not a new, multi-unit plant site.)
C.III.1 13.1.1.3	Qualifications	Conforms. Addressed in Sections 13.1 and 17.5.
C.III.1 13.1.2(1)		Exception. The guidelines of Regulatory Guide 1.33 for operating organization are met through equivalent administrative controls described in Chapter 17.
C.III.1 13.1.2(2)		Exception. The guidelines of Regulatory Guide 1.33 for onsite review and rules of practice are met through equivalent administrative controls described in Chapter 17.

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Section	Section Title	Conformance Evaluation
C.III.1 13.1.2(3)		Conforms. Addressed in Subsections 9.5.1 and Section 13.1.
C.III.1 13.1.2(4)		Conforms with the following exception: experience requirements cannot be met prior to operations as described in Appendix 13BB.
C.III.1 13.1.2(5)		Conforms
C.III.1 13.1.2(6)		Conforms
C.III.1 13.1.2(7)		Conforms. Addressed in Appendix 13AA.
C.III.1 13.1.2(8)		Conforms. Addressed in Appendix 13AA.
C.III.1 13.1.2.1	Plant Organization	Conforms
C.III.1 13.1.2.2(1)	Plant Personnel Responsibilities and Authorities	Conforms. Addressed in Sections 13.1 and 17.5.
C.III.1 13.1.2.2(2)		Conforms
C.III.1 13.1.2.2(3)		Conforms
C.III.1 13.1.2.3	Operating Shift Crews	Conforms
C.III.1 13.1.3.1	Qualification Requirements	Conforms with the following exception: experience requirements cannot be met prior to operations, as described in Appendix 13BB.
C.III.1 13.1.3.2	Qualifications of Plant Personnel	Exception. Resumes will not be included in the application, but will be available for inspection upon request.
C.III.1 13.2.1	Plant Staff Training Program	Conforms with the following exception: experience requirements of Regulatory Guide 1.8 cannot be met prior to operations, as described in Appendix 13BB. The Commission’s regulations, guides, and reports pertaining to training are listed in Section 1.6 of NEI 06-13.

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Section	Section Title	Conformance Evaluation
C.III.1 13.2.1.1 Licensed Staff (1)		Conforms with the following exceptions: 1) this item discusses inclusion of details of the licensed training program. As noted in NEI 06-13, which is incorporated by reference, the systematic approach to training (SAT) process is used to establish and maintain training programs. Course duration and content are determined by the SAT process and by administrative procedure and are not included in the FSAR section; 2) the requirement for a "contingency plan…in the event fuel loading is subsequently delayed" is met by the operator re-qualification program; and 3) the industry standard content for this section does not include a discussion of proposed schedule for licensed personnel.
C.III.1 13.2.1.1 Licensed Staff (2)		Conforms
C.III.1 13.2.1.1 Licensed Staff (3)		Conforms
C.III.1 13.2.1.1 Licensed Staff (4)		Conforms
C.III.1 13.2.1.1 Licensed Staff (5)		Conforms
C.III.1 13.2.1.1 Licensed Staff (6)		Conforms Section 13.4 contains milestones for implementation of operational programs.
C.III.1 13.2.1.1 Non-licensed Staff (1)		Conforms
C.III.1 13.2.1.1 Non-licensed Staff (2)		Conforms
C.III.1 13.2.1.1 Non-licensed Staff (3)		Exception – This item discusses programs not covered under 10 CFR 50.120. As noted in NEI 06-13, which is incorporated by reference, the systematic approach to training (SAT) process is used to establish and maintain training programs. Course duration and content are determined by the SAT process and by administrative procedure and are not included in the FSAR section.

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Section	Section Title	Conformance Evaluation
C.III.1 13.2.1.1 Non-licensed Staff (4)		Conforms. Addressed in Subsection 9.5.1.
C.III.1 13.2.1.1 Non-licensed Staff (5)		Conforms
C.III.1 13.2.1.1 Non-licensed Staff (6)		Conforms with the following exception: The first part of this item discusses detailed course descriptions. As noted in NEI 06-13, which is incorporated by reference, the systematic approach to training (SAT) process is used to establish and maintain training programs. Course duration and content are determined by the SAT process and by administrative procedure and are not included in the FSAR section. The implementation milestone is addressed in Section 13.4.
C.III.1 13.2.1.1 Non-licensed Staff (7)		Conforms
C.III.1 13.2.1.2	Coordination with Preoperational Tests and Fuel Loading	Conforms with the following exception: Rather than providing contingency plans for training in the event of significantly delayed fuel loading the retraining programs are utilized, as described in NEI 06-13. Figure 13AA-202 shows the training schedule relative to fuel loading.
C.III.1 13.2.2(1)	Applicable NRC Documents: 10 CFR 19	Conforms
C.III.1 13.2.2(2)	10 CFR 26	Conforms
C.III.1 13.2.2(3)	10 CFR 50	Conforms
C.III.1 13.2.2(4)	10 CFR 50 Appendix E	Conforms
C.III.1 13.2.2(5)	10 CFR 52	Conforms
C.III.1 13.2.2(6)	10 CFR 55	Conforms
C.III.1 13.2.2(7)	RG 1.8	Addressed in Table 1.9-202.
C.III.1 13.2.2(8)	Regulatory Guide 1.149	Addressed in Table 1.9-202.
C.III.1 13.2.2(9)	NUREG-0711	Conforms. HFE addressed in DCD Chapter 18.

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Section	Section Title	Conformance Evaluation
C.III.1 13.2.2(10)	NUREG-1021	Exception: Industry standard content for this section does not explicitly include discussion of compliance with NUREG-1021, Operator Licensing Examination Standards for Power Reactors.
C.III.1 13.2.2(11)	NUREG-1220	Not applicable. NUREG provides instructions for NRC inspectors.
C.III.1 13.2.2(12)	GL 86-04	Conforms
C.III.1 13.2.2(13)	Regulatory Guide 1.134	Exception: Industry standard content for this section does not explicitly include a discussion of compliance with Regulatory Guide 1.134, Medical Evaluations.
C.III.1 13.3(1)	Emergency Planning	Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3(2)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3(3)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3(4)		Conforms. Addressed in Chapter 2, and the Emergency Plan and Evacuation Time Estimate in COLA Part 5.
C.III.1 13.3(5)		Conforms. Addressed in COLA Part 5.
C.III.1 13.3(6)		Not applicable. Applies when state and/or local governments decline to participate in emergency planning and preparedness.
C.III.1 13.3(7)		Conforms
C.III.1 13.3.1 (1)	Combined License Application and Emergency Plan Content	Conforms. Addressed in COLA Part 5.
C.III.1 13.3.1 (2)		Conforms. Addressed in COLA Parts 5 and 10.
C.III.1 13.3.1 (3)		Conforms. Addressed in Chapter 1 and the Emergency Plan in COLA Part 5.
C.III.1 13.3.1 (4)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3.1 (5)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3.1 (6)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3.1 (7)		Conforms. Addressed in Chapter 1.
C.III.1 13.3.1 (8)		Conforms. Addressed in the Emergency Plan in COLA Part 5.

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Section	Section Title	Conformance Evaluation
C.III.1 13.3.1 (9)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3.2 (1)	Emergency Plan Considerations for Multiunit Sites	Conforms. The Unit 3 EP is a stand-alone plan and does not rely upon the EP for Unit 1.
C.III.1 13.3.2 (2)		Not applicable. The Unit 3 EP is a stand-alone plan and does not rely upon the EP for Unit 1.
C.III.1 13.3.2 (3)		Conforms. Addressed in the Emergency Plan in COLA Parts 5 and 10.
C.III.1 13.3.2 (4)		Conforms. Addressed in COLA Part 5.
C.III.1 13.3.2 (5)		Conforms. Addressed in the Emergency Plan in COLA Part 5.
C.III.1 13.3.2 (6)		Conforms. Addressed in the Emergency Plan and the Evacuation Time Estimate in COLA Part 5.
C.III.1 13.3.2 (7)		Not applicable. Provisions for co-located licensees do not apply.
C.III.1 13.3.2 (8)		Conforms. Addressed in COLA Part 10.
C.III.1 13.3.2 (9)		Not applicable. There are no adjacent sites.
C.III.1 13.3.3	Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria	Conforms. Addressed in COLA Part 10.
C.III.1 13.4	Operational Program Implementation	Conforms
C.III.1 13.5.1	Administrative Procedures	Conforms with the following exception: ANSI/ANS-3.2-1994 (R1999) is used as guidance instead of the 1976 version endorsed by Regulatory Guide 1.33.
C.III.1 13.5.2.1	Operating and Emergency Operating Procedures	Conforms with the following exception: Subsection 13.5.1 identifies classes of procedures by topic or type in lieu of the specific title. Operating procedures will be developed after activities such as job and task analyses have been completed.
C.III.1 13.5.2.2	Maintenance and Other Operating Procedures	Conforms
C.III.1 13.6	Security	Conforms. Addressed in Sections 13.4 and 13.6, and COLA Part 8.
C.I 13.7	FFD	Conforms
C.III.1 14.1	Verification Program: Specific Information to be Addressed for the Initial Plant Test Program	Conforms. Addressed in Sections 14.2 and 14.3.
C.III.1 14.2	Initial Plant Test Program	Conforms

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Table 1.9-203 (Sheet 34 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 14.2.1	Summary of Test Program and Objectives	Conforms
C.III.1 14.2.2	Organization and Staffing	Conforms. Addressed in DCD Section 14.2 and in FSAR Section 13.1, Appendix 13AA and Section 14.2.
C.III.1 14.2.3	Test Procedures	Conforms. Addressed in DCD Section 14.2 and FSAR Section 14.2.
C.III.1 14.2.4	Conduct of Test Program	Conforms. Addressed in DCD Section 14.2.
C.III.1 14.2.5	Review, Evaluation, and Approval of Test Results	Conforms. Addressed in DCD Section 14.2.
C.III.1 14.2.6	Test Records	Conforms
C.III.1 14.2.7	Conformance of tests programs with Regulatory Guides	Conforms. Addressed in DCD Section 14.2.3.
C.III.1 14.2.8	Utilization of Reactor Operating and Testing Experiences in Development of Test Program	Conforms. Addressed in DCD Section 14.2 and in FSAR Section 14.2.
C.III.1 14.2.9	Trial Use of Plant Operating and Emergency Procedures	Conforms. Addressed in DCD Section 14.2.5 and in FSAR Section 13.2.
C.III.1 14.2.10	Initial Fuel Loading and Initial Criticality	Conforms. Addressed in DCD Section 14.2.6.
C.III.1 14.2.11	Test Program Schedule	Conforms. Addressed in DCD Section 14.2.7 and in FSAR Subsection 14.2.7.
C.III.1 14.2.12	Individual Test Descriptions	Conforms. Addressed in DCD Section 14.2.8 and in FSAR Subsection 14.2.9.
C.III.1 14.3	Inspections, Tests, Analyses, and Acceptance Criteria	Conforms. Addressed in COLA Part 10.
C.III.1 15.1	Transient and Accident Analyses: Transient and Accident Classification	Conforms. There are no aspects of the site-specific design that affect the transient and accident analyses in the DCD.
C.III.1 15.2	Frequency of Occurrence	Conforms
C.III.1 15.3	Plant Characteristics Considered in the Safety Evaluation	Conforms
C.III.1 15.4	Assumed Protection System Actions	Conforms
C.III.1 15.5	Evaluation of Individual Initiating Events	Conforms
C.III.1 15.6.1	Identification of Causes and Frequency Classification	Conforms
C.III.1 15.6.2	Sequence of Events and Systems Operation	Conforms

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Table 1.9-203 (Sheet 35 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 15.6.3	Core and System Performance	Conforms
C.III.1 15.6.4	Barrier Performance	Conforms
C.III.1 15.6.5	Radiological Consequences	Conforms. Table 2.0-201 compares the site-specific, short-term χ/Qs for the EAB, LPZ, and control room to the χ/Qs assumed in the DCD.
C.III.1 16.1	Technical Specifications and Bases	Conforms. Addressed in COLA Part 4. There are no deviations from the generic TS bases.
C.III.1 16.2	Content and Format of Technical Specifications and Bases	Conforms. Addressed in COLA Part 4. No plant-specific deviations from the referenced certified generic Technical Specifications or Bases are required and none are being requested (e.g., incorporation of TSTF travelers).
C.III.1 17.1	Quality Assurance and Reliability Assurance: Quality Assurance During the Design and Construction Phase	Conforms
C.III.1 17.2	Quality Assurance During the Operations Phase	Conforms
C.III.1 17.3	Quality Assurance Program Description	Conforms
C.III.1 17.4.1	New Section 17.4 in the Standard Review Plan	Conforms
C.III.1 17.4.2	Reliability Assurance Program Scope, Stages, and Goals	Not applicable. This RG section does not request information from the COL applicant.
C.III.1 17.4.3	Reliability Assurance Program Implementation	Conforms. Addressed in Sections 17.4, 17.5 (QAPD), and 17.6.
C.III.1 17.4.4	Reliability Assurance Program Information Needed in a COL Application	Conforms. Addressed in DCD Section 17.4 and in FSAR Sections 17.4, 17.5, and 17.6.
C.III.1 17.5.1	COL Applicant QA Program Responsibilities	Conforms
C.III.1 17.5.2	Updated SRP Section 17.5 and the QA Program Description	Conforms. Section 17.5 references the QAPD which is based on NEI 06-14A, which complies with SRP Section 17.5.
C.III.1 17.5.3	Evaluation of the QAPD Against the SRP and QAPD Submittal Guidance	Conforms
C.III.1 17.6	Description of the Applicant's Program for Implementation of 10 CFR 50.65, the Maintenance Rule	Conforms
C.III.1 17.6.1	Scoping per 10 CFR 50.65(b)	Conforms
C.III.1 17.6.2	Monitoring per 10 CFR 50.65(a)	Conforms

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Table 1.9-203 (Sheet 36 of 39)
Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.III.1 17.6.3	Periodic Evaluation per 10 CFR 50.65(a)(3)	Conforms
C.III.1 17.6.4	Risk Assessment and Management per 10 CFR 50.65(a)(4)	Conforms
C.III.1 17.6.5	Maintenance Rule Training and Qualification	Conforms
C.III.1 17.6.6	Maintenance Rule Program Role in Implementation of Reliability Assurance Program (RAP) in the Operations Phase	Conforms
C.III.1 17.6.7	Maintenance Rule Program Implementation	Conforms
C.III.1 Chapter 18	Human Factors Engineering	Conforms
	HFE principles incorporated into:	
	(1) Planning and management	Conforms. Addressed in DCD Section 18.2.
	(2) Plant design processes not closed with design certification	Conforms. Addressed in DCD Tier 1 ITAAC Table 3.3-1.
	(3) HSI, procedures, and training	Conforms. Addressed in DCD Tier 1 ITAAC Table 3.3-1, Items 6, 7, and 8.
	(4) Implementation of the design	Conforms. Addressed in DCD Tier 1 ITAAC Table 3.3-1, Item 10.
	(5) Monitoring of performance at the site	Conforms. Addressed in DCD Tier 1 ITAAC Table 3.3-1, Item 11.
	Applicant program addresses normal and emergency, maintenance, test, inspection, and surveillance activities	Conforms. Addressed in DCD Section 18.1.
	FSAR/DCD describe objectives and scope of the applicant's activities related to element, methodology, and results for (12 HFE elements)	Conforms. Addressed in DCD Sections 18.3 through 18.13.
	Applicant should reference detailed implementation plan reviewed and approved as part of design certification	Conforms. Addressed in DCD Section 18.2.1.
C.I 18.1	HFE Program Management	Conforms. Addressed in DCD Sections 18.2.2 and 18.2.3.
C.I 18.1.1	General HFE Program and Scope	Conforms. Addressed in DCD Sections 18.2.1 and 18.2.2.
C.I 18.1.2	HFE Team and Organization	Conforms. Addressed in DCD Section 18.2.3.
C.I 18.1.3	HFE Process and Procedures	Conforms. Addressed in DCD Sections 18.2.1 and 18.2.2.
C.I 18.1.4	HFE Issues Tracking	Conforms. Addressed in DCD Section 18.2.2.
C.I 18.1.5	HFE Technical Program	Conforms. Addressed in DCD Sections 18.3 through 18.13.

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Table 1.9-203 (Sheet 37 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.I 18.2.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.3.1.
C.I 18.2.2.1	OER Process	Conforms. Addressed in DCD Section 18.3.2.
C.I 18.2.2.2	Predecessor Plants and Systems	Conforms. Addressed in DCD Section 18.3.2.1.
C.I 18.2.2.3	Risk-Important Human Actions	Conforms. Addressed in DCD Section 18.3.2.2.
C.I 18.2.2.4	HFE Technology	Conforms. Addressed in DCD Section 18.3.2.3.
C.I 18.2.2.5	Recognized Industry Issues	Conforms. Addressed in DCD Section 18.3.2.4.
C.I 18.2.2.6	Issued Identified by Plant Personnel	Conforms. Addressed in DCD Section 18.3.2.5.
C.I 18.2.2.7	Issue Analysis, Tracking, and Review	Conforms. Addressed in DCD Section 18.3.2.6.
C.I 18.2.3	Results	Conforms. Addressed in DCD Section 18.3.3.
C.I 18.3.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.4.2.
C.I 18.3.1.1	Functional Requirements Analysis	Conforms. Addressed in DCD Section 18.4.1.
C.I 18.3.1.2	Function Allocation Analysis	Conforms. Addressed in DCD Section 18.4.2.
C.I 18.3.2.1	Methodology for Functional Requirements Analysis	Conforms. Addressed in DCD Section 18.4.1.
C.I 18.3.2.2	Methodology for Function Allocation Analysis	Conforms. Addressed in DCD Section 18.4.2.
C.I 18.3.3	Results	Conforms. Addressed in DCD Sections 18.4.1 and 18.4.2.
C.I 18.4.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.5.1.
C.I 18.4.2	Methodology	Conforms. Addressed in DCD Section 18.5.1.
C.I 18.4.3	Results	Conforms. Addressed in DCD Section 18.5.1.
C.I 18.5.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.6.2. Training is addressed in Section 13.2 and Appendix 13BB.
C.I 18.5.2	Methodology	Conforms. Addressed in DCD Sections 18.6.4 and 18.6.5. Training is addressed in Section 13.2 and Appendix 13BB.

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Table 1.9-203 (Sheet 38 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.I 18.5.3	Results	Conforms. Addressed in DCD Section 18.6.6. Training is addressed in Section 13.2 and Appendix 13BB.
C.I 18.6.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.7.1.
C.I 18.6.2	Methodology	Conforms. Addressed in DCD Section 18.7.2.
C.I 18.6.3	Results	Conforms. Addressed in DCD Section 18.7.3.
C.I 6.3.2.8	Manual Actions	Conforms. Addressed in DCD Section 18.7.2.
C.I 18.7.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.1	HSI Design Inputs	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.2	Concept of Operations	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.3	Functional Requirements Specification	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.4	HSI Concept Design	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.5	HSI Detailed Design and Integration	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.2.6	HSI Tests and Evaluations	Conforms. Addressed in DCD Section 18.8.1.
C.I 18.7.3.1	Overview of HSI Design and its Key Features	Conforms. Addressed in DCD Section 18.8.1(3).
C.I 18.7.3.2	Safety Aspects of the HSI	Conforms. Addressed in DCD Section 18.8.1(3).
C.I 18.7.3.3	HSI Change Process	Conforms. Addressed in DCD Section 18.8.1(4).
C.I 18.8.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.9.1. Procedure development is discussed in Section 13.5.
C.I 18.8.2	Methodology	Conforms. Addressed in DCD Section 18.9.2. Procedure development is discussed in Section 13.5.
C.I 18.8.3	Results	Conforms. Addressed in DCD Section 18.9.3. Procedure development is discussed in Section 13.5.
C.I 18.9.1	Objectives and Scope	Conforms. Addressed in DCD Sections 18.10.1 and 18.10.2. The training program is described in Section 13.2 and Appendix 13BB.

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Table 1.9-203 (Sheet 39 of 39) Conformance with the FSAR Content Guidance in Regulatory Guide 1.206

Section	Section Title	Conformance Evaluation
C.I 18.9.2	Methodology	Conforms. Addressed in DCD Sections 18.10.3 and 18.10.4. The training program is described in Section 13.2 and Appendix 13BB.
C.I 18.9.3	Results	Conforms. Addressed in DCD Section 18.10.5. The training program is described in Section 13.2 and Appendix 13BB.
C.I 18.10.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.11 and 18.11.1.
C.I 18.10.2	Methodology	Conforms. Addressed in DCD Section 18.11.
C.I 18.10.2.1	Operational Conditions Sampling	Conforms. Addressed in DCD Section 18.11.
C.I 18.10.2.2	Design Verification	Conforms. Addressed in DCD Section 18.11.
C.I 18.10.2.3	Integrated System Validation	Conforms. Addressed in DCD Section 18.11.
C.I 18.10.2.4	Human Engineering Discrepancy Resolution	Conforms. Addressed in DCD Section 18.11.
C.I 18.10.3	Results	Conforms. Addressed in DCD Section 18.11.2.
C.I 18.11.1	Objectives and Scope	Conforms. Addressed in DCD Section 18.12.1.
C.I 18.11.2	Methodology	Conforms. Addressed in DCD Section 18.12.2.
C.I 18.11.3	Results	Conforms. Addressed in DCD Section 18.12.3.
C.I 18.12.1	Objectives and Scope	Conforms. Addressed in DCD Sections 18.13.1 and 18.13.2.
C.I 18.12.2	Methodology	Conforms. Addressed in DCD Sections 18.13.2 and 18.13.3.
C.I 18.12.3	Results	Conforms. Addressed in DCD Section 18.13.4.
C.III.1 Chapter 19	Probabilistic Risk Assessment and Severe Accident Evaluation	Conforms. As discussed in RG 1.206, Section C.III.1.10, the FSAR follows the organization and numbering of the referenced certified design.

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Table 1.9-204 (Sheet 1 of 5)
Industrial Codes and Standards

Code or Standard Number	Year	Title
American Nuclear Society (ANS)		
3.1	1993	Selection, Qualification, and Training of Personnel for Nuclear Power Plants
American Society of Civil Engineers (ASCE)		
ASCE 43-05	2005	Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities
American Society of Mechanical Engineers (ASME)		
A17.1	2007	Safety Code for Elevators and Escalators
B31.1	2007	Power Piping
NQA-1	2004	Quality Assurance Requirements for Nuclear Facility Applications
Boiler and Pressure Vessel Code, Section IX	2007	Welding and Brazing Qualifications
American Society for Testing and Materials (ASTM)		
D422-63(2007)e1	2007	Standard Test Method for Particle-Size Analysis of Soils
D698-07	2007	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m^3])
D854-06	2006	Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
D1557-07	2007	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 [2,700 kN-m/m^3])
D1586-99	1999	Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

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Table 1.9-204 (Sheet 2 of 5)
Industrial Codes and Standards

Code or Standard Number	Year	Title
D1587-00	2000	Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
D2216-05	2005	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2435-04	2004	Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading
D2488-06	2006	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
D2850-03a	2003	Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
D4220-95	2000	Standard Practices for Preserving and Transporting Soil Samples
D4318-05	2005	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
D4633-05	2005	Standard Test Method for Energy Measurement for Dynamic Penetrometers
D4767-04	2004	Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
D5778-95	2000	Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils
ASTM E84	2007	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	2007	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E814	2006	Standard Test Method for Fire Tests for Through-Penetration Fire Stops

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Table 1.9-204 (Sheet 3 of 5) Industrial Codes and Standards

Code or Standard Number	Year	Title
Applicable Building Codes		
Standard Southern Building Code	1997	Standard Southern Building Code
Uniform Building Code	1997	Uniform Building Code
28 CFR 36		American Disability Act (ADA) Accessibility Guidelines
Factory Mutual		
Data Sheet 7-42	2006	Guidelines for Evaluating the Effects of Vapor Cloud Explosions Using a TNT Equivalency Method
	2007	Approval Guide
Institute of Electrical and Electronics Engineers (IEEE)		
C2	2007	National Electrical Safety Code
National Fire Protection Association (NFPA)		
NFPA 10	2007	Standard for Portable Fire Extinguishers
NFPA 11	2005	Standard for Low-, Medium-, and High-Expansion Foam
NFPA 13	2007	Standard for the Installation of Sprinkler Systems
NFPA 14	2007	Standard for the Installation of Standpipe and Hose Systems
NFPA 15	2007	Standard for Water Spray Fixed Systems for Fire Protection
NFPA 16	2007	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems
NFPA 20	2007	Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24	2007	Standard for the Installation of Private Fire Service Mains and Their Appurtenances

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Table 1.9-204 (Sheet 4 of 5)
Industrial Codes and Standards

Code or Standard Number	Year	Title
NFPA 25	2008	Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
NFPA 30	2008	Flammable and Combustible Liquids Code
NFPA 37	2006	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 55	2005	Standard for Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks
NFPA 70	2008	National Electrical Code
NFPA 72	2007	National Fire Alarm Code
NFPA 80	2007	Standard for Fire Doors and Other Opening Protectives
NFPA 80A	2007	Recommended Practice for Protection of Buildings from Exterior Fire Exposures
NFPA 101	2006	Life Safety Code
NFPA 204	2007	Standard for Smoke and Heat Venting
NFPA 214	2005	Standard on Water-Cooling Towers
NFPA 241	2004	Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 252	2008	Standard Methods of Fire Tests of Door Assemblies
NFPA 255	2006	Standard Method of Test of Surface Burning Characteristics of Building Materials
NFPA 780	2008	Standard for the Installation of Lightning Protection Systems

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Table 1.9-204 (Sheet 5 of 5)
Industrial Codes and Standards

Code or Standard Number	Year	Title
Occupational Safety and Health Act (OSHA)		
29 CFR 1910	2006	Occupational Safety and Health Standards
29 CFR 1926	2006	Safety and Health Regulations for Construction
Underwriters Laboratories (UL)		
	2007	Fire Protection Equipment Directory
United States Army Corps of Engineers (USACE)		
EM 1110-2-1906	1986	Laboratory Soils Testing, U.S. Army Corps of Engineers
Environmental Protection Agency (EPA)		
40 CFR 60	2006	EPA Standards of Performance for Stationary Compression Ignition Internal Combustion Engines
SW-846 9045d	2004	Test Methods for Evaluating Solid Waste
MCAWW 300.0A	1983	Methods for the Chemical Analysis of Water and Wastes

RBS SUP 1.9-2

Table 1.9-205
NUREG Reports Cited

NUREG No.	Issue Date	Title	Comment/Section Where Discussed
0570	06/1979	Toxic Vapor Concentrations in the Control Room Following a Postulated Accidental Release	6.4
0612	07/1980	Control of Heavy Loads at Nuclear Power Plants	13.5
0737	11/1980	Clarification of TMI Action Plan Requirements	13.1, 13.5
0800	03/2007	Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants	1.1, 2.0, 9.3, 11.5
1488	04/1994	Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear Power Plant Sites East of the Rocky Mountains	2.5
1736	10/2001	Consolidated Guidance: 10 CFR Part 20 – Standards for Protection Against Radiation	1.9
CR-2650	10/1982	Allowable Shipment Frequencies for the Transport of Toxic Gases Near Nuclear Power Plants	2.2
CR-4013	04/1986	LADTAP II Technical Reference and User Guide	12.2
CR-6331	05/1997	Atmospheric Relative Concentrations in Building Wakes	2.3
CR-6728	10/2001	Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines	2.5, 3.7.1.1.5
CR-6769	04/2002	Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Development of Hazard- & Risk-Consistent Seismic Spectra for Two Sites	2.5
CR-6937	06/2007	User's Manual for RESRAD-OFFSITE Version 2	2.4

1.10 SUMMARY OF COL ITEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following at the end of this section.

RBS SUP 1.10-1 Table 1.10-201 lists the FSAR location(s) where the individual COL items from the DCD are addressed.

RBS SUP 1.10-1

Table 1.10-201 (Sheet 1 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
1.1-1-A	Establish Rated Electrical Output	1.1.2.7
1.3-1-A	Update Table 1.3-1	1.3
1.7-1-H	Final Design Configuration Confirmation	1.7
1.9-3-A	SRP and Regulatory Guide Applicability	SRP: 1.9.1 and Table 1.9-201 RGs: 1.9.2 and Table 1.9-202 RG 1.206: 1.9.2 and Table 1.9-203
1.11-1-A	Address Table 1.11-1 Items that Refer to Notes (2) and (7)	1.11.1 and Table 1.11-201
1C.1-1-A	Handling of Safeguards Information	1C.1, Table 1C-201
1C.1-2-A	Emergency Preparedness and Response Actions	1C.1, Table 1C-201
2.0-1-A	Site Characteristics Demonstration	2.0 and Table 2.0-201
2.0-2-A	Site Location and Description Information in Accordance with SRP 2.1.1	2.0, 2.1
2.0-3-A	Site-Specific Exclusion Area Authority and Control Information in Accordance with SRP 2.1.2.	2.0 and 2.1
2.0-4-A	Describe the Population Distribution in Accordance with SRP 2.1.3	2.0 and 2.1
2.0-5-A	Identify Potential Hazards in the Site Vicinity, in Accordance with SRP 2.2.1 - 2.2.2	2.0 and 2.2
2.0-6-A	Evaluation of Potential Accidents in Accordance with SRP 2.2.3	2.0 and 2.2
2.0-7-A	Regional Climatology in Accordance with SRP 2.3.1	2.0 and 2.3
2.0-8-A	Local Meteorology in Accordance with SRP 2.3.2	2.0 and 2.3

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Table 1.10-201 (Sheet 2 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
2.0-9-A	On-Site Meteorological Measurement Programs in Accordance with SRP 2.3.3	2.0 and 2.3
2.0-10-A	Short-Term Diffusion Estimates for Accidental Atmospheric Releases in Accordance with SRP 2.3.4	2.0 and 2.3
2.0-11-A	Long-Term Diffusion Estimates in Accordance with SRP 2.3.5	2.0 and 2.3
2.0-12-A	Hydraulic Description Maximum Groundwater Level in Accordance with SRP 2.4.1	2.0 and 2.4.1
2.0-13-A	Protection of Below-Grade Penetrations and Access Openings from Floods in Accordance with SRP 2.4.2	2.0 and 2.4.2
2.0-14-A	Probable Maximum Flood on Streams and Rivers in Accordance with SRP 2.4.3	2.0 and 2.4.3
2.0-15-A	Potential Dam Failures Seismically Induced in Accordance with SRP 2.4.4	2.0 and 2.4.4
2.0-16-A	Probable Maximum Surge and Seiche Flooding in Accordance with SRP 2.4.5	2.0 and 2.4.5
2.0-17-A	Probable Maximum Tsunami in Accordance with SRP 2.4.6	2.0 and 2.4.6
2.0-18-A	Ice Effects in Accordance with SRP 2.4.7	2.0 and 2.4.7
2.0-19-A	Cooling Water Canals and Reservoirs in Accordance with SRP 2.4.8	2.0 and 2.4.8
2.0-20-A	Channel Diversion in Accordance with SRP 2.4.9	2.0 and 2.4.9
2.0-21-A	Flooding Protection Requirements in Accordance with SRP 2.4.10	2.0 and 2.4.10

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Table 1.10-201 (Sheet 3 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
2.0-22-A	Cooling Water Supply in Accordance with SRP 2.4.11	2.0 and 2.4.11
2.0-23-A	Groundwater in Accordance with SRP 2.4.12	2.0 and 2.4.12
2.0-24-A	Accidental Releases of Liquid Effluents in Ground and Surface Waters in Accordance with SRP 2.4.13	2.0 and 2.4.13
2.0-25-A	Technical Specifications and Emergency Operation Requirements in Accordance with SRP 2.4.14	2.0 and 2.4.14
2.0-26-A	Basic Geologic and Seismic Information in Accordance with SRP 2.5.1	2.0 and 2.5.1
2.0-27-A	Vibratory Ground Motion in Accordance with SRP 2.5.2	2.0 and 2.5.2
2.0-28-A	Surface Faulting in Accordance with SRP 2.5.3	2.0 and 2.5.3
2.0-29-A	Stability of Subsurface Materials and Foundations in Accordance with SRP 2.5.4	2.0 and 2.5.4
2.0-30-A	Stability of Slopes in Accordance with SRP 2.5.5	2.0, 2.5.5 and Appendix 2AA
3.6.5-1-A	Pipe Break Analysis Results and Protection Methods	3.6.2.5
3.9.9-1-H	Reactor Internals Vibration Analysis, Measurement, and Inspection Program	3.9.2.4
3.9.9-2-H	ASME Class 2 or 3 or Quality Group D Components with 60-Year Design Life	3.9.3.1
3.9.9-3-A	In-Service Testing Programs	3.9.6
3.9.9-4-A	Snubber Inspection and Test Program	3.9.3.7.1(3)e and 3.9.3.7.1(3)f

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Table 1.10-201 (Sheet 4 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
3.10.4-1-A	Dynamic Qualification Report	3.10.1.4
3.11-1-A	Environmental Qualification Document (EQD)	3.11.2.2
4.3-1-A	Variances from Certified Design	4.3
4A-1-A	Variances from Certified Design	4A
5.2-1-H	Pre-Service and In-Service Inspection Program Plan	5.2.4 and 5.2.4.11
5.2-2-H	Leak Detection Monitoring	5.2.5.9
5.3-2-A	Materials and Surveillance Capsule	5.3.1.8
6.1.3-1-A	Protective Coatings and Organic Materials	6.1.2.3
6.2-1-H	Information Indicated in Tables 6.2-16 through 6.2-42	6.2.4.2
6.4-1-A	Control Room Habitability Area (CRHA) Procedures and Training	6.4.4
6.4-2-A	Toxic Gas Analysis	6.4.5 and Table 2.2-201
6.6-1-A	Pre-Service Inspection (PSI) and In-Service Inspection (ISI) Program Description	6.6
8.2.4-1-A	Transmission System Description	8.2.1.1, Table 8.2-201, and Figure 8.2-201
8.2.4-2-A	Switchyard Description	8.2.1.2.1.1, 8.2.1.2.1.2, and Figures 8.2-202 and 8.2-203
8.2.4-3-A	Normal Preferred Power	8.2.1.2.1.2 and Figure 8.2-204
8.2.4-4-A	Alternate Preferred Power	8.2.1.2.1.2
8.2.4-5-A	Protective Relaying	8.2.1.2.1.1
8.2.4-6-A	Switchyard DC Power	8.2.1.2.1.1
8.2.4-7-A	Switchyard AC Power	8.2.1.2.1.1
8.2.4-8-A	Switchyard Transformer Protection	8.2.4
8.2.4-9-A	Stability and Reliability of the Off-Site Transmission Power Systems	8.2.2.1 and 8.2.3

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Table 1.10-201 (Sheet 5 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
8.2.4-10-A	Interface Requirements	8.2.2.1 and 8.2.1.2.1.1
8A.2.3-1-A	Cathodic Protection System	8A.2.1
9.1.6-4-A	Fuel Handing Operations	9.1.4.13 and 9.1.4.19
9.1.6-5-A	Handling of Heavy Loads	9.1.5.6, 9.1.5.8, and 9.1.5.9
9.2.1-1-A	Material Selection	9.2.1.2
9.2.5-1-A	Post 7-Day Makeup to Ultimate Heat Sink (UHS)	9.2.5
9.3.2-1-A	Post-Accident Sampling Program	9.3.2.2
9.3.9-1-A	Implementation of Hydrogen Water Chemistry	9.3.9
9.3.9-2-A	Hydrogen and Oxygen Storage and Supply	9.3.9.2 and 9.3.9.2.1
9.3.10-1-A	Oxygen Storage Facility	9.3.10.2
9.3.11-1-A	Determine Need for Zinc Injection System	9.3.11.2
9.3.11-2-A	Provide System Description for Zinc Injection System	9.3.11.4
9.5.1-1-A	Secondary Fire Water Storage Source	9.5.1.2 and 9.5.1.4
9.5.1-2-A	Secondary Fire Water Capacity	9.5.1.2 and 9.5.1.4
9.5.1-4-A	Piping and Instrument Diagrams	9.5.1.2, 9.5.1.4, 9.5.1.5, and Figure 9.5-201
9.5.1-5-A	Fire Barriers	9.5.1.10
9.5.1-6-H	Smoke Control	9.5.1.11
9.5.1-7-H	Fire Hazards Analysis (FHA) Compliance Review	9.5.1.12
9.5.1-8-A	Fire Protection (FP) Program Description	9.5.1.15
9.5.1-9-A	FP Licensing Changes	9.5.1.15.2
9.5.1-10-H	Fire Brigade	9.5.1.15.4, 13.1.2.1.5
9.5.1-11-A	Quality Assurance (QA)	9.5.1.15.9

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Table 1.10-201 (Sheet 6 of 8) Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
9.5.2.5-1-A	Off-Site Interfaces	9.5.2.2
9.5.2.5-2-A	Grid Transmission Operator	9.5.2.2
9.5.4-1-A	Fuel Oil Capacity	9.5.4.2
9.5.4-2-A	Protection of Underground Piping	9.5.4.2
9A.7-1-A	Yard Fire Zone Drawings	9A.4.7
9A.7-2-A	FHA for Site-Specific Areas	9A.4.7, 9A.5.7, 9A.5.8, and 9A.5.9
10.2-1-H	Turbine Missile Probability Analysis	10.2.3.8
10.4-1-A	Leakage (of Circulating Water into the Condenser)	10.4.6.3 and Table 10.4-201
11.2-1-A	Implementation of IE Bulletin 80-10	11.2.2.3
11.2-2-A	Implementation of Part 20.1406	11.2.2.3
11.4-1-A	Mobile System Regulatory Guide Compliance	11.4.2.3
11.4-2-A	Compliance with IE Bulletin 80-10	11.4.2.3
11.4-3-A	Process Control Program	11.4.2.3
11.4-4-A	Temporary Storage Facility	11.4.1
11.4-5-A	Compliance with Part 20.1406	11.4.1
11.5-1-A	Subsystem Lower Limit of Detection	11.5.4.7
11.5-2-A	Off-Site Dose Calculation Manual	11.5.4.4, 11.5.4.5, and 11.5.5.8
11.5-3-A	Process and Effluent Monitoring Program	11.5 and 11.5.4.6 and Table 11.5-201
11.5-4-A	Site-Specific Off-Site Dose Calculation	11.5.4.8
11.5-5-A	Instrument Sensitivities	11.5.4.9
12.1-1-A	Regulatory Guide 8.10	12BB
12.1-2-A	Regulatory Guide 1.8	12BB
12.1-3-A	Operational Considerations	12BB
12.1-4-A	Regulatory Guide 8.8	12BB

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Table 1.10-201 (Sheet 7 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
12.2-2-A	Airborne Effluents and Doses	12.2.2.2 and 11.3.2
12.2-3-A	Liquid Effluents and Doses	12.2.2.4
12.3-2-A	Operational Considerations	12.3.4
12.3-3-A	Controlled Access	12.3.1.3
12.5-1-A	Equipment, Instrumentation, and Facilities	12BB
12.5-2-A	Compliance with Paragraph 50.34 (f)(2)(xxvii) of 10 CFR 50 and NUREG-0737 Item III.D.3.3	12BB
12.5-3-A	Radiation Protection Program	12BB
13.1-1-A	Organizational Structure	13.1.1 through 13.1.3 and Appendix 13AA
13.2-1-A	Reactor Operator Training	13.2.1 and 13BB
13.2-2-A	Training for Nonlicensed Plant Staff	13.2.2 and 13BB
13.3-1-A	Identification of Operational Support Center (OSC) and Communication Interfaces with Control Room and Technical Support Center (TSC)	13.3 and COLA Part 5 (EP), Sections II.F and II.H
13.3-2-A	Identification of Emergency Operations Facility (EOF) and Communication Interfaces with Control Room and TSC	13.3 and COLA Part 5 (EP), Sections II.F and II.H
13.3-3-A	Decontamination Facilities	13.3 and COLA Part 5 (EP), Section II.J
13.4-1-A	Operation Programs	13.4
13.4-2-A	Implementation Milestones	13.4
13.5-1-A	Administrative Procedures Development Plan	13.5.1
13.5-2-A	Plant Operating Procedures Development Plan	13.5.2
13.5-3-A	Emergency Procedures Development	13.5.2

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Table 1.10-201 (Sheet 8 of 8)
Summary of FSAR Sections Where DCD COL Items Are Addressed

Item No.	Subject/ Description of Item	Section
13.5-4-A	Implementation of the Plant Procedures Plan	13.5, 13.5.2
13.5-5-A	Procedures Included in Scope of Plan	13.5.2
13.5-6-H	Procedures for Calibration, Inspection, and Testing	13.5.2
14.2-1-H	Startup Administration Manual	14.2.2.1
14.2-2-H	Approved Plant Preoperational and Startup Test Procedure	14.2.2.2
14.2-3-H	Detailed Testing Schedule	14.2.7
14.2-4-H	Approved Test Procedures for Site-Specific System	14.2.9
14.3-1-A	Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)	14.3.8
14.3-2-A	Site-Specific ITAAC	14.3.9
16.0-1	Replace Technical Specification Information in Brackets with Plant-Specific Information	COLA Part 4 (TS and TS Bases)
17.2-1-A	QA Program for the Construction and Operations Phases	17.2 and 17.5
17.2-2-A	QA Program for Design Activities	17.1 and 17.5
17.3-1-A	QA Program Document	17.3 and 17.5
17.4-1-A	Operation Reliability Assurance Activities	17.4.1, 17.4.6, 17.4.9, 17.4.10, and 17.6
19.2.6-1-H	Seismic High Confidence Low Probability of Failure Margins	19.2.3.2.4

1.11 TECHNICAL RESOLUTIONS OF TASK ACTION PLAN ITEMS, NEW GENERIC ISSUES, NEW GENERIC SAFETY ISSUES AND CHERNOBYL ISSUES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

1.11.1 APPROACH

Add the following to the end of the section.

RBS COL 1.11-1-A FSAR Table 1.11-201 supplements DCD Table 1.11-1 to address the site-specific aspects of items that refer to Notes (2) and (7).

RBS SUP 1.11-1 FSAR Table 1.11-202 supplements DCD Table 1.11-1 to provide references to FSAR locations that provide additional information on specific issues.

1.11.2 COL INFORMATION

1.11-1-A Address Table 1.11-1 Items that refer to Notes (2) and (7).

RBS COL 1.11-1-A This COL item is addressed in Section 1.11 and Table 1.11-201.

RBS COL 1.11-1-A

Table 1.11-201 (Sheet 1 of 2)
COL Item Resolutions Related to NUREG-0933 Table II Task Action Plan Items and New Generic Issues

Action Plan Item/ Issue Number	Description	Associated Location(s) Where Discussed and/or Technical Resolution
TASK ACTION PLAN ITEMS		
A-33	NEPA Review of Accident Risks	This environmental issue involves consideration of accidents on a risk-specific basis. This subject is addressed in COLA Part 3, Chapter 7.
B-1	Environmental Technical Specifications	Issue is addressed in COLA Part 4, Subsections 5.5.1 and 5.5.3, which address the ODCM and Radioactive Effluent Controls Program. See also Subsections 11.5.4.5 and 11.5.4.6.
B-28	Radionuclide/Sediment Transport Program	Issue is addressed in COLA Part 4, Subsections 5.5.1 and 5.5.3, which address the ODCM and Radioactive Effluent Controls Program. See also Subsections 2.4.13, 11.5.4.5, and 11.5.4.6. This issue is also addressed in COLA Part 3, Sections 5.4, 5.9, 5.10.2, and 6.2.
B-37	Chemical Discharges to Receiving Waters	Issue is addressed in COLA Part 3, Sections 3.6, 4.2, and 5.2.
B-38	Reconnaissance Level Investigations	Issue is addressed in COLA Part 3, Sections 2.4 and 4.3.
B-39	Transmission Lines	Issue is addressed in COLA Part 3, Sections 2.2, 3.7, 4.1, 4.3, and 5.6.
B-40	Effects of Power Plant Entrainment on Plankton	Issue is addressed in COLA Part 3, Section 5.3.
B-41	Impacts on Fisheries	Impact of power plant operation on fishery resources is addressed in COLA Part 3, Section 5.3.
B-42	Socioeconomic Environmental Impacts	Issue is addressed in COLA Part 3, Sections 2.5, 4.4, and 5.8.

RBS COL 1.11-1-A

Table 1.11-201 (Sheet 2 of 2)
COL Item Resolutions Related to NUREG-0933 Table II Task Action Plan Items and New Generic Issues

Action Plan Item/ Issue Number	Description	Associated Location(s) Where Discussed and/or Technical Resolution
B-43	Value of Aerial Photographs for Site Evaluation	Work completed to date on this issue is published in NUREG/CR-2861. Results of visual impact are presented in COLA Part 3, Section 5.8.
C-16	Assessment of Agricultural Land in Relation to Power Plant Siting and Cooling System Selection	The impact of construction and power plant operation on agricultural land use is addressed in COLA Part 3, Sections 2.2, 4.1, 5.1, and 9.4.
NEW GENERIC ISSUES		
184	Endangered Species	Issue is addressed in COLA Part 3, Sections 2.4, 4.3, and 5.3.

RBS SUP 1.11-1

**Table 1.11-202 (Sheet 1 of 2)
Supplementary Resolutions Related to NUREG-0933
Table II TMI Action Plan Items and Human Factors Issues**

Action Plan Item/ Issue Number	Description	Associated Location(s) Where Discussed and/or Technical Resolution
TMI ACTION PLAN ITEMS		
1.A.1.1	Shift Technical Advisor	Subsection 13.1.2.1.2.8 and DCD Section 18.6
1.A.1.2	Shift Supervisor Administrative Duties	Subsections 13.1.2.1.2.4 and 13.1.2.1.2.5
1.A.1.3	Shift Manning	Subsection 13.1.2.1.4, Table 13.1-202, Figure 13.1-202, and DCD Section 18.6
1.A.2.1(1)	Qualifications – Experience	Subsection 13.1.3.1, Table 13.1-201, and DCD Section 18.6
1.C.3	Shift Supervisor Responsibilities	Subsections 13.1.2.1.2.4 and 13.1.2.1.2.5
1.F.2(6)	Increase the Size of Licensees' QA Staff	Subsection 13.1.1.2.3, Table 13.1-201, and Section 17.5
1.F.2(9)	Clarify Organizational Reporting Levels for the QA Organization	Subsection 13.1.1.2.3, Figure 13.1-201, and Section 17.5
II.B.3	Post-Accident Sampling	Appendix 12BB
III.D.3.3	In-Plant Radiation Monitoring	Appendix 12BB

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Table 1.11-202 (Sheet 2 of 2)
Supplementary Resolutions Related to NUREG-0933
Table II TMI Action Plan Items and Human Factors Issues

Action Plan Item/ Issue Number	Description	Associated Location(s) Where Discussed and/or Technical Resolution
HUMAN FACTORS ISSUES		
HF1.1	Shift Staffing	Table 13.1-201, Table 13.1-202, Subsection 13.1.2.1.4
HF4.1	Inspection Procedure for Upgraded Emergency Operating Procedures	This item relates to inspection results indicating that licensees were not appropriately developing and implementing their Emergency Operating Procedures in accordance with their Procedure Generation Packages. Subsection 13.5.2.1.4 requires implementation of the Procedure Generation Packages.

1.12 IMPACT OF CONSTRUCTION ACTIVITIES ON UNIT 1

RBS SUP 1.12-1

1.12.1 INTRODUCTION

Paragraph 10 CFR 52.79(a)(31) requires that the FSAR include the following information:

> For nuclear power plants to be operated on multi-unit sites, an evaluation of the potential hazards to the structures, systems, and components important to safety of operating units resulting from construction activities, as well as a description of the managerial and administrative controls to be used to provide assurance that the limiting conditions for operation are not exceeded as a result of construction activities at the multi-unit sites.

Accordingly, the evaluation of the potential impact of the construction of Unit 3 on Unit 1 structures, systems, and components (SSCs) important to safety is summarized below, along with a description of the managerial and administrative controls used to provide assurance that Unit 1 limiting conditions for operations (LCOs) are not exceeded as a result of Unit 3 construction activities. This evaluation involves several 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.

1.12.2 POTENTIAL CONSTRUCTION ACTIVITY HAZARDS

Unit 3 is located on the existing RBS site on a parcel of land adjacent to and generally west of the operating unit, Unit 1, as shown in Figure 2.1-204.

Based on experience from similar construction projects, the scope of work necessary to construct Unit 3 is well understood. In general, it includes, but is not necessarily limited to, activities such as site exploration, grading, clearing and installation of drainage and erosion control measures; boring, drilling, dredging, demolition, and excavating; storage and warehousing of equipment; and construction, erection, and fabrication of new facilities. These activities involve major ESBWR standard plant structures such as the Reactor Building, Control Building, Fuel Building, Turbine Building, Radwaste Building, Electrical Building, and plant stack, as well as related support facilities such as transformers, switchyard(s), transmission lines, cooling water structures and systems, water treatment facilities, storage tanks, cooling towers, etc.

The applicable time period for such activities starts when work is first performed under the COL for Unit 3 and ends for each Unit 3 SSC when responsibility for that SSC is transferred to the accountable operating organization.

Each of the types of construction activities necessary to build a new unit was examined to identify the potential hazards to the existing unit. The resulting list of construction activities and potential hazards is shown in Table 1.12-201.

1.12.3 STRUCTURES, SYSTEMS, AND COMPONENTS IMPORTANT TO SAFETY

Consistent with 10 CFR 50.34 and 10 CFR 50, Appendix A, Unit 1 SSCs important to safety were identified from Chapter 3 of the Unit 1 Updated Safety Analysis Report (USAR) (Reference 1.12-201); additionally, information in Chapters 4, 5, 6, 7, 8, and 9 of the RBS Unit 1 USAR was utilized.

1.12.4 LIMITING CONDITIONS FOR OPERATION

Pursuant to 10 CFR 50.36, LCOs are the lowest functional capability or performance levels of equipment required for the safe operation of a facility and are established in operating unit Technical Specifications for each item meeting one or more of the following 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 (DBA) or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

- Criterion 3 - A SSC that is part of the primary success path and that functions or actuates to mitigate a DBA or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

- Criterion 4 - A SSC that operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

The applicable LCOs are found in the Unit 1 Technical Specifications (Reference 1.12-202).

1.12.5 IMPACTED STRUCTURES, SYSTEMS, AND COMPONENTS AND LIMITING CONDITIONS FOR OPERATION

The information described in Subsections 1.12.2 through 1.12.4 was evaluated to identify Unit 1 SSCs and LCOs that might be impacted by Unit 3 construction activities. This evaluation focused on Seismic Category I structures and components and/or systems outside of Seismic Category I structures to ensure that they were capable of withstanding any construction impacts without loss of safety function. SSCs that are within Seismic Category I structures and that are specific to Unit 1 are not affected because they are protected against construction activities as long as the Seismic Category I structure in which they are housed is protected. These SSCs include items such as the ADS accumulators, fuel storage racks, and control rod drive assemblies. Additionally, Unit 1 LCO parameters such as "Control Rod OPERABILITY," "Shutdown Margin," and "RCS Specific Activity" are eliminated from consideration because they are related to specific parameters rather than physical equipment.

For each of the potential hazards listed in Table 1.12-201, Table 1.12-202 presents the potential consequences to the SSCs of the existing unit that were identified in the above process.

1.12.6 MANAGERIAL AND ADMINISTRATIVE CONTROLS

Managerial and administrative controls are utilized to identify preventive and mitigative measures and provide notification of hazard activity initiation in order to prevent or minimize exposure of SSCs to the identified hazards. Applicable managerial and administrative controls are listed in Table 1.12-203.

Specific hazards, impacted SSCs, and managerial and administrative controls are developed and implemented as work progresses on site. For example, prior to construction activities that involve the use of large construction equipment such as cranes, managerial and administrative procedures will be in place to prevent adverse impacts on Unit 1 overhead power lines, switchyard, security boundary, etc., by providing the necessary restrictions on their use.

1.12.7 REFERENCES

1.12-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report" through Revision 19, July 2006.

1.12-202 Entergy Operations, Inc., River Bend Station Unit 1 Technical Specifications.

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**Table 1.12-201 (Sheet 1 of 3)
Potential Hazards to Unit 1
from Unit 3 Construction Activities**

Activity	Representative Hazards
Site Exploration, Grading, Clearing, and Installation of Drainage and Erosion Control Measures, etc.	Impact on Overhead Power Lines
	Impact on Transmission Towers
	Impact on Underground Conduits, Piping, Tunnels, etc.
	Impact on Site Access and Egress
	Impact on Drainage Facilities and Structures
	Impact on On-Site Transportation Routes
	Impact on Slope Stability
	Impact of Increased Soil Erosion and Local Flooding
	Impact of Construction-Generated Dust and Equipment Exhausts
	Impact of Encroachment on Protected or Vital Areas
	Impact of Encroachment on Structures and Facilities
Boring, Drilling, Pile Driving, Dredging, Demolition, Excavation, etc.	Impact on Underground Conduits, Piping, Tunnels, etc.
	Impact on Foundation Integrity
	Impact on Building Settlement
	Impact on Structural Integrity
	Impact on Slope Stability
	Impact of Ground Vibration
	Impact of Overpressure Due to Use of Explosives

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**Table 1.12-201 (Sheet 2 of 3)
Potential Hazards to Unit 1
from Unit 3 Construction Activities**

Activity	Representative Hazards
Equipment Movement, Material Delivery, Vehicle Traffic, etc.	Impact on Overhead Power Lines
	Impact on Transmission Towers
	Impact on Underground Conduits, Piping, Tunnels, etc.
	Impact of Crane Load Drops
	Impact of Crane or Crane Boom Failures
	Impact of Vehicle Accidents
	Impact of Vehicle Runaways
Equipment and Material Laydown, Storage, Warehousing, etc.	Impact of Releases of Stored Flammable, Hazardous, or Toxic Materials
	Impact of Wind-Generated, Construction-Related Debris and Missiles
	Impact of Increased Local Flooding
General Construction, Erection, Fabrication, etc.	Impact on Instrumentation and Control Systems and Components
	Impact on Electrical Systems and Components
	Impact on Cooling Water Systems and Components
	Impact on Radioactive Waste Release Points and Parameters
	Impact of Abandonment of SSCs
	Impact of Relocation of SSCs
Connection, Integration, Tie-In, Testing, etc.	Impact on Instrumentation and Control Systems and Components
	Impact on Electrical and Power Systems and Components
	Impact on Cooling Water Systems and Components

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**Table 1.12-201 (Sheet 3 of 3)
Potential Hazards to Unit 1
from Unit 3 Construction Activities**

Activity	Representative Hazards
General Site Construction Activities	Impact on Site Security Systems

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Table 1.12-202 (Sheet 1 of 7)
Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
CONTAINMENT STRUCTURE	
Impact of Crane or Crane Boom Failures	Building Degradation Due to Crane Boom Failure
Impact of Wind-Generated Construction-Related Debris and Missiles	Effects of Construction-Related Debris or Missiles
Impact on Foundation Integrity	Building Degradation Due to Foundation Undermining as a Result of Demolition, Excavation, etc.
Impact on Structural Integrity	Building Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	Building Degradation Due to Structural Damage as a Result of Explosion
CONTROL ROOM EMERGENCY HVAC SYSTEMS	
Impact of Construction-Generated Dust and Equipment Exhausts	Effects of Construction-Generated Dust and Equipment Exhausts on Control Room Habitability Systems Air Intakes
Impact of Releases of Flammable, Hazardous or Toxic Materials	Effects of Releases of Flammable, Hazardous or Toxic Materials on Control Room Habitability Systems Design Basis
Impact of Vehicle Accidents	Effects of Releases of Flammable, Hazardous or Toxic Materials and/or Smoke on Control Room Habitability Systems Design Basis
DIESEL GENERATOR BUILDING	
Impact of Crane or Crane Boom Failures	Building Degradation Due to Crane Boom Failure
Impact of Wind-Generated Construction-Related Debris and Missiles	Effects of Construction-Related Debris or Missiles
Impact on Drainage Facilities and Structures	Design Basis Flood Elevation Exceeded

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Table 1.12-202 (Sheet 2 of 7) Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
DIESEL GENERATOR BUILDING (CONTINUED)	
Impact of Increased Soil Erosion and Local Flooding	Design Basis Flood Elevation Exceeded
Impact of Increased and Local Flooding	Design Basis Flood Elevation Exceeded
Impact on Slope Stability	Drainage Degradation Due to Damming Effect Resulting in Exceedence of Design Basis Flood Elevation
Impact on Foundation Integrity	Building Degradation Due to Foundation Undermining as a Result of Demolition, Excavation, etc.
Impact on Structural Integrity	Building Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	Building Degradation Due to Structural Damage as a Result of Explosion
DIESEL GENERATORS	
Impact of Construction-Generated Dust and Equipment Exhausts	Effects of Construction-Generated Dust and Equipment Exhausts on Emergency Diesel Generator Combustion Air Intakes
Impact on Site Access and Egress	Prevention of Diesel Fuel Oil Delivery
Impact on On-Site Transportation Routes	Prevention of Diesel Fuel Oil Delivery
FIRE PROTECTION SYSTEM	
Impact on Underground Conduits, Piping, Tunnels, etc.	Degradation of Fire Protection System Availability or Capacity
Impact of the Relocation of SSCs	Degradation of Fire Protection System Availability or Capacity
Impact on On-Site Transportation Routes	Degradation of Firefighting Capabilities

RBS SUP 1.12-1

Table 1.12-202 (Sheet 3 of 7) Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
AUXILIARY BUILDING	
Impact of Crane or Crane Boom Failures	Building Degradation Due to Crane Boom Failure
Impact of Wind-Generated Construction-Related Debris and Missiles	Effects of Construction-Related Debris or Missiles
Impact on Drainage Facilities and Structures	Design Basis Flood Elevation Exceeded
Impact of Increased Soil Erosion and Local Flooding	Design Basis Flood Elevation Exceeded
Impact of Increased and Local Flooding	Design Basis Flood Elevation Exceeded
Impact on Slope Stability	Drainage Degradation Due to Damming Effect Resulting in Exceedence of Design Basis Flood Elevation
Impact on Foundation Integrity	Building Degradation Due to Foundation Undermining as a Result of Demolition, Excavation, etc.
Impact on Structural Integrity	Building Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	Building Degradation Due to Structural Damage as a Result of Explosion
GASEOUS RADIOACTIVE WASTE MANAGEMENT SYSTEM	
Impact on Radioactive Waste Release Points and Parameters	Building and Facility Effects on Gaseous Release χ/Q and D/Q Assumptions
OFF-SITE POWER SYSTEM	
Impact on Overhead Power Lines	Transmission Line Disruptions Due to Grading or Clearing, Equipment Movement, Crane Boom Failures, etc.
Impact on Transmission Towers	Transmission Line Disruptions Due to Grading or Clearing, Equipment Movement, Crane Boom Failures, etc.

RBS SUP 1.12-1

Table 1.12-202 (Sheet 4 of 7)
Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
OFF-SITE POWER SYSTEM (CONTINUED)	
Impact of Crane or Crane Boom Failures	Transmission Line Disruptions or Tower Degradation Due to Crane Boom Failure
Impact of Encroachment on Structures and Facilities	Transmission Line Disruptions Due to Construction Activities
Impact of Vehicle Runaways	Transmission Line Disruptions or Tower Degradation Due to Vehicle Impact
Impact on On-Site Transportation Routes	Impede Identification and Restoration of Switchyard Equipment Malfunctions
Impact of Ground Vibration	Operability Disruptions Due to Vibration Induced Spurious Trips
Impact on Foundation Integrity	Transmission Tower Degradation Due to Foundation Undermining as a Result of Demolition, Excavation, etc.
Impact on Structural Integrity	Transmission Tower Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	Transmission Tower Degradation Due to Structural Damage as a Result of Explosion
Impact on Electrical Systems and Components	Operability Disruptions Due to Equipment Movement, System Interconnections, etc.
Impact on Instrumentation and Control Systems and Components	Operability Disruptions Due to Connection, Integration, Tie-In, Testing, etc.
ON-SITE POWER SYSTEMS	
Impact of Ground Vibration	Operability Disruptions Due to Vibration Induced Spurious Trips

RBS SUP 1.12-1

Table 1.12-202 (Sheet 5 of 7)
Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
ON-SITE POWER SYSTEMS (CONTINUED)	
Impact on Electrical Systems and Components	Operability Disruptions Due to Vibration Induced Spurious Trips, System Interconnections, etc.
Impact on Instrumentation and Control Systems and Components	Operability Disruptions Due to Connection, Integration, Tie-In, Testing, Etc.
CONTROL BUILDING	
Impact of Crane or Crane Boom Failures	Building Degradation Due to Crane Boom Failure
Impact of Wind-Generated Construction-Related Debris and Missiles	Effects of Construction-Related Debris or Missiles
Impact on Drainage Facilities and Structures	Design Basis Flood Elevation Exceeded
Impact of Increased Soil Erosion and Local Flooding	Design Basis Flood Elevation Exceeded
Impact of Increased and Local Flooding	Design Basis Flood Elevation Exceeded
Impact on Slope Stability	Drainage Degradation Due to Damming Effect Resulting in Exceedence of Design Basis Flood Elevation
Impact on Foundation Integrity	Building Degradation Due to Foundation Undermining as a Result of Demolition, Excavation, etc.
Impact on Structural Integrity	Building Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	Building Degradation Due to Structural Damage as a Result of Explosion

RBS SUP 1.12-1

Table 1.12-202 (Sheet 6 of 7)
Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
PLANT SERVICE WATER (PSW) SYSTEM	
Impact on Underground Conduits, Piping, Tunnels, etc.	Degradation of PSW System Availability or Capacity
Impact on Cooling Water Systems and Structures	Degradation of PSW System Availability or Capacity
Impact of the Relocation of SSCs	Degradation of PSW System Availability or Capacity
Impact of Encroachment on Structures and Facilities	Degradation of PSW System Availability or Capacity
Impact of Crane Load Drops	Degradation of PSW System Availability or Capacity
Impact on On-Site Transportation Routes	Degradation of Ability to Access PSW Pump and Switchgear Houses
Impact of Overpressure Due to Inadvertent Explosives Detonation	Degradation of PSW System Due to Structural Damage as a Result of Explosion
ULTIMATE HEAT SINK (UHS)	
Impact on Underground Conduits, Piping, Tunnels, etc.	Degradation of UHS Availability or Capacity
Impact on Cooling Water Systems and Components	Degradation of UHS Availability or Capacity
Impact of Wind-Generated Construction-Related Debris and Missiles	Effects of Construction-Related Debris or Missiles
Impact on Drainage Facilities and Structures	Design Basis Flood Elevation Exceeded
Impact of Increased Soil Erosion and Local Flooding	Design Basis Flood Elevation Exceeded
Impact of Increased and Local Flooding	Design Basis Flood Elevation Exceeded
Impact on Slope Stability	Drainage Degradation Due to Damming Effect Resulting In Exceedence of Design Basis Flood Elevation

RBS SUP 1.12-1

Table 1.12-202 (Sheet 7 of 7)
Potential Consequences to Unit 1 Due to Potential Hazards Resulting from Unit 3 Construction Activities

Potential Hazard	Potential Consequences
ULTIMATE HEAT SINK (UHS) (CONTINUED)	
Impact on Structural Integrity	UHS Basin Degradation Due to Structural Damage as a Result of Demolition, Excavation, etc.
Impact of Overpressure Due to Inadvertent Explosives Detonation	UHS Basin Degradation Due to Structural Damage as a Result of Explosion
SITE	
Impact on Site Security Systems	Security Threat to Operating Unit Could Impact SSCs
Impact on Site Access and Egress	Emergency Plan Impact
Impact on Drainage Facilities and Structures	Design Basis Flood Elevation Exceeded
Impact of Increased Soil Erosion and Local Flooding	Design Basis Flood Elevation Exceeded
Impact of Increased and Local Flooding	Design Basis Flood Elevation Exceeded
Impact on Slope Stability	Drainage Degradation Due to Damming Effect Resulting In Exceedence of Design Basis Flood Elevation
Impact on On-Site Transportation Routes	Emergency Plan, Firefighting Capabilities, and Security Impacts
Impact of Encroachment on Plant Protected or Vital Areas	Security Impacts
Impact of Vehicle Runaways	Security Impacts
Impact of Overpressure Due to Inadvertent Explosives Detonation	Security Impacts
Impact of Abandonment of SSCs	Security Impacts

RBS SUP 1.12-1

Table 1.12-203 (Sheet 1 of 5)
Managerial and Administrative Controls for Unit 3 Construction Activity Hazards

Hazard	Control
Impact on Overhead Power Lines	Administrative Controls for Appropriate Standoff and/or Installation of Temporary Support Towers
Impact on Transmission Towers	Administrative Controls for Appropriate Standoff and/or Installation of Temporary Support Towers
Impact on Underground Conduits, Piping, Tunnels, etc.	Administrative Controls to Identify Potentially Affected Structures, Systems, and Components, Evaluation to Ensure Their Structural Integrity During Construction, and/or Measures to Mitigate Impacts
Impact on Site Access and Egress	Administrative Controls to Ensure Adequate Site Access and Egress is Maintained (for example, Additional Access Road During Construction)
Impact on Drainage Facilities and Structures	Administrative Controls to Ensure that Drainage Capability is Maintained (for example, Addition of Temporary Drainage Culverts During Construction)
Impact on On-Site Transportation Routes	Administrative Controls to Ensure Adequate On-Site Transportation Routes (for example, Segregation of Construction Traffic Routes from Operating Plant Routes)
Impact on Slope Stability	Administrative Controls to Ensure Adequate Controls on Grading and Excavation to Maintain Slope Stability (for example, Construction Control Plans, Temporary Barriers to Mitigate Inadvertent Earth Movement, etc.)

RBS SUP 1.12-1

Table 1.12-203 (Sheet 2 of 5)
Managerial and Administrative Controls for Unit 3
Construction Activity Hazards

Hazard	Control
Impact of Increased Soil Erosion and Local Flooding	Administrative Controls to Ensure that Drainage Capability is Maintained to Prevent Soil Erosion or Local Flooding (for example, Addition of Temporary Drainage Culverts or Temporary Construction Barriers)
Impact of Increased and Local Flooding	Administrative Controls to Ensure that Drainage Capability is Maintained to Prevent Increased or Local Flooding (for example, Addition of Temporary Drainage Structures and/or Temporary Barriers, Design of Laydown and Storage Areas to Divert Runoff to Drainage Structures, etc.)
Impact of Construction-Generated Dust and Equipment Exhausts	Administrative Controls to Avoid or Minimize Construction Dust (for example, Use of Water Spray Trucks) and/or Enhanced Monitoring of Potentially Affected System Intakes, Filters, etc.
Impact of Encroachment on Structures and Facilities	Administrative Controls to Avoid Encroachment (for example, Temporary Barriers Erected, Additional Security Personnel, etc.)
Impact on Foundation Integrity	Administrative Controls to Identify Potentially Affected Structures, Systems and Components and to Provide Adequate Controls on Construction Activities (for example, Construction Control Plans, Pre-Activity Planning, etc.)
Impact on Structural Integrity	Administrative Controls to Identify Potentially Affected Structures, Systems, and Components and to Provide Adequate Controls on Construction Activities (for example, Construction Control Plans, Pre-Activity Planning, etc.)

RBS SUP 1.12-1

**Table 1.12-203 (Sheet 3 of 5)
Managerial and Administrative Controls for Unit 3
Construction Activity Hazards**

Hazard	Control
Impact of Overpressure Due to Inadvertent Explosives Detonation	Administrative Controls to Coordinate Transport On-Site, On-Site Use and On-Site Storage of Explosive Materials with Security and Safety Departments in Accordance with Unit 1 and/or 3 Security Plan(s)
Impact of Vehicle Accidents	Administrative Controls to Respond to Site Accidents (for example, Construction Control Plans for Construction Fire Brigade, Hazardous Materials Response Team, etc.)
Impact of Vehicle Runaways	Administrative Controls to Limit Access of Construction Vehicles to Defined Areas of the Site to Minimize Impact of a Runaway Vehicle
Impact of Abandonment of Structures, Systems, or Components	Administrative Controls for Post-Construction Disposition of Construction Related Structures (for example, Disposition of Abandoned Structures to Ensure Structures do not Impede Security's Line of Sight)
Impact of Ground Vibration	Administrative Controls to Identify Potentially Affected Structures, Systems and Components and to Evaluate Nature of Activity and Limit The Possible Impact on SSCs (for example, Case-by-Case Evaluations or Generic Evaluations of Specific Activities to Determine Possible Adverse Impacts)
Impact of Crane or Crane Boom Failures	Administrative Controls for Appropriate Standoff and/or Load Limits (for example, Controls to Limit Cranes to Defined Areas that Maintain Safe Distance from SSCs and Establishment of Programs Requiring Adherence to Equipment Load Limitations)

RBS SUP 1.12-1

Table 1.12-203 (Sheet 4 of 5)
Managerial and Administrative Controls for Unit 3
Construction Activity Hazards

Hazard	Control
Impact of Crane Load Drops	Administrative Controls for Appropriate Rigging, Load Limits, and Standoff (for example, Construction Plan Defines Acceptable Paths and Locations for Transporting and/or Lifting Large Loads)
Impact of Releases of Flammable, Hazardous or Toxic Materials	Administrative Controls on Quantities and Types of Flammable, Hazardous, or Toxic Materials
Impact of Wind-Generated, Construction-Related Debris and Missiles	Administrative Controls on Equipment and Material Storage and Transport, and for Reducing Power or Shutting Down Unit 1 During High Winds or High Wind Warnings
Impact on Electrical Systems and Components	Administrative Controls to Identify Potentially Affected Structures, Systems and Components, Evaluation to Ensure their Electrical Integrity During Construction, and/or Measures to Mitigate Impacts (for example, Performance of Construction Activities When Systems and/or Components are not Required to be Operable)
Impact on Instrumentation and Control Systems and Components	Administrative Controls to Identify Potentially Affected Structures, Systems, and Components, Evaluation to Ensure their Electrical Integrity During Construction, and/or Measures to Mitigate Impacts (for example, Performance of Construction Activities When Systems and/or Components are not Required to be Operable)

RBS SUP 1.12-1

**Table 1.12-203 (Sheet 5 of 5)
Managerial and Administrative Controls for Unit 3
Construction Activity Hazards**

Hazard	Control
Impact on Cooling Water Systems and Components	Administrative Controls to Identify Potentially Affected Structures, Systems, and Components, Evaluation to Ensure their Electrical Integrity During Construction, and/or Measures to Mitigate Impacts (for example, Performance of Construction Activities When Systems and/or Components are not Required to be Operable)
Impact on Radioactive Waste Release Points and Parameters	Enhanced Monitoring and Control to Ensure Releases are Within Limits
Impact of Relocation of Structures, Systems, or Components	Administrative Controls to Identify Potentially Affected Structures, Systems, and Components, Evaluation to Ensure Their Integrity During Construction, and/or Measures to Mitigate Impacts (for example, Provisions for Supplemental Fire Protection Equipment)
Impact on Site Security Systems	Security Plan Controls Site Activities, Reference Security Plan (for example, Maintaining Adequate Separation Distances, Controlling Vehicles and Personnel Access, Increased Security Personnel During Construction, etc.)
Impact of Encroachment on Plant Protected or Vital Areas	Security Plan Controls Site Activities, Reference Security Plan (for example, Maintaining Adequate Separation Distances)

APPENDIX 1A RESPONSE TO TMI RELATED MATTERS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Table 1A-1, 10 CFR 50.34(f)(3)(i), TMI Item I.C.5

Add the following to the end of the ESBWR Resolution statement.

STD SUP 1A.1-1 ESBWR construction and operations engineers are also continually involved in reviewing industry experience from these same sources in accordance with the administrative procedures described in DCD Section 18.3.2.

Table 1A-1, 10 CFR 50.34(f)(3)(iii), TMI Item I.F.2

Add the following to the end of the ESBWR Resolution statement.

STD SUP 1A.1-1 The Quality Assurance Program described in Chapter 17 also meets the requirements of issue I.F.2 as they apply to the construction and operation of the ESBWR.

Table 1A-1, 10 CFR 50.34(f)(3)(vii), TMI Item II.J.3.1

Add "13.1" as an "Associated Location(s)" and add the following to the end of the ESBWR Resolution statement.

STD SUP 1A.1-1 The ESBWR construction and operations teams have also developed a management plan for the ESBWR project that consists of a properly structured organization with open lines of communication, clearly defined responsibilities, well-coordinated technical efforts, and appropriate control channels.

The organizational structure is discussed in Section 13.1.

APPENDIX 1B PLANT SHIELDING TO PROVIDE ACCESS TO AREAS AND PROTECT SAFETY EQUIPMENT FOR POST-ACCIDENT OPERATION [II.B.2]

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 1C INDUSTRY OPERATING EXPERIENCE

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

APPENDIX 1C.1 EVALUATION

Replace the last paragraph with the following.

STD COL 1C.1-1-A
STD COL 1C.1-2-A
STD SUP 1C-1

Tables 1C-201 and 1C-202. These tables address Generic Letters and Bulletins that have been in effect/issued up to six months before the COL application submittal date, and after the SRP revisions that are applicable to this FSAR. They also address Generic Letter 82-39 and IE Bulletin 2005-02, which were identified in the DCD as the responsibility of the COL applicant.

APPENDIX 1C.2 COL INFORMATION

1C.1-1-A Handling of Safeguards Information

STD COL 1C.1-1-A

This COL item is addressed in Section 1C.1 and the Table 1C-201 entry for Generic Letter 82-39.

1C.1-2-A Emergency Preparedness and Response Actions

STD COL 1C.1-2-A

This COL item is addressed in Section 1C.1 and the Table 1C-202 entry for IE Bulletin 2005-02.

STD COL 1C.1-1-A

Table 1C-201
Operating Experience Review Results Summary - Generic Letters

No.	Issue Date	Title	Evaluation Result or Location(s) Where Discussed
82-39	12/22/1982	Problems with the Submittals of 10 CFR 73.21 Safeguards Information Licensing Review	Not Applicable. Is an administrative communication. The site has an approved procedure for handling Safeguards Information including how to mail such information to authorized recipients.

STD COL 1C.1-2-A

Table 1C-202
Operating Experience Review Results Summary - IE Bulletins

No.	Issue Date	Title	Evaluation Result or Location(s) Where Discussed
2005-02	07/18/2005	Emergency Preparedness and Response Actions for Security-Based Events	COLA Part 5 Emergency Plan

CHAPTER 2 SITE CHARACTERISTICS

2.0 INTRODUCTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the last two paragraphs of DCD Section 2.0 with the following.

Comparison of Site Characteristics and ESBWR Site Parameters

RBS COL 2.0-1-A

The site parameters[a] for the ESBWR standard plant are identified in Table 2.0-1 of the referenced DCD. Table 2.0-201, Comparison of ESBWR DCD Site Parameters with Unit 3 Site Characteristics, lists the ESBWR site parameters and the corresponding Unit 3 site characteristics[b], and provides the comparison showing that either the Unit 3 site characteristic falls within the ESBWR DCD site parameter, or identifies a departure.

RBS COL 2.0-2-A through 2.0-30-A

Information on Unit 3 site characteristics is provided in Sections 2.1 through 2.5 of this chapter. The information addresses the Standard Review Plan (SRP), NUREG-0800 information requirements of the DCD for a COL application, as identified in Table 2.0-2R. In the column identified as “COL Information,” the COL item from the ESBWR DCD is replaced with a sentence identifying the FSAR section that addresses the corresponding COL item.

2.0.1 COL UNIT-SPECIFIC INFORMATION

2.0-1-A Site Characteristics Demonstration

RBS COL 2.0-1-A

This COL Item is addressed in Section 2.0 and Table 2.0-201.

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a. 10 CFR 52.1 defines site parameters as the postulated physical, environmental and demographic features of an assumed site.

b. 10 CFR 52.1 defines site characteristics as the actual physical, environmental and demographic features of a site.

2.0-2-A through 2.0-30-A Standard Review Plan Conformance

RBS COL 2.0-2-A through 2.0-30-A

These COL Items are addressed in Section 2.0 and Table 2.0-2R.

RBS COL
2.0-2-A
through 2.0-30-A

TABLE 2.0-2R (SHEET 1 OF 4)
LIMITS IMPOSED ON ACCEPTANCE CRITERIA IN SECTION II OF SRP BY ESBWR DESIGN

Section	Subject	ESBWR DCD Parameters, Considerations and/or Limits	COL Information
2.1.1	Site Location and Description	None.	COL Item 2.0-2-A is addressed in Section 2.1.
2.1.2	Exclusion Area Authority and Control	None.	COL Item 2.0-3-A is addressed in Section 2.1.
2.1.3	Population Distribution	ESBWR PRA off-site consequence analysis in DCD Reference 2.0-1 is based on a population density of 305 people per square kilometer (790 per square mile).	COL Item 2.0-4-A is addressed in Section 2.1.
2.2.1 – 2.2.2	Identification of Potential Hazards in Site Vicinity	Per DCD Table 2.0-1.	COL Item 2.0-5-A is addressed in Section 2.2.
2.2.3	Evaluation of Potential Accidents	None considered in vicinity of plant.	COL Item 2.0-6-A is addressed in Section 2.2.
2.3.1	Regional Climatology	Per DCD Table 2.0-1.	COL Item 2.0-7-A is addressed in Section 2.3.
2.3.2	Local Meteorology	None.	COL Item 2.0-8-A is addressed in Section 2.3.
2.3.3	On-site Meteorological Measurements Programs	None.	COL Item 2.0-9-A is addressed in Section 2.3.

TABLE 2.0-2R (SHEET 2 OF 4)
LIMITS IMPOSED ON ACCEPTANCE CRITERIA IN SECTION II OF SRP BY ESBWR DESIGN

RBS COL
2.0-2-A
through 2.0-30-A

Section	Subject	ESBWR DCD Parameters, Considerations and/or Limits	COL Information
2.3.4	Short-Term Dispersion Estimates for Accidental Atmospheric Releases	Per DCD Table 2.0-1. See also DCD Chapter 15.	COL Item 2.0-10-A is addressed in Section 2.3.
2.3.5	Long-Term Diffusion Estimates	Per DCD Table 2.0-1. See DCD Section 12.2.2.1 for a discussion of the generation of these values.	COL Item 2.0-11-A is addressed in Section 2.3.
2.4.1	Hydraulic Description Maximum Ground Water Level	Per DCD Table 2.0-1.	COL Item 2.0-12-A is addressed in Section 2.4.1.
2.4.2	Floods	Per DCD Table 2.0-1.	COL Item 2.0-13-A is addressed in Section 2.4.2.
2.4.3	Probable Maximum Flood (PMF) on Streams and Rivers	Probable maximum flooding level on streams and rivers does not exceed the maximum flood level defined in DCD Table 2.0-1.	COL Item 2.0-14-A is addressed in Section 2.4.3.
2.4.4	Potential Dam Failures Seismically Induced	Potential seismically induced dam failures do not cause flooding to exceed the maximum flood level defined in DCD Table 2.0-1.	COL Item 2.0-15-A is addressed in Section 2.4.4.
2.4.5	Probable Maximum Surge and Seiche Flooding	Probable maximum surge and seiche flooding level does not exceed the maximum flood level defined in DCD Table 2.0-1.	COL Item 2.0-16-A is addressed in Section 2.4.5.

RBS COL
2.0-2-A
through 2.0-30-A

TABLE 2.0-2R (SHEET 3 OF 4)
LIMITS IMPOSED ON ACCEPTANCE CRITERIA IN SECTION II OF SRP BY ESBWR DESIGN

Section	Subject	ESBWR DCD Parameters, Considerations and/or Limits	COL Information
2.4.6	Probable Maximum Tsunami Flooding	Probable maximum tsunami flooding level does not exceed the maximum flood level defined in DCD Table 2.0-1.	COL Item 2.0-17-A is addressed in Section 2.4.6.
2.4.7	Ice Effects	None.	COL Item 2.0-18-A is addressed in Section 2.4.7.
2.4.8	Cooling Water Canals and Reservoirs	None.	COL Item 2.0-19-A is addressed in Section 2.4.8.
2.4.9	Channel Diversions	None.	COL Item 2.0-20-A is addressed in Section 2.4.9.
2.4.10	Flooding Protection Requirements	None.	COL Item 2.0-21-A is addressed in Section 2.4.10.
2.4.11	Low Water Considerations	None.	COL Item 2.0-22-A is addressed in Section 2.4.11.
2.4.12	Groundwater	Per DCD Table 2.0-1.	COL Item 2.0-23-A is addressed in Section 2.4.12.
2.4.13	Accidental Releases of Liquid Effluents in Ground and Surface Waters	The source term provided in DCD Table 12.2-13a, “Liquid Waste Management System Equipment Drain Collection Tank Activity,” is used in the effects analysis.	COL Item 2.0-24-A is addressed in Section 2.4.13.

RBS COL
2.0-2-A
through 2.0-30-A

TABLE 2.0-2R (SHEET 4 OF 4)
LIMITS IMPOSED ON ACCEPTANCE CRITERIA IN SECTION II OF SRP BY ESBWR DESIGN

Section	Subject	ESBWR DCD Parameters, Considerations and/or Limits	COL Information
2.4.14	Technical Specifications and Emergency Operation Requirements	None.	COL Item 2.0-25-A is addressed in Section 2.4.14.
2.5.1	Basic Geologic and Seismic Information	None.	COL Item 2.0-26-A is addressed in Section 2.5.1.
2.5.2	Vibratory Ground Motion	Per DCD Table 2.0-1 (and DCD Figures 2.0-1 and 2.0-2).	COL Item 2.0-27-A is addressed in Section 2.5.2.
2.5.3	Surface Faulting	ESBWR design assumes no permanent ground deformation from tectonic or non-tectonic faulting.	COL Item 2.0-28-A is addressed in Section 2.5.3.
2.5.4	Stability of Subsurface Materials and Foundations	Per DCD Table 2.0-1.	COL Item 2.0-29-A is addressed in Section 2.5.4.
2.5.5	Stability of Slopes	Per DCD Table 2.0-1.	COL Item 2.0-30-A is addressed in Section 2.5.5.

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 1 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS [(1)] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Maximum Groundwater Level:	0.61 m (2 ft.) below plant grade	Approximately 27 ft. below plant grade	Yes	FSAR 2.4.12.5.1 provides a maximum measured groundwater elevation of 70 ft. msl. Therefore, the maximum groundwater level is about 27 ft. below plant (site) grade. Therefore, the Unit 3 site characteristic value for maximum groundwater level is bounded by the value established by the ESBWR site parameter.
Extreme Wind:				
Seismic Category I and II Structures				
100-year Wind Speed (3-sec gust):[(12)]	67.1 m/s (150 mph)	128.4 mph	Yes	FSAR 2.3.1.2.1.2 provides a 100-year wind speed lower than that in the DCD. Therefore, the Unit 3 site characteristic value for 100-year wind speed falls within the value established by the ESBWR site parameter.
Exposure Category:	D	C	Yes	The RBS site parameter for exposure category is determined using ASCE 7-02 (DCD Ref. 2.0-2) and is bounded by Exposure Category D; therefore, the RBS falls within the ESBWR site parameter value for extreme wind exposure category.
Non-Seismic Standard Plant Structures				
50-year Wind Speed (3-sec gust):	58.1 m/s (130 mph)	120 mph (3-second gust)	Yes	FSAR 2.3.1.2.1.2 provides a 50-year wind speed lower than that in the DCD. Therefore, the Unit 3 site characteristic value for 50-year wind speed falls within the value established by the ESBWR site parameter.
Maximum Flood (or Tsunami) Level: [(2)]	0.3 m (1 ft.) below plant grade	More than 1 ft. below plant grade	Yes	FSAR 2.4.3 provides the maximum flood level of more than 1 ft. below plant (site) grade (94.61 ft. NGVD PMF for West Creek, plant grade elevation is 98 ft. NGVD). Therefore, the Unit 3 site characteristic value for maximum flood level falls within the value established by the ESBWR site parameter.

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 2 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS [1] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Tornado:				
Maximum Tornado Wind Speed: [3]	147.5 m/s (330 mph)	230 mph	Yes	FSAR 2.3.1.2.1.3 provides a maximum tornado wind speed lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum tornado wind speed falls within the value established by the ESBWR site parameter.
Maximum Rotational Speed:	116.2 m/s (260 mph)	184 mph	Yes	FSAR 2.3.1.2.1.3 provides a tornado maximum rotational speed lower than that in the DCD. Therefore, the Unit 3 site characteristic value for tornado maximum rotational speed falls within the value established by the ESBWR site parameter.
Translational Speed:	31.3 m/s (70 mph)	46 mph	Yes	FSAR 2.3.1.2.1.3 provides a tornado translational speed lower than that in the DCD. Therefore, the Unit 3 site characteristic value for tornado translational speed falls within the value established by the ESBWR site parameter.
Radius:	45.7 m (150 ft.)	150 ft.	Yes	FSAR 2.3.1.2.1.3 provides a tornado radius equal to that in the DCD. Therefore, the Unit 3 site characteristic value for tornado radius falls within the value established by the ESBWR site parameter.
Pressure Drop:	16.6 kPa (2.4 psi)	1.2 psi	Yes	FSAR 2.3.1.2.1.3 provides a tornado pressure drop lower than that in the DCD. Therefore, the Unit 3 site characteristic value for tornado pressure drop falls within the value established by the ESBWR site parameter.
Rate of Pressure Drop:	11.7 kPa/s (1.7 psi/s)	0.5 psi/s	Yes	FSAR 2.3.1.2.1.3 provides a tornado rate of pressure drop lower than that in the DCD. Therefore, the Unit 3 site characteristic value for tornado rate of pressure drop falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 3 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Missile Spectrum: (3)	Spectra I of SRP 3.5.1.4, Rev 2 applied to full building height.	See comment	Yes	DCD Section 3.5.1.4 specifies that Seismic Category I buildings are designed to resist tornado generated missiles as defined in DCD Table 2.0-1 and their resistance to missiles is independent of site topography. Therefore, the Unit 3 site characteristic for tornado missile spectrum, defined as that required by the DCD, falls within (is the same as) the ESBWR site parameter value.
Precipitation (for Roof Design):				
Maximum Rainfall Rate: (4)	49.3 cm/hr (19.4 in/hr)	19.4 in/hr	Yes	FSAR Table 2.4.3-201 provides a maximum rainfall rate equal to that in the DCD. Therefore, the Unit 3 site characteristic value for maximum rainfall rate falls within the value established by the ESBWR site parameter.
Maximum Short Term Rate:	15.7 cm (6.2 in.) in 5 minutes	6.2 in. in 5 minutes	Yes	FSAR Table 2.4.3-201 provides a maximum short-term rainfall rate equal to that in the DCD. Therefore, the Unit 3 site characteristic value for maximum short term rainfall rate falls within the value established by the ESBWR site parameter.
Maximum Roof Load: (5)	2873 Pa (60 lbf/ft^2)	33.0 lbf/ft^2	Yes	FSAR 2.3.1.2.4.2 provides a maximum roof load for extreme winter precipitation lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum roof load falls within the ESBWR site parameter value.
Maximum Ground Snow Load (5) (100-year recurrence interval):	2394 Pa (50 lbf/ft^2)	7.2 lbf/ft^2	Yes	FSAR 2.3.1.2.4.2 provides a maximum ground snow load lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum ground snow load within the value established by the ESBWR site parameter.
Maximum 48-hr Winter Rainfall: (5)	91.4 cm (36 in.)	35.2 in.	Yes	FSAR 2.3.1.2.4.1 provides a maximum 48-hr winter rainfall lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum 48-hr winter rainfall falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 4 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Ambient Design Temperature:(6)				
2% Exceedance Values				
Maximum:	35.6°C (96°F) dry bulb	91.2°F dry bulb	Yes	FSAR 2.3.1.2.5 provides a maximum 2% exceedance dry bulb temperature lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum 2% exceedance dry bulb temperature falls within the value established by the ESBWR site parameter.
	26.1°C (79°F) wet bulb (coincident)	77°F wet bulb (coincident)	Yes	FSAR 2.3.1.2.5 provides a maximum 2% exceedance coincident wet bulb temperature lower than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum 2% exceedance coincident wet bulb temperature falls within the value established by the ESBWR site parameter.
Maximum:	27.2°C (81°F) wet bulb (non-coincident)	78.8°F wet bulb (non-coincident)	Yes	FSAR 2.3.1.2.5 provides the Unit 3 site characteristic value for maximum 2% exceedance non-coincident wet bulb temperature, which falls within the value established by the ESBWR site parameter.
Minimum:	-23.3°C (-10°F)	30.6°F (1% exceedance value) See Comment	Yes	The 2% annual exceedance value for minimum temperature is not provided in the 2005 ASHRAE Handbook. However, the value would be greater than the site 1% exceedance value of 30.6°F shown, which is from FSAR Table 2.3-211. Therefore, the Unit 3 site characteristic value for minimum 2% exceedance temperature falls within the value established by the ESBWR site parameter.
1% Exceedance Values				
Maximum:	37.8°C (100°F) dry bulb	92.6°F dry bulb	Yes	The site characteristic 1% annual exceedance value for maximum dry bulb temperature from the 2005 ASHRAE Handbook falls within the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).

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TABLE 2.0-201 (SHEET 5 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Maximum:	26.1°C (79°F) wet bulb (coincident)	77.3°F wet bulb (coincident)	Yes	The site characteristic 1% annual exceedance value for the maximum wet bulb temperature (coincident) from the 2005 ASHRAE Handbook is bounded by the ESBWR dry bulb site parameter (refer to FSAR Table 2.3-211).
	27.8°C (82°F) wet bulb (non-coincident)	79.6°F(non-coincident)	Yes	The site characteristic 1% annual exceedance value for the maximum wet bulb temperature (non-coincident) from the 2005 ASHRAE Handbook falls is bounded by the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).
Minimum:	-23.3°C (-10°F)	30.6°F	Yes	The site characteristic 1% annual exceedance value for minimum temperature from the 2005 ASHRAE Handbook is bounded by the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).
0% Exceedance Values				
Maximum:	47.2°C (117°F) dry bulb	105°F dry bulb	Yes	The site characteristic 0% annual exceedance value for maximum temperature was determined using 1961 - 2006 data from Ryan Airport and is bounded by the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).
	26.7°C (80°F) wet bulb (coincident)	77.9°F wet bulb	Yes	The site characteristic 0% annual exceedance value for maximum (coincident) wet bulb temperature was determined using 1961 - 2006 data from Ryan Airport and is bounded by the value established by the ESBWR parameter (refer to FSAR Table 2.3-211).
Maximum:	31.1°C (88°F) wet bulb (non-coincident)	85.2°F wet bulb	Yes	The site characteristic 0% annual exceedance value for maximum (non-coincident) wet bulb temperature was determined using 1961 - 2006 data from Ryan Airport and is bounded by the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).

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TABLE 2.0-201 (SHEET 6 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Minimum:	-40°C (-40°F)	9°F	Yes	The site characteristic 0% annual exceedance value for minimum temperature was determined using 1961 - 2006 data from Ryan Airport and is bounded by the value established by the ESBWR site parameter (refer to FSAR Table 2.3-211).
Soil Properties:				
Minimum Static Bearing Capacity: (7)				
Reactor/Fuel Building:	699 kPa (14,600 lbf/ft^2)	72,000 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides a Reactor/Fuel Building allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for Reactor/Fuel Building minimum static bearing capacity falls within the value established by the ESBWR site parameter.
Control Building:	292 kPa (6100 lbf/ft^2)	121,500 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides a Control Building allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for Control Building minimum static bearing capacity falls within the value established by the ESBWR site parameter.
Fire Water Service Complex (FWSC):	165 kPa (3450 lbf/ft^2)	48,800 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides an FWSC allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for FWSC minimum static bearing capacity falls within the value established by the ESBWR site parameter.
Minimum Dynamic Bearing Capacity: (7)				
Reactor/Fuel Building:	2700 kPa (56,400 lbf/ft^2)	72,000 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides a Reactor/Fuel Building allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for Reactor/Fuel Building minimum dynamic bearing capacity falls within the value established by the ESBWR site parameter.

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 7 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

	Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
	Control Building:	2800 kPa (58,500 lbf/ft^2)	121,500 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides a Control Building allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for Control Building minimum dynamic bearing capacity falls within the value established by the ESBWR site parameter.
	Fire Water Service Complex:	440 kPa (9200 lbf/ft^2)	48,800 lbf/ft^2	Yes	FSAR 2.5.4.10.2 provides an FWSC allowable bearing capacity greater than that in the DCD. Therefore, the Unit 3 site characteristic value for FWSC minimum dynamic bearing capacity falls within the value established by the ESBWR site parameter.
RBS DEP 2.0-2	Minimum Shear Wave Velocity:(8)	300 m/s (1000 ft/s)	735 ft/s minimum	No	FSAR Table 2.5.2-231 provides a minimum equivalent uniform shear wave velocity (V_{eq}) less than that in the DCD. Therefore, the Unit 3 site characteristic value for minimum equivalent uniform shear wave velocity does not fall within the value established by the ESBWR site parameter.
	Liquefaction Potential:				
	Seismic Category I Structures	None under footprint of Seismic Category I structures resulting from site-specific SSE.	None under footprint of Seismic Category I structures resulting from site-specific SSE.	Yes	FSAR 2.5.4.8 provides evidence of no liquefaction potential under the footprint of Seismic Category I structures resulting from site-specific SSE. Therefore, the Unit 3 site characteristic value for liquefaction potential under Seismic Category I structures falls within the value established by the ESBWR site parameter.
	Other than Seismic Category I Structures	See Note (13)	None under footprint of other than Seismic Category I structures.	Yes	FSAR 2.5.4.8.2 provides geologic evidence of no liquefaction potential under the footprint of the Unit 3 powerblock and adjacent ground. Therefore, the Unit 3 site characteristic value for liquefaction potential under other than Seismic Category I structures falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 8 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

	Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
	Angle of Internal Friction	≥ 30 degrees	> 30 degrees See comment	Yes	FSAR 2.5.4.5.3.2 indicates the soil structure interface will be an engineered backfill material similar to that used for Unit 1 and compacted to provide an angle of friction of approximately 40 degrees.
	Seismology:				
RBS DEP 2.0-1	SSE Horizontal Ground Response Spectra: (9)	See DCD Figure 2.0-1	See Figure 2.0-201	No	FSAR Figure 2.0-201 (taken from FSAR Figures 2.5.2-300 through 2.5.2-302) provides the site-specific horizontal ground response spectrum, which is bounded by the ESBWR horizontal ground response spectrum except for frequencies below approximately 0.23 Hz.
RBS DEP 2.0-1	SSE Vertical Ground Response Spectra:(9)	See DCD Figure 2.0-2	See Figure 2.0-202	No	FSAR Figure 2.0-202 (taken from FSAR Figures 2.5.2-300 through 2.5.2-302) provides the site-specific vertical ground response spectrum, which is bounded by the ESBWR vertical ground response spectrum except for frequencies below approximately 0.15 Hz.
	Hazards in Site Vicinity:				
	Site Proximity Missiles and Aircraft:	< about 10^{-7} per year	Less than 10^{-7} per year	Yes	FSAR 2.2.3.2 provides the probability of aircraft accidents having the potential for radiological consequences greater than 10 CFR 100 exposure guidelines is less than that in the DCD. Therefore, the Unit 3 site characteristic value for site proximity missiles and aircraft falls within the value established by the ESBWR site parameter.
	Volcanic Activity:	None	None	Yes	FSAR 2.5.1.2.4 provides that there is no volcanic risk to the RBS site. Therefore, the Unit 3 site characteristic value for volcanic activity falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 9 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Toxic Gas Concentrations at the Main Control Room HVAC Intakes:	< toxicity limits	< toxicity limits	Yes	FSAR 2.2.3 and 6.4 indicate that the quantity stored on the site for toxic gases is not a hazard for Unit 3. Therefore, the Unit 3 site characteristic value for toxic gases falls within the value established by the ESBWR site parameter.
Required Stability of Slopes: (10)				
Factor of safety (FOS) for static (non-seismic) loading	1.5	Minimum FOS of 5	Yes	FSAR 2.5.5.1.2 provides static factors of safety in excess of 1.5. Therefore, the Unit 3 site characteristic value for static FOS falls within the value established by the ESBWR site parameter.
FOS for dynamic (seismic) loading due to site-specific SSE	1.1	Minimum FOS of 1.3	Yes	FSAR 2.5.5.1.2 provide dynamic factors of safety in excess of 1.1. Therefore, the Unit 3 site characteristic value for dynamic FOS falls within the value established by the ESBWR site parameter.
Maximum Settlement Values for Seismic Category I Buildings(14)**:**				
Maximum Settlement at any Corner of Basemat				
Under Reactor/Fuel Building	103 mm (4.0 inches)	0.7 inch	Yes	FSAR Table 2.5.4-213 provides basemat maximum corner settlement under the Reactor/Fuel Building less than that in the DCD. Therefore, the Unit 3 site characteristic value for Reactor/ Fuel Building basemat maximum corner settlement falls within the value established by the ESBWR site parameter.
Under Control Building	18 mm (0.7 inches)	0.7 inch	Yes	FSAR Table 2.5.4-213 provides basemat maximum corner settlement under the Control Building equal to that in the DCD. Therefore, the Unit 3 site characteristic value for Control Building basemat maximum corner settlement falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 10 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Under FWSC Structure	17 mm (0.7 inches)	0.4 inch	Yes	FSAR Table 2.5.4-213 provides basemat maximum corner settlement under the FWSC structure less than that in the DCD. Therefore, the Unit 3 site characteristic value for FWSC structure basemat maximum corner settlement falls within the value established by the ESBWR site parameter.
Average Settlement at Four Corners of Basemat				
Under Reactor/Fuel Building	65 mm (2.6 inches)	0.6 inch	Yes	FSAR Table 2.5.4-213 provides basemat average corner settlement under the Reactor/Fuel Building less than that in the DCD. Therefore, the Unit 3 site characteristic value for Reactor/ Fuel Building basemat average corner settlement falls within the value established by the ESBWR site parameter.
RBS DEP 2.5-1 Under Control Building	12 mm (0.5 inches)	0.7 inch	No	FSAR Table 2.5.4-213 provides basemat average corner settlement under the Control Building greater than that in the DCD. Therefore, the Unit 3 site characteristic value for Control Building basemat average corner settlement does not fall within the value established by the ESBWR site parameter.
Under FWSC Structure	10 mm (0.4 inches)	0.4 inch	Yes	FSAR Table 2.5.4-213 provides basemat average corner settlement under the FWSC structure equal to that in the DCD. Therefore, the Unit 3 site characteristic value for FWSC structure basemat average corner settlement falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 11 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS [1] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Maximum Differential Settlement Along the Longest Mat Foundation Dimension				
Within Reactor/Fuel Building	77 mm (3.0 inches)	0.6 inch	Yes	FSAR Table 2.5.4-213 provides maximum differential settlement under the Reactor/Fuel Building less than that in the DCD. Therefore, the Unit 3 site characteristic value for Reactor/Fuel Building basemat maximum differential settlement falls within the value established by the ESBWR site parameter.
Within Control Building	14 mm (0.6 inches)	0.3 inch	Yes	FSAR Table 2.5.4-213 provides maximum differential settlement under the Control Building less than that in the DCD. Therefore, the Unit 3 site characteristic value for Control Building maximum differential settlement falls within the value established by the ESBWR site parameter.
Under FWSC Structure	12 mm (0.5 inches)	0.2 inch	Yes	FSAR Table 2.5.4-213 provides maximum differential settlement under the FWSC structure less than that in the DCD. Therefore, the Unit 3 site characteristic value for FWSC structure maximum differential settlement falls within the value established by the ESBWR site parameter.
Maximum Differential Displacement between Reactor/Fuel Buildings and Control Building	85 mm (3.3 inches)	0.8 inch	Yes	FSAR Table 2.5.4-213 provides maximum differential displacement between the Reactor/Fuel Buildings and the Control Building less than that in the DCD. Therefore, the Unit 3 site characteristic value for maximum differential displacement between the Reactor/Fuel Buildings and Control Building falls within the value established by the ESBWR site parameter.

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TABLE 2.0-201 (SHEET 12 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS [1] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Meteorological Dispersion (χ/Q):[11]				
EAB χ/Q:				
0-2 hours:	2.00E-03 sec/m^3	8.12E-4 sec/m^3	Yes	FSAR 2.3.4 and Table 2.3-299 provide EAB and LPZ χ/Q values less than those in the DCD. Therefore, the Unit 3 site characteristic values for EAB and LPZ χ/Q fall within the values established by the ESBWR site parameters.
LPZ χ/Q:				
0-8 hours:	1.90E-04 sec/m^3	8.23E-5 sec/m^3	Yes	
8-24 hours:	1.40E-04 sec/m^3	5.76E-5 sec/m^3	Yes	
1-4 days:	7.50E-05 sec/m^3	2.66E-5 sec/m^3	Yes	
4-30 days:	3.00E-05 sec/m^3	8.75E-6 sec/m^3	Yes	
Control Room χ/Q: Reactor Building Release to Control Room Unfiltered Inleakage				
0-2 hours:	1.90E-03 sec/m^3	1.72E-03 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for Reactor Building release to Control Room unfiltered inleakage less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Reactor Building release to Control Room unfiltered inleakage fall within the values established by the ESBWR site parameters.
2-8 hours:	1.30E-03 sec/m^3	1.11E-03 sec/m^3	Yes	
8-24 hours:	5.90E-04 sec/m^3	3.76E-04 sec/m^3	Yes	
1-4 days:	5.00E-04 sec/m^3	3.55E-04 sec/m^3	Yes	
4-30 days	4.40E-04 sec/m^3	2.85E-04 sec/m^3	Yes	
Control Room χ/Q: Reactor Building Release to Control Room Air Intake (emergency and normal)				
0-2 hours:	1.50E-03 sec/m^3	1.26E-03 sec/m^3	Yes	Normal intake χ/Q values bound emergency intake χ/Q values. FSAR Table 2.3-302 provides Control Room χ/Q values for Reactor Building release to the Control Room air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Reactor Building release to the Control Room air intake fall within the values established by the ESBWR site parameters.
2-8 hours:	1.10E-03 sec/m^3	9.80E-04 sec/m^3	Yes	
8-24 hours:	5.00E-04 sec/m^3	4.10E-04 sec/m^3	Yes	
1-4 days:	4.20E-04 sec/m^3	3.55E-04 sec/m^3	Yes	
4-30 days	3.80E-04 sec/m^3	2.49E-04 sec/m^3	Yes	

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TABLE 2.0-201 (SHEET 13 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Control Room χ/Q: Passive Containment Cooling System (PCCS)/Reactor Building Roof Release to the Control Room Unfiltered Inleakage				
0-2 hours:	3.40E-03 sec/m^3	2.42E-03 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for PCCS/ Reactor Building Roof release to the Control Room unfiltered inleakage less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for PCCS/Reactor Building Roof release to the Control Room unfiltered inleakage fall within the values established by the ESBWR site parameters.
2-8 hours:	2.70E-03 sec/m^3	2.07E-03 sec/m^3	Yes	
8-24 hours:	1.40E-03 sec/m^3	8.86E-04 sec/m^3	Yes	
1-4 days:	1.10E-03 sec/m^3	6.84E-04 sec/m^3	Yes	
4-30 days	7.90E-04 sec/m^3	4.74E-04 sec/m^3	Yes	
Control Room χ/Q: Passive Containment Cooling System/Reactor Building Roof Release to Control Room Air Intake (emergency and normal)				
0-2 hours:	3.00E-03 sec/m^3	2.50E-03 sec/m^3	Yes	Emergency intake χ/Q values bound normal intake χ/Q values. FSAR Table 2.3-302 provides Control Room χ/Q values for PCCS/ Reactor Building Roof release to the Control Room air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for PCCS/Reactor Building Roof release to the Control Room air intake fall within the values established by the ESBWR site parameters.
2-8 hours:	2.50E-03 sec/m^3	2.08E-03 sec/m^3	Yes	
8-24 hours:	1.20E-03 sec/m^3	8.48E-04 sec/m^3	Yes	
1-4 days:	9.00E-04 sec/m^3	6.79E-04 sec/m^3	Yes	
4-30 days	7.00E-04 sec/m^3	4.77E-04 sec/m^3	Yes	
Control Room χ/Q: Turbine Building Release to Control Room Unfiltered Inleakage				
0-2 hours:	1.20E-03 sec/m^3	8.59E-04 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for Turbine Building release to the Control Room unfiltered inleakage less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Turbine Building release to the Control Room unfiltered inleakage fall within the values established by the ESBWR site parameters.
2-8 hours:	9.80E-04 sec/m^3	5.24E-04 sec/m^3	Yes	
8-24 hours:	3.90E-04 sec/m^3	2.44E-04 sec/m^3	Yes	
1-4 days:	3.80E-04 sec/m^3	2.31E-04 sec/m^3	Yes	
4-30 days	3.20E-04 sec/m^3	1.84E-04 sec/m^3	Yes	

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TABLE 2.0-201 (SHEET 14 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS [1] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Control Room χ/Q: Turbine Building Release to Control Room Air Intake (emergency and normal)				
0-2 hours:	1.20E-03 sec/m^3	9.60E-04 sec/m^3	Yes	Emergency intake χ/Q values bound normal intake χ/Q values. FSAR Table 2.3-302 provides Control Room χ/Q values for Turbine Building release to the Control Room air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Turbine Building release to the Control Room air intake fall within the values established by the ESBWR site parameters.
2-8 hours:	9.80E-04 sec/m^3	6.45E-04 sec/m^3	Yes	
8-24 hours:	3.90E-04 sec/m^3	2.85E-04 sec/m^3	Yes	
1-4 days:	3.80E-04 sec/m^3	2.61E-04 sec/m^3	Yes	
4-30 days	3.20E-04 sec/m^3	1.90E-04 sec/m^3	Yes	
Control Room χ/Q: Fuel Building – Diffuse Source Release to the Control Room Normal Air Intake				
0-2 hours:	2.80E-03 sec/m^3	2.44E-03 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for Fuel Building-Diffuse Source release to the Control Room normal air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Fuel Building-Diffuse Source release to the Control Room normal air intake fall within the values established by the ESBWR site parameters. Emergency intake filtration is not credited in releases from this source.
2-8 hours:	2.50E-03 sec/m^3	1.62E-03 sec/m^3	Yes	
8-24 hours:	1.25E-03 sec/m^3	5.95E-04 sec/m^3	Yes	
1-4 days:	1.10E-03 sec/m^3	5.27E-04 sec/m^3	Yes	
4-30 days	1.00E-03 sec/m^3	4.14E-04 sec/m^3	Yes	
Control Room χ/Q: Fuel Building Cask Doors Release to Control Room Normal Air Intake				
0-2 hours:	1.50E-03 sec/m^3	8.73E-04 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for Fuel Building Cask Doors release to Control Room normal air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Fuel Building Cask Doors release to Control Room normal air intake fall within the values established by the ESBWR site parameters. Emergency intake filtration is not credited for this source.
2-8 hours:	1.30E-03 sec/m^3	5.26E-04 sec/m^3	Yes	
8-24 hours:	6.80E-04 sec/m^3	2.20E-04 sec/m^3	Yes	
1-4 days:	5.60E-04 sec/m^3	1.88E-04 sec/m^3	Yes	
4-30 days	4.30E-04 sec/m^3	1.39E-04 sec/m^3	Yes	

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 15 OF 18) COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments
Control Room χ/Q: Radwaste Building Release to Control Room Normal Air Intake				
0-2 hours:	1.50E-03 sec/m^3	1.03E-03 sec/m^3	Yes	FSAR Table 2.3-302 provides Control Room χ/Q values for Radwaste Building release to Control Room normal air intake less than those in the DCD. Therefore, the Unit 3 site characteristic values for Control Room χ/Q for Radwaste Building release to Control Room normal air intake fall within the values established by the ESBWR site parameters. Emergency intake filtration is not credited for this source.
2-8 hours:	1.30E-03 sec/m^3	8.00E-04 sec/m^3	Yes	
8-24 hours:	6.80E-04 sec/m^3	3.78E-04 sec/m^3	Yes	
1-4 days:	5.60E-04 sec/m^3	2.66E-04 sec/m^3	Yes	
4-30 days	4.30E-04 sec/m^3	1.91E-04 sec/m^3	Yes	
Long-Term Dispersion Estimates:				
RBS DEP 9.4-1 RBS DEP 12.2-1 χ/Q:				
RB/FB Vent Stack	3.0E-07 sec/m^3	6.0E-07 sec/m^3	No	FSAR Table 12.2-202 provides long-term dispersion estimate χ/Q values that are greater than the DCD ESBWR site parameter value. In accordance with Note 12 of DCD Table 2.0-1, if a selected site has an χ/Q value that exceeds the ESBWR reference site value, the release concentrations in DCD Table 12.2-17 would be adjusted proportionate to the change in χ/Q to show that the 10 CFR 20 limits are met. In addition, for a site selected that exceeds the bounding χ/Q values, the resulting annual average doses must be addressed to demonstrate that the doses continue to meet the dose reference values provided in 10 CFR 50, Appendix I, using site-specific χ/Q values. In accordance with DCD COL Item 12.2-2-A, Subsection 12.2.2.2 demonstrates that site-specific doses and gaseous effluent isotopic concentrations and off-site doses are well within allowable limits using the higher χ/Q site characteristic.
TB Vent Stack	2.0E-07 sec/m^3	5.3E-07 sec/m^3		
RWB Vent Stack	2.0E-05 sec/m^3	2.1E-05 sec/m^3 (Undepleted/No decay)		
D/Q:				
RB/FB Vent Stack	1.0E-08 m^{-2}	8.9E-09 m^{-2}	No	
TB Vent Stack	6.0E-09 m^{-2}	7.9E-09 m^{-2}		
RWB Vent Stack	3.0E-08 m^{-2}	4.4E-08 m^{-2}		

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 16 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS [(1)] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments

Notes for Table 2.0-201:

(1) The design of the Radwaste Building uses a set of design parameters that are specified in RG 1.143, Table 2, Class RW IIa instead of the corresponding values given in this table.

(2) PMF, as defined in Table 1.2-6 of Volume III of DCD Reference 2.0-4.

(3) Maximum speed selected is based on Attachment 1 of DCD Reference 2.0-5, which summarizes the NRC Interim Position on RG 1.76. Concrete structures designed to resist Spectrum I missiles of SRP 3.5.1.4, Rev. 2, will also resist missiles postulated in RG 1.76, Revision 1.

(4) Based on probable maximum precipitation (PMP) for one hour over 2.6 km^2 (one square mile) with a ratio of 5 minutes to one hour PMP of 0.32 as found in DCD Reference 2.0-3. Roof scuppers and drains are designed independently to limit water accumulation on the roof to no more than 100 mm (4 in) during PMP conditions. See also DCD Table 3G.1-2.

(5) Maximum design roof load accommodates snow load and 48-hour probable maximum winter precipitation (PMWP) in DCD References 2.0-2 and 2.0-6. Roof scuppers and drains are designed independently to limit water accumulation on the roof to no more than 100 mm (4 in) during PMWP conditions. See also DCD Table 3G.1-2.

(6) Zero percent exceedance values are based on conservative estimates of historical high and low values for potential sites. One and two percent exceedance values were selected in order to bound the values presented in DCD Reference 2.0-4 and available Early Site Permit applications.

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 17 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS [(1)] WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments

(7) At foundation level of Seismic Category I structures. For minimum dynamic bearing capacity site-specific application, use the larger value or a linearly interpolated value of the applicable range of shear wave velocities at the foundation level. River Bend is considered a soft soil site; the corresponding shear wave velocity is 1000 ft/sec.

(8) This is the equivalent uniform shear wave velocity (V_{eq}) over the entire soil column at seismic strain, which is a lower bound value after taking into account uncertainties. V_{eq} is calculated to achieve the same wave traveling time over the depth equal to the embedment depth plus 2 times the largest foundation plan dimension below the foundation as follows:

$$V_{eq} = \frac{\sum d_i}{\sum \frac{d_i}{V_i}}$$

where d_i and V_i are the depth and shear wave velocity, respectively, of the i^{th} layer. Per Section 2.5.4.7.1, the ratio of the largest to the smallest shear wave velocity over the mat foundation width at the foundation level does not exceed 1.7.

(9) Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For ground surface founded FWSC structures, the CSDRS is 1.35 times the values shown in DCD Figures 2.0-1 and 2.0-2.

RBS COL 2.0-1-A

TABLE 2.0-201 (SHEET 18 OF 18)
COMPARISON OF ESBWR DCD SITE PARAMETERS (1) WITH UNIT 3 SITE CHARACTERISTICS

Parameter	ESBWR Site Parameter	Unit 3 Site Characteristic	Bounding Yes/No	Comments

(10) Values reported here are actually design criteria rather than site design parameters. They are included here because they do not appear elsewhere in the DCD.

(11) Unit 3 χ/Q values fall within the ESBWR reference site values. Therefore, the radiological consequences associated with the controlling DBA meet the dose reference values provided in 10 CFR 50.34(a) and control room operator dose limits provided in General Design Criterion 19.

(12) Value was selected to comply with expected requirements of southeastern coastal locations.

(13) Localized liquefaction potential under other than Seismic Category I structures is addressed per SRP 2.5.4 in Section 2.0-2R.

(14) Settlement values are long-term (post-construction) values except for differential settlement within the foundation mat. The design of the foundation mat accommodates immediate and long-term (post-construction) differential settlements after the installation of the basemat.

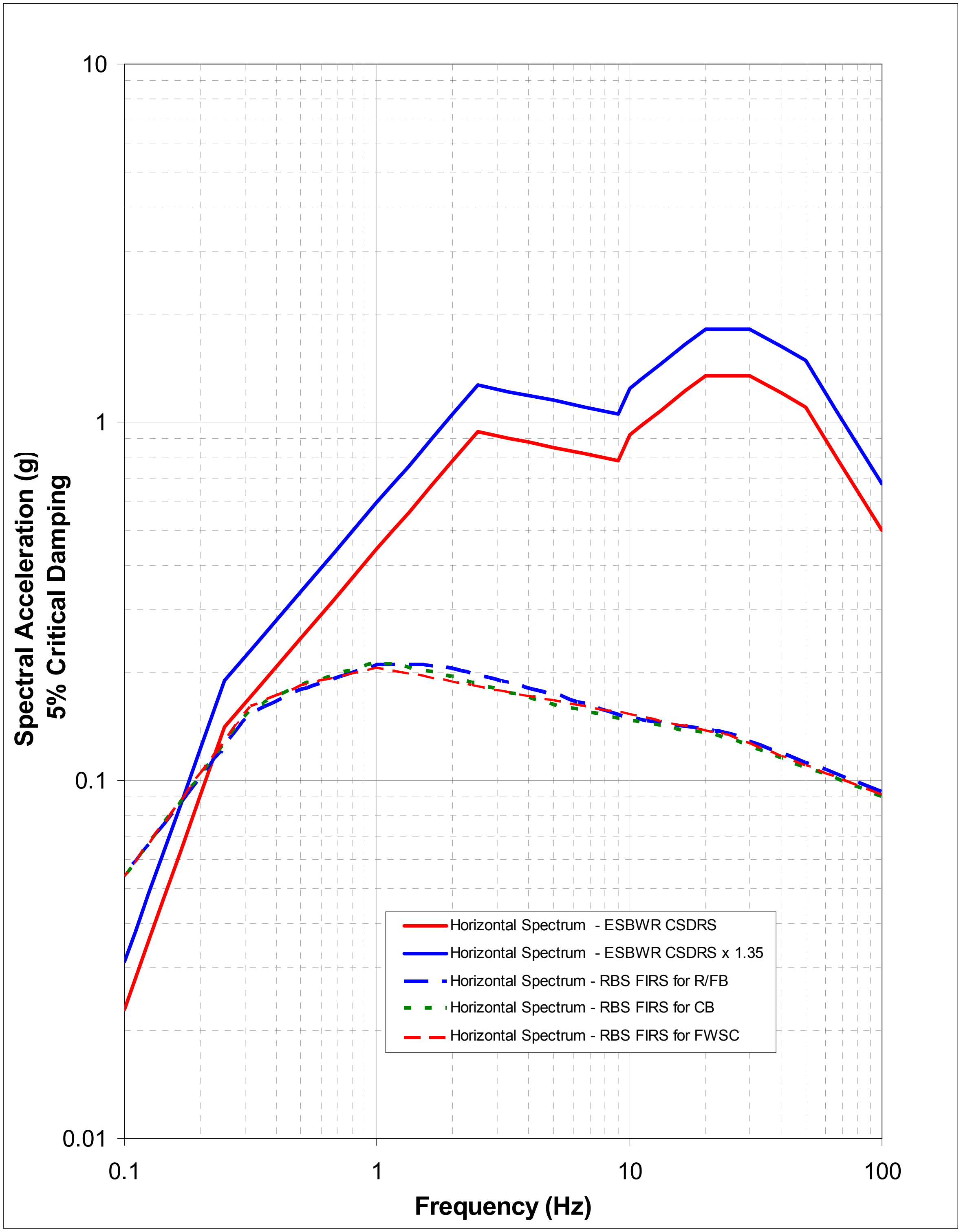

Figure 2.0-201. ESBWR Horizontal Design Ground-Motion Response Spectra Comparisons at Foundation Level

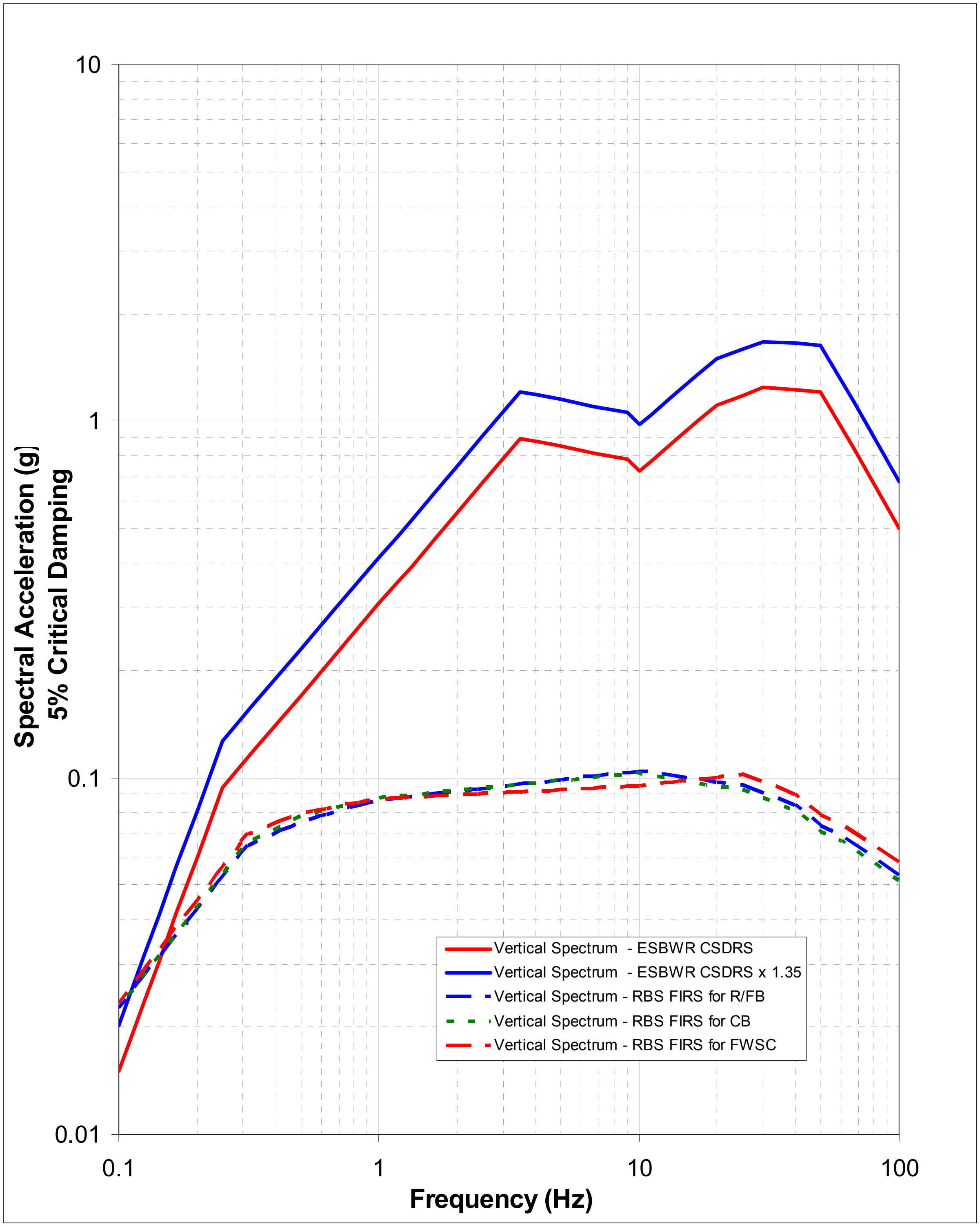

Figure 2.0-202. ESBWR Vertical Design Ground-Motion Response Spectra Comparisons at Foundation Level

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

RBS COL 2.0-2-A

2.1.1.1 Specification of Location

RBS SUP 2.1-1

Entergy Operations, Inc. (EOI), referred to herein as the Applicant, currently operates a nuclear generation plant referred to as River Bend Station (RBS) Unit 1. Unit 2 was planned but never built (cancelled January 5, 1984); therefore, the proposed reactor is designated as Unit 3. The location of each reactor at the RBS site is specified by latitude, longitude, and Universal Transverse Mercator (UTM) coordinates below.

River Bend Station	Latitude	Longitude
Unit 1 (existing operation)	30° 45' 26" North	91° 19' 54" West
	Zone 15 UTM (NAD83) Coordinates	
	3,403,705 m Northing	659,678 m Easting
Unit 3 (proposed)	30° 45' 23" North	91° 20' 02" West
	Zone 15 UTM (NAD83) Coordinates	
	3,403,793 m Northing	659,460 m Easting

Unit 1 and Unit 3 are located in the southern part of the Elm Park quadrangle in the U.S. Geological Survey (USGS) map index for Louisiana. The USGS Port Hudson quadrangle also brackets the site area to the south (Reference 2.1-202).

The RBS is located in the southeastern corner of West Feliciana Parish, Louisiana (Reference 2.1-201), at address 5485 U.S. Highway 61, St. Francisville, Louisiana, 70775, between U.S. Highway 61 and the east bank of the Mississippi River. The site is near the southwest corner of Mississippi, about 16 mi. south of the Louisiana-Mississippi border. Figure 2.1-201 shows the location of the facility in relation to the larger cities and towns in the region within a radius of 50 mi. (80 km) from the center of the proposed power block. The facility is approximately 3 mi. southeast of St. Francisville, Louisiana; about 7 mi. northeast of New Roads, Louisiana; 24 mi. north-northwest of Baton Rouge, Louisiana; and 53 mi. south-southwest of Natchez, Mississippi.

The RBS and its environs are heavily wooded with several open fields dotting the landscape. The vicinity is mostly rural, consisting primarily of farmland and forests. Elevations at the site range from 35 to 130 ft. National Geodetic Vertical Datum (NGVD). The site is on two levels: an alluvial floodplain along the east bank of the Mississippi River at an elevation of about 35 ft. above mean sea level (msl), and an upper terrace with an average elevation of 100 ft. above msl.

Figure 2.1-202 shows the site in relation to the features of the surrounding 6 mi. (10 km) vicinity. The Mississippi River is adjacent to the western RBS boundary. The Audubon State Commemorative Area is located 3 mi. north-northeast of the property. Other natural features in the vicinity include Thompson Creek to the east, Bayou Sara to the northwest, Alligator Bayou in the western portion of the RBS property, and Grants Bayou in the eastern part of the RBS property. Numerous unnamed, intermittent streams cross the site and drain to either Grants or Alligator Bayou. Just south of the RBS property, Grants Bayou enters Alligator Bayou, which flows south into Thompson Creek. Thompson Creek enters the Mississippi River approximately 7 mi. downstream of the RBS embayment (Reference 2.1-201). East and south of the site, the corridor is cleared for proposed State Highway 10, and work has begun on the new John James Audubon Bridge, slated for completion in the summer of 2010 (Reference 2.1-203). Scattered industrial facilities are present southeast of the RBS property, mainly east of Thompson Creek in East Feliciana Parish.

2.1.1.2 Site Area Map

The RBS property boundary, shown in Figure 2.1-203, encompasses approximately 3330 ac. The site boundaries are the same as the plant property lines Figures 2.1-203 and 2.1-204 include a scaled plot plan of the exclusion area. Figure 2.1-204 shows the site plan with the location and orientation of principal plant structures, including the Reactor Building, auxiliary boiler, Turbine Building, control room, Electrical Building, main transformers, plant stack, Radwaste Building, Fuel Building, Water Treatment Building, and cooling towers. The Unit 3 site is situated where the Unit 1 service water storage tanks were located as well as in the area occupied by West Canal, a man-made drainage ditch. West Canal was relocated up to 325 ft. west of its old location to accommodate the addition of RBS Unit 3. To the west, the Unit 3 site is surrounded by the primary spoils area from Unit 1 construction in the late 1970s/early 1980s as well as on-site forested areas; RBS Unit 1 and its accompanying facilities occupy the east side. North of the proposed Unit 3 location is the north construction area that was used for Unit 1 construction.

The Starhill microwave tower is a commercial structure located along Highway 965, north of the North Access Road intersection. Recreational facilities include a hunting club and a ball park to the northwest across Highway 965 and a Community Building/Activity Center east of Highway 965. There is a security firing range next to the hunting club. A heliport and hangar are across the North Access Road from the Main Administrative Building. There are no military or residential buildings within the site area.

There are seven roads that traverse or are adjacent to the site (refer to Figure 2.1-203):

- U.S. Highway 61 is the nearest major transportation route; it runs adjacent to a small portion of the RBS's northern boundary, which is a minimum of approximately 1 mi. from the reactor.

- North Access Road is the main entrance to the site from U.S. Highway 61.
- State Highway 965 connects to U.S. Highway 61 northwest of the RBS property, runs south onto the site by the Starhill microwave tower, intersects North Access Road, and continues south where it ends at the intersection of the River Access Road and West Feliciana Parish 7 (WFP 7) (Police Jury Road).
- River Access Road is the heavy haul road to and from the Mississippi River; it intersects the junction of State Highway 965 and WFP 7 (Police Jury Road).
- West Feliciana Parish 7 (Police Jury Road) starts at the intersection of State Highway 965 and River Access Road, proceeds south past the switchyard, and leaves the RBS property. It then turns northeast through Powell and reconnects with U.S. Highway 61.
- River Road is an unimproved parish road that parallels the Mississippi River bank at the extreme west edge of the RBS property and is approximately 1.8 mi. from the reactor at its nearest point.
- The new section of State Highway 10 that connects the Audubon Bridge to U.S. Highway 61 runs quite close to, and occasionally adjacent to, the RBS southeastern boundary.

The heavily wooded site fronts on 9000 ft. of the eastern bank of the Mississippi River and extends inland approximately 2-1/2 mi. Major buildings, cooling towers, and switchyards of the existing Unit 1 are situated on a terrace (95 to 105 ft. above msl) overlooking the 3000 to 4000 ft. wide alluvial floodplain (35 ft. above msl). The southern portion of the RBS site (in the undeveloped areas surrounding the existing plant and its facilities) is rough and irregular, with steep slopes and deep-cut stream valleys and drainage courses. River Access Road, the abandoned rail line, and 230 kV transmission lines are to the south (Reference 2.1-201).

2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

RBS COL 2.0-3-A

2.1.2.1 Authority

The RBS Unit 1 and Unit 3 exclusion areas overlap a significant amount of the same area and are entirely within the 3330 ac. owned by Entergy Gulf States Louisiana, L.L.C. (EGSL). The Unit 1 exclusion area boundary (EAB) is designated as the area encompassed by a 3000-ft. radius circle around the reactor center (Reference 2.1-201). The Unit 3 exclusion area is designated as the area encompassed by a 2364-ft. radius circle around the proposed reactor power block.

EGSL has ownership of the RBS property, subject to reservations of mineral rights by predecessors-in-title. EGSL owns the mineral rights within the exclusion area, subject to reservations of mineral rights by predecessors-in-title, but controls the right to use the surface of the exclusion area for the extraction or development of minerals. There are no easements/servitudes that affect the exclusion area, except such easements/servitudes that grant EGSL the right to exclude or remove persons or property from the exclusion area consistent with the safety and security requirements of EGSL. For all practical purposes, the Applicant maintains control of ingress to and egress from the exclusion area and provides for evacuation of individuals from the area in the event of an emergency. Since the proposed exclusion area for Unit 3 is wholly contained within the RBS property boundary, the Applicant has effective control, or appropriate permission for control, over the exclusion area. EGSL owns all property inside the exclusion area. The exclusion area will not be traversed by any public highway, waterway, or active railroad (Reference 2.1-201).

EGSL owns two roads that traverse the exclusion area and that were constructed as part of the plant in the late 1970s/early 1980s. North Access Road serves as the principal station access from U.S. Highway 61 and connects with State Highway 965 just outside of the EAB. River Access Road runs from River Road near the water intake and barge slip facilities, across the intersection of State Highway 965 and WFP 7 (Police Jury Road), then inside the EAB. River Access Road serves as a construction heavy haul road and embayment access road, and the section outside the EAB is open to the public for use when necessary during periods of flooding to alleviate any traffic problems along the levee from River Road (Reference 2.1-201).

EGSL owns 1.2 mi. of railroad south of the old connection to the RBS plant access railroad, and the track has been removed. From this junction northward past the RBS property boundary, the Illinois Central Gulf Railroad has abandoned the track, which traversed the site in a northwest-southeast direction. There are no pipelines crossing the EABs, but there are pipelines in proximity to the RBS property (refer to Subsection 2.2.2.3). No one resides in the exclusion area (Reference 2.1-201).

2.1.2.2 Control of Activities Unrelated to Plant Operation

Any permitted activities taking place within the exclusion area and unrelated to facility operation are restricted. All visitors have employee escorts and are provided with general safety rules and evacuation instructions, which are posted at all facilities used by the public. The estimate of time required to evacuate nonessential personnel from the exclusion area is generally less than 30 minutes. Plant tours are not normally provided, because of security and insurance restrictions (Reference 2.1-201).

The Applicant controls all activities at the site and has specified guidelines for public access and use of facilities within the Emergency Preparedness Owner Controlled Area. The Sheriff's Department houses a helicopter in the RBS hangar, and one pilot comes on-site frequently to use the heliport. The Louisiana Department of Wildlife & Fisheries (LDWF) monitors hunting at the site, and one or two people occasionally perform state research studies and collect samples, but these activities would normally be outside the exclusion area. The RBS has a timber management plan, and there could be some selective logging activity inside the exclusion area to remove trees that have been killed by a beetle infestation; a typical logging crew would consist of 10 to 18 members.

2.1.2.3 Arrangements for Traffic Control

The proposed exclusion area for RBS Unit 3 is not traversed by any highway, functional railway or public waterway and no control of traffic on these modes of transportation is required. The major shipping lane of the Mississippi River lies outside of the RBS Unit 3 EAB and the RBS site property lines. Louisiana State Highway 965 lies just outside the southwestern portion of the exclusion area, and agreements are in place so that local law enforcement authorities can block the road to control traffic under emergency conditions.

2.1.2.4 Abandonment or Relocation of Roads

Construction and operation of RBS Unit 3 will not require the abandonment of any existing roads. Expansion of the Fancy Point switchyard is expected to result in the rerouting of part of Police Jury Road.

RBS COL 2.0-4-A

2.1.3 POPULATION DISTRIBUTION[a]

The permanent population data presented in this section are primarily derived from the 2000 U.S. Census information contained in LandView® 6.[b] This software is a flexible tool capable of identifying economic and demographic information in a selected geographic area. The census data was augmented by information from other agencies and public organizations from the states of Louisiana and Mississippi.[c] The region, defined as the area encompassed by a 50-mi. radius from the center of the proposed RBS Unit 3 power block, includes all or a portion of the 24 parishes/counties in Louisiana and Mississippi shown in Figure 2.1-205 and Table 2.1-201 (Reference 2.1-204).

2.1.3.1 Permanent Population within 10 Mi.

Figure 2.1-206 is a map of the area within 10 mi. of the RBS site. Concentric circles are drawn on this map with the RBS site as the center point, at distances of 1, 2, 3, 4, 5, and 10 mi. The circles are then divided into 22.5-degree segments, with each segment centered on one of the 16 compass points (e.g., north, north-northeast). Within each area formed by the concentric circles and radial lines, the

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a. Sources for population data and projections, as well as information on seasonal variations (transient) population in the area around the RBS site are identified and referenced in this section, as appropriate. The population data and general descriptions of human activity and seasonal variations are provided to comply with Regulatory Guide 1.206.

b. LandView® 6 software is the result of a collaborative effort among the U.S. Environmental Protection Agency (EPA), the U.S. Census Bureau, the National Oceanic and Atmospheric Administration (NOAA), and the USGS to provide the public readily accessible published federal spatial and demographic data. It is composed of two software programs: the LandView® 6 database manager and the MARPLOT® map viewer. These two programs work in tandem to create a computer mapping system that displays individual map layers and the associated demographic and spatial data.

c. This augmented information includes descriptions and data for facilities, schools, parks, recreational areas, etc.

estimated permanent (resident) population for 2000 is listed, according to the LandView® 6 information.[d] These population statistics are also listed in Table 2.1-202 (Reference 2.1-205).

Consistent with the rural nature of the vicinity, the population within 10 mi. of the proposed RBS Unit 3 is relatively low, totaling 24,756 in 2000. The largest population areas were associated with the New Roads, Louisiana (southwest, west-southwest segments) and Jackson, Louisiana (northeast segment). Both cities were more than 5 mi. from the proposed RBS Unit 3 power block.

Within each area formed by the concentric circles and radial lines, the permanent (resident) population for 2000, the projected population for 2012 (the assumed year of plant approval), the projected population for 2017 (the assumed first year of facility operations), and the projected population for each decade for four decades through the year 2057 are estimated in Table 2.1-203 (Reference 2.1-205). The projections are based upon the average annual growth rate in census population from 1990 through 2005, applied to the 2000 population estimate for each segment.[e]

There are no residents within the EAB.

2.1.3.2 Permanent Population, 10 to 50 Mi.

Figure 2.1-207 illustrates the 50-mi. radius around RBS Unit 3. The segmented population statistics for 2000 are also shown in Table 2.1-204, where a total 50-mi. population of 859,874 is indicated.

Table 2.1-205 lists the permanent (resident) population for 2000 and the projected population for each decade for four decades from the projected first year of plant operations (2017 through 2057) for each area formed by the concentric circles and radial lines. The basis of estimating the projected population distributions are the same as those described in Subsection 2.1.3.1.

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d. The segment population was derived from LandView® 6 as follows. For the 0- to 1-mi. distance from the plant, the population for all census block points lying within the 1-mi. radius was summed consistent with Figure 2.5.1-1 in NUREG-1555 (October 1999). For the 1- to 3-mi. segments, census block points were allocated based upon their location indicated in LandView® 6, as further modified based upon a review of aerial photographs. This modification was appropriate, because the population represented as a single block point in LandView® 6 is actually distributed over a limited but unspecified area around the block point. For segments beyond 3 mi., the population in a census block point was allocated in its entirety to the segment in which it was reported in LandView® 6.

e. ArcGIS software was used to find the percentage of each segment lying within a parish or county. A weighted average growth rate for each segment was calculated by summing up the product of the parish/county growth rate and the segment tract area percentage associated with each parish/county.

2.1.3.3 Transient Population

Transient populations include those populations that do not reside permanently in an area but, instead, are there on a temporary basis. There are a large number of categories that can potentially be considered to be part of the transient population; these include employees at businesses located outside the workers' area of residence, hotel and motel guests, and patrons of sporting events and recreational facilities. Other special facilities whose populations can be counted as transient include schools, hospitals and nursing homes, and correctional facilities.

When viewing transient population figures, it should be kept in mind that it is not possible to determine whether some category populations (e.g., the workforce of an employer, guests in a hotel, etc.) reside within or outside the area of study, and, therefore, the category can lead to double counting, especially in larger geographic areas. Therefore, the sum of the resident and transient populations tends to overstate the total area population. Nevertheless, transient population estimates for the 10-mi. radius from RBS and the 10- to 50-mi. radius are provided below.

2.1.3.3.1 Transient Population within Approximately 10 Mi.

An estimate of the total transient population for the Emergency Planning Zone (EPZ), which includes the transient population (persons who live outside the EPZ boundary but enter the EPZ for a specific reason, and then leave the EPZ; examples include campers or recreational facility users) plus commuter-employees (persons who live outside the EPZ yet commute to work within the EPZ), is presented in the "River Bend Station Development of Evacuation Time Estimates" (the "Evacuation Time Estimate" [ETE]) (Reference 2.1-206). This draft estimate was developed in May 2008 by KLD Associates, Inc. for Entergy Nuclear.

The ETE reports the transient population for the two groups listed above. The information is organized by the distance and compass direction from the RBS site, as depicted in Figure 2.1-211. Based on the resident population developed above and the total transient population from the ETE, the total 10-mi. radius population (permanent plus transient total) is estimated at 33,446 in Table 2.1-213; the transient population of 6349 comprises approximately 18.2 percent of this figure.

2.1.3.3.2 Transient Population, 10 to 50 Mi.

The estimated transient and special facilities population for the region in a 10- to 50-mi. radius around the RBS site is 53,076; it is shown in Table 2.1-206. The table also shows the resident and total population for the 10- to 50-mi. concentric circles. Approximately 6.4 percent of the total population in the 10- to 50-mi. radius concentric circle is estimated to be transient.

Figure 2.1-208 is a map of the 50-mi. RBS region. The transient population for each segment within each concentric circle that, other than the 0- to 10-mi. population, sums to the totals in Table 2.1-206, was calculated by combining estimates of the following, as explained below:

- 2000 U.S. Census commuter information for each county/parish (Reference 2.1-212).
- Louisiana tourism information from 2003 TravelScope® Profile of U.S. Travelers to Louisiana (Reference 2.1-207).
- 2000 U.S. Census information from LandView® 6 on the number of recreational, seasonal, and occasional housing units in the 50-mi. region (Reference 2.1-208).
- Transient population data from Table 2.1-207 (Reference 2.1-210).

The 2000 U.S. Census reports commuter information for each county/parish. The data details the residents' county/parish of residence and employment. Table 2.1-214 shows the results of the U.S. Census information for parish and county commuters within 50 mi. of the RBS. Once the commuter information was compiled, ArcGIS software was used to find the percentage of each parish or county lying within a segment. The commuter transient population for each county/parish was multiplied by this percentage to produce an estimate of the commuter transient population for each concentric circle segment for the 10- to 50-mi. radius.

Louisiana tourism information from the 2003 TravelScope® Profile of U.S. Travelers to Louisiana reports the number of resident and nonresident visitors, both business and leisure, to Louisiana and many of Louisiana's major cities. The report further describes the average length of stay for visitors and the seasonal (by month) travel distribution. Based on this information, the average number of daily visitors to each major Louisiana city and rural area can be calculated. Dividing the number of daily visitors by the population for each city and rural area produces the number of visitors per permanent resident for each city and the rest of Louisiana. Multiplying these figures with each concentric circle segment's population produces an estimate of the tourist transient population for each concentric circle segment.

The LandView® 6 software provides the number of vacant housing units that are classified as recreational, seasonal, or occasional; the number of total housing units; and the average household size for each Census Block Group (CBG). Dividing the housing unit classified as recreational, seasonal, or occasional by the total housing units for each CBG results in the percentage of total housing units that are classified as recreational, seasonal, or occasional. The methodology assumes that three quarters of the housing units would be occupied for only 3 months of the year. Multiplying this assumption by the recreational, seasonal, or occasional housing percentage, the average household size and the number of housing units for each census block point provides an estimate of the transient population according to the recreational, seasonal, or occasional housing units in each concentric circle segment.

Table 2.1-207 lists transient population information for several categories (correctional facilities, college dormitories, nursing homes, hospitals, religious group quarters, and other non-household living situations) for each parish or county within 50 mi. of the site. The ArcGIS software was used to find the percentage of each parish or county lying within a segment. Multiplying this percentage by the transient population for each county produces an estimate of transient population for each concentric circle segment for these several categories. Some modifications to this analysis were necessary to take into account large populations that apply wholly to a specified section. The college dormitories population for Louisiana State University (LSU) was assumed to wholly apply to the Baton Rouge area. Likewise, correctional facility populations were applied to the specific section based on data from the Louisiana Department of Public Safety and Corrections (Reference 2.1-210).

For schools (excluding college) in the 10- to 50-mi. radius, no net change in transient population was assumed because students and school staff would likely be captured in the census information. While a certain amount of double counting of school-related population was included in the 10-mile EPZ total population, this was not considered appropriate for the 10- to 50-mi. range because most students both reside and attend schools within the same 50-mi. area.

2.1.3.3.3 Projected Total Populations

Methods for determining projected permanent populations are discussed in Subsection 2.1.3.1. The same method used for permanent populations was applied to the projection of changes in transient populations, based on the assumption that the growth rates for both population segments would be generally comparable. The projected population for the 0- to 10-mi. section is shown in Table 2.1-208.

Table 2.1-209 presents total populations, permanent and transient, for 10- to 20-, 20- to 30-, and 30- to 40-, and 40- to 50-mi., projected to 2012 (assumed plant approval date), 2017 (approximate start of facility operation), and for every 10 years until 2057 (approximate end of life for the proposed new facility).

2.1.3.4 Low Population Zone

The low population zone (LPZ) was determined in accordance with the guidance of Regulatory Guide 4.7 and is defined in 10 CFR 100 as "...the area immediately surrounding the exclusion area which contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident." The RBS Unit 3 LPZ radius is assumed to be a 2-mi. radial distance measured from the proposed power block location. The Applicant also determined the LPZ so that appropriate protective measures could be taken on behalf of the the enclosed populace in the event of an emergency.[f] Figure 2.1-209 illustrates the LPZ and the transportation routes within approximately a 5-mi. radius of the site. As Figure 2.1-209 illustrates, there are no institutions such as schools, hospitals, prisons, beaches, or parks less than 2 mi. from the RBS Unit 3. The facilities or institutions within 5 mi. of the RBS that may require special consideration are identified in Table 2.1-210 and Figure 2.1-209.

The number and density of residents in the area immediately surrounding the RBS site are low, enabling simple and effective evacuation procedures to be followed in the event of an accident. The permanent (resident) population within the LPZ is 483 people (LandView® 6).

The proposed RBS Unit 3 daily workforce is estimated to be 500, and the combined Unit 1 and Unit 3 workforce would be approximately 1000 to 1100 workers divided among multiple shifts. Occasional maintenance and outage workers would add to this normal workforce size. Table 2.1-210 shows the number of employees, as well as seasonal variation, that work in other institutions within 5 mi. of the facility that are of special concern (Reference 2.1-211). Based on the analysis developed above, the transient population for the LPZ is estimated to be 34 persons over and above the working transient population shown in Table 2.1-210 and the RBS workforce (Reference 2.1-206).

2.1.3.5 Population Center

A population center is defined in 10 CFR 100 as a densely populated area where there are about 25,000 or more inhabitants. Figure 2.1-210 shows all the densely populated areas within, or partly within, a 50-mi. radius of the RBS Unit 3 location. Four urban areas are located within 50 mi. of the RBS, but only Baton Rouge is within 40 mi. of the RBS. Baton Rouge is the largest of the four population centers, with a permanent 2000 population of 479,019. Adding the estimated transient population of 26,976 results in a total estimated population of 505,995. The closest portion of the larger Baton Rouge metropolitan area is approximately 10 mi. to the southeast of the RBS. The majority of the Baton Rouge metropolitan area is located 20 to 30 mi. from the RBS. The distance of all population centers is well in excess of the minimum population center distance required by 10 CFR 100 and, therefore, complies with Regulatory Guide 4.7 (at least 1-1/3 times the distance from the reactor to the LPZ boundary).

Population projections for the Baton Rouge area were determined for the plant licensing period since Baton Rouge would remain the nearest population center, i.e., no populations closer to the site are expected to grow by more than 25,000 people. Using the weighted average population growth rate (0.51 percent) for 1990 to 2005 for East Baton Rouge Parish and West Baton Rouge Parish, the

f. If an institution had a sizable population or handled hazardous material, it was deemed as requiring special consideration.

projected 2017 population for these parishes is 552,049. Table 2.1-211 shows the projected population out to year 2057 (approximate end of life for the purposed new facility) for the larger Baton Rouge area. The current population density for the larger Baton Rouge area is 1707 persons per square mile.

2.1.3.6 Population Density

The cumulative permanent (resident) population for 2000 was calculated using the data from LandView® 6 software provided by the U.S. Census Bureau. The permanent population density for West Feliciana Parish, in which the site is located, is 24.3 persons per square mile; for the state of Louisiana, it is 102.6 persons per square mile; for the state of Mississippi, it is 60.6 persons per square mile.

Using data from Table 2.1-208 and 2.1-209, population densities for each 10 mi. concentric circle to 50 mi. were calculated for 2012 (approximately site approval date) and 2017. Tables 2.1-212 and 2.1-213 show the projected population density for 2012 and 2017, respectively. As shown in the tables, the site's projected population density is well below the value specified in Regulatory Guide 4.7, Position C.4 (at the time of initial site approval and within about 5 years thereafter, the population density, including weighted average transient population averaged over any radial distance out to 20 mi. [cumulative population at a distance divided by the circular area at that distance], does not exceed 500 persons per square mile).

2.1.4 REFERENCES

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2.1-212 U.S. Census 2000, "County-to-County Worker Flow Files," Website, http://www.census.gov/population/www/cen2000/commuting.html, accessed November 19, 2007.

Table 2.1-201
Parishes and Counties Partly or Wholly within a 50-Mi. Radius of the RBS Unit 3 Power Block

Louisiana Parishes		Mississippi Counties
Ascension	Lafayette	Adams
Assumption	Livingston	Amite
Avoyelles	Pointe Coupee	Franklin
Catahoula	St. Helena	Pike
Concordia	St. Landry	Wilkinson
East Baton Rouge	St. Martin	
East Feliciana	Tangipahoa	
Evangeline	West Baton Rouge	
Iberia	West Feliciana	
Iberville		

Source: Reference 2.1-204.

Table 2.1-202
Segment Population Distribution 0 to 10 Mi. from the Proposed RBS Unit 3 Power Block, 2000

	Miles from the Proposed Unit 3 Power Block					
Compass Direction	**0-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**
NORTH		100	126	0	43	773
N-NE		106	83	59	0	511
NE		0	35	2	22	4265
E-NE		17	16	72	0	220
EAST		0	8	24	0	289
E-SE		0	16	8	38	720
SE		0	45	0	9	1953
S-SE		4	44	0	0	202
SOUTH		2	0	0	0	844
S-SW		0	0	0	208	920
SW		0	0	0	0	3404
W-SW		0	0	0	150	4635
WEST		0	0	0	0	0
W-NW		4	409	398	0	17
NW		134	507	712	805	805
N-NW		75	0	0	244	632
Total Population per Circle	41	442	1289	1275	1519	20,190
Total, All Segments	24,756					

Source: Reference 2.1-205.

Table 2.1-203 (Sheet 1 of 4)
Regional Residential Population Projections

	Year						
Mile Radius	**2000**	**2012**	**2017**	**2027**	**2037**	**2047**	**2057**
0-1	41	46	49	54	61	68	75
Compass Direction		**Mile Range**					
	Year	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**Total**
NORTH	2000	100	126	0	43	773	1042
	2012	113	143	0	48	879	1183
	2017	120	151	0	51	928	1250
	2027	133	168	0	57	1034	1392
	2037	149	187	0	64	1152	1552
	2047	166	209	0	71	1283	1729
	2057	185	233	0	79	1430	1927
N-NE	2000	106	83	59	0	511	759
	2012	120	94	67	0	581	862
	2017	127	100	70	0	613	910
	2027	141	111	78	0	683	1013
	2037	158	124	87	0	761	1130
	2047	176	138	97	0	848	1259
	2057	196	154	109	0	945	1404
NE	2000	0	35	2	22	4265	4324
	2012	0	39	2	25	4759	4825
	2017	0	41	2	26	4982	5051
	2027	0	46	2	29	5460	5537
	2037	0	51	2	32	5983	6068
	2047	0	57	3	36	6556	6652
	2057	0	64	3	40	7184	7291
E-NE	2000	17	16	72	0	220	325
	2012	19	18	81	0	235	353
	2017	20	19	86	0	242	367
	2027	22	21	96	0	256	395
	2037	25	23	107	0	271	426
	2047	28	26	119	0	286	459
	2057	31	29	133	0	303	496

Table 2.1-203 (Sheet 2 of 4) Regional Residential Population Projections

Mile Radius	Year 2000	2012	2017	2027	2037	2047	2057
0-1	41	46	49	54	61	68	75

Compass Direction	Year	Mile Range 1-2	2-3	3-4	4-5	5-10	Total
	2000	0	8	24	0	289	321
	2012	0	9	26	0	306	341
	2017	0	9	27	0	314	350
EAST	2027	0	10	30	0	330	370
	2037	0	11	32	0	347	390
	2047	0	13	35	0	365	413
	2057	0	14	38	0	384	436
	2000	0	16	8	38	720	782
	2012	0	18	8	40	764	830
	2017	0	19	8	41	783	851
E-SE	2027	0	21	9	43	823	896
	2037	0	23	9	45	866	943
	2047	0	26	10	48	910	994
	2057	0	29	10	50	957	1046
	2000	0	45	0	9	1953	2007
	2012	0	51	0	9	2074	2134
	2017	0	54	0	9	2126	2189
SE	2027	0	60	0	10	2235	2305
	2037	0	67	0	10	2350	2427
	2047	0	74	0	11	2471	2556
	2057	0	83	0	11	2598	2692
	2000	4	44	0	0	202	250
	2012	4	50	0	0	215	269
	2017	4	52	0	0	222	278
S-SE	2027	5	58	0	0	234	297
	2037	5	65	0	0	248	318
	2047	6	73	0	0	262	341
	2057	7	81	0	0	277	365

Table 2.1-203 (Sheet 3 of 4)
Regional Residential Population Projections

Mile Radius	Year 2000	2012	2017	2027	2037	2047	2057
0-1	41	46	49	54	61	68	75

Compass Direction	Year	Mile Range 1-2	2-3	3-4	4-5	5-10	Total
	2000	2	0	0	0	844	846
	2012	2	0	0	0	878	880
	2017	2	0	0	0	893	895
SOUTH	2027	2	0	0	0	924	926
	2037	2	0	0	0	955	957
	2047	3	0	0	0	988	991
	2057	3	0	0	0	1022	1025
	2000	0	0	0	208	920	1128
	2012	0	0	0	206	911	1117
	2017	0	0	0	205	908	1113
S-SW	2027	0	0	0	204	901	1105
	2037	0	0	0	203	894	1097
	2047	0	0	0	201	888	1089
	2057	0	0	0	200	881	1081
	2000	0	0	0	0	3404	3404
	2012	0	0	0	0	3373	3373
	2017	0	0	0	0	3360	3360
SW	2027	0	0	0	0	3335	3335
	2037	0	0	0	0	3310	3310
	2047	0	0	0	0	3286	3286
	2057	0	0	0	0	3261	3261
	2000	0	0	0	150	4635	4785
	2012	0	0	0	148	4605	4753
	2017	0	0	0	148	4593	4741
W-SW	2027	0	0	0	146	4568	4714
	2037	0	0	0	145	4544	4689
	2047	0	0	0	144	4520	4664
	2057	0	0	0	143	4496	4639

Table 2.1-203 (Sheet 4 of 4)
Regional Residential Population Projections

	Year						
Mile Radius	**2000**	**2012**	**2017**	**2027**	**2037**	**2047**	**2057**
0-1	41	46	49	54	61	68	75
Compass Direction		**Mile Range**					
	Year	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**Total**
WEST	2000	0	0	0	0	0	0
	2012	0	0	0	0	0	0
	2017	0	0	0	0	0	0
	2027	0	0	0	0	0	0
	2037	0	0	0	0	0	0
	2047	0	0	0	0	0	0
	2057	0	0	0	0	0	0
W-NW	2000	4	409	398	0	17	828
	2012	4	465	453	0	19	941
	2017	4	491	478	0	20	993
	2027	5	547	532	0	22	1106
	2037	5	609	593	0	25	1232
	2047	6	679	661	0	28	1374
	2057	7	756	736	0	31	1530
NW	2000	134	507	712	805	805	2963
	2012	152	577	810	916	916	3371
	2017	160	609	855	967	967	3558
	2027	179	678	952	1077	1077	3963
	2037	199	755	1061	1200	1200	4415
	2047	222	842	1182	1337	1337	4920
	2057	247	938	1317	1489	1489	5480
N-NW	2000	75	0	0	244	632	951
	2012	85	0	0	277	719	1081
	2017	90	0	0	293	759	1142
	2027	100	0	0	326	845	1271
	2037	111	0	0	363	942	1416
	2047	124	0	0	405	1049	1578
	2057	138	0	0	451	1169	1758

Source: Reference 2.1-205.

Table 2.1-204
Segment Population Distribution 0 to 50 Mi. from the Proposed RBS Unit 3 Power Block, 2000

	Miles from the Proposed Unit 3 Power Block				
Compass Direction	**0-10**	**10-20**	**20-30**	**30-40**	**40-50**
NORTH		975	4,575	869	3,130
N-NE		391	1,478	2,895	1,275
NE		2184	2800	2258	3276
E-NE		4500	3826	1827	4605
EAST		2559	2940	3797	16,750
E-SE		11,422	24,019	18,035	16,133
SE		34,042	131,618	68,166	38,114
S-SE		21,352	170,275	42,308	23,852
SOUTH		2676	5498	13,085	2304
S-SW		4005	4060	175	3278
SW		4396	1076	1965	33,354
W-SW		606	2822	3990	47,241
WEST		1114	1476	1818	2863
W-NW		168	1978	4892	15,259
NW		370	5543	215	828
N-NW		855	763	53	146
Total Population per Circle	24,756	91,615	364,747	166,348	212,408
Total, All Segments			859,874		

Source: Reference 2.1-205.

Table 2.1-205 (Sheet 1 of 4)
Regional Residential Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
NORTH	2000	975	4575	869	3130	9,549
	2012	1069	4746	898	2952	9,665
	2017	1110	4820	911	2882	9,723
	2027	1199	4970	936	2745	9,850
	2037	1295	5125	963	2615	9,998
	2047	1398	5284	990	2491	10,163
	2057	1509	5449	1018	2373	10,349
N-NE	2000	391	1478	2895	1275	6,039
	2012	433	1533	2973	1268	6,207
	2017	451	1556	3006	1266	6,279
	2027	491	1605	3074	1260	6,430
	2037	535	1654	3143	1255	6,587
	2047	583	1706	3214	1250	6,753
	2057	634	1759	3286	1245	6,924
NE	2000	2184	2800	2258	3276	10,518
	2012	2324	2889	2267	3289	10,769
	2017	2386	2928	2270	3294	10,878
	2027	2513	3006	2278	3305	11,102
	2037	2647	3086	2286	3316	11,335
	2047	2789	3168	2294	3327	11,578
	2057	2938	3253	2301	3338	11,830
E-NE	2000	4500	3826	1827	4605	14,758
	2012	4777	4059	1865	4752	15,453
	2017	4898	4160	1882	4815	15,755
	2027	5148	4371	1915	4943	16,377
	2037	5411	4592	1949	5074	17,026
	2047	5688	4824	1984	5209	17,705
	2057	5979	5068	2019	5348	18,414

Table 2.1-205 (Sheet 2 of 4)
Regional Residential Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
EAST	2000	2559	2940	3797	16,750	26,046
	2012	2716	3107	3893	18,618	28,334
	2017	2785	3180	3934	19,457	29,356
	2027	2927	3330	4018	21,250	31,525
	2037	3077	3487	4103	23,208	33,875
	2047	3235	3652	4190	25,346	36,423
	2057	3400	3825	4279	27,682	39,186
E-SE	2000	11,422	24,019	18,035	16,133	69,609
	2012	12,130	28,985	25,306	22,417	88,838
	2017	12,438	31,347	29,142	25,710	98,637
	2027	13,077	36,662	38,648	33,818	122,205
	2037	13,750	42,879	51,254	44,484	152,367
	2047	14,457	50,151	67,971	58,514	191,093
	2057	15,200	58,655	90,142	76,968	240,965
SE	2000	34,042	131,618	68,166	38,114	271,940
	2012	36,154	145,118	89,976	53,800	325,048
	2017	37,072	151,144	101,009	62,109	351,334
	2027	38,979	163,957	127,300	82,777	413,013
	2037	40,984	177,856	160,434	110,321	489,595
	2047	43,092	192,934	202,192	147,031	585,249
	2057	45,309	209,290	254,818	195,957	705,374
S-SE	2000	21,352	170,275	42,308	23,852	257,787
	2012	22,854	182,189	45,511	29,721	280,275
	2017	23,511	187,397	46,916	32,575	290,399
	2027	24,882	198,262	49,858	39,130	312,132
	2037	26,333	209,757	52,984	47,004	336,078
	2047	27,869	221,919	56,306	56,462	362,556
	2057	29,494	234,786	59,837	67,824	391,941

Table 2.1-205 (Sheet 3 of 4)
Regional Residential Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
SOUTH	2000	2676	5498	13,085	2304	23,563
	2012	2899	5899	13,464	2408	24,670
	2017	2998	6075	13,625	2453	25,151
	2027	3205	6443	13,953	2546	26,147
	2037	3427	6832	14,290	2642	27,191
	2047	3664	7246	14,634	2742	28,286
	2057	3918	7684	14,986	2845	29,433
S-SW	2000	4005	4060	175	3278	11,518
	2012	4067	4190	185	3634	12,076
	2017	4094	4245	189	3794	12,322
	2027	4147	4358	198	4135	12,838
	2037	4201	4475	208	4507	13,391
	2047	4256	4594	218	4912	13,980
	2057	4311	4716	228	5354	14,609
SW	2000	4,396	1,076	1,965	33,354	40,791
	2012	4356	1093	2164	37,116	44,729
	2017	4340	1100	2253	38,806	46,499
	2027	4307	1115	2442	42,421	50,285
	2037	4275	1130	2647	46,372	54,424
	2047	4243	1145	2869	50,691	58,948
	2057	4212	1161	3109	55,413	63,895
W-SW	2000	606	2822	3990	47,241	54,659
	2012	600	2895	4356	51,589	59,440
	2017	598	2926	4519	53,517	61,560
	2027	593	2989	4862	57,591	66,035
	2037	589	3053	5232	61,976	70,850
	2047	585	3119	5629	66,695	76,028
	2057	580	3186	6057	71,772	81,595

Table 2.1-205 (Sheet 4 of 4)
Regional Residential Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
WEST	2000	1114	1476	1818	2863	7,271
	2012	1152	1527	1980	3107	7,766
	2017	1168	1549	2052	3216	7,985
	2027	1201	1595	2203	3443	8,442
	2037	1235	1641	2366	3687	8,929
	2047	1270	1689	2541	3948	9,448
	2057	1306	1738	2728	4227	9,999
W-NW	2000	168	1978	4892	15,259	22,297
	2012	178	1990	5137	16,073	23,378
	2017	183	1995	5243	16,425	23,846
	2027	192	2005	5462	17,153	24,812
	2037	202	2015	5690	17,912	25,819
	2047	213	2025	5927	18,706	26,871
	2057	224	2035	6174	19,534	27,967
NW	2000	370	5543	215	828	6,956
	2012	414	5682	219	839	7,154
	2017	434	5742	220	844	7,240
	2027	477	5862	224	855	7,418
	2037	524	5985	227	865	7,601
	2047	575	6111	231	875	7,792
	2057	632	6239	235	886	7,992
N-NW	2000	855	763	53	146	1,817
	2012	945	791	51	136	1,923
	2017	986	803	51	133	1,973
	2027	1073	828	50	126	2,077
	2037	1167	854	48	119	2,188
	2047	1270	881	47	113	2,311
	2057	1381	908	46	107	2,442

Source: Reference 2.1-205.

Table 2.1-206
Permanent and Transient Population (Concentric Circles)

Concentric Circle	Resident	Transient	Total
10 - 20 Mile	91,615	12,619	104,234
20 - 30 Mile	364,747	23,303	388,050
30 - 40 Mile	166,348	6824	173,172
40 - 50 Mile	212,408	10,330	222,738
10 - 50 Mile	835,118	53,076	888,194

Source: References 2.1-205, 2.1-207, 2.1-208, 2.1-209, 2.1-210, and 2.1-212.

Table 2.1-207
Transient Population Data for the Regional Parishes and Counties

	Number of People Living in					
Parish/County	State Prisons/ Local Jails[(a)]	College Dormitories[(b)]	Nursing Homes	Hospitals or Wards[(c)]	Religious Group Quarters[(d)]	Other Non-Household Living Situations[(e)]
Ascension	234	0	314	65	21	12
Assumption	57	0	106	3	25	0
Avoyelles	2337	0	728	38	9	0
Catahoula	392	0	116	0	0	0
Concordia	457	0	155	77	0	0
East Baton Rouge	2706	7713	2412	771	232	842
East Feliciana	1720	0	527	5	0	18
Evangeline	1220	0	331	170	24	27
Iberia	390	0	562	253	19	446
Iberville	3100	0	233	6	12	3
Lafayette	986	1803	1220	174	119	474
Livingston	142	0	316	79	39	7
Pointe Coupee	106	0	224	0	7	0
St. Helena	0	0	66	6	0	0
St. Landry	355	0	814	220	57	107
St. Martin	420	0	296	71	18	0
Tangipahoa	541	1292	647	293	109	35
West Baton Rouge	436	0	116	13	4	0
West Feliciana	5022	0	116	0	6	2
Adams (MS)	165	14	259	9	9	31
Amite (MS)	24	0	0	0	0	0
Franklin (MS)	2	0	67	10	0	14
Pike (MS)	174	256	404	6	0	22
Wilkinson (MS)	947	0	91	0	0	0
Total	21,933	11,078	10,120	2269	710	2040

a) Includes local jails (including police lockups), halfway houses, state prisons, juvenile institutions (including short-term care, detention or diagnostic centers), other correctional institutions, federal prisons, military disciplinary barracks.

b) Includes college quarters off campus.

c) Includes homes for the mentally/physically handicapped/ill, hospitals/wards and hospices for chronically ill, orthopedic wards, institutions for the deaf or blind, patients who have no usual home elsewhere.

d) Includes workers' dormitories, agriculture workers' dormitories on farms, other group homes.

e) Includes other noninstitutional group quarters, job corps, and vocational training facilities.

Source: Reference 2.1-210.

Table 2.1-208 (Sheet 1 of 5)
0- to 10-Mi. Resident and Transient Population Projections

Year	0-1 Miles
2000	691
2012	786
2017	830
2027	924
2037	1030
2047	1147
2057	1278

Cardinal Compass Direction	Year	Mile Range					Total
		1-2	2-3	3-4	4-5	5-10	
NORTH	2000	100	126	0	43	773	1042
	2012	113	143	0	48	879	1183
	2017	120	151	0	51	928	1250
	2027	133	168	0	57	1034	1392
	2037	149	187	0	64	1152	1552
	2047	166	209	0	71	1283	1729
	2057	185	233	0	79	1430	1927
N-NE	2000	106	83	1059	0	511	1759
	2012	120	94	1205	0	581	2000
	2017	127	100	1272	0	613	2112
	2027	141	111	1417	0	683	2352
	2037	158	124	1578	0	761	2621
	2047	176	138	1758	0	848	2920
	2057	196	154	1959	0	945	3254
NE	2000	0	35	2	22	4503	4562
	2012	0	39	2	25	5025	5091
	2017	0	41	2	26	5260	5329
	2027	0	46	2	29	5764	5841
	2037	0	51	2	32	6317	6402
	2047	0	57	3	36	6922	7018
	2057	0	64	3	40	7585	7692

Table 2.1-208 (Sheet 2 of 5)
0- to 10-Mi. Resident and Transient Population Projections

Cardinal Compass Direction	Year	Mile Range 1-2	2-3	3-4	4-5	5-10	Total
E-NE	2000	17	16	72	0	220	325
	2012	19	18	81	0	235	353
	2017	20	19	86	0	242	367
	2027	22	21	96	0	256	395
	2037	25	23	107	0	271	426
	2047	28	26	119	0	286	459
	2057	31	29	133	0	303	496
EAST	2000	0	8	24	19	289	340
	2012	0	9	26	20	306	361
	2017	0	9	27	20	314	370
	2027	0	10	30	22	330	392
	2037	0	11	32	23	347	413
	2047	0	13	35	24	365	437
	2057	0	14	38	26	384	462
E-SE	2000	0	16	8	38	720	782
	2012	0	18	8	40	764	830
	2017	0	19	8	41	783	851
	2027	0	21	9	43	823	896
	2037	0	23	9	45	866	943
	2047	0	26	10	48	910	994
	2057	0	29	10	50	957	1046
SE	2000	0	45	0	39	2267	2351
	2012	0	51	0	41	2407	2499
	2017	0	54	0	42	2468	2564
	2027	0	60	0	44	2595	2699
	2037	0	67	0	46	2728	2841
	2047	0	74	0	49	2869	2992
	2057	0	83	0	51	3016	3150

Table 2.1-208 (Sheet 3 of 5)
0- to 10-Mi. Resident and Transient Population Projections

Cardinal Compass Direction	Year	Mile Range					Total
		1-2	2-3	3-4	4-5	5-10	
S-SE	2000	4	44	0	0	772	820
	2012	4	50	0	0	825	879
	2017	4	52	0	0	848	904
	2027	5	58	0	0	897	960
	2037	5	65	0	0	949	1019
	2047	6	73	0	0	1003	1082
	2057	7	81	0	0	1061	1149
SOUTH	2000	2	0	100	0	844	946
	2012	2	0	113	0	878	993
	2017	2	0	120	0	893	1015
	2027	2	0	133	0	924	1059
	2037	2	0	149	0	955	1106
	2047	3	0	166	0	988	1157
	2057	3	0	185	0	1022	1210
S-SW	2000	0	0	0	208	936	1144
	2012	0	0	0	206	927	1133
	2017	0	0	0	205	924	1129
	2027	0	0	0	204	917	1121
	2037	0	0	0	203	910	1113
	2047	0	0	0	201	903	1104
	2057	0	0	0	200	896	1096
SW	2000	0	245	0	0	3439	3684
	2012	0	251	0	0	3408	3659
	2017	0	254	0	0	3395	3649
	2027	0	259	0	0	3370	3629
	2037	0	265	0	0	3344	3609
	2047	0	271	0	0	3319	3590
	2057	0	277	0	0	3295	3572

Table 2.1-208 (Sheet 4 of 5)
0- to 10-Mi. Resident and Transient Population Projections

Cardinal Compass Direction	Year	Mile Range 1-2	2-3	3-4	4-5	5-10	Total
W-SW	2000	0	0	0	150	4850	5000
	2012	0	0	0	148	4819	4967
	2017	0	0	0	148	4806	4954
	2027	0	0	0	146	4780	4926
	2037	0	0	0	145	4755	4900
	2047	0	0	0	144	4730	4874
	2057	0	0	0	143	4705	4848
WEST	2000	0	0	400	0	80	480
	2012	0	0	427	0	90	517
	2017	0	0	439	0	94	533
	2027	0	0	464	0	105	569
	2037	0	0	491	0	116	607
	2047	0	0	519	0	128	647
	2057	0	0	549	0	142	691
W-NW	2000	4	409	598	0	17	1028
	2012	4	465	680	0	19	1168
	2017	4	491	718	0	20	1233
	2027	5	547	800	0	22	1374
	2037	5	609	891	0	25	1530
	2047	6	679	993	0	28	1706
	2057	7	756	1,106	0	31	1900
NW	2000	678	507	1131	805	905	4026
	2012	771	577	1287	916	1030	4581
	2017	814	609	1358	967	1087	4835
	2027	907	678	1513	1077	1211	5386
	2037	1010	755	1686	1200	1349	6000
	2047	1126	842	1878	1337	1503	6686
	2057	1254	938	2092	1489	1674	7447

Table 2.1-208 (Sheet 5 of 5)
0- to 10-Mi. Resident and Transient Population Projections

Cardinal Compass Direction	Year	Mile Range					Total
		1-2	2-3	3-4	4-5	5-10	
N-NW	2000	75	0	0	244	948	1267
	2012	85	0	0	277	1079	1441
	2017	90	0	0	293	1138	1521
	2027	100	0	0	326	1268	1694
	2037	111	0	0	363	1413	1887
	2047	124	0	0	405	1574	2103
	2057	138	0	0	451	1753	2342

Source: References 2.1-205 and 2.1-206.

Table 2.1-209 (Sheet 1 of 4)
10- to 50-Mi. Resident and Transient Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
NORTH	2000	1116	4916	1154	3452	10,638
	2012	1223	5100	1193	3256	10,772
	2017	1271	5179	1210	3178	10,838
	2027	1372	5340	1244	3028	10,984
	2037	1482	5507	1279	2884	11,152
	2047	1600	5678	1315	2748	11,341
	2057	1728	5855	1352	2617	11,552
N-NE	2000	462	1690	3149	1406	6707
	2012	511	1753	3234	1399	6897
	2017	533	1780	3270	1396	6979
	2027	581	1835	3344	1390	7150
	2037	632	1892	3419	1384	7327
	2047	688	1950	3496	1379	7513
	2057	750	2011	3575	1373	7709
NE	2000	2351	2994	2377	3415	11,137
	2012	2502	3090	2386	3428	11,406
	2017	2568	3130	2390	3434	11,522
	2027	2705	3214	2398	3445	11,762
	2037	2850	3300	2406	3457	12,013
	2047	3002	3388	2414	3468	12,272
	2057	3162	3478	2423	3480	12,543
E-NE	2000	4726	4145	2011	4891	15,773
	2012	5017	4397	2053	5047	16,514
	2017	5144	4507	2072	5114	16,837
	2027	5407	4735	2108	5250	17,500
	2037	5683	4975	2146	5389	18,193
	2047	5974	5227	2184	5533	18,918
	2057	6279	5491	2222	5680	19,672
EAST	2000	2750	3421	3997	17,538	27,706
	2012	2919	3615	4098	19,494	30,126
	2017	2993	3700	4142	20,372	31,207
	2027	3146	3875	4230	22,250	33,501
	2037	3307	4058	4319	24,300	35,984
	2047	3476	4250	4411	26,539	38,676
	2057	3654	4451	4505	28,984	41,594

Table 2.1-209 (Sheet 2 of 4)
10- to 50-Mi. Resident and Transient Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
E-SE	2000	12,557	25,415	18,626	16,794	73,392
	2012	13,335	30,670	26,135	23,335	93,475
	2017	13,674	33,169	30,097	26,763	103,703
	2027	14,377	38,793	39,914	35,204	128,288
	2037	15,116	45,372	52,933	46,307	159,728
	2047	15,893	53,066	70,199	60,911	200,069
	2057	16,711	62,064	93,095	80,121	251,991
	2000	35,819	136,295	70,550	39,564	282,228
	2012	38,041	150,275	93,123	55,847	337,286
	2017	39,007	156,515	104,542	64,472	364,536
SE	2027	41,014	169,783	131,752	85,926	428,475
	2037	43,123	184,176	166,045	114,518	507,862
	2047	45,342	199,790	209,263	152,625	607,020
	2057	47,674	216,727	263,730	203,412	731,543
	2000	22,586	182,560	47,038	24,759	276,943
	2012	24,175	195,334	50,599	30,851	300,959
	2017	24,870	200,917	52,161	33,813	311,761
S-SE	2027	26,320	212,566	55,432	40,618	334,936
	2037	27,855	224,891	58,907	48,791	360,444
	2047	29,479	237,930	62,601	58,609	388,619
	2057	31,198	251,726	66,526	70,403	419,853
	2000	2961	5883	13,523	2606	24,973
	2012	3208	6312	13,914	2724	26,158
	2017	3317	6500	14,081	2775	26,673
SOUTH	2027	3547	6894	14,420	2880	27,741
	2037	3792	7311	14,768	2988	28,859
	2047	4055	7753	15,124	3101	30,033
	2057	4335	8222	15,488	3218	31,263
	2000	4226	4252	308	3805	12,591
	2012	4292	4388	325	4219	13,224
	2017	4319	4446	333	4404	13,502
S-SW	2027	4376	4565	349	4800	14,090
	2037	4433	4686	366	5232	14,717
	2047	4490	4811	384	5702	15,387
	2057	4549	4939	402	6215	16,105

Table 2.1-209 (Sheet 3 of 4)
10- to 50-Mi. Resident and Transient Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
SW	2000	4658	1166	2358	34,775	42,957
	2012	4616	1184	2597	38,697	47,094
	2017	4599	1192	2703	40,459	48,953
	2027	4564	1208	2930	44,228	52,930
	2037	4530	1225	3176	48,348	57,279
	2047	4496	1241	3442	52,851	62,030
	2057	4463	1258	3731	57,774	67,226
W-SW	2000	659	3043	4434	48,824	56,960
	2012	653	3121	4841	53,317	61,932
	2017	650	3155	5022	55,310	64,137
	2027	645	3223	5403	59,521	68,792
	2037	640	3292	5814	64,053	73,799
	2047	636	3363	6256	68,929	79,184
	2057	631	3436	6731	74,177	84,975
WEST	2000	1180	1667	2115	3260	8222
	2012	1220	1725	2303	3538	8786
	2017	1237	1750	2387	3661	9035
	2027	1272	1801	2563	3921	9557
	2037	1308	1854	2753	4198	10,113
	2047	1345	1908	2956	4495	10,704
	2057	1384	1963	3174	4814	11,335
W-NW	2000	261	2174	5330	17,582	25,347
	2012	277	2187	5597	18,520	26,581
	2017	284	2192	5713	18,926	27,115
	2027	299	2203	5951	19,764	28,217
	2037	315	2215	6199	20,639	29,368
	2047	331	2226	6458	21,553	30,568
	2057	349	2237	6727	22,508	31,821
NW	2000	414	5770	483	1202	7869
	2012	463	5915	492	1219	8089
	2017	485	5977	496	1226	8184
	2027	533	6102	504	1241	8380
	2037	586	6230	512	1256	8584
	2047	644	6361	520	1271	8796
	2057	708	6495	528	1286	9017

Table 2.1-209 (Sheet 4 of 4)
10- to 50-Mi. Resident and Transient Population Projections

Compass Direction	Year	Mile Range 10-20	20-30	30-40	40-50	Total
	2000	5981	1132	286	375	7774
	2012	6617	1174	278	351	8420
	2017	6901	1192	275	342	8710
N-NW	2027	7508	1229	269	324	9330
	2037	8168	1267	264	307	10,006
	2047	8886	1307	258	292	10,743
	2057	9667	1347	253	276	11,543

Source: References 2.1-205, 2.1-207, 2.1-208, 2.1-209, 2.1-210, and 2.1-212.

Table 2.1-210
Nearby Facilities within 5 Mi.

Facility Name	Distance/ Direction	Function	Products	No. of People
Big Cajun 2 Louisiana Generating, LLC	3.1 mi. SW	Power Plant	Fossil Fuel Electric Power Generation	260 (up to 1350 during outage)
Possible New Facility at the Tembec USA LLC	3.4 mi. S	Paper Mill **NOTE: THE OLD PLANT CLOSED JULY 31, 2007**	Fluffy Pulp, Absorbent Products, Paper Towels	200 (estimated, if a new facility is opened)
West Feliciana High School	3 mi. NW	School		652
West Feliciana Middle School	3 mi. NW	School		580
USACE (Fordice Construction Company, contractor)	3.35 mi. W	Casting Yard	Concrete Products, Revetments (except block and brick)	6 full time (85 seasonal for 3 months per year)
PalletOne of Louisiana, Inc.	3.3 mi. W	Manufacture Wood Pallets	Wood Pallets, Skids	50
Southern Belle Truck Stop	2.1 mi. E	Truck Stop, Convenience Store, and Casino	Underground Gas and Diesel Fuel Tanks, Food Mart	30
Red Stick Armature Works	3.4 mi. E	Motor Repair	Rebuild Large Electric Motors	40
Colonial Pipeline Company (Bengal now owns much of Tank Farm)	4.3 mi. SE	Pipeline and Tank Farm	Gasoline, Diesel Fuel, Kerosene, Jet Fuel	35
Williams Gas Pipeline – Transco	4 mi. E	Natural Gas Transmission	Natural Gas	25 at Compressor Station 60
West Feliciana Parish Hospital	2.4 mi. NW	Health Care	NA	Approx. 25

Source: Reference 2.1-211.

Table 2.1-211
Baton Rouge Population

Year	Resident	Transient	Total
2000	479,019	26,976	505,995
2012	509,398	28,687	538,085
2017	555,762	31,298	587,059
2027	638,225	35,942	674,166
2037	771,458	43,445	814,903
2047	981,532	55,275	1,036,807
2057	1,314,470	74,025	1,388,495

Source: Reference 2.1-205.

Table 2.1-212
2012 Population Density by Concentric Circle

Concentric Circle (mi.)	Population			Land Area (sq. mi.)	Population Density
	Resident	Transient	Total		
0 - 10	26,359	6082	32,441	314	103
10 - 20	97,068	12,001	109,069	942	116
20 - 30	396,693	23,547	420,240	1571	268
30 - 40	200,245	12,923	213,168	2199	97
40 - 50	251,719	13,523	265,242	2827	94
0 - 50	972,084	68,076	1,040,160	7854	132

Source: References 2.1-205, 2.1-206, 2.1-207, 2.1-208, 2.1-209, 2.1-210, and 2.1-212.

Table 2.1-213
2017 Population Density by Concentric Circle

Concentric Circle (mi.)	Population			Land Area (sq. mi.)	Population Density
	Resident	Transient	Total		
0 - 10	27,097	6349	33,446	314	106
10 - 20	99,452	14,312	113,764	942	121
20 - 30	410,967	26,437	437,404	1571	278
30 - 40	217,222	8835	226,057	2199	103
40 - 50	271,296	12,610	283,906	2827	100
0 - 50	1,026,034	68,543	1,094,577	7854	139

Source: References 2.1-205, 2.1-206, 2.1-207, 2.1-208, 2.1-209, 2.1-210, and 2.1-212.

Table 2.1-214
U.S. Census Commuter Information

Parish or County (State)	Inflow	Outflow	Net Flow
Ascension Parish (LA)	11,813	-16,847	-5034
Assumption Parish (LA)	745	-5522	-4777
Avoyelles Parish (LA)	1353	-4078	-2725
Catahoula Parish (LA)	637	-1447	-810
Concordia Parish (LA)	1216	-2853	-1637
East Baton Rouge Parish (LA)	55,878	-21,727	34,151
East Feliciana Parish (LA)	1808	-4119	-2311
Evangeline Parish (LA)	1483	-3896	-2413
Iberia Parish (LA)	8021	-7307	714
Iberville Parish (LA)	8181	-5046	3135
Lafayette Parish (LA)	30,417	-12,020	18,397
Livingston Parish (LA)	3991	-27,804	-23,813
Pointe Coupee Parish (LA)	934	-3990	-3056
St. Helena Parish (LA)	522	-2432	-1910
St. Landry Parish (LA)	4724	-11,092	-6368
St. Martin Parish (LA)	3204	-10,825	-7621
Tangipahoa Parish (LA)	6431	-12,439	-6008
West Baton Rouge Parish (LA)	5925	-5804	121
West Feliciana Parish (LA)	3061	-1784	1277
Adams Co. (MS)	3329	-1921	1408
Amite Co. (MS)	558	-2767	-2209
Franklin Co. (MS)	471	-1385	-914
Pike Co. (MS)	4221	-2773	1448
Wilkinson Co. (MS)	641	-1281	-640
Total 50-Mi. Area	159,564	-171,159	-11,595

Source: Reference 2.1-212.

FSAR 2.1 Figures

Due to the large file sizes of the figures for FSAR Section 2.1, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

2.2.1 LOCATIONS AND ROUTES

RBS COL 2.0-5-A

All significant manufacturing plants, storage facilities, and transportation routes within 5 mi. (8 km) of the RBS are presented in Figure 2.2-201 (References 2.2-201, 2.2-202, and 2.2-203). Principal products include electrical power, paper products, concrete revetments, and petroleum. There are no chemical plants, refineries, mining or quarrying operations, drilling operations, active oil or gas wells (Reference 2.2-204), military bases, or missile sites within 5 mi. (8 km) of the RBS. The nearest military facility is the New Orleans Naval Air Station Joint Reserve Base, Belle Chasse, Louisiana, approximately 100 mi. southeast of the RBS (References 2.2-205 and 2.2-206).

Figure 2.2-202 shows the location of natural gas and oil pipelines within the vicinity of the site. The nearest pipelines carry natural gas. Texas Eastern Transmission Corporation has two pipelines that share a right-of-way (ROW) located approximately 2.1 mi. (3.3 km) east and continuing south of the plant. Transcontinental Gas Pipe Line Corporation, doing business as Williams Gas Pipelines - Transco, operates four pipelines south of the RBS, with the closest isolation valves approximately 3 mi. (4.8 km) and 3.5 mi. (5.6 km) away on both sides of the river crossing. Enbridge Pipelines LLC and Mid Louisiana Gas Company pipelines run about 3.4 mi. (5.5 km) south through the vacant Tembec property (Reference 2.2-207).

Colonial Pipeline Company operates five oil pipelines in a ROW approximately 4.3 mi. (6.8 km) southeast of the RBS running from the Mississippi River to the Bengal Pipeline Company Tank Farms, a major storage facility of petroleum products. Other storage facilities for local distributors of petroleum products are located 4 to 5 mi. (6.4 to 8 km) northwest of the plant in the vicinity of Hardwood, Louisiana. There are no hazardous waste storage or disposal sites permitted by the Louisiana Department of Natural Resources (LDNR) within 5 mi. (8 km) of the RBS (Reference 2.2-208).

The Mississippi River is adjacent to the RBS's southwest property boundary and is a major route for waterborne commerce. The nearest major river facility to the RBS is the port of Baton Rouge (Reference 2.2-209), located approximately 32 river miles (RM) downstream. Cars and trucks (maximum vehicle length 51 ft.) cross the Mississippi River from Pointe Coupee Parish and West Feliciana Parish by means of the New Roads/St. Francisville ferry, approximately 3.7 mi. (6 km) west of the RBS. The new John James Audubon Bridge will replace the existing ferry in the summer of 2010 (Reference 2.2-210) and will cross the Mississippi River near RM 262, approximately 1/2 mi. south of the RBS water intake-discharge embayment.

U.S. Highway 61 parallels the Mississippi River from New Orleans, Louisiana, to St. Louis, Missouri, and runs adjacent to the RBS's northern property boundary at the main entrance on North Access Road. As part of the new Audubon Bridge project, State Highway 10 will be routed along U.S. Highway 61 north of the RBS, then a new four-lane highway facility will be completed in year 2010 extending from a terminus in West Feliciana Parish from U.S. Highway 61 past RBS's southeast boundary, across the bridge, and connecting to a Pointe Coupee Parish terminus at the intersection of Louisiana Highways 1 and 10, and Louisiana Highway 3131 (Hospital Road). This new section of Louisiana Highway 10 will run approximately 1.1 mi. east of the RBS at its closest point.

Two rail companies transport freight in the vicinity of the RBS (Reference 2.2-211). The Kansas City Southern makes deliveries to the railway spur serving the Big Cajun 2 power plant across the Mississippi River, approximately 3.1 mi. to the southwest. The Canadian National Railway is located 3.2 mi. to the southeast and has a spur serving the vacant Tembec site.

Figure 2.2-203 shows the locations of nearby airports and air routes. Within the 5 mi. vicinity, the RBS has a heliport (LA96), which is located approximately 0.42 mi. northwest of the proposed RBS Unit 3 reactor; West Feliciana Parish Hospital operates a heliport (LA37) about 2.4 mi. northwest; and the Federal Airway Victor 71 (V71) center line is located 2-1/2 mi. east of the plant. The nearest commercial airport is Ryan Field (BTR) in Baton Rouge, approximately 19 mi. southeast of the RBS (Reference 2.2-212).

2.2.2 DESCRIPTIONS

2.2.2.1 Description of Facilities

Industrial facilities that use, store, or transport significant quantities of hazardous materials within 5 mi. of the RBS are described in Table 2.2-201, including primary functions, major products, and the number of persons employed. The Tembec USA LLC paper mill, located approximately 3.4 mi. (5.5 km) south of the RBS, idled operations on July 31, 2007 (Reference 2.2-213). It was the largest employer in the vicinity. The Big Cajun 2 power plant is now the largest employer, with 260 personnel during normal operations, increasing up to 1350 employees during planned outages or special projects. No hazardous materials are manufactured within the 5-mi. radius around the RBS, although Georgia-Pacific Corporation Port Hudson Operations has a major paper manufacturing plant and pulp mill 8 mi. southeast, Dow Chemical Company runs a chemical manufacturing plant approximately 22 mi. southeast, and ExxonMobil Corporation operates a petroleum refinery 24 mi. southeast in Baton Rouge, Louisiana.

2.2.2.2 Description of Products and Materials

Nearby industrial firms, pipeline companies, and oil distributors were surveyed to identify hazardous materials regularly stored, used, or transported in the vicinity of RBS. Toxic chemicals, flammable materials, explosive substances, and shipment information reported by nearby facilities are summarized in Table 2.2-202. (Refer to Table 2.2-208 and 2.2-209 for toxicity limits.) Tembec USA LLC paper mill, which was the largest user of chlorine and ammonia (Reference 2.2-208), ceased operations on July 31, 2007, and all chemicals were removed by the middle of August 2007. Hazardous materials used and stored on-site at the RBS are presented in Table 2.2-203 for Unit 1 and in Table 2.2-204 for Unit 3.

Industries within the 5-mi. radius reported receiving shipments of hazardous materials by truck or pipeline only. The Big Cajun 2 power plant receives no chemicals by railroad, only bulky items or equipment; deliveries by barge from the Mississippi River consist of coal. Hazardous material transport and storage in the vicinity of the RBS are described further in Subsection 2.2.3.

2.2.2.3 Description of Pipelines

Pipelines in the area transport natural gas and petroleum products. Details including pipe size, age, operating pressure, depth of burial, and type of gas or liquid presently carried are listed in Table 2.2-205. None of the pipelines are used for gas storage at higher than normal pressure; pipeline companies have no plans to carry a different product in the future. Local pipeline distribution, storage locations, and isolation valves are shown in Figure 2.2-202.

2.2.2.4 Description of Waterways

The RBS water intake-discharge embayment is located on the east bank of the Mississippi River at approximately RM 262.5 and has a barge slip, used for deliveries during construction of Unit 1, located in the center. The water intake structure is the same for Units 1 and 3; it extends about 100 ft. into the water and is located approximately 700 ft. from the shipping channel. The 400-ft wide navigation channel is near the midpoint of the Mississippi River. The river is approximately 2000 ft. wide with a channel depth of approximately 40 to 50 ft. at seasonal low water and 90 to 100 ft. deep at seasonal high water (Reference 2.2-214). All 29 locks and dams on the Upper Mississippi River (UMR) are beyond the Ohio River (RM 954) more than 690 mi. away. Many types of ships and barges use the river near the RBS, including industrial vessels, open barges for coal, oil barges, tank barges for petroleum products, covered freight barges for grain and mixed cargo, ferry barges, and multiple barge tows with up to 20,000 tons of freight loaded on 12 or 15 barges (Reference 2.2-215).

The closest river facility in use is located across the Mississippi River at the Big Cajun 2 power plant, where a total of 60 coal barges can be held in the loading and unloading areas (Reference 2.2-208). The vacant Tembec site has the capability of receiving shipments by barge at RM 260, 2 mi. downstream from the RBS embayment (Reference 2.2-216). Near this area, a new West Feliciana Port is planned, with 1800 ft. of dock space for clients' water port needs at the future West Feliciana Business Park (Reference 2.2-214). Approximately 3.7 mi. (6 km) west of the RBS, the New Roads/St. Francisville ferry operates every 15 minutes between 4 a.m. and midnight every day of the year. In 2006, there was an average of 28,000 vehicle crossings per month (Reference 2.2-217).

Hazardous materials transported past the RBS on the Mississippi River are described in Table 2.2-206. Approximately 188.4 million tons of cargo were transported between Baton Rouge and the Ohio River in 2006. An estimated 19.5 percent or 36.7 million tons were potentially hazardous materials. Since more specific data are not collected, there are no means of identifying frequency, types, and amounts of hazardous material shipments past the site. Waterborne commerce statistics prepared by the U.S. Army Corps of Engineers (USACE) identify freight traffic by general commodity code (Reference 2.2-218).

2.2.2.5 Description of Highways

Nearby industries reported receiving shipments of hazardous material primarily by truck. Trucks deliver freight along U.S. Highway 61 and pass within approximately 1.1 mi. northeast of the plant. The Louisiana Department of Transportation and Development (LDOTD) grants permits to highway carriers of hazardous materials, but does not record the type, amount, or route of materials carried. Near the RBS, U.S. Highway 61 had a 2006 daily traffic count of 11,172 vehicles in East Feliciana Parish between Louisiana Highways 964 and 954. U.S. Highway 61 just south of Louisiana Highway 10 had an average daily traffic count of 9846 vehicles, and Louisiana Highway 964 had a traffic count of 2366 vehicles per day in 2004. Louisiana Highway 10, within 20 mi. of the Mississippi River, had traffic counts between 3000 to 5000 vehicles per day.

2.2.2.6 Description of Railroads

Two rail lines are in the vicinity of the RBS. The Kansas City Southern Railway spur serving Big Cajun 2 power plant delivers no chemicals or hazardous materials - only bulky items or equipment.The Canadian National Railway spur no longer delivers hazardous materials to the vacant Tembec site, since operations idled on July 31, 2007, and all chemicals were removed from the site. The Canadian National Railway does not carry hazardous materials north of the rail yard at Zee, located near the turnoff of the rail spur to the vacant Tembec site. The main lines of both railroads are located outside the 5-mi. radius around the proposed RBS Unit 3; refer to Figure 2.2-201.

2.2.2.7 Description of Airports

Nearby airports, runway descriptions, types of aircraft, number of operations per year, and accident statistics (References 2.2-219 and 2.2-220) are provided in Table 2.2-207. The closest aviation facility is the RBS heliport (LA96), approximately 0.42 mi. northwest of the proposed Unit 3 reactor (Reference 2.2-221). West Feliciana Parish Hospital operates a heliport (LA37) about 2.4 mi. northwest of the plant (Reference 2.2-222). Jackson Airport (4LA3) is a private airfield about 8 mi. to the northeast (Reference 2.2-223). False River Regional

Airport (HZR) is approximately 9.2 mi. southwest in New Roads, Louisiana (Reference 2.2-224). Refer to Figure 2.2-203.

Nineteen mi. to the southeast, Baton Rouge Metropolitan Airport, Ryan Field (BTR), completed Phase I (32,800 sq. ft.) of a new Air Cargo Facility in 2005. This facility is at capacity, with air cargo operations conducted by FedEx Air Cargo and Integrated Airlines Services; therefore, Baton Rouge Metropolitan Airport is designing Phase II of its Air Cargo Project, which entails adding an additional 68,000 sq. ft. facility, truck docking, staging, and an aircraft parking area. Airport officials hope to attract two other freight carriers when the new cargo facility is complete, which could include DHL and United Parcel Service (UPS) (Reference 2.2-225).

The two heliports within 5 mi. of the RBS have no reported accidents in the last 40 years near St. Francisville, Louisiana. False River Regional Airport is the only airport within 10 mi. that has annual flight operations greater than the 500 D^2 criteria (where D = statute miles from the site), in accordance with Regulatory Guide 1.206. The National Transportation Safety Board's aviation accident database lists 10 accidents over the last 40 years for New Roads, Louisiana (References 2.2-219 and 2.2-220).

Typically, each federal airway includes the airspace within parallel boundary lines 4 mi. each side of the center line, for an airway width of 8 mi. Therefore, the edge of Federal Airway V71 falls within the proximity criteria listed in Regulatory Guide 1.206 and NUREG-0800. Federal Airway V71 passes 2.5 statute mi. east of the plant oriented in a north-south direction, with an estimated 16,425 flights per year (References 2.2-212 and 2.2-226). The number of operations at the terminal points of Airway V71 - Baton Rouge Metropolitan Airport (BTR) to the south, and Hardy-Anders Field Natchez-Adams County Airport (HEZ) to the north - were equally divided among the airways leading to/from these airports to determine a conservative estimate of the potential number of operations along Airway V71. Federal airways extend from one navigation aid or intersection to another navigation aid (or through several navigational aids or intersections) specified for that airway. However, pilots normally fly point to point and not necessarily within specified airways. The Federal Aviation Administration's (FAA's) National Flight Data Center (NFDC) did not have flight operation statistics for Federal Airway V71 available online at its Website. Federal Airway V566 is located approximately 8 mi. to the northeast passing over Jackson Airport. Federal Airway V222 runs about 9.2 mi. to the northwest at its closest point. All three airways intersect approximately 11.5 mi. north-northeast of RBS. Fort Polk and the Joint Readiness Training Center have an Army Air Field located 108 mi. west of the RBS, with the closest edge of the Warrior 2 High and Low Military Operations Area about 62 mi. to the west (Reference 2.2-227). (References 2.2-228 and 2.2-229)

2.2.2.8 Projections of Industrial Growth

There is likely to be additional long-term growth in industrial facilities in the area because of the locational advantages inherent in the West Feliciana Business

Park. These advantages include low property tax rates, proximity to a large labor pool in Baton Rouge, easy access via U.S. Highway 61 and the future Louisiana Highway 10, and access to rail and river transportation. Moreover, the park has received support from the parish, because as the development is in line with the long-term, controlled growth strategy set forth in Land Use and Growth Management Plan: Strategies, Policies, and Guidelines for West Feliciana Parish (the Plan). This document states that heavy commercial and industrial development are "encouraged in industrial and commercial park settings, especially in Growth Zone 1" (St. Francisville Region), which includes the RBS and the West Feliciana Business Park Development area. The degree to which any new industrial facilities would utilize hazardous materials depends on the type of industry and the processes used. In the absence of a specific tenant with known processes being announced, it is reasonable to assume that possible limited uses of hazardous materials would likely include some storage of flammable liquids on-site, such as the fuel to run vehicles.

Existing industries in the area that use hazardous materials were identified previously in Subsections 2.2.2.1 and 2.2.2.2. It is reasonable to assume that these uses would continue into the future. The primary known expansion of nearby existing facilities includes the planned construction of a new unit at the Big Cajun 2 facility in New Roads, Louisiana, which is located in Pointe Coupee Parish. The Big Cajun 2 expansion plan calls for a new 775 megawatt (MW) supercritical coal-fired generating unit (Unit 4) to be brought into commercial operation in 2010 (Reference 2.2-230). As shown in Figure 2.2-201, the Big Cajun 2 facility is located approximately 3 mi. from the RBS Unit 3 power block. Though the unit would be fired by coal, it is expected that additional quantities of liquid fuel and other hazardous materials would be stored on-site to facilitate operation of the new facility.

With the addition of the John James Audubon Bridge, additional traffic flow will occur in the area, but it is unknown to what extent additional truck traffic would contain hazardous materials. It is reasonable to assume that the additional traffic would contain approximately the same ratio of hazardous material shipments as is currently observed along U.S. Highway 61.

2.2.3 EVALUATION OF POTENTIAL ACCIDENTS

The consideration of a variety of potential accidents, and their effects on the plant or plant operation, is included in this subsection. Types of accidents considered include explosions, flammable vapor clouds, toxic chemicals, fires, collisions with intake structures, and liquid spills.

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2.2.3.1 Determination of Design Basis Events

2.2.3.1.1 Explosions

The nearest highway on which explosive materials may be transported is U.S. Highway 61, which is a minimum distance of 5800 ft. from the center of the RBS

Unit 3 reactor. The future Highway 10 extension, which is a minimum distance of 5800 ft. from the center of the Unit 3 reactor, may also allow for transportation of explosive materials. The separation from U.S. Highway 61 and the future Highway 10 extension meets the criteria in Regulatory Guide 1.91. Therefore, explosions on highways need not be considered design basis events.

The nearest rail routes are the Kansas City Southern Railway spur serving Big Cajun 2 and the Canadian National Railway spur, which serves the former Tembec site. No explosive materials are shipped along these routes. The criteria in Regulatory Guide 1.91 are met. Therefore, explosions on a railroad need not be considered design basis events.

The Mississippi River is the nearest waterway to the plant, with its eastern bank lying approximately 1.7 mi. from safety-related structures. This distance is less than the safe distance of 1.84 mi. calculated using Regulatory Guide 1.91 for a 5000-ton river vessel explosion and further evaluation is required.

An analysis of spill and explosion frequency on the Mississippi River for the period from December 2001 through December 2005 was performed in Reference 2.2-235. The results of that analysis provided a correlation between the frequency of spill and size of shipment. Using this correlation and a mass of 5500 tons per shipment, the spill frequency per river mile is 1.75 x 10-5 spills/mile-yr.

Based on a review of the spills used to develop the correlation for spill frequency above, the probability ([$P_{explosion/spill}$]) of an explosion given that a spill occurred was evaluated to be 0.0008. This was further discussed and confirmed in Reference 2.2-236.

The exposure distance(s) along the river was determined to be less than 2.0 mi. using the guidance of Figure 2 in Regulatory Guide 1.91 for the safe distance for an explosion of 5500 tons. The risk exposure (r) is calculated as:

$$r = \text{Frequency (spills/mile-yr)} \times s \text{ (distance in miles)} \times P_{explosion|spill}$$

$$r = (1.75 \times 10^{-5} \text{ spills/mile-yr}) \times (2.0 \text{ miles}) \times (0.0008 \text{ explosion/spill})$$

$$r = 2.8 \times 10^{-8} \text{ explosions/year}$$

The exposure rate is shown to be less than 10^{-7} per year. Therefore, the risk of damage due to explosions on the Mississippi River is sufficiently low and does not need to be considered as a design basis event.

The nearest storage tank farm for explosive gases is the bulk gas storage facility for the hydrogen water chemistry and generator hydrogen systems. Table 2.2-203 lists the maximum quantity of explosive (hydrogen) liquid/gas stored at this location. Siting considerations for the storage facilities included an evaluation of impact to nearby safety-related structures due to explosion of hydrogen. Based on the separation distances (more than 1300 ft.), the explosion of stored hydrogen does not need to be considered a design basis event.

2.2.3.1.2 Flammable Vapor Clouds (Delayed Ignition)

Flammable materials in the liquid or gaseous state can form an unconfined vapor cloud that can drift towards the plant before an ignition event. Flammable chemicals released into the atmosphere can form vapor clouds, dispersing as they travel downwind. The portion of the cloud with a chemical concentration within the flammable range (i.e., between the lower flammability limit [LFL] and upper flammability limit [UFL]) may burn if the cloud encounters an ignition source. The speed at which the flame front moves through the cloud determines whether it is considered a deflagration or a detonation. If the cloud burns fast enough to create a detonation, an explosive force is generated.

The potential hazardous material sources on-site, off-site, on navigable waterways, and from highways were evaluated to ascertain which hazardous materials had the potential to form flammable vapor clouds and vapor cloud explosions. For those chemicals with an identified flammability range, the Areal Locations of Hazardous Atmospheres (ALOHA) Version 5.4.1, air dispersion model was used to determine the distances that the vapor cloud could exist in the flammability range, thus presenting the possibility of ignition and potential thermal radiation effects (Reference 2.2-234). The identified chemicals were then evaluated to determine the possible effects of a flammable vapor cloud explosion.

2.2.3.1.2.1 On-Site and Off-Site Stationary Sources

The nearest storage tank farm of flammable liquids (i.e., gasoline, kerosene, and fuel oil) is 4.5 mi. southeast of the plant site (Table 2.2-202). The TNT equivalent of accidental explosions of individual tanks (confined vapor cloud) is estimated to be well below the limits of Regulatory Guide 1.91. Because of the separation distance, the overpressure at the site from an explosion at the tank farm from confined or unconfined vapor cloud explosions is much less than 1 psi and does not need to be considered as a design basis event.

The nearest storage tank farm for flammable gases is the bulk gas storage facility for the hydrogen water chemistry and generator hydrogen systems. Table 2.2-203 lists the maximum quantity of flammable gas (hydrogen) and gas that supports combustion (oxygen) stored at this location. Siting considerations for the storage facilities included evaluation of impact to nearby safety-related structures because of flammable vapor clouds of hydrogen or oxygen. Based on the separation distances (more than 1300 ft.), the flammable vapor cloud from the hydrogen water chemistry storage facility does not need to be considered a design basis event.

2.2.3.1.2.2 Pipelines

The nearest pipeline, a 30-in. diameter natural gas transmission pipeline, passes about 2.1 mi. from the plant site. This pipeline and others further from the site are shown in Figure 2.2-202 and are listed in Table 2.2-205. The pipelines may carry natural gas or petroleum products such as gasoline, oil, or kerosene. The pipeline owners anticipate no change in the content of the pipelines during the facility lifetime.

The largest potential effect might occur from a postulated natural gas leak and explosion. Natural gas is mostly methane, with usually 3 percent or less propane and other heavier gases. At one atmosphere, the specific gravity of methane gas at 60°F is about 0.5, and a methane plume would rise very rapidly and a vapor cloud would not form. The effects of an explosion can be conservatively estimated based on a volume of 876,368 cu. ft., a density of 3.203 pounds per cubic feet (lb/cu. ft.), and a 2.4 multiplier, resulting in an equivalent TNT mass of 6.74 x 10^6 pounds. The escaped gas from a pipeline leak is conservatively assumed to gather into the large volume after a period of time. The resultant 1 pound per square inch (psi) overpressure wave would extend about 8500 ft., using the methodology presented in Regulatory Guide 1.91.

A pipeline explosion is not considered a design basis event due to the separation distance from safety-related structures. Missiles are not considered credible. There are no active oil or gas wells within 5 mi.

2.2.3.1.2.3 Mississippi River

An initial screening of commodities included in cargo shipped on the Mississippi River past the site (Table 2.2-206) was conducted to identify those materials that warranted more detailed evaluation, that is, "commodities of interest." This initial screening of the hazardous commodities eliminated all but eight requiring further analysis for potential adverse impact to the site from a river transportation accident. The eight commodities that could not be eliminated were crude oil, gasoline, liquefied natural gas (LNG), naphtha and solvents, acyclic hydrocarbons, benzene and toluene, alcohols, and ammonia.

Analyses were performed for each commodity, taking into account chemical and physical properties, state of the material when shipped, assumed progression of events following the incident that releases the material, reaction kinetics, and release rates. These analyses included the following:

- Analysis of a confined space explosion.
- Analysis of a local free vapor cloud explosion.
- Evaluation of a vapor cloud formation and dispersion downwind toward the site, with a delayed ignition.

Each of the eight commodities was further investigated for the extent of overpressure based on a confined space vapor explosion. The confined vapor cloud explosion scenario assumed that the transport vessel had been breached and sufficient material lost to leave a vapor space filled with an explosive gas mixture. An ignition source is introduced and combustion occurs. Because of the confined space, the internal pressure rises rapidly and eventually ruptures the vessel. The mass of material that can be confined in the hold of the transport is limited, however, because removal of a significant portion of the commodity is necessary for voiding the space. For the confined vapor explosion analysis, none of the commodities evaluated was shown to pose a hazard of an overpressure greater than 1 psi at the site.

The potential for deflagrations and detonation in a plume resulting from the release of the commodities from a barge accident was evaluated. This evaluation assumed dispersion downwind toward the site, with a delayed ignition. Acetone, methanol, and ethanol are not considered for plume generation since they are water soluble. In addition, the possibility of a detonation of LNG was not considered based on its properties. For each commodity of interest, the vapor dispersion was determined based on a wind speed of 2.97 mph (the low mean speed for all months), a stability class of D, and a 92°F ambient air temperature. These meteorological conditions were chosen to maximize the vaporization rate of the commodity of interest while limiting the downwind dispersion.

The mass assumed for barge transportation was 5500 tons for each of the commodities evaluated. This is a conservative estimate based on shipment information from the Waterborne Commerce Statistics Center for shipments past RM 264 for the year 2005.

It is noted that in some cases limitations of the ALOHA code require commodities that are mixtures to be modeled as single components. The components modeled are selected to represent the critical parameters evaluated in ALOHA for vapor cloud explosion. Where a commodity is a mixture of several components that can be modeled, the limiting commodity or commodities were selected.

The release rate from the damaged barge was based on two assumed rupture sizes (holes) of 5 square meters (m^2) and 1 m^2. To maximize barge contents releases, the rupture location was assumed to be on the barge bottom. All commodities were assumed to be at ambient temperature (92°F) except for cryogenic liquids (methane, ethane, ethylene, and propane), which are stored at their normal transport temperature. The assumed release is into the river water, with an assumed water temperature of 83°F (the average mean temperature for July for 1988 - 1992 for the lower Mississippi River at New Orleans), surrounding the damaged barge, since the peak river water temperature will produce increased vaporization. The analysis also neglects the effects of the river flow that would disperse liquid spills and reduce the potential impact to the site.

The results of the analysis for each of the eight commodities for confined and/or vapor cloud explosion show that the peak incident pressure impact at the site is less than 1 psi.

2.2.3.1.2.4 Highways

Table 2.2-202 identifies potential hazardous materials shipped by truck in the vicinity of the site. The transportation routes include U.S. Highway 61 and the proposed future Louisiana Highway 10 extension, both passing within 5800 ft. at their nearest point to the center of the RBS Unit 3 reactor. The hazardous material potentially transported on highways that was identified for further analysis with regard to the potential for forming a flammable vapor cloud capable of delayed ignition following an accidental release was gasoline (modeled as n-heptane in ALOHA). It was conservatively estimated that a truck carries and releases 50,000 lb. or 9000 gal. of gasoline. The methodology presented in Subsection 2.2.3.1.2.3 was used to determine the effects of a possible vapor cloud explosion with the source modeled as a direct source and the explosion initiated by detonation for conservatism. The safe distance, the minimum separation distance required for an explosion to have less than a 1-psi peak incident pressure impact from the drifted gasoline vapor cloud, is less than the shortest distance to the site.

2.2.3.1.3 Toxic Chemicals

Potential accidental releases of toxic chemicals were considered to evaluate main control room habitability. Accidental releases of on-site chemicals stored in quantities greater than 100 lb. and off-site sources within 5 mi. were postulated using the assumptions in Regulatory Guide 1.78. Analyses established the maximum concentrations of toxic chemicals in the control room under a full range of input variables including wind speed, atmospheric stability class, and environmental temperatures.

2.2.3.1.3.1 On-Site Sources of Toxic Chemicals - Unit 1 and Unit 3

Chemicals utilized in Unit 1 are identified in Table 2.2-203. The chemical materials stored on-site at Unit 3 are identified in Table 2.2-204. This table also identifies storage locations and the quantity of each chemical/material.

Properties relative to the hazards of each chemical and the results of a screening analysis based on these hazardous properties are provided in Tables 2.2-208 and 2.2-209. The on-site chemicals with the potential to be flammable or explosive hazards were evaluated for possible effects on Unit 3 safety-related structures, systems, and components (SSC).

The results of the main control room habitability evaluation are presented in Tables 2.2-208 and 2.2-209 for on-site chemicals.

Tables 2.2-208 and 2.2-209 show that many of the chemicals are not toxic. For chemicals with immediately dangerous to life or health (IDLH) values listed in these tables, the effects of toxic vapors or gases and their potential for incapacitating Unit 3 control room operators were evaluated. These tables also show that except for hydrogen, the chemicals listed do not present a flammability or explosive hazard. As shown by the table column labeled "Flammable/ Explosive?" hydrogen has flammability and explosive properties that required analysis.

2.2.3.1.3.2 Off-Site Stationary Sources of Toxic Chemicals

Stationary off-site sources include storage of chemicals at the Big Cajun 2 facility as well as other nearby industrial facilities. Table 2.2-202 lists the quantity of off-site chemicals and the distances from Unit 3. Properties relative to the hazards of each chemical and the results of a screening analysis are provided in Table 2.2-210.

The Big Cajun 2 facility includes several toxic chemicals, all of which were evaluated using the screening criteria of Regulatory Guide 1.78. All of these chemicals met the screening criteria, primarily because the facility is 3.1 mi. away, and further detailed analysis was not required.

As noted in Subsection 2.2.2.1, the Tembec USA LLC paper mill ceased operations in July 2007, and the facilities remain unused. The chemicals that had been used in the Tembec operations have been removed and future use of the site is not finalized.

None of the other nearby facilities identified make use of significant amounts of toxic chemicals that would be of concern for control room operator incapacitation. Evaluation of potential explosions and other accidents is addressed separately in this Subsection 2.2.3.

2.2.3.1.3.3 Transportation Sources of Toxic Chemicals

Transportation sources of hazardous chemicals passing within 5 mi. of the main control room were evaluated if the shipments were frequent. Frequent shipments are defined as exceeding 10 per year for truck shipments, 30 per year for rail shipments, and 50 per year for barge shipments. There are no rail lines transporting hazardous chemicals within 5 mi. of the site (Subsection 2.2.2.6).

An analysis of a potential chlorine truck shipment accident was performed for the proposed Highway 10 extension by considering the largest size cylinder transported to the Big Cajun site across the Mississippi River, in accordance with Regulatory Guide 1.78.

A probabilistic risk assessment was performed for Mississippi River barge shipments of chlorine and ammonia within 5 mi. of the RBS site, in accordance with Regulatory Guide 1.78. The risk level associated with these shipments was conservatively determined to be below 1×10^{-6} using the methodology provided by NUREG/CR-2650 (Reference 2.2-231). Therefore, there is no undue risk associated with chlorine and ammonia shipments on the Mississippi River for Unit 3.

Potential accidents with off-site toxic chemical releases do not represent a design basis for main control room habitability design features, based on the screening criteria of Regulatory Guide 1.78 and detailed analysis of chemicals that do not meet the screening criteria of Regulatory Guide 1.78.

2.2.3.1.4 Fires

Fire and smoke, from accidents at nearby homes, industrial facilities, transportation routes, or from area forest or brush fires, do not jeopardize the safe operation of the plant because of the separation distance of potential fires from the plant. The main control room heating, ventilating, and air conditioning system is equipped with a standby makeup air filter train consisting of a HEPA filter and charcoal adsorber. Any potential heavy smoke problems at the main control room air intakes would not inhibit plant safety.

On-site fuel storage facilities are designed in accordance with applicable fire codes, and plant safety is not jeopardized by fires or smoke in these areas. A detailed description of the plant fire protection system is presented in Subsection 9.5.1.

2.2.3.1.5 Collisions with Intake Structures

The plant makeup water intake screens are located within the embayment, away from the main channel of the Mississippi River at RM 262.5. The makeup water pumps are housed onshore at the embayment. It is very unlikely that river traffic could inadvertently enter the embayment and collide with the intake screens. There is no anticipated traffic in the embayment during plant operation. A barge slip is located in the embayment for delivery of plant equipment only, and there are no plans for use of the slip during plant operation. For short periods every few years, dredging may be required in the embayment because of sediment accumulation.

In the event that makeup water flow is halted because of debris clogging at the intake screens, explosion, or as the result of a collision from a ship or barge in the embayment, plant safety is not jeopardized.

2.2.3.1.6 Liquid Spills

There is a potential for hazardous materials in the form of a liquid spill in the Mississippi River to enter the plant circulating water system (CWS) through the makeup system. No liquids hazardous to plant materials or systems are stored at, delivered to, or transported through the embayment, and an accidental liquid spill in the embayment is considered very unlikely. All liquids used at Big Cajun 2, a coal-fired power plant located across the river from the embayment, are transported by truck, and river deliveries are limited to coal (Subsection 2.2.2).

The potential for a navigational accident causing a liquid spill in the river adjacent to the embayment area is minimized by the embayment location on a 6-mi. reach of straight river channel alignment. Accidental liquid spills would be diluted by the rapidly flowing, turbulent river.

Coagulant materials spilled into the river and intercepted by the plant makeup system do not jeopardize plant operation since makeup water is treated by a clarifier utilizing coagulation prior to being added to the CWS at the cooling towers. The plant makeup water from the Mississippi River is not required for safe shutdown of Unit 3.

The accidental upstream release of oil or cryogenic liquids into the river does not present a hazard to plant operation because these materials would float on the water surface. The intake screens are located more than 10 ft. below mean low water level and more than 20 ft. below normal water level. Makeup water is not drawn from the water surface. A potential spill of corrosive material into the river may affect plant materials or systems if intercepted by the makeup system. However, plant safety would not be jeopardized.

2.2.3.1.7 Unit 1 Turbine Missile Impact on Unit 3

The Unit 1 turbine generator is located in the north-south direction, parallel to Unit 3. The Unit 3 Control Building (CB) is located approximately 840 ft. to the west of the Unit 1 turbine building, with the Unit 3 reactor and fuel buildings approximately 660 ft. from the Unit 1 turbine building (Figure 1.1-201).

As discussed in Subsections 3.5.1.3 and 10.2.3 of Reference 2.2-201, the low pressure turbine rotors are of a monoblock design. The rotor and disc (wheel) are produced as a single forging. This design eliminates all wheel bore and keyway stresses and virtually eliminates the missile generation probability.

Reference 2.2-201 concludes that because the stress levels for the monoblock rotors are very low when compared to the original shrunk-on design, and the keyway stress corrosion cracking mechanism is not present in the monoblock rotors, the probability of turbine missiles being generated is not present. Therefore, when collectively considering these items, the additional shielding provided by other Unit 1 structures, and the separation distance between Units 1 and 3, Unit 1 turbine missiles are not a concern for Unit 3 operation.

2.2.3.2 Aircraft Hazards in the Vicinity

Regulatory Guide 1.206 and NUREG-0800 state that the risks due to aircraft hazards should be sufficiently low. Further, aircraft accidents that could lead to radiological consequences in excess of the exposure guidelines of 10 CFR 50.34(a)(1), with a probability of occurrence greater than an order of magnitude of 10^{-7} per year, should be considered in the design of the plant.

NUREG-0800, Section 3.5.1.6, "Aircraft Hazards," provides the following three acceptance criteria for the probability of aircraft accidents to be less than 10^{-7} per year:

"A. The plant-to-airport distance is between 5 and 10 statute miles, and the projected annual number of operations is less than 500 D^2 or the plant-to-airport distance D is greater than 10 statute miles, and the projected annual number of operations is less than 1000 D^2.

B. The plant is at least 5 statute miles from the nearest edge of military training routes, including low-level training routes, except for those associated with usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation.

C. The plant is at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern."

The distance and number of operations for the False River Regional Airport, as shown in Table 2.2-207, is greater than the criteria of 500 D^2. The RBS heliport and West Feliciana Parish Hospital heliports also do not meet the acceptance criteria above. An evaluation of the probability of an aircraft accident from each of these airports/heliports was performed:

Airport/Heliport	Probability of Accident Impacted RBS Unit 3
False River Regional	<<1.0×10^{-9} per year
West Feliciana Parish Hospital Heliport	6.70×10^{-9} per year
River Bend Heliport	2.62×10^{-8} per year
Total	3.29×10^{-8} per year

Therefore, the total probability was determined to be less than 10^{-7} per year.

As described in Subsection 2.2.2.7, there are three airways passing within the vicinity of the RBS Unit 3 site. Each airway is 8 mi. in width (Reference 2.2-232). The distance from the plant site to the edge of each airway is as follows:

Route	Distance to Center Line	Width	Distance to Edge
V71	2.5 mi.	8 mi.	Site is within path by 1.5 mi.

Route	Distance to Center Line	Width	Distance to Edge
V566	8 mi.	8 mi.	4 mi.
V222	9.2 mi.	8 mi.	5.2 mi.

Airway V71 does not meet acceptance Criterion C above and required more detailed analysis to demonstrate that the probability meets the guidance of NUREG-0800. NUREG-0800, Section 3.5.1.6, Section III.1 states the following:

> "For situations in which federal airways or aviation corridors pass through the vicinity of the site, the probability per year of an aircraft crashing into the plant (P_{FA}) should be estimated. This probability will depend on a number of factors, such as the altitude and frequency of the flights, the width of the corridor, and the corresponding distribution of past accidents.
>
> One way of calculating P_{FA} is by using the following expression:
>
> $$P_{FA} = C \times N \times A/w$$
>
> where:
>
> C = in-flight crash rate per mile for aircraft using airway,
>
> w = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles,
>
> N = number of flights per year along the airway, and
>
> A = effective area of plant in square miles.
>
> This gives a conservative upper bound on aircraft impact probability if care is taken in using values for the individual factors that are meaningful and conservative. For commercial aircraft a value of C = 4×10^{-10} per aircraft mile has been used."

The estimated number of flights per year on Airway V71 is 16,425, as identified in Subsection 2.2.2.7. The average number of flights per day on Airway V71 is 45. Refer to the following:

C = in-flight crash rate per mile for aircraft using airway: 4×10^{-10}

w = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles: 8 mi.

N = number of flights per year along the airway: 16,425

A = effective area of plant in square miles: 0.030 sq. mi.

$P_{FA} = 4 \times 10^{-10} \times 16{,}425 \times 0.030/8 < 2.5 \times 10^{-8} < 10^{-7}$

The probability of an accident on Airway V71 meets the criteria set forth in NUREG-0800, Section 3.5.1.6, "Aircraft Hazards" and, therefore, does not require any further analysis or discussion of protection of safety-related structures from aircraft hazards.

2.2.3.3 Effects of Design Basis Events

Potential design basis events have been analyzed in Subsection 2.2.3. The effects of these events on the safety-related components of the plant are insignificant, as discussed in Subsection 2.2.3.1.

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Table 2.2-201
Industrial Facilities in the Vicinity of RBS

Facility Name	Distance/ Direction	Function	Products	No. of Employees
Southern Belle Truck Stop	2.1 mi. E	Truck Stop, Convenience Store, and Casino	Underground Gas and Diesel Fuel Tanks, Food Mart	30
Texas Eastern Trans Corp (Spectra Energy)	Pipeline 2.1 mi. E and valve site 3.8 mi. S-SW	Natural Gas Transmission	Natural Gas	2 at New Roads Lab (valve site)
Williams Gas Pipeline – Transco	Pipeline 2.5 mi. S, and Compressor Station 4 mi. E	Natural Gas Transmission	Natural Gas	25 at Compressor Station 60
Big Cajun 2 Louisiana Generating, LLC	3.1 mi. SW	Power Plant	Fossil Fuel Electric Power Generation	260 (up to 1350 during outage)
U.S. Army Corps of Engineers (Fordice Construction Company, Contractor)	3.3 mi. W	Casting Yard	Concrete Products, Revetments (except block and brick)	6 full-time (85 seasonal for 3 mo. per year)
New Facility at Vacant Tembec Site	3.4 mi. S	Paper Mill PLANT CLOSED JULY 31, 2007	Fluffy Pulp, Absorbent Products	Approx. 200 (up to 400 by 2010)
Russell Daniel Oil Company, Inc.	3.9 mi. NW	Exxon Distributor	Delivery of Oil, Gasoline, and Diesel	6
Wilcox Oil Co., Inc.	4.3 mi. NW	Chevron Petroleum Distributor	Delivery of Oil, Gasoline, and Diesel	5
Leake Oil Company, Inc.	4.5 mi. NW	Mobil Distributor	Delivery of Gasoline and Diesel Fuel	14
Colonial Pipeline Company/Bengal Pipeline Company	4.5 mi. SE	Petroleum Tank Farms and Pipelines	Gasoline, Diesel Fuel, Kerosene, and Jet Fuel	35
TransMontaigne Product Services, Inc.	4.5 mi. S	Petroleum Permissive Supplier	Unload/Transfer Petroleum Products from River Barges	
Marathon Ashland Pipeline LLC Zachary Terminal	5 mi. SE	Petroleum Tank Farm	Crude Oil Products; Gasoline, Fuel Oils, Kerosene	

Table 2.2-202 (Sheet 1 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments: Mode (by Truck, Rail, River Barge)	Shipments: No. per Year/ Frequency	Shipments: Maximum Quantity (Largest Shipment)
2.1 Mi. E	Southern Belle Truck Stop				
Diesel Fuel	8000 gal.	12,000-gal. tank, at most, three-fourths full	Truck	52 - 104 (1 - 2 x/week based on sales)	Approximately 4000 gal.
Gasoline	15,000 gal.	Three 8000-gal. tanks (unleaded, mid-grade and super, usually one-half full or less)	Truck	52 - 104 (1 - 2 x/week based on sales)	Approximately 4000 gal.
3.1 Mi. SW	Big Cajun 2				
Acetylene	25 cylinders (daily max) 75 cylinder (outage/ turnaround)	One standard size used by maintenance for welding	Truck	6	
Ammonia (29 percent aqua)	1000 gal.	1000 gal.	Truck	1	1000 gal.
Carbon Dioxide	15.5 tons		Truck		7.5 tons
Caustic	24,000 gal.		Truck		3500 gal.
Chlorine	36,750 lb.	Five 150-lb. cylinders; 18 1-ton cylinders	Truck	12 - 15 shipments total 85 - 90 cylinders	< 12 tons

Table 2.2-202 (Sheet 2 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments: Mode (by Truck, Rail, River Barge)	Shipments: No. per Year/ Frequency	Shipments: Maximum Quantity (Largest Shipment)
No. 1 Highway Diesel	500 gal.	500-gal. tank	Truck		
No. 2 Off Road Diesel	41,800 gal.	39,000-gal. tank	Truck		
No. 2 Fuel Oil	560,000 gal.	Two 280,000-gal. tanks	Truck		
Gasoline	1500 gal.	1500-gal. tank	Truck		
Hydrogen	72,288 cu. ft.	Nine tanks at 8032 cu. ft.	Truck	6 - 12	One truck
Nitrogen	2000 lb.	Ten 200-lb. cylinders	Truck		2000 lb.
Sulfuric Acid (96 percent)	55,000 gal.		Truck		3000 gal.
3.3 Mi. W	U.S. Army Corps of Engineers - Fordice Construction Company				
Diesel Fuel	3000 gal.	Tank not full	Truck		
Form Oil	12,000 gal.	(Various reuse oil, sprayed on steel forms for concrete release)	Truck		
Gasoline	2000 gal.	Tank not full	Truck		
3.4 Mi. S	New Facility at Vacant Tembec Site				
All HAZMAT	Removed by mid-August 2007				

Table 2.2-202 (Sheet 3 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments: Mode (by Truck, Rail, River Barge)	Shipments: No. per Year/ Frequency	Shipments: Maximum Quantity (Largest Shipment)
3.5 Mi. SW and 4 Mi. E	Williams Gas Pipeline - Transco				
Valve Yard on West Bank of the Mississippi River 3.5 mi. SW					
Natural Gas Condensate (Distillate)	8800 gal.	8800 gal. (one 210-barrel tank)	Truck		
Compressor Station 60 4 mi. E					
Gasoline	500 gal.	500 gal.	Truck		
Natural Gas Condensate (Distillate)	8800 gal.	8800 gal. (one 210-barrel tank)	Truck		
Diesel Fuel	500 gal.	500 gal.	Truck		
Lube Oil	11,600 gal.		Truck		
3.9 Mi. NW	Russell Daniel Oil Company, Inc.				
Diesel Fuel	17,000 gal.	Two 17,000-gal. tanks, usually one-half full	Truck	365 (daily)	9400-gal. trailer
Gasoline	9000 gal.	Two 17,000-gal. tanks, usually one-fourth full	Truck	365 (daily)	9400-gal. trailer

Table 2.2-202 (Sheet 4 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments: Mode (by Truck, Rail, River Barge)	Shipments: No. per Year/ Frequency	Shipments: Maximum Quantity (Largest Shipment)
Motor Oil	2750 gal.	Fifty 55-gal. drums, also cases and pails	Truck	As-needed	
4.3 Mi.NW	Wilcox Oil Company, Inc.				
Diesel Fuel	5000 gal.	20,000-gal. tank, also one 15,000-gal. tank	Truck	48	3000 gal.
Gasoline	8000 gal.	Two 15,000 gal. tanks, usually one-fourth full	Truck	52	4500 gal.
Motor Oil	1500 gal.	55 gal. drums and cases	Truck	Ordered as-needed	Delivered immediately
4.5 Mi. NW	Leake Oil Company, Inc.				
Diesel Fuel	7000 - 10,000 gal.	Two 20,000-gal. tanks	Truck	600	4000-gal. maximum (deliveries range from 300 - 4000 gal.)
Gasoline	7000 - 10,000 gal.	Three 20,000-gal. tanks	Truck	400	4000-gal. maximum (also use a 2800-gal. truck; total deliveries about 50,000 gal. per month)
Kerosene	At site about 6 mi. away SE				
Liquid Propane	At site about 6 mi. away SE				

Table 2.2-202 (Sheet 5 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments		
			Mode (by Truck, Rail, River Barge)	No. per Year/ Frequency	Maximum Quantity (Largest Shipment)
4.5 Mi. SE	Bengal Pipeline Company LLC, Baton Rouge Tank Farm				
Gasoline	78,822,000	13,540,000 gal.	Pipeline	62	Can empty contents of whole tank if full at time of shipment; 13,000,000-gal. average on-site
Diesel Fuel, Fuel Oil, Distillate	54,915,000	13,520,000 gal.	Pipeline	62	Can empty contents of whole tank if full at time of shipment; 7,560,000-gal. average on-site
Jet Fuel, Kerosene	25,337,000	13,870,000 gal.	Pipeline	62	Can empty contents of whole tank if full at time of shipment; 3,705,000 gal. average on-site
4.5 Mi. S	TransMontaigne Terminaling Inc.				
No on-site storage tanks – Load and unload gasoline, diesel fuel, jet fuel, and kerosene on Mississippi River barges. This is a terminal facility connecting to Colonial Pipelines and Bengal Tank Farms.					

Table 2.2-202 (Sheet 6 of 6)
Off-Site Hazardous Materials in the Vicinity of RBS

Material Name	Amount Processed/ Stored on Premises (Maximum Daily Amount in Pounds)	Largest Container	Shipments: Mode (by Truck, Rail, River Barge)	Shipments: No. per Year/ Frequency	Shipments: Maximum Quantity (Largest Shipment)
5 - 5.5 Mi. SE	Marathon Ashland Pipeline LLC/Zachary Terminal				
Diesel Fuel/Fuel Oil		Six very large and two large tanks	20-in. pipeline		
Distillate			20-in. pipeline		
Gasoline			20-in. pipeline		
Jet Fuel			20-in. pipeline		
Kerosene			20-in. pipeline		

Source: Nearby Facilities Survey, submitted by Black & Veatch Corporation, Overland Park, Kansas, 2007 - 2008.

Table 2.2-203 (Sheet 1 of 5)
Unit 1 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Acetylene (gas)	Maintenance Shop, Hot Machine Shop, Maintenance and Warehouse Bottle Storage Racks, Vehicle Maintenance Shop, Pipe Shop	Maximum 9999 lb. (cylinders)
Alkylphosphoric Acid (70 percent solution/Nalco Sure-Cool 1393)	Service Water	1 x 3000-gal. tank
Ammonium Bisulfite (41 percent solution/Nalco 7905)	West of Sulfuric Acid Tank by Circulating Water Flume	1 x 3800-gal. tank
Argon (cryogenic liquid)	Gas Cylinder Racks for Chemistry and Warehouse	Varies 9999 - 99,999 lb. (cylinders)
Argon (gas)	Chemistry/Environmental Labs, Maintenance and Warehouse Gas Storage Racks, Hot Machine Shop, Maintenance Shop, and Pipe Shop	Varies 999 - 9999 lb. (cylinders)
Boric Acid (solid)	Main Warehouse	Varies 8690 lb. (drums)
Bromotrifluoromethane (Halon 1301/gas)	Various Fire Suppression Systems, Meteorological Instrument and Generator Buildings, and Main Warehouse Gas Storage	Varies 5000 - 9999 lb. (40-, 65-, and 100-lb. cylinders)
Carbon Dioxide (gas)	Various Fire Suppression Systems Throughout Plant	8250 lb. total (65 x 1.52 cu. ft. cylinders 50 x 4 cu. ft. cylinders)
Carbon Dioxide (liquid)	CO_2 Tank System (south of plant)	1 x 5000 - 9999-gal. Cryogenic Storage Tank
Chlorodifluoromethane (HCFC-22/Freon R22/gas)	Unit Coolers Throughout Plant	Varies 3000 + lb. (15-ton rooftop A/C unit 60 lb. 20-ton rooftop A/C unit 80 lb. 40-ton split A/C unit 160 lb. 45-ton split A/C unit 180 lb. 30-ton split A/C unit 120 lb. 60-ton split A/C unit 240 lb. 7.5-ton split A/C unit 30 lb. 40-ton rooftop A/C unit 160 lb. 40-ton rooftop A/C unit 60 lb. 40-ton rooftop A/C unit 160 lb. 120-ton rooftop A/C unit 480 lb. 40-ton rooftop A/C unit 160 lb. 20-ton rooftop A/C unit 80 lb. 50-ton split A/C unit 200 lb. 30-ton split A/C unit 120 lb. Rooftop A/C unit 264 lb. Rooftop A/C unit 264 lb.)

Table 2.2-203 (Sheet 2 of 5)
Unit 1 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Dichlorotetrafluoroethane (Freon 114/gas)	Control Building Chillers, Maintenance Storage, Warehouse Storage	39,370-lb. total (4 x 1630-lb. cylinders, 3 x 1000-lb. cylinders, 199 x 150-lb. cylinders)
2,2-Dichloro-1,1,1-Trifluoroethane (HCFC-123/Freon 123)	Main Warehouse and Turbine Building Chillers	2 x 2800-lb. cylinders
Diesel Fuel Oil (liquid)	Diesel Generator Building Diesel Generator Building Diesel Generator Building Vehicle Maintenance Shop SW of Hazardous Waste Yard Fire Protection Pump House North of Diesel Generator Building East of Field Administration Building Southwest of Turbine Building	163,077-gal. total (3 x 50,000-gal. tanks 3 x 535-gal. tanks 3 x 514-gal. tanks 1 x 6000-gal. tank 1 x 2750-gal. tank 2 x 300-gal. tanks 1 x 180-gal. tank 1 x 200-gal. tank 1 x 200-gal. tank)
Dichlorodifluoromethane (Freon 12)	Non-Flammable Hazardous Materials Warehouse, Maintenance Storage, and Offgas Building	Varies 2510 lb. total (4 x 450 - 500 lb. drum/bottles 7 x 30 and 50 lb. drum/bottles 4 x 30 - 40 lb. drum/bottles)
Ethylene Glycol (Antifreeze/liquid)	Turbine Building, Main Warehouse, Fire Protection Diesel Building, and Various Motors and Pumps	3000 gal. total
Fluorotrichloromethane (Freon 11 - same as CFC-11 Trichlorofluoromethane)	Turbine Building Chiller, Radwaste Building Chiller, Warehouse Storage	1 x 2800 lb. 3 x 1000 lb. 117 x 100 lb.
Fyrquel Electrohydraulic Fluid (13 percent Triphenyl Phosphate, 50 percent Butylated Triphenyl Phosphate, Trixylenyl Phosphate)	Turbine Building 95 ft. east side, Main Warehouse Oil storage area, Various plant equipment	Varies, maximum 9999 lb.
Gasoline	Vehicle Maintenance Shop	1 x 6000-gal. tank
Gluteraldehyde	Service Water	1 x 1000-gal. tank 2 x 400-gal. tanks
HEDP and Dispersant (liquid)	Circulating Water Flume	2 x 3200-gal. tanks
Hydrochloric Acid (liquid)	Hazardous Material Building	Maximum 999 lb. in drums
Hydrogen (gas)	Maintenance and Warehouse Gas Bottle Storage Racks	6 x 20,000 cu. ft. cylinders 300 x 1 lb. cylinders
Hydrogen (liquid)	Hydrogen Water Chemistry Storage Area	1 x 16,500 gal. (Cryogenic Storage Tank)[(a)]
Iron (III) Oxalate Hexahydrate (20 percent solution/liquid)	Main Warehouse	Maximum 9999-lb. steel drum
Isothiazoline Microbiocide (Nalco 7330/liquid)	Service Water	2 x 400-gal. tanks

Table 2.2-203 (Sheet 3 of 5)
Unit 1 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Kerosene (liquid)	Warehouse	Maximum 999-lb. drum
Lubricating Oils and Greases (liquid)	Main Warehouse Oil Storage, Vehicle Maintenance Shop, Hot Machine and Tool Issue Shops, Turbine Building Oil Dispensing Console Room, Turbine Lube Oil Storage Room, and Oil Storage Building	Varies in drums, cans, and tanks, 2 x 12,000-gal. tanks 1600-gal. containers and drums 1440-gal. containers 990-gal. in drums
Monochlorodifluoromethane (Freon 22)	Services Building Chillers, Maintenance Storage, and Administration Building	2370 lb. total (4 x 190 lb., 7 x 50, 100 and 150 lb., 4 x 140 lb.)
Nalco 23289 Dispersant (40 percent solution Sulfermetholated Sodium Salt, 10 percent Sodium Bisulfate)	Circulating Water Flume	Maximum 99,999-lb. tank
Nitrogen (Liquid)	Hydrogen Water Chemistry Storage Area, Warehouse, Chemistry and Service Water Compressed Gas Storage Areas, Pipe, Garage, Maintenance and Hot Machine Shops, Environmental, and Dosimetry	1 x 1500 gal/10,300 lb. (Cryogenic Storage Tank)[a] 8 x 22-lb. cylinders
Oxygen, Liquid	Hydrogen Water Chemistry Storage Area	1 x 9000 gal/85,900 lb. (Cryogenic Storage Tank)[a]
Oxygen Gas	Warehouse Compressed Gas Storage, Maintenance, Chemistry Compressed Gas Storage, Hot Machine and Pipe Shops, Plant Primary Access Point (PAP)	Maximum 9999 lb. in cylinders
Petroleum Distillates (solvents)	Main Warehouse, Maintenance, Machine Shop and Garage, Tool and Chemical Issue Shop, Hot Machine Shop, Oil Storage Building	9999 - 99,999-lb. maximum
Petroleum Oil (Transmission Fluid, Mineral Oil)	Main Warehouse	999 - 9999-lb. maximum
Polymer (flocculant)	Clarifier Building	1 x 5000-gal. tank
Polyquaternary Amine (40 percent Solution, Antimicrobial/Nalco 9217)	Clarifier Building	9999 - 99,999-lb. tank
Propane (Liquid)	Meteorological Tower Emergency Diesel, Environmental Lab, PAP, Main Warehouse Propane Storage Tank Area	Maximum 99,999 lb. (several tanks)
Sodium Bromide (43 percent solution, Nalco 1318)	Circulating Water Flume	1 x 6200-gal. tank

Table 2.2-203 (Sheet 4 of 5)
Unit 1 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Sodium Hydroxide (NaOH 50 percent solution)	Service Water Chemical Area, Chemistry and Environmental Labs, Main Warehouse, Hazardous Material Storage	1 x 1000-gal. tank 2 x 400-gal. tanks
Sodium Hypochlorite (15 percent solution)	Circulating Water Flume, Clarifiers, (Standby Cooling Tower Service Water)	2 x 7600-gal. tanks 1 x 5600-gal. tank (1 x 1000-gal. inactive tank)
Sodium Molybdate (40 percent solution/Nalco 7357)	Service Water Chemical Add area	2 x 400-gal. tanks
Sodium Nitrite (30 percent solution, Nalco 8325)	Service Water Chemical Add area	2 x 400-gal. tanks
Sodium Pentaborate, Anhydrous (solid)	Main Warehouse	Maximum 9999-lb. in drums
Sodium Tolyltriazole (70 percent solution/Nalco 1336)	Circulating Water Flume and Service Water Chemical Add area	1 × 3000-gal. tank 1 × 400-gal. tank
Solvent, Paint Thinner (60 percent Toulene, 30 percent Acetone)	Main Warehouse, Paint Shop, Storage Lockers in plant	999 - 9999 lb. in drum and other containers
Sulfuric Acid (93 percent solution)	Circulating Water Flume, Warehouse	2 x 42,000-gal. tanks Plastic or non-metallic drums
Sulfuric Acid Batteries (29 percent EHS Electrolyte/ Liquid)	Main Warehouse, Varies plantwide	240-cell battery, 2558 gal. (total) 120-cell battery, 1452 gal. (total) 60-cell battery, 642 gal. (total) 60-cell battery, 62 gal. (total) 24-cell battery, 25 gal. (total)
Transformer Oils	Main Warehouse Oil Storage Area, East Wall of Turbine Building, East Wall of Turbine Building, East Wall of Turbine Building, East Wall of Turbine Building, East Wall of Turbine Building, SW of Turbine Building, SW of Turbine Building, Cooling Tower A, Cooling Tower B, Cooling Tower C, Cooling Tower D, Clarifiers, Service Water Area (Closed Loop), Service Water Area (Closed Loop), Service Water Area (Hypochlorite), West Wall of Fuel Building, Circulating Water House, River Intake	Maximum 99,999 lb., 2 x 16,733-gal. transformers, 1 x 15,300-gal. transformer, 1 x 7900-gal. transformer, 2 x 3951-gal. transformers, 1 x 3405-gal. transformer, 1 x 15,300-gal. transformer, 1 x 7900-gal. transformer, 2 x 234-gal. transformers, 2 x 234-gal. transformers, 2 x 234-gal. transformers, 2 x 234-gal. transformers, 2 x 197-gal. transformers, 2 x 1270-gal. transformers, 2 x 241-gal. transformers, 2 x 200-gal. transformers, 2 x 1260-gal. transformers, 2 x 1490-gal. transformers, 2 x 620-gal. transformers

Table 2.2-203 (Sheet 5 of 5)
Unit 1 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Trichlorotrifluoroethane (Freon 113/liquid)	Chemical Lab and Warehouse Hazardous Materials Annex	Varies 999 - 9999 lb. (drums/cylinders/bottles)
Zinc Chloride (70 percent solution, Nalco Sure-Cool 1339)	Circulating Water Flume	1 x 400-gal. tank

a) Note: Existing tanks are shared between Units 1 and 3.

Table 2.2-204
Unit 3 On-Site Chemical Storage Locations and Quantities

Chemical/Material (Formula/Trade/State)	Location	No. x Quantity
Carbon Dioxide	CO_2 Storage Area - Outside the Turbine Building (West Side)	1 x 800 gal. (Cryogenic Storage Tank)
Corrosion Inhibitor (Nalco 7384/Zinc)	Cooling Tower (Adjacent)	1 x 180-gal. tank
Diesel Fuel	East of Electrical Building/ Technical Support Center	2 x 210,500-gal. tanks
Disodium Phosphate (0.18 percent solution)	Auxiliary Boiler Building	1 x 555-gal. tank
Dispersant PCL-401/28 Percent TRC-233	Cooling Tower (Adjacent)	1 x 6000-gal. tank
Hach SiO_2 Analyzer Reagents	Service Water/Water Treatment Building (Inside)	24 x 2.9L bottles
Hydrochloric Acid	Service Water/Water Treatment Building (Inside)	1 x 180-gal. tank
Hydrogen	Bulk Cryogenic Gas Storage Area	1 x 16,500 gal.[a] (Cryogenic Storage Tank)
Hydrogen Peroxide	Service Water/Water Treatment Building (Inside)	1 x 180 gal.
Nitrogen	Bulk Cryogenic Gas Storage Area	1 x 25,000 gal. (Cryogenic Storage Tank)
Oxygen, Liquid	Bulk Cryogenic Gas Storage Area	1 x 9000 gal.[a] (Cryogenic Storage Tank)
Scale Inhibitor SURE-COOL 1393 (50 percent organic phosphate)	Cooling Tower (Adjacent)	1 x 280-gal. tank
Sodium Hydroxide NaOH 60 Percent Solution	Service Water/Water Treatment Building (Inside)	1 x 200-gal. tank
Sodium Hypochlorite 12.5 Percent Solution	Cooling Tower (Adjacent)	1 x 4000-gal. tank 1 x 500-gal. tank
Sodium Sulfite (2.2 percent Solution)	Auxiliary Boiler Building	1 × 555-gal. tank
Sulfuric Acid	Cooling Tower (Adjacent)	1 x 12,000-gal. tank
Trisodium Phosphate (0.72 percent solution)	Auxiliary Boiler Building	1 x 555-gal. tank

a) Note: Existing tanks are shared between Units 1 and 3.

Table 2.2-205 (Sheet 1 of 2)
Pipelines in the Vicinity of RBS

Pipeline Owner	Diameter (In.)	Date Put Into Service	Operating Pressure (Psig)	Depth of Burial (In.)	Isolation Valves	Contents	Remarks
Texas Eastern Transmission Corp.	30	1955	1100	36 minimum	Gate w/EIM operation	Natural gas	Also, ball valves w/Schaeffer type operation at New Roads Lab valve site, west of river.
	30	1960	1100	36 minimum	Gate w/EIM operation	Natural gas	
	36	1964	1100	36 minimum	Gate w/EIM operation	Natural gas	36-in. line runs south from Lab.
Williams Gas Pipeline - Transco	30	1951	550 - 800	30 minimum	Gate and Plug w/EIM and manual	Natural gas	Manual and power valve operation with remote and line break controls (at valve stations on each side of river and at Compressor Station 60).
	36	1956	550 - 800	30 minimum	Gate and Plug w/EIM and manual	Natural gas	
	36	1960	550 - 800	30 minimum	Gate and Plug w/EIM and manual	Natural gas	
	42	1985	550 - 800	30 minimum	Gate and Plug w/EIM and manual	Natural gas	
Enbridge Pipelines (MIDLA) LLC	8	1959	165	30 minimum	Ball valves	Natural Gas	Manually operated ball valves located at supply.
Mid Louisiana Gas Transmission Co.	6	1985	550	30 minimum	Ball valves	Natural Gas	Manually operated ball valves.

Table 2.2-205 (Sheet 2 of 2)
Pipelines in the Vicinity of RBS

Pipeline Owner	Diameter (In.)	Date Put Into Service	Operating Pressure (Psig)	Depth of Burial (In.)	Isolation Valves	Contents	Remarks
Colonial Pipeline Company	6	1964	800	36 minimum	Gate w/manual operation	Petroleum	This line is temporarily out of service.
	36	1964	590	36 minimum	Gate w/manual and hydraulic	Petroleum	Line leaves tank farm to NE.
	36	1972	590	36 minimum	Gate w/manual and hydraulic	Petroleum	Houston line, tank farm, and NE.
	40	1977	590	36 minimum	Gate w/manual and hydraulic	Petroleum	Houston line to tank farm.
	16	1999	130	36 minimum	Gate w/manual and hydraulic	Petroleum	Tank farm line to barge dock.
	16	1999	130	36 minimum	Gate w/manual and hydraulic	Petroleum	Tank farm line to barge dock.
	16	1999	130	36 minimum	Gate w/manual and hydraulic	Petroleum	Tank farm line to barge dock.
Bengal Pipeline Co. (maintained by Shell)	16			36 minimum	Gate w/manual and hydraulic	Petroleum	On-site at Bengal Tank Farm.
	24	2006		36 minimum	Gate w/manual and hydraulic	Petroleum	On-site at Bengal Tank Farm.
Marathon Ashland Pipeline LLC/ Zachary	20					Petroleum	Lines from Marathon Tank Farm to Bengal Tank Farm.
	20					Petroleum	Lines from Marathon Tank Farm to Bengal Tank Farm.

Source: “Survey of Pipelines,” submitted by Black & Veatch Corporation, Overland Park, Kansas, 2007 - 2008.

Table 2.2-206
Hazardous Material Transported on the Mississippi River in 2005 from the Ohio River to Baton Rouge, Louisiana
Trips Past RM 264

WCSC Commodity Code[a]	Cargo Description	Thousand Short Tons
		Annual
2100	Crude petroleum	1032
2211	Gasoline	1849
2221	Kerosene	32
2330	Distillate fuel oil	4507
2340	Residual fuel oil	1861
2350	Lube oil and greases	1374
2429	Naphtha and solvents	697
2430	Asphalt, tar and pitch	1311
2540	Petroleum coke	2745
2640	Hydrocarbon and petroleum gases, liquefied and gaseous	200
2990	Petroleum products NEC	396
3110	Nitrogenous fertilizer	5796
3120	Phosphatic fertilizer	574
3130	Potassic fertilizer	871
3190	Fertilizer and mixes NEC	1708
3211	Acyclic hydrocarbons	124
3212	Benzene and toluene	123
3220	Alcohols	1806
3272	Sulfuric acid	4
3273	Ammonia	888
3274	Sodium hydroxide	1746
3281	Radioactive Material	26
3291	Pesticides	7
3298	Wood and resin chemicals	6
3299	Chemical products NEC	47

a) U.S. Army Corps of Engineers Waterborne Commerce Statistics Center (WCSC) commodity codes were standardized to reflect the hierarchical structure of the Standard International Trade Classification (SITC) Revision 3 commodity codes, and the first two digits correspond with the Lock Performance Monitoring System (LPMS) commodity codes.

Source: Reference 2.2-218.

Table 2.2-207
Airports in the Vicinity of RBS

Airport Name (FAA Identifier) Distance/ Direction	Length/Orientation of Runways	Types of Aircraft	No. of Operations per Year	Accident Statistics
RBS Heliport (LA96) 0.42 mi. (2230 ft.) NW	40 x 20 ft. (12 x 6 m)	Helicopter	Approx. 52	None
West Feliciana Parish Hospital Heliport (LA37) 2.4 mi. NW	40 x 40 ft. (12.2 x 12.2 m)	Helicopter	Approx. 18	None
Jackson Airport (4LA3) 8 mi. NE	3000 x 75 ft. (914 x 23 m) Runway 15: Heading 150 Runway 33: Heading 330	3 Aircraft based: 2 Single engine airplanes 1 Ultralight	1768 avg 57 percent local 43 percent transient	N/A - Operations not greater than 500 D^2
False River Regional Airport (HZR) 9.2 mi. W-SW	5002 x 75 ft. (1525 x 23 m) Runway 18: Heading 180 Runway 36: Heading 000	24 Aircraft based: 19 Single engine 1 Multi-engine airplane 3 Helicopters 1 Glider	47,085 avg 68 percent local 32 percent transient <1 percent military	10 in past 40 years (1 fatal)
Baton Rouge Metropolitan Airport, Ryan Field (BTR) 19 mi. SE	7004 x 150 ft. Runway 13/31: Heading 130/310 6900 x 150 ft. Runway 4L/22R: Heading 040/220 3799 x 75 ft. Runway 4R/22L: Heading 040/220	164 Aircraft based: 103 Single engine 43 Multi-engine 10 Jet airplanes 8 Helicopters	94,900 avg 48 percent transient 27 percent air taxi 16 percent local 7 percent commercial 3 percent military	N/A – Operations not greater than 1000 D^2

Source: References 2.2-212, 219, 220, 221, 222, 223, and 224.

Table 2.2-208 (Sheet 1 of 3)
Unit 1 On-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/ TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Carbon Dioxide	40,000 ppm (IDLH)	No/No	830 psi at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Diesel Fuel No. 2	None established	Yes (Varies)/No	< 0.100 mmHg	No further analysis is required.[a]
Ethylene Glycol	None established	No/No	0.06 mmHg at 68°F	No further analysis is required.
Freon-22/R22 (Chlorodifluoromethane)	1250 ppm (ST TWA)	No/No	9.4 atm at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Freon-11 (Fluorotrichloromethane)	2000 ppm	No/No	690 mmHg at 68°F	Toxic analysis performed and found to have no impact to Unit 3 MCR habitability.
Freon-113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	2000 ppm	No/No	285 mmHg at 68°F	Currently located in RBS Unit 3 construction area – will be relocated. No further analysis required.
Freon-114 (Dichlortetrafluoroethane)	15,000 ppm	No/No	1.9 atm at 70°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Freon-123 (Dichlorotrifluoroethane)	5000 ppm	No/No	11.2 psig at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.

Table 2.2-208 (Sheet 2 of 3)
Unit 1 On-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/ TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Gasoline	None established	Yes/Yes	38 – 300 mmHg	Toxic analysis and explosion analysis performed and found to have no impact on MCR habitability.
Gluteraldehyde	None established	No/No	17 mm Hg	No further analysis is required.
HEDP	None established	No/No	N/A	No further analysis is required.
Hydrogen	None established; asphyxiant	Yes (4 to 75percent)/Yes	29.030 psi at –418°F	Toxic analysis (asphyxiation) performed and found to have no impact to Unit 3 MCR habitability. Explosion analysis safe separation distance is provided as discussed in Subsection 2.2.3.1.1.
Kerosene	None established	Yes/No	5 mmHg at 100°F	Flash Point ranges from 100°F to 152°F. No further explosion analysis required.
Nitrogen	None established; asphyxiant	No/No	65.820 psi at –294°F	Toxicity (asphyxiation) analysis performed and found to have no impact on Unit 3 MCR habitability. No other analysis required.
Oxygen	None established	No/No	36.260 psi at –280°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability. No other analysis required.

Table 2.2-208 (Sheet 3 of 3)
Unit 1 On-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/ TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Sodium Hydroxide NaOH 50 percent Solution	10 mg/m^3 (IDLH)	No/No	14 mmHg at 140°F	Hazardous liquid at ambient conditions. No further analysis required.
Sodium Hypochlorite 12.5 percent Solution	10 ppm for Chlorine	No/No	17.5 mmHg at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Sodium Molybdate (40 percent solution)	None established	No/No	-	No further analysis required.
Sodium Nitrite	None established	No/No	< 0.100 mmHg	No further analysis required.
Sodium Pentaborate	None established	No/No	Not applicable (solid)	No further analysis required.
Sodium Tolyltriazole	None established	No/No	-	No further analysis required.
Sulfuric Acid	15 mg/m^3 (IDLH)	No/No	1 mmHg at 295°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.

a) A fluid with an extremely low vapor pressure will not explode according to NFPA 422 (Reference 2.2-233), which states that the vapor space in tanks storing low vapor pressure liquids is normally too lean to burn. The vapor pressure of diesel fuel is low enough such that the vapor concentration above the liquid (0.36 percent) is significantly lower than the LFL (1.3 percent). As a result, the air-gas mixture is expected to be too lean to ignite and/or explode. Similarly, kerosene grade fuel ordinarily has a low tendency to vaporize, and, in a closed tank, the fuel vapor and air mixture can be too lean to burn.

Table 2.2-209 (Sheet 1 of 2)
Unit 3 On-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Carbon Dioxide	40,000 ppm (IDLH)	No/No	830 psi at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Corrosion Inhibitor (Nalco 7384/Zinc)	50 mg/m^3 for zinc chloride (IDLH)	No/ No	1 mmHg at 802.4°F	Liquid at ambient conditions. No further analysis required.
Diesel Fuel No. 2	None established	Yes (Varies)/ No	< 0.100 mmHg	No further analysis is required.[(a)]
Disodium Phosphate (0.18 percent solution)	None established	No/No	NA	No further analysis required.
Dispersant PCL-401/28 percent TRC-233	None established	No/No	760 mmHg at 212°F	No further analysis required.
Hach SiO_2 Analyzer Reagents	2.5 mg/m^3 respirable dust (TLV)	No/No	10 mmHg at 3150°F	Silicosis Hazard. No further analysis required.
Hydrochloric Acid 35.2 percent Solution	50 ppm (IDLH)	No/No	190 mmHg at 77°F	Hazardous liquid at ambient conditions.
Hydrogen	None established; asphyxiant	Yes (4 to 75 percent)/Yes	29.030 psi at –418°F	Toxic analysis (asphyxiation) performed and found to have no impact on Unit 3 MCR habitability. Explosion analysis safe separation distance is provided as discussed in Subsection 2.2.3.1.1.
Hydrogen Peroxide	75 ppm (IDLH)	No/No	23 mmHg at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.

Table 2.2-209 (Sheet 2 of 2)
Unit 3 On-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Nitrogen	None established; asphyxiant	No/No	65.820 psi at –294°F	Toxic analysis (asphyxiation) performed and found to have no impact on Unit 3 MCR habitability.
Oxygen	None established	No/No	36.260 psi at –280°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability. No other analysis required.
Scale Inhibitor SURE-COOL 1393 (50 percent organic phosphate)	None established	No/No	Not required	No further analysis required.
Sodium Hydroxide NaOH 60 percent Solution	10 mg/m^3 (IDLH)	No/No	14 mmHg at 140°F	Hazardous liquid at ambient conditions required.
Sodium Hypochlorite 12.5 percent Solution	10 ppm for Chlorine (IDLH)	No/No	17.5 mmHg at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Sodium Sulfite (2.2 percent solution)	None Established	No/No	17.535 mm Hg at 93.6°F	No further analysis required.
Sulfuric Acid	15 mg/m^3 (IDLH)	No/No	1 mmHg at 295°F	Toxicity analysis in Section 6.4. No other analysis required.
Trisodium Phosphate (0.72 percent solution)	None established	No/No	Not required	No further analysis required.

a) A fluid with an extremely low vapor pressure will not explode according to NFPA 422 (Reference 2.2-203), which states that the vapor space in tanks storing low vapor pressure liquids is normally too lean to burn. The vapor pressure of diesel fuel is low enough such that the vapor concentration above the liquid (0.36 percent) is significantly lower than the LFL (1.3 percent). As a result, the air-gas mixture is expected to be too lean to ignite and/or explode.

Table 2.2-210 (Sheet 1 of 2)
Off-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/ TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Carbon Dioxide	40,000 ppm (IDLH)	No/No	830 psi at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Chlorine	10 ppm (IDLH)	No/No	4800 mmHg at 68°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.
Diesel Fuel No. 2	None established	Yes (Varies)/No	< 0.100 mmHg	No further analysis is required.[a]
Gasoline	None established	Yes/Yes	38 – 300 mmHg	Flammability analysis performed and found to have no impact on Unit 3 MCR habitability.
Hydrogen	None established; asphyxiant	Yes (4 to 75percent)/Yes	29.030 psi at –418°F	Toxic analysis (asphyxiation) performed and found to have no impact to Unit 3 MCR habitability. Explosion analysis safe separation distance is provided as discussed in Subsection 2.2.3.1.1.
Kerosene	None established	Yes/No	5 mmHg at 100°F	Flash Point ranges from 100°F to 152°F. No further explosion analysis required.
Nitrogen	None established; asphyxiant	No/No	65.820 psi at –294°F	Toxicity (asphyxiation) analysis performed and found to have no impact on Unit 3 MCR habitability. No other analysis required.

Table 2.2-210 (Sheet 2 of 2)
Off-Site Chemicals Evaluation

Chemical/Chemical Product	Toxicity Limit (IDLH)/ TLV	Flammable/ Explosive?	Vapor Pressure	Disposition
Sodium Hydroxide NaOH 50 percent Solution	10 mg/m^3 (IDLH)	No/No	14 mmHg at 140°F	Hazardous liquid at ambient conditions. No further analysis required.
Sulfuric Acid	15 mg/m^3 (IDLH)	No/No	1 mmHg at 295°F	Toxic analysis performed and found to have no impact on Unit 3 MCR habitability.

a) A fluid with an extremely low vapor pressure will not explode according to NFPA 422 (Reference 2.2-233), which states that the vapor space in tanks storing low vapor pressure liquids is normally too lean to burn. The vapor pressure of diesel fuel is low enough such that the vapor concentration above the liquid (0.36 percent) is significantly lower than the LFL (1.3 percent). As a result, the air-gas mixture is expected to be too lean to ignite and/or explode. Similarly, kerosene grade fuel ordinarily has a low tendency to vaporize, and, in a closed tank, the fuel vapor and air mixture can be too lean to burn.

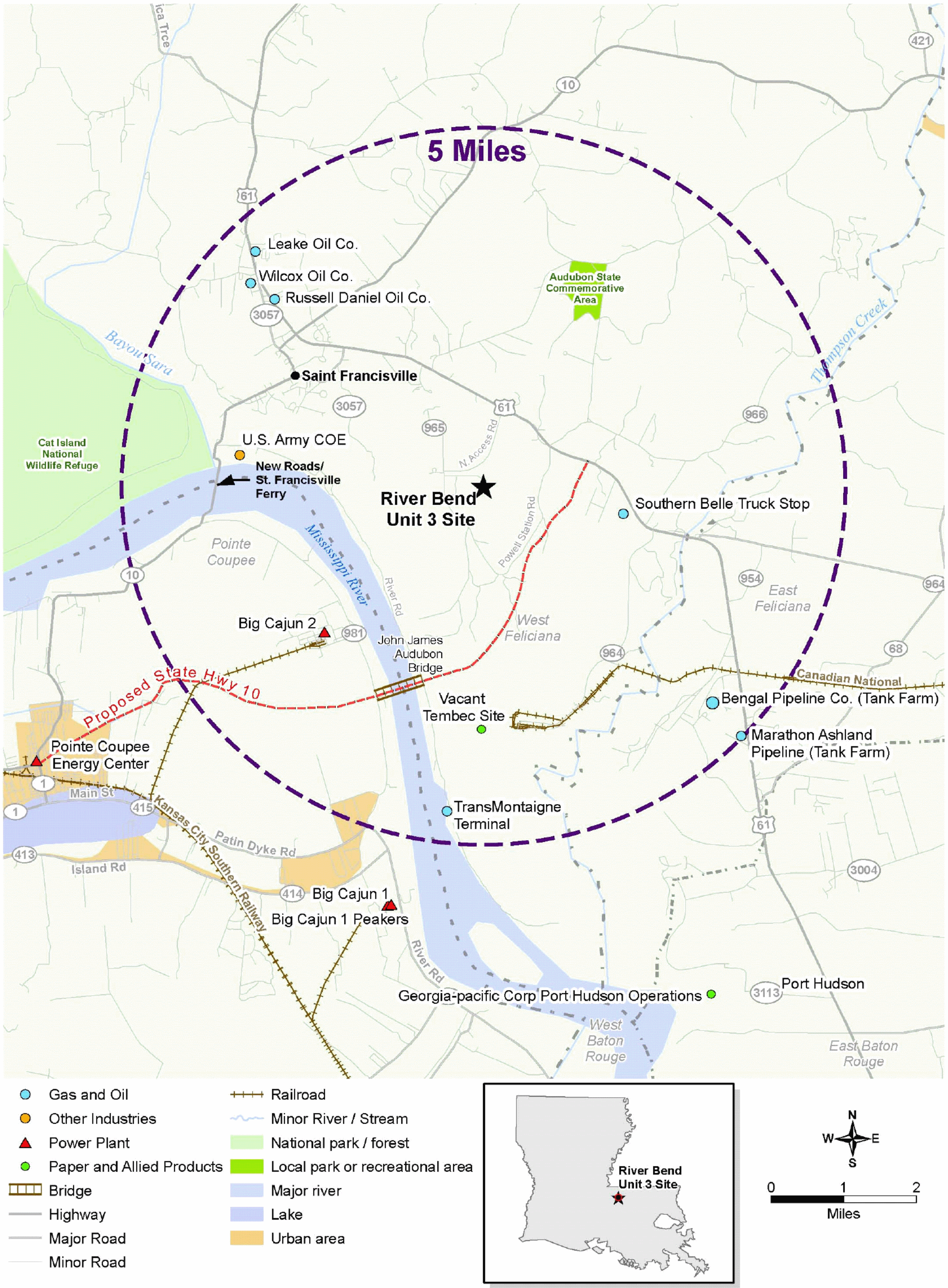

Figure 2.2-201. Nearby Industries and Transportation Routes

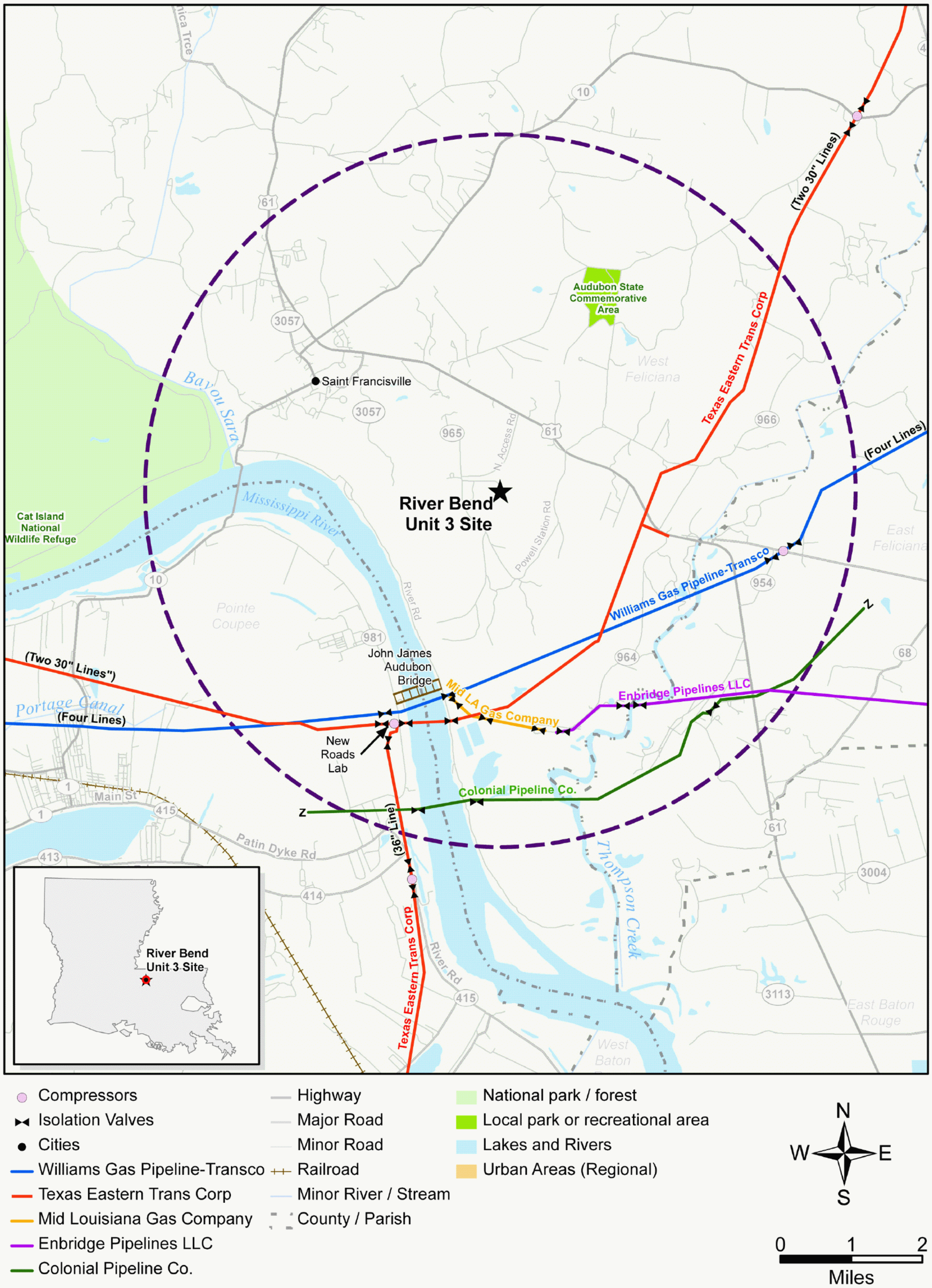

Figure 2.2-202. Pipelines within 5 Mi.

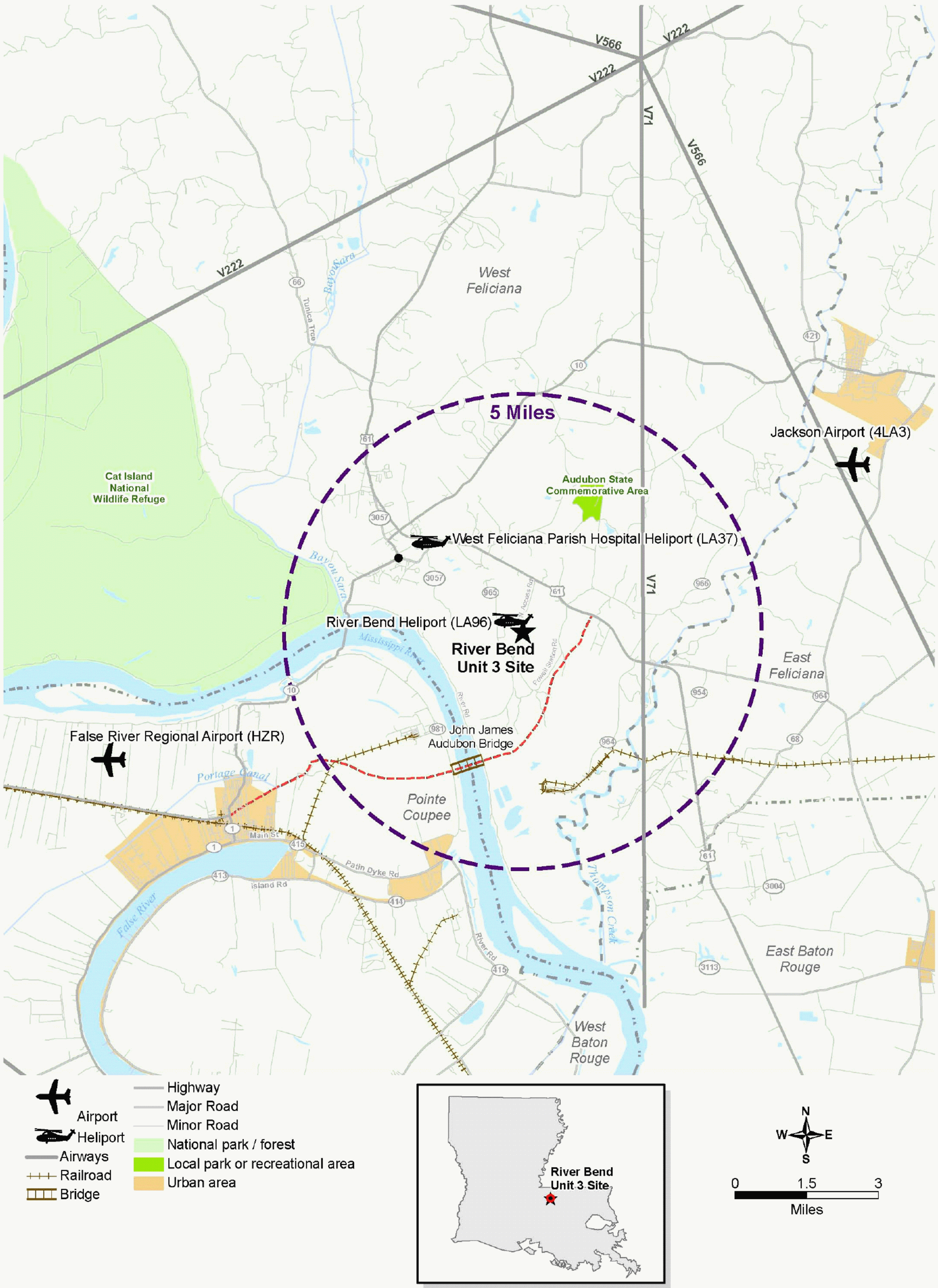

Figure 2.2-203. Nearby Airports and Aviation Routes

2.3 METEOROLOGY AND AIR QUALITY

RBS COL 2.0-7-A Through 2.0-11-A

This section describes the general climate of the RBS and the surrounding regional meteorological conditions. This section also documents the range of meteorological conditions that would likely exist during the construction and operation of a new facility. The data presented include a climatological summary of normal and extreme values of several meteorological parameters recorded by the National Weather Service (NWS) meteorological instruments located in Louisiana at Baton Rouge (Ryan Airport), New Orleans, Lake Charles, and the RBS on-site meteorological station. Supplemental meteorological data from four NWS Cooperative Observation Program (COOP) stations, with data sets dating back 50 years or more, are also included in the analysis of the region surrounding the RBS. Air quality data obtained from the Louisiana Department of Environmental Quality (LDEQ) monitors are used to discuss the regional air quality surrounding the proposed new RBS. Data from the RBS on-site meteorological tower are used to model the influence of the operation of additional cooling towers and their impacts on the surrounding environment. The details of the RBS meteorological monitoring program are also presented in this section. Short- and long-term diffusion estimates of radiation, as they relate to dose concentrations to the public and surrounding area, are presented in Subsections 2.3.4 and 2.3.5.

2.3.1 REGIONAL CLIMATOLOGY

RBS COL 2.0-7-A

The description of the regional climatology at the time of licensing the existing RBS Unit 1 was based primarily on climatological records for Baton Rouge, New Orleans, and Lake Charles, Louisiana, as well as the RBS on-site meteorological tower data. The climatology discussed herein uses data from the three NWS first-order stations listed above, as well as four NWS COOP stations located within 50 mi. of the RBS. The above stations have long return periods of meteorological parameters that provide regional climatology representative of the RBS region. The meteorological data obtained for this climatology were collected and processed by the NOAA Southern Regional Climate Center (SRCC) and National Climatic Data Center (NCDC).

Table 2.3-201 contains the distances and directions of the meteorological observing stations relative to the RBS, as shown in Figure 2.3-201. Ryan Airport in Baton Rouge is the closest first-order station to the site, with a long-term history of recording hourly wind, temperature, precipitation, atmospheric moisture content (e.g., dew point temperature, relative humidity, and wet-bulb [WB] temperature), barometric pressure, and the occurrence of weather phenomena such as thunderstorms and heavy fog (Reference 2.3-201). New Orleans and Lake Charles are additional NWS first-order stations with long-term climatological periods of record (References 2.3-202 and 2.3-203). Tables 2.3-202 through 2.3-204 display the various meteorological parameters in the annual Local Climatological Data (LCD) Summaries for Baton Rouge, New Orleans, and Lake Charles, respectively. The four COOP meteorological stations used in this climatology have complete or nearly complete data sets that extend back to 1948 (Reference 2.3-204).

2.3.1.1 General Climate

RBS COL 2.0-7-A The general climate of the proposed site can be described as humid subtropical with summers dominated by the Bermuda High, a semi-permanent anticyclone that is an extension of the Azores High-Pressure System (Reference 2.3-201). The Bermuda High can remain intact into the spring and fall and occasionally even into the winter season. The prevailing southeasterly winds combined with an abundant moisture supply from the warm waters of the Gulf of Mexico provide mild and rather humid weather throughout most of the year (Reference 2.3-205). The Bermuda High historically can lead to very light winds or even calm weather conditions, thus creating air stagnation problems in the region at times during the summer and early fall seasons (Reference 2.3-206). Air from higher latitudes in the north-central United States occasionally brings drier and cooler conditions to the area, but primarily for only brief periods of time during the winter months (Reference 2.3-201).

The summer climate is warm and humid and is characterized by relatively light winds. Afternoon showers and thunderstorms, which account for much of the summer rainfall, occur nearly one-half of the days during June, July, and August (Reference 2.3-201).

The winter climate is characterized by mild temperatures due to the influence of the maritime air (Reference 2.3-201). The main continental storm track also migrates south into portions of northern Louisiana, but typically remains far enough north of the RBS and surrounding region so that convective showers and storms are the primary source of precipitation events, even during winter months (Reference 2.3-207). Monthly precipitation remains high, with mean monthly rainfall being the greatest in January (Reference 2.3-201). Snow and other freezing precipitation events are rare, with annual totals for snowfall and ice accretion events averaging only a fraction of an inch in the RBS region.

Early spring is the season with the highest frequency of tornadoes and large hail events; however, even these occurrences are rare (Reference 2.3-201). Tropical cyclone frequency is climatologically highest in early autumn, but statistically only one hurricane makes landfall along the coastline of Louisiana approximately every 4 years (Reference 2.3-208). The most pleasant weather usually occurs during late September into October, when temperatures are cooler, average monthly precipitation totals are lower, and average monthly cloudiness decreases. The threat of heavy rainfall is present in all seasons, attributed to the year-round potential for convective rainfall activity (Reference 2.3-201).

2.3.1.1.1 Normal, Mean, and Extreme Climatological Conditions

RBS COL 2.0-7-A This subsection discusses 30-year normals, as well as long-term means and historical extremes for temperature, water vapor, precipitation, and wind that characterize the meteorological conditions in the region surrounding the RBS.

Table 2.3-202 contains long-term normals, means, and extremes for Ryan Airport in Baton Rouge, located 19 mi. southeast of the RBS. Tables 2.3-203 and 2.3-204 exhibit long-term meteorological information for New Orleans and Lake Charles. New Orleans and Lake Charles are located 84 mi. southeast and 115 mi. west-southwest of the RBS, respectively.

The purpose of this subsection is to demonstrate that the long-term data reported at the three NWS first-order meteorological stations, as well as the four COOP stations, are representative of the short- and long-term climate characteristics of the region surrounding the RBS. Subsections 2.3.1.1.1.1 through 2.3.1.1.1.5 provide more detailed discussions of specific meteorological parameters of interest.

2.3.1.1.1.1 Wind Conditions

RBS COL 2.0-7-A According to 35 years of wind data at Ryan Airport, the annual prevailing wind direction is 50 degrees or northeast (Reference 2.3-201). Monthly prevailing winds in Baton Rouge are generally south or southeast during the spring and winter months and northeast during the late summer and fall months. At New Orleans and Lake Charles, the annual prevailing wind directions are 190 degrees (References 2.3-202 and 2.3-203). However, they both generally follow the same monthly variations as Ryan Airport does, except during the winter season when a prominent northerly wind is common. The difference in the winter prevailing wind directions between Baton Rouge and the New Orleans and Lake Charles stations can likely be attributed to offshore flow. As mean temperatures over land begin to cool during the winter, the ocean water along the coastline of Louisiana remains relatively warm. Weak northerly winds tend to blow from coastal areas such as New Orleans and Lake Charles toward the offshore waters in response to the temperature variations of the land versus the sea. Ryan Airport and the RBS are located further inland and are influenced more by the winter storm track that dips into northern Louisiana and produces prevailing surface winds from the southeast.

During the most recent 23-year period, the annual mean wind speed for Ryan Airport was 6.6 mph (Reference 2.3-201). In comparison, New Orleans and Lake Charles have slightly higher annual mean wind speeds, 8.1 and 7.8 mph, respectively (References 2.3-202 and 2.3-203). The highest seasonal mean wind for all three stations is during the winter and spring, as shown in Tables 2.3-202 through 2.3-204. The lowest seasonal mean wind speed occurs during the summer months for Baton Rouge (5.3 mph), New Orleans (6.2 mph), and Lake Charles (6.1 mph). The highest monthly mean wind speeds for Baton Rouge occur in February and March, with a value of 7.9 mph. New Orleans and Lake Charles also have their highest monthly mean wind speeds during February;

however, they have values that are higher, 9.4 mph and 9.5 mph, respectively. The lowest monthly mean wind speed for Baton Rouge and Lake Charles is during August, while New Orleans experiences its lowest monthly mean during July. The overall variation of monthly wind speeds is consistent for the three first-order stations; however, New Orleans and Lake Charles are approximately 20 percent higher in magnitude annually. A likely explanation is the proximity of the two stations to the coastline, where frictional effects are less compared to Baton Rouge which is located farther inland.

Extreme winds for design basis purposes are discussed in Subsection 2.3.1.2.1.2. Wind data summaries for the RBS on-site meteorological station are discussed in Subsections 2.3.2.1.5 and 2.3.2.1.6.

2.3.1.1.1.2 Temperature

RBS COL 2.0-7-A Table 2.3-205 presents mean annual temperatures for the three NWS first-order and four COOP stations in the RBS region. The daily mean temperature for the stations are generally uniform, with only minor differences apparent between the two first-order stations closer to the coastline and the other stations located farther inland. The slight difference in the daily mean across the RBS region can be explained by examining the daily minimum temperatures. Stations that are closer to the coastline have a slightly higher minimum temperature because of the heat content of the Gulf of Mexico. While Baton Rouge and the COOP stations are also influenced by the effects of the Gulf of Mexico, New Orleans and Lake Charles are closer to the coastline and, as a result, have slightly higher mean daily minimum temperatures. Effects of the Gulf of Mexico on mean daily maximum temperatures across the region are less evident.

During the summer months of June, July, and August, daily maximum and minimum temperatures at Baton Rouge average 91°F and 72°F, respectively (Reference 2.3-201). In comparison, summer mean daily maximum and minimum temperatures at New Orleans and Lake Charles are 90°F and 73°F, respectively (References 2.3-202 and 2.3-203). Table 2.3-206 contains climatological extreme maximum and minimum temperatures for the NWS first-order and COOP stations. The highest daily maximum temperature recorded over the last 55 years at Ryan Airport was 105°F in August 2000; however, a temperature of 110°F was recorded in August 1909 at an old weather station located in the Baton Rouge business district (References 2.3-201 and 2.3-209). The highest temperatures recorded at New Orleans over 68 years and Lake Charles over 45 years were 102°F and 107°F, respectively, also occurring in August 2000 (References 2.3-202 and 2.3-203). The extreme high temperatures recorded over the past 50 years at the NWS COOP sites ranged from 105ºF at New Roads and Amite, Louisiana, in August 2000, to 108ºF at Woodville, Mississippi, in early September 2000 (Reference 2.3-210).

During the winter months, the variation of the mean daily minimum temperature is higher between the stations, while the mean daily maximum temperature remains uniform across the region. Mean daily maximum and minimum temperatures during the winter in Baton Rouge are 63°F and 43°F, respectively (Reference 2.3-201). The values of mean daily maximum and minimum temperatures for New Orleans are 64°F and 45°F, respectively, and for Lake Charles are 63°F and 44°F, respectively (References 2.3-202 and 2.3-203). Temperatures drop below freezing several times annually during the late fall and winter months, generally with the arrival of continental polar air masses originating in Canada. Prolonged cold spells are unusual and typically last only 2 to 3 days before milder air returns. Even during the winter cold spells, daytime temperatures nearly always rise above freezing. The first freeze typically occurs in late November, with the average date of the last freeze in late February, producing a mean freeze-free period of approximately 273 days (Reference 2.3-201). The coldest temperature recorded over the latest 55-year period at Ryan Airport was 8°F in December 1989; however, a lower temperature of 2°F was recorded at the Louisiana State University (LSU) campus in 1899 (References 2.3-201 and 2.3-209). During the past 68 years, the lowest temperature recorded at New Orleans and Lake Charles was 11°F, occurring in December 1989 (References 2.3-202 and 2.3-203). The extreme low temperatures recorded over the past 50 years at the four representative COOP stations are 8°F at New Roads and Grand Coteau, Louisiana, in December 1989; 5°F at Amite, Louisiana, in December 1989; and 4°F at Woodville, Mississippi, also in December 1989 (Reference 2.3-210).

2.3.1.1.1.3 Atmospheric Moisture

RBS COL 2.0-7-A The high content of atmospheric moisture in southern Louisiana can be attributed to the nearby Gulf of Mexico. The moisture content in the atmosphere is measured through several parameters (relative humidity, dew point temperature, and WB temperature) and can be evaluated by examining the long-term history of the daily, monthly, and annual means for the stations in the RBS region.

As shown in Tables 2.3-202 through 2.3-204, mean annual relative humidity values at Baton Rouge, New Orleans and Lake Charles average 75 to 79 percent (References 2.3-201, 2.3-202, and 2.3-203). Nighttime relative humidity is highest in the late spring, summer, and early fall and lowest in the winter and early spring months. Daytime humidity readings are highest in late summer, fall, and winter seasons. Daily relative humidity values are typically highest around 6:00 a.m. local standard time (LST), ranging between 85 to 93 percent during the entire year. Lowest relative humidity values occur during early and mid-afternoon, with averages ranging between 55 to 64 percent during all months.

The mean annual WB temperature at Ryan Airport is 61.8ºF, based upon 23 years of records (Reference 2.3-201). July has the highest mean monthly WB temperature, with a value of 75.0ºF. The lowest monthly mean WB temperature is 46.9ºF, which occurs in January. New Orleans and Lake Charles have mean annual WB temperatures of 63.4ºF and 63.2ºF, maximum mean monthly WB temperatures of 76.0ºF and 76.7ºF, and minimum mean monthly WB temperatures of 49ºF and 48.2ºF, respectively (References 2.3-202 and 2.3-203). New Orleans and Lake Charles have slightly higher mean monthly annual WB temperatures than Baton Rouge because of their proximity to the Gulf of Mexico.

Table 2.3-207 provides monthly and annual dew point summaries for Baton Rouge, on the basis of 35 years of data accumulated between 1961 and 1995. Using hourly Solar and Meteorological Surface Observation Network (SAMSON) and Hourly United States Weather Observations (HUSWO) data provided on CD-ROM by the NCDC, the mean annual dew point temperature was calculated to be 57.3ºF (References 2.3-211 and 2.3-212). In comparison, the mean annual dew point temperature for New Orleans and Lake Charles are 60.1ºF and 60.3ºF, respectively, approximately 5 percent higher than Baton Rouge (References 2.3-202 and 2.3-203). Mean dew point temperatures for every month at Baton Rouge, as expected, are lower than the mean dew point for New Orleans and Lake Charles. According to Tables 2.3-203, 2.3-204, and 2.3-207 the maximum monthly mean dew point temperature occurs in July for all first-order stations. The minimum monthly mean dew point temperature occurs in January, when the mean monthly temperature is the lowest. During the winter, the difference in mean dew point between Ryan Airport and the other first-order stations is greatest, while the differences are smallest during the summer. It is apparent that the content of atmospheric moisture can be directly correlated to the distance from the coastline in the region of the RBS.

Extreme values of dew point temperature are also displayed in Table 2.3-207 for Ryan Airport. The highest dew point temperature measured at Ryan Airport in the 35-year period analyzed is 82.9ºF, corresponding with the summer season, while the lowest dew point temperature of -9ºF occurred during the winter season. The last column in Table 2.3-207 shows that mean diurnal variations in dew point vary the least during the late spring, summer, and early fall when mean dew point temperatures are the highest.

2.3.1.1.1.4 Precipitation

RBS COL 2.0-7-A Annual precipitation in the region ranges from just under 50 in. in northwestern Louisiana to nearly 70 in. in eastern parts of the state (Reference 2.3-213). Table 2.3-205 presents normal annual rainfall totals for the four COOP and three first-order stations surrounding the RBS. The normal annual precipitation for Ryan Airport at Baton Rouge is 63.08 in. In comparison, New Orleans receives 64.16 in. per year, and Lake Charles receives 57.19 in. per year (References 2.3-201, 2.3-202, and 2.3-203). Normal annual rainfall totals at the NWS COOP stations (based upon 50 years of data) range from 61.14 in. in New Roads, Louisiana, to 68.22 in. in Woodville, Mississippi (References 2.3-210 and 2.3-214). The consistent annual rainfall totals for the stations within 50 mi. of the RBS demonstrates the regional nature of precipitation events.

Normal monthly precipitation amounts in Baton Rouge average between 5.07 and 6.19 in. during all months except for the fall, when they range between 3.81 and 4.84 in. (Reference 2.3-201). There appear to be two maximum precipitation periods historically during a year. One maximum occurs in January (6.19 in.) and another in July (5.96 in.) and August (5.86 in.). The lowest monthly rainfall occurs in October, when only 3.81 in. of rain falls. New Orleans exhibits a similar normal monthly precipitation pattern as Baton Rouge, with consistent precipitation during most of the months and a minimum of precipitation during the fall months. Lake Charles' normal monthly precipitation trends are somewhat different. Monthly values peak during the summer, but have two minima, during the fall and again late winter into spring. For New Orleans and Lake Charles, the highest monthly precipitation occurs in June, with values of 6.83 in. and 6.07 in., respectively. The lowest values of monthly precipitation occur in October (3.05 in.) for New Orleans and February (3.28 in.) for Lake Charles. Lake Charles experiences a secondary minimum in precipitation during October (3.94 in.).

As displayed in Table 2.3-206, since 1951, the highest 24-hr. rainfall total recorded at Baton Rouge is 12.08 in., occurring during April 1967 (Reference 2.3-201). The highest monthly total for Baton Rouge is 23.18 in. during June 1989. The highest 24-hr. rainfall totals for New Orleans and Lake Charles are 12.66 in. (November 1989) and 16.88 in. (May 1980), respectively. In New Orleans, a monthly maximum of 21.18 in. of rain occurred in May 1995, while, in Lake Charles, the maximum monthly rainfall amount of 25.33 in. occurred in June 1989 (References 2.3-201, 2.3-202, and 2.3-203). The maximum 24-hr. rainfall totals based upon 50 years of data for the four COOP stations surrounding the RBS ranged from 8.77 in. at Amite, Louisiana, in April 1983 to 10.82 in. at Woodville, Mississippi, in October 1964. Maximum monthly rainfall totals range from a minimum of 19.38 in. in March 1973 in Woodville, Mississippi, to a maximum of 21.26 in. at New Roads, Louisiana, in June 1989 (Reference 2.3-210). Extreme events of 24-hr. and monthly rainfall occur primarily between March and November in the region surrounding the RBS.

As shown in Tables 2.3-202 through 2.3-204, snowfall is very infrequent across central and southern Louisiana. Normal annual snowfall values at Baton Rouge and Lake Charles are 0.20 and 0.30 in., respectively, while New Orleans' annual normal snowfall is zero. Table 2.3-206 shows that the maximum 24-hr. and monthly snow total at Baton Rouge over 45 years of record is 3.2 in., occurring in February 1998 (Reference 2.3-201). The largest 24-hr. and monthly snowfall totals at New Orleans and Lake Charles are 2.7 and 4.0 in., respectively (References 2.3-202 and 2.3-203). The highest 24-hr. snowfall at the four NWS COOP stations shown in Table 2.3-206 is 6.0 in., which occurred at Amite and Woodville (Reference 2.3-215). New Roads reported maximum 24-hr. and monthly snowfall totals of 3.2 in., while Grand Coteau reported maximum 24-hr. and monthly snowfall of 5.5 in. and 5.6 in., respectively. Higher 24-hr., 2-day, and 3-day snowfall totals were found at other observation sites near the RBS. Simmesport in Avoyelles Parish and Clinton in East Feliciana Parish recorded 24-hr. snowfall totals of 9.0 in. The highest 2- and 3-day snowfall totals occurred at the Baton Rouge Government recording station, where an isolated measurement of 12.5 in. was reported in 1899; however, there are no details regarding the accuracy of this measurement (Reference 2.3-209).

2.3.1.1.1.5 Drought

RBS COL 2.0-7-A Louisiana is one of the wettest states in the United States (Reference 2.3-201). However, droughts do happen from time to time. Many of the droughts last only a few weeks and typically occur during the summer or fall months. In Baton Rouge from September 28 through November 6, 1978 (932 hr. or 38.8 days), no measurable amounts of precipitation were reported (References 2.3-211 and 2.3-212). This was the longest dry stretch that occurred during the 1961 to 1995 time period. Prolonged extreme droughts, while rare, do occur occasionally (Reference 2.3-205). According to the Palmer Drought Index (PDI), five extreme droughts (PDI values of less than -4.0) have occurred in Louisiana between 1900 and 2000 (References 2.3-216 and 2.3-217).

2.3.1.2 Regional Meteorological Conditions for Design and Operating Bases

2.3.1.2.1 Severe Weather

2.3.1.2.1.1 Thunderstorms and Lightning

RBS COL 2.0-7-A Thunderstorms are a common occurrence at the RBS and the surrounding region at all times during the year. Based upon 59 years of data, Table 2.3-202 indicates that Baton Rouge averages nearly 74 days per year where thunder is at least heard (Reference 2.3-201). The highest seasonal rate of occurrence for thunderstorms is during the summertime (June to August), when around 51 percent of all thunderstorm days occur. Specifically, July has the highest occurrence of thunderstorms, with an average 15.2 days reported. The mean number of thunderstorm days per month is lowest during the late fall and winter seasons, reaching a minimum of 2.2 days per month in January.

The frequency of lightning strikes to earth can be estimated using a method from the Electric Power Research Institute (EPRI). The method is presented by the U.S. Department of Agriculture, Rural Utilities Service, in a publication titled *Summary of Items of Engineering Interest*. The formula assumes a relationship between the number of thunderstorm days per year (T) and the number of lightning strikes to hit Earth per square mile (N) (Reference 2.3-218).

$$N = 0.31T$$

Using the above formula and the previously given average of 74 days of thunderstorms per year, the average number of lightning strikes is then calculated as 23 strikes per square mile (mi^2) per year or nearly 9 strikes per square kilometer (km^2) per year for the region. This calculation compared well with the 1996 to 2000 flash density map created by Vaisala, which indicates that the RBS falls in the region that averages around 9 to 16 strikes per km^2 per year (Reference 2.3-219).

For a more detailed look at the average number of strikes to occur near the reactor (i.e., within a 1000-ft. radius or 0.113 mi^2), the following ratio was applied:

> 23 strikes/mi^2 per year x 0.113 mi^2 = 2.60 strikes/year that may strike near (within 1000 ft.) or even possibly hit the reactor itself.

2.3.1.2.1.2 Extreme Winds and High Wind Events

RBS COL 2.0-7-A *Extreme Winds*

Wind loading on plant structures is estimated using a 3-second wind gust at 33 ft. (10 m) above ground level to create a basic wind speed for regions across the United States. The American Society of Civil Engineers (ASCE) classifies the RBS region into Exposure Category C (Reference 2.3-220). From the Engineering Weather Data, Version 1.0 CD-ROM, the maximum basic wind speed with a 50-year recurrence interval is 120 mph for Baton Rouge (Reference 2.3-221). Applying a 50- to 100-year wind multiplier of 1.07 supplied by the ASCE and Structural Engineering Institute (SEI) in Table C6-7 of ASCE/SEI 7-05, the maximum basic wind speed for the RBS increases to 128.4 mph (Reference 2.3-220).

Local and regional records of maximum wind speeds occurring from thunderstorms and other high wind events present values lower than the above maximum basic wind speed. According to the NCDC storm database, the highest wind speed recorded for West Feliciana Parish is 72.5 mph on March 5, 1992 (Reference 2.3-222). Using the same NCDC storm database, the highest wind speed recorded in the surrounding parishes is 86 mph, occurring in East Baton Rouge Parish on August 1, 1959. For comparison, a maximum 2-minute wind speed of 60 mph, along with a corresponding 78 mph 5-second wind gust, was recorded at Ryan Airport in December 2002 (Reference 2.3-201). Wind data records from the LCD for Ryan Airport span back only 13 years. As expected, the observed wind speeds from the NCDC database are much lower than the calculated maximum basic wind speed for the RBS. The reason for this difference is that the highest observed wind speeds in the NCDC database were recorded from thunderstorms, while the maximum basic wind speed value is used to predict maximum wind speeds that could occur during a hurricane.

High Wind Events

This subsection provides the frequency of occurrence of winds greater than 50 knots, in accordance with the NRC Regulatory Guide 4.2. Storm reports that include wind speeds of 50 knots or greater occur with many types of weather phenomena such as thunderstorms, tornadoes, and hurricanes. Wind reports for thunderstorms and tornadoes were obtained from the NCDC storm database for the following seven-parish region surrounding the RBS: Pointe Coupee, West Baton Rouge, East Baton Rouge, Avoyelles, West Feliciana, East Feliciana, and the Mississippi County of Wilkinson. Tropical cyclone data was pulled from the National Hurricane Center (NHC) online database.

Between January 1, 1950 and March 31, 2007, there have been 62 reports of wind events that were 50 knots or greater in the seven-parish region. The highest wind speed reported was 75 knots (86 mph) in the East Baton Rouge Parish on August 1, 1959 (Reference 2.3-222). Many of the reports for high winds contained in the NCDC storm database do not specify wind speeds and, therefore, may underestimate the count of wind events 50 knots or greater in the region of the RBS.

In the same time period, 74 tornadoes were reported in the seven-parish area (Reference 2.3-222). All tornadoes are categorized as F0 or stronger on the Enhanced Fujita (EF) scale, thereby containing wind speeds greater than 50 knots. Additional discussion of tornadoes in the region surrounding the RBS is provided in Subsection 2.3.1.2.1.3.

There were 21 tropical storms and hurricanes where the center of the storm passed within 25 nautical mi. of the RBS between 1851 and 2006. Of the 21 tropical storms and hurricanes, only nine remained classified as hurricanes as they passed within 25 nautical mi. of the site (Reference 2.3-223). Hurricanes categorized on the Saffir-Simpson Scale contain minimum wind speeds of 64 knots, indicating that all nine events may have contained winds of 50 knots or greater at the RBS. Tropical storms, however, are classified as storm systems containing wind speeds between 34 to 63 knots. Because of this range, not all of the tropical storms counted in the previous estimate may have contained wind speeds equal to or greater than 50 knots; however, they are included to provide a conservative estimate of high wind events for the RBS.

2.3.1.2.1.3 Tornadoes and Waterspouts

RBS COL 2.0-7-A *Waterspouts*

Waterspouts are considered to be the counterpart of tornadoes, but occur over large bodies of water. The Mississippi River is the nearest body of water, but is not large enough to spawn waterspouts. Therefore, waterspouts are not expected to occur at the RBS.

Tornadoes

Design-Basis Tornado (DBT) and Tornado Missiles for Nuclear Power Plants (Regulatory Guide 1.76), published in March 2007, was used to determine the design parameters that should be considered in the event that the most severe tornado strikes the RBS. In addition, DBT wind speeds for the RBS, utilizing information from the *Tornado Climatology of the Contiguous United States* (NUREG/CR-4461, Rev. 2) published in February 2007, are presented herein. NUREG/CR-4461, Rev. 2, is an update to Rev. 1 that recalculated the tornado climatology using the EF scale for the time period of 1950 through August 2003

(Reference 2.3-224). The relationship of the damage intensity to the tornado maximum wind speed in the new EF scale is as follows (Reference 2.3-225):

- EF0: 65 - 85 mph
- EF1: 86 - 110 mph
- EF2: 111 - 135 mph
- EF3: 136 - 165 mph
- EF4: 166 - 200 mph
- EF5: 201+ mph

The EF scale uses the fastest 3-second wind speeds as opposed to the fastest quarter mi. wind speeds used in the original Fujita Scale (Reference 2.3-224). The result of this new methodology is lower DBT maximum wind speeds, as shown in Table 1 of Regulatory Guide 1.76. NUREG/CR-4461, Rev. 2, also introduces a term to account for the finite dimensions of structures, as well as the variation of wind speed along and across the tornado footprint (Reference 2.3-224). The seven DBT values deemed critical by the NRC when designing nuclear facilities are as follows:

- Tornado strike probability
- Maximum wind speed.
- Translational speed.
- Maximum rotational speed.
- Radius of maximum rotational speed.
- Pressure drop.
- Rate of pressure drop.

Tornado Strike Probability

NUREG/CR-4461, Rev. 2, divides the United States into 2-degree latitude/longitude boxes containing the number of tornado events reported from 1950 through August 2003. Figure 5-7 of NUREG/CR-4461, Rev. 2, shows that the RBS is located in the far northern section of the 2-degree box that is bound between the 90- and 92-degree west longitudes and the 29- and 31-degree north latitudes. Adjacent 2-degree boxes to the north, northwest, and west contain significantly higher numbers of tornado events. In addition, part of the RBS 2-degree box lies in coastal waters of the Gulf of Mexico, which may explain the decreased number of tornado events. To incorporate these higher tornado numbers, a 4-degree latitude/longitude box was chosen to replace the 2-degree box presented in NUREG/CR-4461, Rev. 2. A larger box provides a more conservative basis for calculating the probability of a tornado striking the RBS. Guidelines for calculating strike probability are presented in NUREG/CR-4461, Rev 2. Following the NUREG/CR-4461, Rev. 2, methodology, the strike probability for a point structure in any given year is provided by the following equation (Reference 2.3-224):

$$P_p = A_t/NA_r$$

Where:

P_p= Tornado strike probability for a point structure per year, regardless of wind speed.

A_t= Total area affected by tornadoes within a region of interest in N years.

N = Number of years of tornado record.

A_r= Area of the region of interest.

The 4-degree latitude/longitude box was centered on the location of the RBS proposed reactor at the following coordinates:

Latitude: 30º 45' 26.39"N; Longitude: 91º 19' 58.62"W

The 4-degree box encompasses 24 counties in Mississippi and all but eight parishes in Louisiana that are either fully or partially inside the box. The number of tornadoes occurring in the 4-degree box was obtained from the NCDC storm database for the 57.33-year period of January 1, 1950 through March 31, 2007.

In the following table, the number of tornadoes for each EF scale class is displayed. On average, 29.43 tornadoes per year occurred in the 4-degree box, based on the 1687 tornadoes that were reported during the 57.33-year period (Reference 2.3-222). The total area affected by tornadoes in the 4-degree box, shown in the following table, can be found by multiplying the number of tornadoes in each EF scale class by the expected values for tornado segment statistics in the central United States (found in Table 2-10 of NUREG/CR-4461, Rev. 2).

	F0	**F1**	**F2**	**F3**	**F4**	**F5**	**Total**
Number of Tornadoes	470	742	345	104	23	3	1687
Expected Value of Tornado Area (mi^2)[(a)]	0.0341	0.3374	1.1784	3.0857	4.7263	6.0152	
Total Tornado Area (mi^2)=A_t	16.03	250.35	406.55	320.91	108.71	18.05	1120.60

a) From Table 2-10 of NUREG/CR-4461, Rev. 2.

The total area of the 4-degree box is calculated by summing the areas of Mississippi counties and Louisiana parishes inside the 4-degree box. With the county and parish areas data collected from the U.S. Census Bureau, an estimate was made of a total area of 51,399.9 mi^2 (Reference 2.3-226). Using a total tornado area of 1120.60 mi^2 (A_t), a 4-degree box area of 51,399.9 mi^2 (A_r), and a time period of 57.33 years (N), the calculated strike probability (P_p) for the RBS becomes 3.80 x 10^{-4} for the RBS site, or a recurrence interval of once every 2630 years.

In comparison, Table 5-1 in NUREG/CR-4461, Rev. 2, shows the calculated probability of a tornado striking any point in the central United States as 3.58 x 10^{-4} or a recurrence interval of once every 2793 years (Reference 2.3-224). The results demonstrate that incorporating the tornado statistics for adjacent 2-degree boxes creates a more conservative estimate of the probability of a tornado striking the RBS, rather than utilizing the generalized value for the central United States.

Regulatory Guide 1.76 defines DBT characteristics for nuclear power plants that have a tornado strike probability greater than 1.0 x 10^{-7}. The calculated RBS tornado strike probability of 3.80 x 10^{-4} exceeds the previous probability threshold, which requires Unit 3 to meet the design requirements of Regulatory Guide 1.76. Table 1 from Regulatory Guide 1.76 presents the remaining six DBT characteristics for new reactors located in the United States whose tornado strike probabilities exceed the 1.0 x 10^{-7} threshold. According to Table 1, since the RBS is located in Region I, the DBT characteristics are as follows:

DBT Characteristics	RBS[(a)]	ESBWR DCD[(b)]
Maximum wind speed (mph)	230	330
Translational speed (mph)	46	70
Maximum rotational speed (mph)	184	260
Radius of maximum rotational speed (ft.)	150	150
Pressure drop (psi)	1.2	2.4
Rate of pressure drop (psi/sec)	0.5	1.7

a) From Table 1 of Regulatory Guide 1.76.

b) From ESBWR DCD Tier 2, Revision 4.

The DBT characteristics for the RBS are bounded by the values cited in Table 2.0-1 of the ESBWR DCD and are listed in the table above. In addition, the ESBWR DCD values are applied to the full building height of structures at the RBS for the spectrum of tornado-generated missiles specified in Table 2 of Regulatory Guide 1.76.

2.3.1.2.1.4 Hail

RBS COL 2.0-7-A Because of the frequent occurrence of thunderstorms, hail is possible throughout the year at the RBS. In the RBS region, hail occurs most frequently in the spring months, with the peak number of hail events occurring in March (Reference 2.3-227). A secondary, but much smaller, peak for hail occurrence is in December. Hail tends to occur much more frequently north of 31º N latitude in Louisiana, with more than 81 percent of the annual Louisiana hail reports occurring there. The RBS is located in the region south of the 31º N latitude and typically receives fewer hail events.

A study done by Stanley A. Changnon, Jr., estimates that hail occurs on average 2 days per year at the RBS (Reference 2.3-228). Hail reports were obtained from the NCDC storm database for the Louisiana parishes of Pointe Coupee, West Baton Rouge, East Baton Rouge, West Feliciana, East Feliciana, Avoyelles, and the Mississippi County of Wilkinson. The seven-parish area surrounding the RBS reported 144 severe hail events (hail diameter ≥ 0.75 in.) over a 57.33-year period of January 1, 1950 through March 31, 2007, producing an average of 2.51 occurrences of severe hail per year (Reference 2.3-222). Of the 144 severe hail reports, 52 were reported as large hail (hail diameter ≥ 1.75 in.). The largest hail report was 2.00 in., occurring in East Baton Rouge County on April 6, 1960. As would be expected, hail reports were more commonly reported near areas with higher population densities. In addition, the overall frequency of hail reports has steadily increased since the study done by Changnon (1977). It is reasonable to assume that the increase may be explained by the improved technology of Doppler radars, cell phones, and the increased public awareness of reporting hail events (Reference 2.3-229).

2.3.1.2.1.5 Tropical Weather

RBS COL 2.0-7-A This subsection includes statistics regarding hurricanes, tropical storms, tropical depressions, subtropical depressions, and extratropical storms affecting the region surrounding the RBS. The general term that is used to describe all of the mentioned tropical systems is a tropical cyclone. All tropical cyclones present the potential for heavy rain and strong winds to coastal and inland areas. Hurricanes and some tropical storms are more organized systems and usually produce the highest potential for widespread damaging winds. The RBS is located approximately 75 mi. from the nearest point on the Gulf Coast. The potential still exists for strong winds associated with hurricanes and tropical storms to make it as far inland as the RBS, as demonstrated over areas of Mississippi during Hurricane Katrina. As Hurricane Katrina weakened and slowly moved inland, hurricane force sustained winds greater than 100 mph were experienced as far as 60 mi. inland from the coastline (Reference 2.3-230). The intensity and forward speed of hurricanes largely determines how far inland hurricane speeds are realized. Additionally, all hurricanes and tropical storms bring the threat of extremely heavy rainfall intensities and amounts as the center of the storm passes near the RBS.

A total of 76 tropical cyclones have passed within 100 nautical mi. of the current RBS location between 1851 and 2006 (Reference 2.3-223). The frequency of tropical cyclones peaks in September, when 34 of the storms passed within 100 nautical miles of the RBS. The next highest month is August, with 15 tropical cyclones occurring. Tropical cyclones historically occur near the RBS as early as May and as late as the end of November. Frequencies of the 76 tropical cyclones by classification during the 156-year period are as follows:

Tropical Cyclone Type	Total Occurrences
Hurricane, Category 5	1
Hurricane, Category 4	4
Hurricane, Category 3	3
Hurricane, Category 2	10
Hurricane, Category 1	12
Tropical Storms	40
Tropical Depressions	4
Subtropical Storms	1
Subtropical Depressions	0
Extratropical Storms	1
Total	76

Heavy rainfall events associated with tropical cyclones are one of the biggest concerns for the RBS. The occurrence of such events can be seen by examining historical monthly and 24-hr. rainfall amounts around the area, as well as the statistical rainfall values for long return periods. The highest monthly rainfall at Ryan Airport (23.18 in.) and the New Roads COOP site (21.26 in.) occurred in June 1989 when Tropical Storm Allison made landfall (References 2.3-201, 2.3-208, and 2.3-210). The two highest 24-hr. rainfall totals occurred at New Roads (9.85 in.) and Woodville (10.82 in.) when Hurricane Hilda made landfall in 1964. According to the *Rainfall Frequency/Magnitude Atlas for the South-Central United States*, the 50-year and 100-year return values of 24-hr. maximum rainfall amounts are 11.0 in. and 12.0 in., respectively (Reference 2.3-231). As expected, these values are consistent with and slightly higher than the actual recorded 24-hr. maximum rainfall amounts.

2.3.1.2.2 Probable Maximum Annual Frequency of Occurrence and Duration of Dust (Sand) Storms

RBS COL 2.0-7-A The RBS is located in a region where prolonged dry periods are infrequent and the occurrence of dust, blowing dust, blowing sand, and dust storms are rare. Typically, the major dust events that occur in southeast Louisiana are when the southern plain states of Oklahoma, Texas, and New Mexico are suffering from extreme drought conditions and a synoptic scale system transports the dust eastward. Hourly observations were obtained from Ryan Airport to provide an estimate of the occurrence of dust at the RBS (References 2.3-211 and 2.3-212). As previously discussed, Ryan Airport is located 19 mi. southeast of the RBS and records data that are considered representative of the meteorological conditions at the RBS. Table 2.3-208 presents the annual number of hours that dust was reported for each year during the period 1961 - 1995. Noticeable are the low number of years that reported hours with dust and the absence of dust events after 1983. An anomalous event occurred in 1977 when 90 hr. of dust occurred in the observations for the year, a value significantly higher than any year in the 35-year period. A large portion of the annual hours with dust occurred in February 1977 and can be attributed to a very significant dust storm that formed over eastern New Mexico and western Texas (Reference 2.3-232). The dust and sand pall from the dust storm was transported eastward and across the northern two-thirds of Louisiana. Ryan Airport reported 41 consecutive hours of dust, and horizontal visibilities were reduced at times in Baton Rouge to as low as 0.8 mi. In March 1977, another stretch of 39 hr. of dust was recorded; however, visibilities remained above 4 mi. the entire time.

Table 2.3-208 displays the annual frequency of occurrence of dust for each year during the period 1961 - 1995. One method to determine the probable maximum annual frequency of occurrence is to find the 99.9 percent percentile rank from the data set of annual hours with dust reported at Baton Rouge during the 35-year period. However, the variance and standard deviation of the data values are large and, therefore, would not provide for an accurate depiction of the probable maximum frequency of occurrence. A more conservative method is to consider the probable maximum annual frequency of occurrence as 1.03 percent of hours annually (90 hr.), corresponding with the 1977 event, as an example of a worst-case scenario.

Table 2.3-209 displays the distribution for duration of discrete dust events that occurred at Baton Rouge. Discrete events are defined as at least 1 hr. of consecutive observations of dust, blowing dust, blowing sand, or a dust storm occurring. The majority of dust events lasted 4 hr. or less. For more organized dust events, such as the dust event of 1977, durations would typically range between 39 and 41 hr. The probable maximum duration for dust events at the RBS can be estimated through numerous statistical methods. However, the variability and standard deviation of the data set for discrete dust events is large, and such statistical calculations would underestimate the probable maximum duration of dust events at the RBS. For this reason, it can be conservatively stated that the probable maximum duration of dust events at the RBS is 41 hr., a duration associated with the worst dust event experienced at Baton Rouge over the 35 years analyzed.

2.3.1.2.3 Probable Maximum Annual Frequency of Occurrence and Duration of Freezing Rain

RBS COL 2.0-7-A Freezing rain is defined as an accretion of ice resulting from liquid precipitation striking a frozen surface (e.g., tree branches or power lines) and freezing. Typically, the liquid droplets are supercooled-liquid at subfreezing temperatures during their fall to the ground. The weight of the ice accretion can become sufficient to cause damage to trees and power lines, as well as slow down or even halt transportation on ice covered roads and bridges. The surface air temperature during freezing rain events typically ranges between 25ºF and 32ºF (Reference 2.3-233). However, in the region of the RBS, subfreezing temperatures are short-lived, especially after freezing rain events when temperatures usually rise above freezing within a few hours after the end of precipitation (Reference 2.3-233). The region surrounding the RBS averages less than 1 day per year of sleet, freezing drizzle, and/or freezing rain (References 2.3-234 and 2.3-235).

Frequency of Occurrence

Ice storm reports were obtained from the NCDC storm database to estimate the frequency of occurrence and duration of freezing rain events at the RBS. The NCDC storm database contains only three ice storms occurring from 1950 through March 2007 in the seven-parish region surrounding the RBS (Reference 2.3-222). Table 2.3-210 presents the three freezing rain events that have affected the seven-parish region during the period 1993-2007. From the data, the frequency of freezing rain events during the 15-year period is 1 event every 5 years, or 0.20 events per year. It is likely that the overall recording of freezing rain and sleet events has improved over the last 15 years, as evidenced by the fact that no events were recorded in the NCDC storm database before 1996. Prior to 1993, records for ice storms are not available from the NCDC storm database. However, the low frequency of the freezing precipitation events during the last 15 years signifies how rare and infrequent they are.

Duration of Events

Table 2.3-210 provides beginning and end dates of each freezing rain event during the period 1993 - 2007. The durations provided in the table are for ice storms that moved across several parishes or counties and would be less for a single location. For this reason, hourly data were obtained from Ryan Airport to determine the exact duration of each event for the RBS. The three freezing rain events are summarized below.

The freezing rain event of February 1-3, 1996 occurred in Avoyelles County, northwest of the RBS, causing numerous trees to snap and subsequent power outages. During the 38-hr. event, 0.71 in. of liquid precipitation was recorded at Ryan Airport (Reference 2.3-236). The first 4 hr. of the event were reported as rain, with ambient air temperatures between 37ºF and 39ºF. After 3 dry hours, rain and thunderstorms were recorded for 11 consecutive hours at Ryan Airport, while ambient air temperatures ranged between 35ºF and 36ºF. After another break in precipitation, temperatures dropped to 18ºF, and the precipitation ended with 1 hr. of light snow. A conservative estimate of the duration for this ice event would be to neglect dry hours, counting only those hours with measurable precipitation recorded. Therefore, the duration of freezing rain hours for this event can be estimated to be 16 hr. Another conservative approach is to consider all liquid precipitation as freezing rain for calculating the total ice accretion. The total amount of liquid precipitation recorded from this event is 0.71 in. Accounting for the expansion that occurs when liquid water freezes, the ice accretion becomes 0.77 in. (0.71 in. + [0.71 in. x 0.09]).

The ice storm of January 12-14, 1997 caused the most damage of the three ice events analyzed. The precipitation at Ryan Airport started as rain and lasted for 4 hr., with surface air temperatures of 32ºF to 34ºF. A mixture of freezing rain, sleet, and snow then occurred for a stretch of 5 hr. as air temperatures held at 32ºF. The following 3 hr. were reported as rain with air temperatures rising slightly from 33ºF to 34ºF. Temperatures then dropped back to 32ºF, and precipitation changed to freezing rain for 2 hr. followed by 1 hr. of snow. A 6-hr. period of dry weather occurred before 6 hr. of intermittent freezing rain and light snow occurred as temperatures ranged between 30ºF and 32ºF. The temperature rose to 34ºF, and precipitation fell as rain during the final hours of precipitation. Conservatively, the duration of this ice storm can be estimated to be 22 hr. The liquid equivalent for the precipitation is estimated to be 0.38 in., which is equivalent to 0.41 in. of ice (0.38 in. + [0.38 in. x 0.09]).

The third ice storm included in this study occurred January 1-2, 2002. Hourly reports from Ryan Airport for this event included rain, snow, and sleet, but not freezing rain. For the purpose of this study, it is conservative to count all precipitation hours as containing freezing rain, especially since the air temperature remained at 32ºF during the entire event. Using this method, the duration of the ice storm is estimated to be 10 hr. The liquid equivalent for the precipitation is estimated to be 0.20 in., which is equivalent to 0.22 in. of ice (0.20 in. + [0.20 in. x 0.09]).

Probable Maximum Annual Duration

Based on the 22-hr. freezing rain event as the 14-year event and the 16-hr. event as the 7-year event, the maximum probable duration in 100 years is estimated to be 36 hr. assuming a logarithmic extrapolation, i.e., 36=22 + (22-16) * Log(100-14)/Log(14-7). This is a very conservative estimate, considering the small sample size of ice events and the large standard deviation of the duration of the events.

2.3.1.2.4 Weight of Snow and Ice on Structures

RBS COL 2.0-7-A For safety reasons, it is important to determine the potential maximum weight of frozen precipitation on structures at the RBS. The following subsections provide estimates for the weights of the 100-year return period snowpack and the 48-hr. probable maximum winter precipitation (PMWP), as well as the 100-year probable maximum ice accretion for the RBS. In accordance with the guidance of NUREG-0800, winter precipitation loads to be considered in the design of the proposed nuclear reactor at the RBS should be based on the weight of the 100-year return period snowpack at ground level plus the weight of the 48-hr. PMWP. As mentioned previously, the climate at the RBS is primarily humid subtropical and characteristically experiences very few snow and ice events on an annual basis. The infrequent nature of frozen precipitation events also lends to the low probability that a snow event followed by an ice event, or vice versa, would likely occur. In addition, air temperatures average annually only 150.8 hr. per year when temperatures are below freezing (References 2.3-211, 2.3-212, and 2.3-236). For these reasons, the following analysis provides an estimate of the weight of the 48-hr. PMWP in the form of rain in combination with the 100-year probable maximum ice accretion, as well as the 100-year snowpack. This estimate provides a conservative and realistic probable maximum weight of snow and ice on structures for design purposes at the RBS.

2.3.1.2.4.1 Rain on Ice Load

RBS COL 2.0-7-A *Probable Maximum Winter Precipitation*

Hydrometeorological Report (HMR) No. 53 provides a method to determine the 48-hr. PMWP for the RBS, based on long-term climatological normals. The winter precipitation amounts provided in HMR No. 53 are liquid equivalent amounts and incorporate all winter precipitation in the 10-mi^2 area that surrounds the RBS (Reference 2.3-237). Section 5 of HMR No. 53 recommends interpolation with a smooth depth-duration curve of the 24-hr. and 72-hr. PMWP amounts through the point of origin (0,0) to estimate the 48-hr. PMWP. Winter at the RBS can be defined as the months of December, January, and February. This is confirmed by the fact that only those months mentioned above average a fraction of a day annually where the maximum temperature does not rise above freezing (Reference 2.3-201). In addition, all freezing rain and ice accretion events in Subsection 2.3.1.2.3 occurred in January and February. From Figures 26 and 36 in Reference 2.3-237, the 24-hr. and 72-hr. PMWP are determined to be 28.5 and 38.5 in., respectively, both occurring in January and February. Using the method recommended by HMR 53 yields a 48-hr. PMWP of 35.2 in. for the RBS. Scuppers and drains on the roof of the ESBWR are designed to limit water accumulation to no more than 4 in. of water.

Rain on Ice

Subsection 2.3.1.2.3 provides details on the three ice events that occurred in the RBS region during the period 1993 - 2007. The ice accretion from the three events was estimated to be 0.77 in., 0.41 in., and 0.22 in. To determine the 100-year return period probable maximum ice accretion for the RBS, Gumbel distributions were calculated as described by Wilks (Reference 2.3-238). Using this method, the 100-year recurrence return period probable maximum ice accretion becomes 1.46 in. The lack of ice events and the large standard deviation for the ice accretion amounts provide an inaccurate depiction of the probable maximum ice accretion amount for the RBS. A more reasonable approach is to use the weight of 0.77 in. of ice (equivalent to 0.71 in. of water) and the 4 in. of water to estimate the weight of rain on ice on the roof of the ESBWR.

The weight of 4 in. of water is calculated to be 20.8 lb_f/ft^2 (4 in. of water x 5.2 $lb_f/in\ ft^2$). The weight of 0.71 in. of water is calculated to be 3.7 lb_f/ft^2 (0.71 in. of water x 5.2$lb_f/in\ ft^2$). The summation of these two weights yields 24.5 lb_f/ft^2 as the maximum probable weight of rain on ice on the roof of the ESBWR.

2.3.1.2.4.2 Rain on Snow Load

RBS COL 2.0-7-A *100-Year Return Period Snowpack*

Southern Louisiana is well south of the storm track of systems that produce heavy snow across the United States. However, snow does occur from time to time at the RBS. The ASCE/SEI 7-05, "Minimum Design Loads for Buildings and Other Structures," identifies that the RBS is located in a snow load zone of 5 lb_f/ft^2, based on a 50-year recurrence (Reference 2.3-220). To convert to a 100-year recurrence, Table C7-3 of ASCE/SEI 7-05 cites a conversion factor of 1.22 (1/0.82). Using this conversion factor, the 100-year recurrence snowpack for the RBS becomes 6.1 lb_f/ft^2 (5 lb_f/ft^2 x 1.22).

Snow measurements in the RBS region are consistent with the calculated ASCE/SEI 7-05 100-year recurrence snowpack value. The highest 24-hr. snowfall amounts for the NWS first-order and COOP sites around the RBS are displayed in Table 2.3-206. The highest 24-hr. snowfall of 9.0 in., however, occurred during February 1960 at Simmesport in Avoyelles Parish and Clinton in East Feliciana Parish. The highest 2- and 3-day snowfalls occurred at the Baton Rouge Government recording station, where an isolated measurement of 12.5 in. was reported in 1899; however, there are no details regarding the accuracy of this measurement (Reference 2.3-209).

Snowpack is defined as the amount of measured snow on the ground reported in inches. The NWS measures snowpack on a daily basis at first-order and most COOP stations reporting it as snow depth. Determining the weight of the snowpack is not exact, because snow can vary in density with different air temperatures. In addition, snow around the RBS typically melts quickly, rarely lasting more than a day or two, as a result of both a warm ground and freezing temperatures that are short-lived (Reference 2.3-201). A more useful method to determine the weight of snowpack is to calculate the water equivalent of the falling snow. The snow-to-water equivalent ratio varies anywhere from 0.07 to 0.15 in. for 1 in. of snow (Reference 2.3-239). Using this ratio, the weights of the 24-hr. and 2- and 3-day snowfall maximums in the RBS region is given by the following:

$$12.5 \text{ in. x } (0.07 + 0.15)/2 \text{ x } 5.2 lb_f/in\ ft^2 = \quad 7.2\ lb_f/ft^2$$

$$9.0 \text{ in.} \times (0.07 + 0.15)/2 \times 5.2 lb_f/\text{in ft}^2 = \quad 5.2 lb_f/ft^2$$

These values resemble the 100-year snowpack for the RBS indicated by ASCE/SEI 7-05. Conservatively, 7.2 lb_f/ft^2 is considered to be the 100-year maximum snowload for structures at the RBS.

Rain on Snow

As mentioned in Subsection 2.3.1.2.4.1, the maximum load of water on the roof of the ESBWR is 20.8 lb_f/ft^2. The weight of the 100-year snowpack on safety-related structures at the RBS is 7.2 lb_f/ft^2. A conservative approach would be to consider the weight of the snowpack on the ground as equivalent to that on the roof of the ESBWR. Section C7.10 of ASCE/SEI 7-05 also mentions that for rain on snow loads, a surcharge of 5 lb_f/ft^2 must be added to account for heavy rain events where rain flows through the snowpack and then drains away. This is reasonable because thunderstorms are a common occurrence at the RBS. Therefore, the maximum total load of the rain load on the 100-year snowpack for design purposes at the RBS is determined as follows:

$$7.2 lb_f/ft^2 + 20.8 lb_f/ft^2 + 5 lb_f/ft^2 = \quad 33.0 lb_f/ft^2$$

The weight of the rain on snow scenario, therefore, provides a more conservative estimate of the maximum loads of snow and ice on the roofs of safety-related structures at the RBS. However, this estimate is bounded by the ESBWR standard plant site parameters cited in the ESBWR DCD that provides the maximum roof load as 60 lb_f/ft^2.

2.3.1.2.5 Design Basis Ambient Temperature and Humidity Statistics

RBS COL 2.0-7-A The design of structures at power generating facilities, such as the plant heat sink and plant heating, ventilation, and air conditioning systems, is based upon long-term climatological data such as that produced in the *2005 ASHRAE Handbook* (Reference 2.3-240). For design purposes, ASHRAE provides 2.0 percent and 1.0 percent maximum ambient threshold values (annual exceedance probabilities) for the dry-bulb (DB) temperature and the mean coincident wet-bulb (MCWB) temperature, as well as the non-coincident wet-bulb (WB) temperatures. The 99.0 percent and 99.6 percent annual exceedance probabilities are also provided for minimum ambient thresholds. Ryan Airport is the closest location to the RBS for which the *2005 ASHRAE Handbook* provides design values. Based on a 30-year period of record from 1972 through 2001, Table 2.3-211 shows that the maximum 2.0 percent annual DB cooling exceedance temperature is 91.2ºF, with a corresponding MCWB of 77.0ºF. The maximum 1.0 percent annual DB cooling exceedance temperature is 92.6ºF, with a corresponding MCWB of 77.3ºF. The maximum 2.0 percent and 1.0 percent annual WB cooling exceedance temperatures are 78.8ºF and 79.6ºF, respectively. The minimum 99.0 percent and

99.6 percent annual DB heating exceedance temperatures are 30.6ºF and 27.0ºF, respectively.

0 Percent Exceedance Values

0 percent exceedance values represent the maximum or minimum value that is observed over a long period of time, usually 30 years or greater. In order to determine the 0 percent exceedance values for the RBS, hourly DB and WB temperatures were obtained from Ryan Airport for the period 1961 - 2006 (46 years) (References 2.3-211, 2.3-212, and 2.3-236). Table 2.3-211 displays the 0 percent exceedance values of maximum DB, coincident WB, and non-coincident WB, as well as the minimum DB.

100-Year Temperature Values

Values of 100-year maximum and minimum DB temperatures and 100-year maximum WB temperature (non-coincident) are estimated from data obtained from Ryan Airport during a 46-year period (1961 - 2006) (References 2.3-211, 2.3-212, 2.3-236, and 2.3-241). As mentioned in Subsection 2.3.1.1.1.2, long-term temperatures for stations across the RBS are related to the distance from the coastline. Ryan Airport is located approximately 19 mi. southeast of the RBS and is considered to have similar temperature extremes. Maximum and minimum DB and WB values were determined for each year of the 46-year period. Using the method of moments as suggested by Wilks with the annual minimum DB values, the Gumbel distribution estimates the 100-year minimum DB to be 2ºF (Reference 2.3-238). Using this same method, the 100-year maximum DB temperature is calculated to be 106ºF, while the 100-year maximum WB (non-coincident) temperature is estimated to be 86ºF. These values are provided in Table 2.3-211. Because the 100-year return period maximum DB temperature value is extrapolated from a probability distribution, the MCWB temperature is not available for this return interval.

Extreme maximum and minimum DB temperatures for meteorological stations in the region surrounding the RBS were discussed in Subsection 2.3.1.1.1.2 and summarized in Table 2.3-206. The highest DB temperature of 110ºF occurred at the old weather station in the southern Baton Rouge business district in August 1909. The lowest DB temperature recorded was 2ºF, occurring at the old LSU campus in Baton Rouge. There are no details that can verify the accuracy of these measurements. More recent data (1961 - 2006) shows that the highest DB temperature (108ºF) in the region of the RBS occurred at Woodville in August 2000. The lowest temperature (4ºF) also occurred at the Woodville COOP station in December 1989. In comparison, Baton Rouge maximum and minimum DB temperatures over the 46-year period were 105ºF and 8ºF, respectively, occurring in August 2000 and December 1989, respectively. Therefore, the 100-year maximum and minimum DB temperatures and 100-year maximum WB temperature (non-coincident) displayed in Table 2.3-211 are considered representative of the RBS for design purposes. However, the RBS specific design basis ambient temperature and humidity values are bounded by the values in Table 2.0-1 of the ESBWR DCD.

2.3.1.2.6 Ultimate Heat Sink

RBS COL 2.0-7-A The ultimate heat sink (UHS) for the ESBWR at the RBS will be located inside the Reactor Building. The RBS-specific temperatures for the Reactor Building that were provided in Subsection 2.3.1.2.5 are bounded by the maximum and minimum DB temperatures, as well as the maximum WB temperatures that are cited in Table 2.0-1 of the ESBWR DCD. A detailed description of the location and operation of the UHS is provided in Subsection 9.2.5 of the FSAR.

2.3.1.2.7 Regional Air Quality

2.3.1.2.7.1 Background Air Quality

RBS COL 2.0-7-A The RBS is located in the southern tip of West Feliciana Parish and is in attainment for all U.S. Environmental Protection Agency (EPA)-listed criteria pollutants. Several of the EPA-listed criteria pollutants are routinely monitored near the RBS. In fact, the area immediately south of the RBS facility, Baton Rouge, is heavily monitored. Monitors in the Baton Rouge area routinely monitor nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), particulate matter $(PM)_{2.5}$, PM_{10}, and ozone. The Baton Rouge area is considered to be an attainment area for NO_2, SO_2, CO, $PM_{2.5}$, and PM_{10} (Reference 2.3-242). However, the Baton Rouge area is considered a nonattainment area for the EPA's 8-hr. ozone standard. The EPA defines ozone nonattainment areas as those that record 8-hr. ozone levels of 0.075 parts per million (ppm) or higher (Reference 2.3-243). The maximum 8-hr. ozone concentration recorded in the Baton Rouge airshed between 2000 and 2005 was 0.121 ppm at the LSU ozone monitor. In addition, there were 11 design value violations in the Baton Rouge five-parish area between 2002 and 2005. The LSU ozone monitor accounted for 4 of the 11 violations (Reference 2.3-244). The next closest nonattainment area is Orange County, Texas (also nonattainment for ozone), located approximately 155.34 mi. west-southwest of the proposed RBS (Reference 2.3-242).

The closest Class I Area is the Breton National Wildlife Refuge located offshore on the Chandeleur Islands. The Breton National Wildlife Refuge is located 154 mi. east-southeast of the RBS site (Reference 2.3-245). Given the minor nature of air emissions associated with operations of the facility (discussed below), this distance is sufficiently far as to not warrant a concern.

2.3.1.2.7.2 Projected Air Quality

RBS COL 2.0-7-A Air emissions of criteria pollutants would be minor given the nature of a nuclear facility and its lack of significant gaseous exhausts of effluents to the air. Sources of air emissions for the proposed facility include two standby diesel generators, an auxiliary boiler, and a diesel fire pump, as well as a natural draft and a 12-cell mechanical draft cooling tower (MDCT). The combustion sources mentioned above would be designed for efficiency and operated with good combustion practices on a limited basis throughout the year (often only for testing). Given their small size and infrequent operation, emissions from these sources would not only have little effect on the nearby ozone nonattainment area, but would also have minimal effect on the local and regional air quality. The air emissions from the listed equipment are regulated by the LDEQ.

Construction of a new facility at the RBS would lead to an increase of vehicular traffic surrounding the site prior to operations. Furthermore, increased traffic and construction activities would lead to further release of particulates prior to operation of a new facility. However, any increase in particulate emissions from vehicles is expected to be short-term, minor, and remain local to the RBS.

The proposed cooling towers would not be a source of the typical combustion-related criteria pollutants or other toxic emissions. They would, however, emit small amounts of PM as drift. The towers would be equipped with drift eliminators designed to limit drift to 0.002 percent or less of total water flow. Additionally, the primary normal power heat sink (NPHS) proposed for the project is a natural draft cooling tower (NDCT). The height of the tower would allow for good dispersion of the drift and not allow localized concentrations of PM to be realized. The minor nature of the effects of the new cooling towers on visibility and air quality, including the potential for increases in ambient temperature and moisture, icing, fogging, and salt deposition, is discussed in greater detail in Subsection 2.3.2.2.

2.3.1.2.7.3 Air Stagnation

RBS COL 2.0-7-A The main components of air stagnation are light winds and weak vertical mixing. Light winds can also be associated with weak or poor horizontal mixing of the atmosphere, which has the general effect of leading to restrictive horizontal and vertical dispersion and thus air stagnation (Reference 2.3-206). Along with wind speed, wind direction also plays a roll in horizontal mixing, because winds with non-persistent directions can lead to poor dispersion, especially under light wind speeds when the air may recirculate. Finally, temperature inversions are also associated with little to no vertical mixing of the atmosphere and, therefore, air stagnation. Analyses of the persistence of wind speeds and directions are addressed in Subsection 2.3.2.1.6, while inversions are discussed in Subsection 2.3.2.1.8.

Air stagnation episodes typically occur when strong high-pressure systems (anti-cyclones) have a strong influence on the regional weather for 4 days or more. These systems often lead to generally light winds and little vertical mixing as a result of a general sinking of the air in their vicinity. The region surrounding the RBS can expect between 20 and 30 days per year of air stagnation, or four to five episodes per year (Reference 2.3-206). The mean duration of each air stagnation episode is approximately 5 days.

Air stagnation conditions primarily occur during an extended summer season that runs from May through October. This is a result of the weaker pressure and temperature gradients and, therefore, weaker wind circulations during this period. Wang & Angell confirm that air stagnation episodes in the region surrounding the RBS begin to occur in May and June. However, during July and August, the likelihood of air stagnation episodes actually decreases before increasing and reaching a maximum likelihood during late September into October. The decrease in the mean air stagnation days in July and August correlates with the Bermuda High. The high is strongest during July, thus creating a stronger meridional flow of the wind field in the Gulf region and a relative minimum of air stagnation (Reference 2.3-206). The weakening of the Bermuda High from September into October leads to more of a northeasterly surface flow at the RBS during a period when the monthly mean wind speeds are at a minimum. The decreases in mean wind speeds during the late summer and early fall for Baton Rouge are also confirmed by the New Orleans and Lake Charles meteorological stations (References 2.3-201, 2.3-202, and 2.3-203).

2.3.2 LOCAL METEOROLOGY

RBS COL 2.0-8-A Measurements from the RBS on-site meteorological tower, located approximately 1/2 mi. from the proposed unit, are used in this subsection to characterize the local meteorology conditions at the RBS. The on-site meteorological tower (the details of which are contained in Subsection 2.3.3) collects wind speed, wind direction, and temperature at the 30-ft. and 150-ft. levels. The system also records stability, based on the change in temperature (ΔT) between the two levels. Ten-minute data from the most recent 2 years (December 2004 through November 2006) were obtained and converted into hourly format. Data recovery rates for all meteorological parameters collected at the RBS on-site meteorological station are greater than 94 percent. Dew point, precipitation, and fog are not collected at the RBS on-site meteorological station; however, as mentioned in Subsection 2.3.1.1, meteorological conditions at Baton Rouge are representative of the RBS and have been used to supplement RBS data.

2.3.2.1 Normal, Mean, and Extreme Values of Meteorological Parameters

RBS COL 2.0-8-A Regional normal, mean, and extreme values of temperature, wind, moisture, and precipitation are discussed in Subsection 2.3.1.1.1. To demonstrate that the long-term data reported at Ryan Airport are representative of the RBS, this subsection provides a more comprehensive analysis of these parameters and how they represent conditions at the RBS.

Data were obtained for 2 years (December 2004 through November 2006) for the RBS meteorological on-site station for the analysis of temperature and wind. As mentioned above, data for atmospheric moisture content, precipitation, and heavy fog have been obtained from Ryan Airport because of its long reporting history and proximity to the RBS. Extreme values of temperature, rainfall, and snowfall have also been obtained for several COOP stations within a 50-mi. radius of the RBS, since those parameters are more representative from a regional perspective.

2.3.2.1.1 Temperature

RBS COL 2.0-8-A Table 2.3-212 presents monthly and annual mean temperature for the 30-ft. and 150-ft. levels at the RBS, as well as the 10-m temperature at Ryan Airport. To show the similarity of temperatures at Ryan Airport and the RBS, temperature data were analyzed for a 2-year period during December 2004 through November 2006 (Reference 2.3-236). From Table 2.3-212, it is apparent that the mean annual temperature, as well as extreme maximum and minimum temperatures, are uniform for the two stations. Furthermore, these results indicate that the temperature data at Ryan Airport are characteristic of the RBS for longer climatological periods.

Climatological values of temperature for Ryan Airport are presented in Subsection 2.3.1.1.1.2 and summarized in Tables 2.3-202 and 2.3-205. As shown in Table 2.3-202, the mean daily temperature for the 77-year period is 67.4ºF. Mean daily maximum temperatures are highest in August (91.2ºF) and lowest in January (61.8ºF). Mean daily minimum temperatures are highest in July (72.8ºF) and lowest in January (41.5ºF). To illustrate the extreme maximum and minimum values of temperature that are characteristic of the RBS, temperature data were analyzed for the first-order and COOP stations. Table 2.3-206 presents extreme values of temperature in the region surrounding the RBS. The table shows that temperatures have risen as high as 110ºF and dropped as low as 2ºF in the region surrounding the RBS. In general, the RBS is vulnerable to both extreme heat in the summer and short-lived cold outbreaks during the winter months.

2.3.2.1.2 Atmospheric Moisture

RBS COL 2.0-8-A The RBS on-site meteorological monitoring tower does not record atmospheric moisture; however, Subsection 2.3.1.1.1.3 discusses the uniformity of dew point, relative humidity, and WB temperature in the RBS region. It also was discovered that the magnitude of atmospheric moisture content for stations in southern Louisiana is directly related to the distance to the coastline. This relationship indicates that moisture parameters at Ryan Airport, only 19 mi. from the RBS, are representative of the conditions at the RBS.

Atmospheric moisture content at the RBS is highly affected by the nearby Gulf of Mexico. Table 2.3-202 provides normal annual and monthly values of relative humidity and WB temperature for Baton Rouge. Normal annual relative humidity is 75 percent, remaining above 72 percent for each normal monthly value. Daily, the relative humidity is highest around 6:00 a.m. LST and lowest during the early and mid-afternoon hr. The mean annual WB temperature for Baton Rouge is 61.8°F. Mean monthly WB values are highest during the summer months and lowest during the winter months. The highest and lowest values of mean monthly WB, as expected, are during July (75.4°F) and January (46.9°F), respectively.

Table 2.3-207 contains annual and monthly summaries of dew point temperature calculated from HUSWO and SAMSON data for the time period 1961 to 1995. The mean annual dew point temperature for Baton Rouge is 57.3ºF. As would be expected, the mean monthly dew point temperature values are highest during July (72.5°F) and lowest in January (40.7°F). Extreme values of dew point temperature are also presented in Table 2.3-207. The highest dew point temperature measured at Ryan Airport is 82.9ºF, corresponding with the summer season, while the lowest dew point temperature of -9ºF occurred during the winter season. The last column in Table 2.3-207 shows that mean monthly diurnal variations in dew point vary the least during the late spring, summer, and early fall, when mean dew point temperatures are the highest.

2.3.2.1.3 Precipitation

RBS COL 2.0-8-A The RBS on-site meteorological station does not measure rainfall or snowfall on a daily basis. Ryan Airport is the nearest first-order station that has a long period-of-record for reporting precipitation. Normal annual and monthly rainfall values are discussed in Subsection 2.3.1.1.1.4 and summarized in Tables 2.3-202 and 2.3-205. These tables indicate that the RBS region is annually characterized as having high rainfall and very low snowfall. These values are reasonably consistent over the region so as to indicate that these stations are representative of precipitation averages that would be observed at the site.

Maximum 24-Hr. and Monthly Rainfall

Maximum 24-hr. and monthly precipitation totals for the region are discussed in Subsections 2.3.1.1.1.4 and 2.3.1.2.1.5 and are summarized in Table 2.3-206 for the NWS first-order and COOP stations presented in this evaluation. The maximum precipitation values are reasonably uniform across the area, given that precipitation can be highly influenced by individual storm events that can be local in nature, hitting one station and not another. It is therefore assumed that the precipitation data are representative of precipitation extremes that might be observed at the site.

As identified in Subsection 2.3.1.2.1.5, tropical cyclones are responsible for some of the highest 24-hr. and monthly rainfall events in the region surrounding the RBS. The highest monthly rainfall of 23.18 in. at Ryan Airport coincided with the landfall of Tropical Storm Allison during June 1989 (Reference 2.3-208). However, the heaviest 24-hr. rainfall total at Ryan Airport of 12.08 in. in April 1967 was not related to a tropical cyclone, occurring outside of the typical tropical cyclone season that runs May 1 through November 30 (Reference 2.3-201).

Total Hours of Precipitation and 1-Hr. Rainfall Rate Distribution

Hourly precipitation data for Ryan Airport were obtained from NCDC for the most recent 5-year time period (2002 to 2006) to identify the precipitation intensity frequencies in the region surrounding the RBS (Reference 2.3-246). Ryan Airport is the closest NWS first-order station that has reliable precipitation records and, as previously discussed, is representative of the RBS. Table 2.3-213 presents the distribution of hourly precipitation amounts in various intensity categories for each month during the 2002 to 2006 time frame. Precipitation was recorded approximately 10 percent of the time during the 5-year period. February has the highest occurrence of hourly rainfall, while May has the lowest. Additionally, as expected, rainfall is most frequent in lighter intensity categories and decreases in frequency as intensity increases.

Maximum Rainfall Rate Distributions for 1 Hr. up to 24 Hr.

In an effort to characterize possible heavy rainfall events at the RBS, probable maximum precipitation amounts for various durations and recurrence intervals were analyzed and are presented in Table 2.3-214. Maximum rainfall amounts were obtained from Reference 2.3-231 for recurrence intervals of 2 to 100 years and for durations of 3 to 24 hr. For durations of 1 hr. and recurrence intervals of 2 to 100 years, maximum rainfall amounts were extrapolated from the method described in National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NWS Hydro-35 (Hydro 35) (Reference 2.3-247). Estimates from U.S. Weather Bureau Technical Paper 40 (TP 40) were also obtained for this analysis, because updated literature does not provide amounts for 1-year recurrence intervals and durations of 2 hr. (Reference 2.3-248).

For comparison, maximum observed precipitation amounts were obtained for Ryan Airport from Reference 2.3-249 for the time period 1948 to 1961 and calculated from Reference 2.3-246 for the time period 2002 to 2006. These amounts are presented in Table 2.3-215. The table shows that, for durations of 1 to 6 hr., higher maximum precipitation amounts were found during the older 1948 to 1961 period when compared to the more recent 2002 to 2006 period. However, the more recent 2002 to 2006 period has experienced higher maximum precipitation events for durations of 12 and 24 hr. Outside the two time periods examined, the highest 24-hr. rainfall amount at Ryan Airport, mentioned earlier, occurred in April 1967 and is the only rainfall event that exceeds the 100-year recurrence in Table 2.3-214.

Precipitation Wind Roses

Monthly and annual precipitation roses were created to correlate hourly precipitation with wind direction for Ryan Airport during the 2002 to 2006 time frame and are presented in Figures 2.3-202 through 2.3-214. As shown in Figure 2.3-202, annually, the majority of hourly precipitation events, regardless of intensity, occur when winds are from the north, with secondary maximum occurring clockwise to the east-southeast. As noted in both Table 2.3-213 and Figure 2.3-202, a significant amount of the hourly precipitation events were less than 0.10 in.

Snowfall

Mean annual snowfall values, as well as maximum monthly and 24-hr. snowfall values, are discussed in Subsection 2.3.1.1.1.4. Annual snowfall at Ryan Airport averages 0.2 in. per year, with a maximum 24-hr. and monthly snowfall total of 3.2 in. over a 46-year period of record (Reference 2.3-201). Tables 2.3-205 and

2.3-206 present these values for the first-order and COOP stations in the RBS region. As indicated in these tables, heavy snow is a rare occurrence in the vicinity of the RBS. The highest 24-hr. snowfall was 9.0 in. at Simmesport in Avoyelles Parish, northwest of the RBS and near Clinton in East Feliciana Parish (Reference 2.3-215). The highest 2- and 3-day snowfall was an isolated amount of 12.5 in. reported at the Baton Rouge government recording station in 1899; however, there are no details regarding the accuracy of this measurement. The majority of reporting stations outside of the NWS stations used in this document have 24-in. and monthly maximum snowfall totals of 9.0 in. or less.

2.3.2.1.4 Fog and Smog

RBS COL 2.0-8-A *Fog*

Fog is reported at NWS first-order stations when the horizontal visibility is less than or equal to 7 mi. Ryan Airport is the nearest NWS station that routinely observes visibility and fog. Ryan Airport is located 19 mi. southeast of the RBS and has a similar elevation and relative proximity to the Mississippi River. Table 2.3-216 displays the mean annual, mean monthly, and frequency of hours that reported fog during the period 1961 to 1995 (References 2.3-211 and 2.3-212). On an annual basis, fog occurs 13.1 percent of the hours during a calendar year (1147 hr.). The highest monthly averages occur during December and January when 17.1 percent (127 hr.) and 18.1 percent (135 hr.) of total monthly hours, respectively, report fog. Fog is least frequent during June and July, when fog only occurs 66 and 70 hr. per month, respectively.

Heavy Fog

Mean annual and monthly values of hours with fog, as well as frequency of hours of heavy fog, are presented in Table 2.3-216. Heavy fog is defined as a horizontal visibility less than or equal to 0.25 mi. Annually, Ryan Airport averages 80 hr. per year where heavy fog is reported. Heavy fog most frequently occurs October through January, when 10 to 13 hr. per month, respectively, report heavy fog. During June through August, heavy fog is least likely to occur because only 1 to 2 hr. each month are reported to have heavy fog.

Smog

Smog is simply defined as the combination of fog and smoke that collects in a region of weak vertical dispersion and reduces horizontal visibility. Haze is also caused by any atmospheric pollutant that obscures the horizontal visibility. The region surrounding Baton Rouge is highly industrial and contains many sources that emit various pollutants that lead to the creation of smog and haze. Smog and haze are most likely to occur in the RBS region during the summer and early fall seasons, when air above the surface is warmer and winds are lighter, preventing the pollutants from dispersing horizontally and vertically. Ryan Airport reports the occurrence of smoke and haze in its hourly observations. Table 2.3-216 indicates that the months May through September have the highest number of hr. where smoke and/or haze are reported. This corresponds with the months when horizontal and vertical dispersion is weakest (Reference 2.3-201).

2.3.2.1.5 Wind Direction and Wind Speeds

RBS COL 2.0-8-A Wind direction and speed are two of the main components that define the dispersion characteristics of a site. Wind speed and direction can be classified on macro, synoptic, meso-, or micro-spatial scales. Macro and synoptic scales typically cover areas of 100 km^2 to 10,000 km^2. The influences on these two scales include features such as oceans and other large bodies of water, continents, and mountain ranges.

Meso- and micro-scale features better represent the general wind characteristics of the RBS and surrounding region. Meso-scale features typically cover areas of 1 km^2 to 100 km^2 and are influenced by such things as local vegetation and river valleys. Micro-scale features are spatially 1 km^2 or less and include the proximity of the RBS on-site meteorological tower to the proposed cooling tower, trees, and general site-specific land use characteristics of the immediate location.

The influence of these smaller scale features may be seen by evaluating local wind data both at the RBS and the nearby Ryan Airport. Table 2.3-217 presents the mean monthly and annual wind speeds at the RBS and Ryan Airport. The mean annual wind speed for the 30-ft. and 150-ft. level is 3.85 mph and 7.26 mph, respectively. The mean annual wind speed at Ryan Airport is 5.73 mph at a 30-ft. level. The large difference in the wind speeds between Ryan Airport and the 30-ft. level at the RBS can be explained by the macro and micro-scale features such as the land use characteristics of the site. Ryan Airport lies in an urban area that has primarily been cleared of trees and provides a broader sample of prevailing wind direction and speed of the region. The RBS is surrounded by both deciduous and evergreen forests (Figure 2.1-203 of Section 2.1 of the FSAR), which have the effect of reducing wind speeds near and below the height of their canopy, up to ten times the height of the object.

Figures 2.3-215 through 2.3-227 contain the 30-ft. annual and monthly wind roses presenting the distribution of wind speed at 22.5-degree intervals for Ryan Airport during the most recent 5-year period (Reference 2.3-236).

The annual wind rose plot in Figure 2.3-215 shows that winds at Ryan Airport blow predominantly from a range of northeasterly and southerly directions. According to the annual 2006 LCD, the prevailing wind direction for Ryan Airport is from 50 degrees (northeast) (Reference 2.3-201). Monthly wind roses for Ryan Airport are presented in Figures 2.3-216 to 2.3-227. The transition is apparent from dominant northerly and easterly winds during the winter months to southerly wind directions during the spring months as the Bermuda High begins to influence the region. During June, July, and August, the number of calm hours increases and the wind directions often become light and variable. Ryan Airport considers calm hours as those with wind speeds less than 3 knots. Northeasterly and easterly wind directions become more dominant during September and for the rest of the fall months before wind speeds increase and become more variable during December.

Annual and monthly wind roses for the 30-ft. level at the RBS are depicted in Figures 2.3-228 through 2.3-240. These figures show wind speeds and directions at 22.5-degree intervals by direction at the RBS for the December 2004 through November 2006 time period.

Figure 2.3-228 indicates that annually winds are most often northerly, occurring approximately 11 percent of the time. Southeasterly wind is the second most common direction for the 30-ft. level at the RBS. The prevailing RBS wind direction for the 30 ft. level of 31 degrees, as well as the 150-ft. level of 89 degrees, both compare favorably to the prevailing wind direction at Ryan Airport. However, there is an apparent lack of easterly winds annually at the RBS when compared to Ryan Airport at the same level. A likely explanation is the effect of trees blocking the wind directly to the east of the RBS on-site meteorological tower. Also noticeable are the high occurrence of winds that are less than 4 knots. Calm hours are counted when wind speeds are less than 1 knot at the RBS, explaining the large drop in percentage when compared to annual calm hours at Ryan Airport. Figures 2.3-229 through 2.3-240 present the monthly wind roses for 30-ft. level at the RBS. During January through May, the wind blows dominantly from the north, south, and southeast directions. The number of calm hours drastically increases during June, with overall lighter wind speeds and more variable wind directions continuing through August. During September, northerly and southerly winds are dominant at the RBS. Northerly and southeasterly continue to be dominant wind directions from October through December.

Figure 2.3-241 presents the annual wind rose at the 150-ft. level for the RBS. There is an apparent similarity of the RBS 150-ft. annual wind rose and Ryan Airport annual wind rose. East winds remain lower at the RBS in comparison to Ryan Airport; however, they are much more frequent than at the 30-ft. level. The annual 150-ft. wind rose for the RBS shows that winds most often blow from an east-southeast direction, with a secondary maximum wind direction out of the northeast. The wind speeds, as expected, are somewhat higher at all directions as compared to the lower 30-ft. tower. Monthly wind roses are represented by Figures 2.3-242 through 2.3-253. From January through March, the wind blows dominantly from the east-southeast and north directions. During April and May, south winds are most common. As expected, wind speeds become lighter and wind directions are more variable during June, July, and August. Northeast winds occur most frequently during September and October, before dominant east-southeast and north winds return in November and December.

2.3.2.1.6 Wind Persistence

RBS COL 2.0-8-A Persistence of wind direction is a measurement of the duration of the transport of air from a specific direction to locations downwind. It reflects the possible amount of time that radioactive contamination or any other type of pollution may travel in the same or a similar direction. The dilution potential of the pollutant as it moves downstream of its source is directly proportional to wind speed. Higher wind speeds lead to increased dilution, while lower wind speeds create less dilution.

Tables 2.3-218 through 2.3-241 present the persistence of wind direction and speed at both the 30-ft. and 150-ft. tower levels, respectively, for 22.5-degree (single) and 67.5-degree (three adjoining) wind sector widths for various wind speeds at the RBS during the 24-month period of December 2004 through November 2006. The longest recorded single sector persistence was from the north (70 hr.) for the 30-ft. level and from the north-northwest direction (26 hr.) for the 150-ft. level. For three adjoining sectors, the 30-ft. level and 150-ft. level recorded the longest persistence from the north-northwest (139 hr.) and south (88 hr.), respectively. Tables containing summaries of wind persistence for all wind speeds indicate that winds are most likely to be persistent from the north direction at the 30-ft. level and from the east-southeast at the 150-ft. level. In addition, the final row in the tables displays the average persistent hours for each wind direction and provides a method for determining which direction winds are most likely to persist longer. For the 30-ft. level, the wind is most likely to persist longer from the southeast and north directions for single and three adjoining sector widths, respectively. A persistent wind is most likely to last longer at the 150-ft. level for east-southeast and north-northeast wind directions for single sector and three adjoining sector widths, respectively.

Tables 2.3-242 through 2.3-253 present the persistence of wind direction and speed at the 30-ft. level for the single sector and three adjoining sectors for various wind speeds at Ryan Airport during the 2002 through 2006 time period. At the 30-ft. level (the only level at Ryan Airport), the longest persistent wind blew from the south and lasted 23 hr. for a single sector. For three adjoining sectors, the longest persistent wind lasted 88 hr. from the south. Tables 2.3-242 and 2.3-248 present wind persistence summaries for various wind speeds for the single sector and three adjoining sector widths, respectively. The most likely direction for a wind to be persistent for both sector widths is east, but a wind is most likely to persist longer when blowing from the south. Previously, in Subsection 2.3.2.1.5, the noticeable lack of east winds at the RBS was discussed. It is possible that winds may likely be more easterly for the upper and lower instruments if trees had no effect on the on-site meteorological tower. However, it is reasonable to assume that winds are most likely to be persistent regardless of speed from the east or east-southeast direction and persist longer from the southeast, east-southeast, north, and north-northeast directions at the RBS.

2.3.2.1.7 Monthly Mean Mixing Heights

RBS COL 2.0-8-A The mixing height (or depth) is the height above the surface in which air can freely mix vertically without the help of additional atmospheric forcing mechanisms. George C. Holzworth presented seasonal mixing heights for several stations around the United States, based on upper-air data from the period 1960 to 1964 (Reference 2.3-250). Holzworth included seasonal morning and afternoon mixing heights for Lake Charles, Louisiana, in the analysis. In general, morning mixing heights are lowest in the fall and winter seasons and highest in the spring and summer seasons. Afternoon mixing heights followed the same trends, with the highest afternoon mixing heights in the summer and lowest in the winter.

Annual and monthly mean mixing heights for Lake Charles, Louisiana, were calculated using daily morning and afternoon mixing height data obtained from the NCDC (Reference 2.3-251). The NCDC calculated the mixing heights from data recorded during the morning and afternoon release of weather balloons at Lake Charles that measure the vertical temperature and wind information of the atmosphere. Surface wind data from Ryan Airport were used by the NCDC in conjunction with the weather balloon data to create daily mixing heights for the region. The calculated mean monthly and annual mixing heights for Lake Charles during 2002 to 2006 are presented in Table 2.3-254. The values shown in the table follow the same trends found by Holzworth.

2.3.2.1.8 Inversions

RBS COL 2.0-8-A The frequency and persistence of temperature inversions may also indicate periods where air stagnation is highest. Frequency and persistence of inversions were calculated annually and monthly utilizing the vertical change in temperature (ΔT) obtained from the RBS on-site meteorological tower data from December 2004 through November 2006. The presence of an inversion was defined as anytime $\Delta T>0$ for the hour. A summary of the frequency and persistence of inversion conditions is presented in Table 2.3-255, which shows for 16,609 hr. analyzed during the 2-year period that an inversion was present a total of 8,151 hr., equivalent of 49.1 percent of the total hours. Many of the inversions were short-lived, with a 46.3 percent probability that if an inversion formed, it would be less than 6 hr., and a 65.8 percent probability of it lasting less than 12 hr. Almost all the inversions lasted less than 24 hr., with only 1.5 percent of all the inversions lasting longer than 24 hr. In the 2 years of data used, the longest inversion lasted 63 hr. Tables 2.3-256 through 2.3-267 present the persistence of inversions tallied for each month. These tables show that the probability of an inversion lasting longer is higher during the months of September through October. This correlates well with the findings by Wang & Angell that the number of days with air stagnation increases during September and October.

2.3.2.1.9 Atmospheric Stability

RBS COL 2.0-8-A Atmospheric diffusion, independent of the effects of wind speed, is proportional to the stability of the atmosphere and has a large effect on potential vertical and horizontal dispersion of radioactive contamination or any other type of pollutant in the ambient air. Atmospheric stability can generally be classified as unstable, neutral, and stable. During stable conditions, diffusion is at its lowest levels, while under unstable conditions, diffusion is at its highest levels. Pasquill-Gifford developed seven categories measuring atmospheric stability that are accepted and used by the NRC. The various categories can be determined by the difference in temperature (ΔT) between two temperature measurement levels normalized to 100 m (328 ft.). As defined in Regulatory Guide 1.23, the following categories of atmospheric stability reflect the ΔT in degrees Celsius (°C) per 100 m.

Class A	Extremely Unstable	$\Delta T/\Delta Z \leq -1.9°C$
Class B	Moderately Unstable	$-1.9°C < \Delta T/\Delta Z \leq -1.7°C$
Class C	Slightly Unstable	$-1.7°C < \Delta T/\Delta Z \leq -1.5°C$
Class D	Neutral Stability	$-1.5°C < \Delta T/\Delta Z \leq -0.5°C$
Class E	Slightly Stable	$-0.5°C < \Delta T/\Delta Z \leq +1.5°C$
Class F	Moderately Stable	$+1.5 < \Delta T/\Delta Z \leq +4.0°C$
Class G	Extremely Stable	$+4.0°C < \Delta T/\Delta Z$

Table 2.3-268 presents mean annual and monthly wind speeds for the 30-ft. level at the RBS for each of the Pasquill-Gifford stability categories. Annually, the mean wind speeds are highest when the air above the RBS is slightly unstable, while mean wind speeds are the lowest under extremely stable conditions, characteristic of high pressure systems. Table 2.3-268 also contains the annual and monthly distribution of stability summaries. The RBS experienced slightly stable conditions 50 percent of the total number of hours during the 2-year period. Unstable conditions (Classes A, B, and C combined) occurred only 1.8 percent of the total hours.

Tables 2.3-269 through 2.3-284 present the annual Joint Frequency Distributions (JFD) of wind speed and direction by stability category at the 30-ft. and 150-ft. measurement levels of the RBS on-site meteorological tower for the December 2004 to November 2006 time period, respectively. It is noticeable from the JFD for the 30-ft. level that for stable conditions (Classes E, F, and G), the observations with wind speeds less than 4 mph occur most frequently, implying that stable conditions generally are associated with light winds. Tables for the 150-ft. tower suggest that for stable conditions, wind speeds are most frequently 4 to 8 mph. These data indicate that the frictional effect of the trees that surround the on-site meteorological station have an effect of lowering wind speeds as height is decreased from the 150-ft. level to the 30-ft. level. Therefore, wind data from the 30-ft. level are representative of air dispersion conditions at the RBS below the height of the trees.

2.3.2.2 Influence of the RBS and Its Facilities on Local Meteorology

RBS COL 2.0-8-A The impact of the operation of a new facility at the current RBS on the local climatology is expected to be minor. These impacts will be limited to the construction and operation of an NDCT and 12-cell octagonal MDCT cooling tower, as well as the reactor building and other various structures. This subsection discusses the regional topography and the estimated extent of the impacts of the new facility on the meteorological variables reviewed in Subsection 2.3.2.

Regional Topography

The RBS is located in the southern part of West Feliciana Parish and is located above the Mississippi River floodplain in an area of heavily forested gently rolling hills. Figures 2.3-254 and 2.3-255 show topographic features within 5 and 50 mi., respectively, of the RBS. The general site elevation is roughly less than 100 ft.. The elevation increases for compass directions between the north-northwest clockwise to the east. Areas to the west, south, and southeast contain elevations that are lower than the RBS. Figure 2.3-256 shows the terrain elevation profiles for each of the sixteen 22.5-degree compass directions to a distance of 5 mi. from the site. The Mississippi River valley is located at a distance approximately 1.5 mi. southwest of the RBS. Figure 2.3-257 presents similar terrain profiles out to 50 mi. from the RBS.

Estimated Impacts of Facility Construction

The construction activities of the RBS Unit 3 are not expected to affect the local climate of the site significantly. The proposed unit for the RBS will be located just southwest of the existing nuclear unit (refer to Figures 2.1-203 and 2.1-204 in Section 2.1 of the FSAR). Portions of the proposed unit will be located in a general undeveloped area that will require additional grading and clearing of trees. Any influence of the grading and clearing of trees on the micro-scale climate will be minimal during the construction of a new facility and would be limited to the RBS Unit 3 site and the immediate surrounding area. This would lead to a minimal change in the overall topography around the RBS and, thus, would not represent a significant alteration to the flat-to-gently rolling topographic character of the area and region around the site. Additionally, roads are already in place to accommodate the construction traffic for the new facility, and the addition of buildings, parking areas, and other structures should have little to no effect on the local meteorology of the site. Once construction is complete, consideration will be made for the replanting of trees in the construction laydown area and the construction parking area in Figure 2.1-204 (Section 2.1 of the FSAR).

Estimated Impacts of New Structures

As previously discussed in Subsection 2.3.2.1.5, trees at the RBS are the primary effect on the on-site meteorological tower. The addition of an NDCT and MDCT would add additional effects to the airflow trajectories downwind of the cooling towers. Regulatory Guide 1.23 estimates that a meteorological tower located at least a distance of 10-building-heights' horizontal distance downwind from the nearest structure would not have adverse wake effects exerted by the structure. Figure 2.1-204 of Section 2.1 of the FSAR provides the location of the proposed NDCT and MDCT in relation to the current on-site meteorological tower. The RBS site, according to Figure 2.3-256, is located at an elevation approximately 95 to 100 ft. above msl. The plant area where the structures would be located is relatively flat, with only minor differences in plant grade. The MDCT is located approximately 3407 ft. from the on-site meteorological tower and positioned roughly 343 ft. southwest of the NDCT. The height of the MDCT structure is approximately 61.34 ft. above plant grade. Using the method suggested by Regulatory Guide 1.23, the adverse horizontal wake effects exerted by the structure are thereby estimated to extend approximately 613 ft. downwind from the MDCT. The meteorological tower is located approximately 3407 ft. from the MDCT and would not be influenced by the adverse wake effects from the structure.

The NDCT is also located approximately 3407 ft. southeast of the on-site meteorological tower and would be built to a height of 550 ft. above plant grade, the tallest structure at the RBS. Because the NDCT is hyperbolically shaped, the downwind wake zone is different than square or rectangular structures and is estimated to be approximately five times the width of the tower at the top of the structure (Reference 2.3-252). Using this method with a width of 262 ft. at the top of the tower, the downwind wake effect of the NDCT is estimated to be 1310 ft. Therefore, the NDCT is not expected to influence airflow trajectories at the on-site meteorological tower.

The other major Unit 3 structures proposed for the RBS are the Reactor and Turbine Buildings. The Reactor Building is sited approximately 2186 ft. east-southeast of the on-site meteorological tower. The height of the Reactor Building is approximately 158 ft. above plant grade. The Turbine Building is adjacent to the Reactor Building on the south and southeast sides and located approximately 2271 ft. from the on-site meteorological tower. The height of the Turbine Building is approximately 177 ft. above plant grade. Therefore, the zone of turbulent flow created by the Reactor and Turbine Buildings would be limited to approximately 1580 and 1770 ft., respectively, and would not affect the airflow trajectories at the meteorological tower. The other structures at the site are below the height of the tree line that surrounds the on-site meteorological tower and are not considered to influence the airflow trajectories at the meteorological tower.

The dominant wind directions for the 30-ft. and 150-ft. levels on the meteorological tower, as provided in Figures 2.3-228 and 2.3-241, are north and east-southeast, respectively. Southeast winds, which would allow wake effects from the NDCT toward the meteorological tower, occur approximately 10 percent and 7 percent of the time for the upper and lower level, respectively. Winds that blow from the Unit 3 reactor occur 5 percent and 9 percent of the time at the upper and lower levels, respectively. Wake effects from the cooling towers and reactor structures would have some influence on the local airflow immediately downwind of the structures. However, considering the distance of the on-site meteorological tower from the RBS structures, the effect on the wind measurements is negligible, and the data collected at the tower during the December 2004 through November 2006 time period are representative of the site conditions.

Other Estimated Impacts

The operation of large power generation units can have two distinct effects on the local climate: (1) additional generation of particulates (PM and fog) and (2) effects by cooling tower plumes. Air emissions of PM would be minor given the nature of a nuclear facility and its lack of significant gaseous exhausts of effluents to the air. Sources of air emissions for the proposed facility include two standby diesel generators, an auxiliary boiler, a diesel fire pump, and increased automobile traffic. The combustion sources mentioned above will be designed for efficiency and operated with good combustion practices on a limited basis throughout the year (often only for testing). Given the small magnitude of size and infrequent operation, these emissions would only have a minimal impact on the local and regional air quality and, furthermore, the local climate. These emissions will be regulated by the LDEQ.

Plumes emitted from cooling towers can also affect the local climate. The proposed unit will include an NDCT and a 12-cell octagonal MDCT cooling tower. The prevailing winds at the RBS site range from north and southeast directions at the 30-ft. level and from the east-southeast and northeast directions at the 150-ft. level. This indicates that the cooling tower plumes would most frequently extend over the RBS and toward the Mississippi River. A more detailed explanation of the effects of the cooling tower plumes on the local meteorology is provided in the following subsection.

2.3.2.2.1 Cooling Tower Plumes

RBS COL 2.0-8-A Cooling systems depend on water evaporation to dissipate heat created from the energy production process. In this cooling process, the NDCT and MDCT often create visible plumes that can produce effects on the local environment. The visible plumes can produce shadows on surfaces such as trees, vegetation, and nearby buildings. Cooling tower plumes can also create or enhance ground-level fogging or icing, as well as increase salt deposition. An assessment of cooling tower plumes emitted during the operation of a new power production facility at the RBS on the local environment and atmosphere was performed. The investigation was performed using the EPRI's Seasonal/Annual Cooling Tower Impact Prediction Code (SACTI), a model endorsed by NUREG-1555, Section 5.3.3.1. The model used on-site meteorological data from the RBS tower for the available 2-year period of December 2004 through November 2006. The on-site data contain wind direction, wind speed, and DB temperature measurement at 30-ft. and 150-ft. heights. Because the meteorological tower does not record atmospheric moisture variables, dew point temperature data commensurate with the on-site data, were taken from Ryan Airport. Using the DB temperature from the RBS, as well as both the dew point temperature and sea-level pressure from Ryan Airport, the required WB temperature and relative humidity values were calculated (Reference 2.3-241). Mean monthly mixing height values calculated in Subsection 2.3.2.1.7 were also used for the SACTI cooling tower model analysis.

To assess the potential plume impacts, both the NDCT and the MDCT were evaluated for the new RBS unit. The SACTI model requires each tower to be run separately; however, the results were combined to provide the most conservative estimate. Both cooling towers were modeled as if the power generation process was producing the maximum heat load. The SACTI cooling tower model requires tower-specific data such as projected cooling tower dimensions, top exit diameter, and total heat rejection rates to perform its analysis.

Table 2.3-285 displays the average plume lengths by season and direction during NDCT operation, while Table 2.3-286 displays the expected plume lengths for the MDCT. A comparison of the tables indicates that average plume lengths, regardless of wind direction, are slightly longer for all seasons when they are produced by the MDCT. Average plume lengths are longest for both the MDCT and NDCT during the winter and fall, when average monthly temperatures are cooler (Reference 2.3-201). Tables 2.3-287 and 2.3-288 present the annual plume length frequency for the NDCT and MDCT, respectively. Previously, it was stated that the NDCT and MDCT would be positioned approximately 3407 ft. (1039 m) southeast from the meteorological tower. It can be reasonably stated that winds that blow from the east-southeast, southeast, and south-southeast would allow a plume to travel toward the on-site meteorological tower. Using this method, the tables indicate that plumes from the NDCT and MDCT reached the on-site meteorological tower 10.70 percent and 5.62 percent, respectively, of the time annually. This evaluation does not account for the height of the plume as it travels from the cooling towers and is likely an overestimate of the number of times that a plume reaches the meteorological tower on an annual basis. In addition, plumes from the NDCT are emitted at a height of 550 ft. and, after additional plume rise, would have negligible effects on the meteorological tower. The MDCT, which has a height of 61.34 ft., has the highest potential to create a plume that would influence the meteorological tower. However, considering the low frequency of plumes arriving from the east-southeast, southeast, and south-southeast and the factor of additional plume rise, the plumes emitted from the MDCT would also have minimal influence on the meteorological tower.

2.3.2.2.2 Cooling Tower Plume Effects on Ground-Level Meteorological Variables

RBS COL 2.0-8-A As discussed previously, the plume effects on the on-site meteorological tower are considered negligible. However, cooling tower plumes would influence some of the ground-level meteorological variables very near the cooling towers. This subsection investigates these influences and their impact at the RBS.

Wind

There are two effects of the NDCT and MDCT on the local wind field. During the operation of the cooling towers air is drawn in at the base of the tower. The air is then heated, collects moisture, and is forced to rise, exiting from the cooling tower at high velocities as a plume. This process is continuous and causes the local wind field to converge toward the base of the cooling towers. The effect of airflow toward the cooling tower is localized and would likely remain within the RBS property boundary. The cooling towers also have an effect of lowering the wind speed downwind of the wind direction to a distance of ten times the height of the tower. However, the wake effects from the cooling towers are not expected to affect the on-site meteorological tower.

Temperature

The plume that is released from the cooling towers is typically warmer than the ambient air and is mostly dissipated into the atmosphere above the tower height. However, some of the heat is transported downward to the ground downwind of the wind direction. Air temperature at the surface, thereby, is expected to be only slightly warmer within a few hundred feet of the tower. Large plumes may also block the heat from the sun and have the effect of cooling the ambient air at the surface during the day and warming it at night. Once again, the effect of the plume on the surface ambient temperature is minimal and cannot be measured beyond a few hundred feet from the tower or plume.

Atmospheric Water Vapor

The vapor plumes increase the absolute and relative humidity values immediately above cooling towers, as indicated by the high frequency of visible plume occurrence. At the surface, the absolute humidity increases slightly as some of the moisture from the plume is transported downward downwind from the cooling tower. During colder temperatures, the increase of relative humidity near the cooling tower may be greater as a result of the relatively lower moisture-bearing capacities of cold air. Overall, the ground-level humidity increases from the operation of cooling towers is expected to be very small.

Precipitation

As presented by Huff, drizzle and light snow have been observed within a few hundred feet downwind of cooling towers (Reference 2.3-253). The occurrence of such precipitation events is rare and primarily localized. Huff compared the fluxes of water vapor from the NDCT and MDCT cooling towers to those natural water vapor fluxes ingested into cloud bases of showers and thunderstorms. His results indicate that some enhancement of small rain showers might be expected, because tower fluxes are within an order of magnitude of the shower fluxes. Thunderstorms, with their much greater flux values, should not be significantly affected, except that the cooling tower plume may act as a triggering mechanism. In addition, discharge of cooling tower moisture has been shown to augment natural precipitation as much as 0.4 in. annually for a 2200-MWe station (Reference 2.3-253). The maximum SACTI model-predicted water deposition rate for the NDCT and MDCT at the RBS is approximately 0.001 mm per month. By comparison, this precipitation rate is less than 0.001 percent of the mean monthly rainfall of the driest month at Baton Rouge. Thus, impacts due to water deposition are expected to be small at the RBS.

Light snowfall has also been observed at distances downwind from cooling towers. However, induced snowfall events have resulted only in light, fluffy snow accumulations of less than 1 in. (Reference 2.3-254). Most induced snowfall that was observed preceded or occurred during natural snowfall events, occurring when temperatures were very cold and diffusion conditions at plume height were relatively stable. The RBS does not frequently experience such prolonged cold conditions, as stated in the LCD for Baton Rouge (Reference 2.3-201). Annually, the RBS averages 150.8 hr. per year of subfreezing temperatures (References 2.3-211 and 2.3-212). Therefore, the operation of a MDCT and NDCT cooling tower is not expected to increase average snowfall at the RBS.

Fogging and Icing

Ground-level fogging and icing occurs when the visible plume from a cooling tower reaches the ground. Studies conducted by Broehl, Zeller, Kramer, and Hosler indicated that icing and fogging from an NDCT do not present a significant problem (References 2.3-255 through 2.3-258). Zeller, in a 2-year study, observed one occurrence where the plume from an NDCT reached the ground. Fogging and, therefore, icing is more susceptible to occur with MDCT plumes on account of their lower tower height. Hosler indicates that that fogging from the MDCT is likely to be greatest in areas where natural fog is most frequent. He also notes that an MDCT may have the effect of causing fog to form sooner and perhaps last longer, especially at colder temperatures.

The SACTI cooling tower model was run to assess the potential for fogging and icing at the RBS as a result of the operation of a NDCT and MDCT. The model assumed that the occurrence of fogging from the NDCT is unlikely and thus does not predict estimates of fogging for the NDCT (Reference 2.3-259). The SACTI cooling tower model predicted no hours of fogging from the operation of the MDCT at the RBS. Based upon the above SACTI model predictions, ground-level fogging or icing at the RBS from operation of the NDCT and MDCT is not expected to be significant.

Stability

Theoretically, the increased flux of moisture and heat into the atmosphere above an NDCT would create slightly more stable conditions during the day and slightly more unstable conditions at night. There has been no quantitative analysis performed that can be referenced to evaluate what would occur at the RBS. However, it can be reasonably stated that any effect on stability from the effluents of an NDCT would be minimal and local to the RBS.

Dew

Dew typically forms during the night and before sunrise, when radiational loss from the ground to the atmosphere is greatest. The ground becomes cooler than the surrounding ambient air, and air that is nearly saturated will condense on objects, such as grass, that are slightly cooler. Dew is most likely to occur when skies are clear and winds are light. Tate studied the formation of dew, amongst other variables, at the Bowen plant in Cartersville, Georgia (Reference 2.3-260). From the data that Tate collected, there was no indication that the plumes emitted from the NDCT had any effect on dew formation surrounding the power plant site. However, from a theoretical perspective, the plume may act as a cloud and decrease the amount of radiational loss of the ground. Therefore, areas downwind of the plume may see a decrease of dew occurrences, especially on clear and cool nights when the wind is light.

Dispersion of Radioactive Effluents

The exact effect of the dispersion of radioactive effluents beneath the tower is difficult to provide quantitatively. Radioactive effluents that are entrained at ground level into the NDCT and MDCT would be dispersed aloft with the plume. Subsections 2.3.4 and 2.3.5 provide a discussion of the short- and long-term effects of radioactive effluents emitted from the NDCT and MDCT.

The discussion above concerning the effects of the cooling tower on local meteorology variables indicates that an NDCT and MDCT would have very minor effects at the plant site and negligible effects to local areas outside the RBS boundary.

2.3.2.3 Local Meteorological Conditions for Design and Operating Bases

Subsection 2.3.2 provides a discussion of the on-site meteorological conditions in comparison to the regional conditions. The conclusion is that nearby meteorological stations, such as Ryan Airport in Baton Rouge, experience climatic conditions that are representative of meteorological conditions at the RBS. Wind speed and direction conditions that determine the air dispersion of the region are unique at the RBS below the height of the trees and structures. As mentioned in Subsections 2.3.2.1.5 and 2.3.2.1.6, the 30-ft. level is highly influenced by the trees, while the effect is less realized at the 150-ft. level. For these reasons, the on-site meteorological data would be used for design and operating bases of the Unit 3 facility; however, these data may be supplemented with data from Ryan Airport.

2.3.3 METEOROLOGICAL MONITORING

The current RBS on-site meteorological monitoring program has been in place since its installation in December 1971, prior to the construction and operation of RBS Unit 1. The details of the operational meteorological monitoring program for RBS Unit 1 are described in Subsection 2.3.3 of the Unit 1 USAR (Reference 2.3-261). Since 1971, the on-site meteorological monitoring program has met the requirements of Safety Guide 23 (1972) and the most recent version of Regulatory Guide 1.23 (March 2007). This subsection describes the current state of the on-site meteorological measurement program.

The RBS Unit 1 meteorological monitoring program provides the basis for the RBS Unit 3 meteorological pre-application monitoring, site preparation and construction monitoring, pre-operational monitoring, and operational monitoring programs. In addition, data from the on-site meteorological tower is used as the sole input for models that describe the atmospheric transport and diffusion characteristics of the site, as provided in NRC Regulatory Guides 1.111 and 1.21.

A description of the model used to analyze the atmospheric transport and diffusion conditions of the site is described in Subsection 2.3.5.

2.3.3.1 On-Site Meteorological Measurement Program

The purpose of this subsection is to identify that the on-site meteorological measurements program and other data-collection programs used by RBS Unit 3 are adequate to: (1) describe local and regional atmospheric transport and diffusion characteristics within 50 mi. (80 km) from the plant, (2) ensure environmental protection, and (3) provide an adequate meteorological database for the evaluation of the effects of plant operation. This discussion includes an analysis of the following meteorological monitoring system elements:

- The location of the meteorological tower and instrument siting.
- Meteorological parameters measured.
- Meteorological sensors.
- Data recording and transmission.
- Instrument surveillance.
- Data acquisition and reduction.
- Data validation and screening.
- Data display and archiving.
- System accuracy.
- Data recovery rate and annual and JFD of data.

2.3.3.1.1 Tower and Instrument Siting

RBS COL 2.0-9-A Figures showing the location of the RBS facility in respect to off-site meteorological stations and surrounding topography are provided in Figure 2.3-201 and Figures 2.3-254 through 2.3-257, respectively. The on-site meteorological open-latticed tower is located approximately 2186 ft. west-northwest of the proposed Unit 3 reactor building (refer to Figures 2.1-203 and 2.1-204 in Section 2.1) and has a height of 150 ft. above plant grade (Reference 2.3-261). This location is sufficiently close to the facility to provide representative observations and sufficiently distant to negate small-scale disturbances caused by building structures and plant construction operations. The meteorological parameters specified in Regulatory Guide 1.23 are measured by instrumentation mounted at two levels (30-ft. and 150-ft.) of the tower. The 30- and 150-ft. elevations were selected to approximate the heights of release of activity emanating from ground level and the plant heat dissipation system, respectively.

The meteorological sensors are mounted on booms, which are greater than one tower width away from the tower. The booms are attached to a tower elevator system used for raising and lowering the instruments during routine calibration.

The influence of terrain near the base of the tower on temperature measurements is minimal. The tower is situated in a flat fenced-off area (100-ft. by 55-ft.), that is covered with crushed rocks and grass. A small 18-ft. by 16-ft. Instrument Building and utility shed housing a standby generator are located approximately 47 ft. to the west-southwest of the meteorological tower. Although recently trimmed, groves of trees located in the vicinity of the tower affect the wind speed and direction at the 30-ft. level of the tower, as discussed in Subsection 2.3.2.1.5. This condition is representative of the site because the facility itself is located in a heavily wooded area of the Louisiana countryside.

2.3.3.1.2 Meteorological Sensors and Their Accuracies and Thresholds

RBS COL 2.0-9-A The meteorological tower instrumentation consists of the following: wind speed and wind direction sensors at the 30- and 150-ft. levels; a 30-ft. ambient temperature sensor; as well as a 30- to 150-ft. vertical temperature difference system. A dew point temperature sensor was initially installed at the 30- and 150-ft. prior to operation of the RBS Unit 1. However, the sensor suffered from constant dust contamination that caused excessive maintenance and was removed in 1998. Since then, dew point information has been obtained from Ryan Airport in Baton Rouge. In addition, a heated tipping bucket rain gauge was located approximately 15-ft. above the ground on top of the instrument building during the operation of RBS Unit 1. However, the rain gauge is no longer in operation, and precipitation data are currently obtained from Ryan Airport in Baton Rouge. Instrumentation on the tower includes redundant wind speed and wind direction sensors at the 30- and 150-ft. levels, a redundant 30-ft. ambient temperature sensor, and a redundant vertical temperature difference system. The pertinent characteristics of each sensor are listed in Table 2.3-289. Subsections 2.3.3.1.2.1 through 2.3.3.1.2.4 discuss the details of each meteorological sensor, including their resolution and accuracies.

2.3.3.1.2.1 Wind Sensors

RBS COL 2.0-9-A Wind speed and direction for the RBS is measured on the meteorological tower at 30- and 150-ft. levels. As mentioned previously, groves of trees are located directly east of the sensors and have some effects on the lower measurements. Table 2.3-289 provides the pertinent characteristics of the wind speed and direction sensors located on the meteorological tower. The wind speed is recorded with an accuracy of ±0.15 mph or ±1 percent, whichever is greater, and with a starting threshold of less than 0.75 mph. The wind direction is measured with an accuracy of ±2 degrees of azimuth and has a starting threshold of 0.93 mph. The redundant wind sensors at the 30- and 150-ft. levels contain the same accuracy and thresholds as the primary sensors. The accuracies and thresholds of wind speed and direction for the RBS are within the limits specified in Regulatory Guide 1.23.

2.3.3.1.2.2 Temperature Sensors

RBS COL 2.0-9-A Sensors on the meteorological tower measure ambient temperature at the 30-ft. level, as well as the differential temperature between the 30-ft. and 150-ft. level. A sun shield is located on each of the upper and lower temperature sensors to minimize solar effects. The characteristics of the 30- and 150-ft. temperature sensors are presented in Table 2.3-289. The upper level temperature, in combination with the lower-level sensor, calculates the differential temperature. The sensors' signals are input into a temperature/delta temperature processor contained in the data acquisition system to provide output signals proportional to one ambient and one differential temperature. The ambient temperature sensors at the 30- and 150-ft. level contain accuracies of ±0.2°F. The differential temperature is also recorded with an accuracy of ±0.2°F. The accuracies of the ambient temperature and differential temperature sensors meet the required accuracies presented in Regulatory Guide 1.23.

The backup sensors for the ambient upper and lower temperature sensors are located on the meteorological tower at the same levels as the primary sensors. The accuracies of the secondary sensors are also within the limitations required in Table 2 of Regulatory Guide 1.23.

2.3.3.1.2.3 Dew Point Sensors

RBS COL 2.0-9-A The dew point sensor on the meteorological tower suffered from constant dust contamination resulting in excessive maintenance and was removed in 1998. Currently, the RBS obtains hourly dew point data electronically from Ryan Airport. Ryan Airport is located 19 mi. southeast of the RBS and records hourly dew point temperatures. Subsection 2.3.2.1.2 demonstrates how dew point data from Ryan Airport represent the conditions found at the RBS.

2.3.3.1.2.4 Precipitation Sensor

RBS COL 2.0-9-A Precipitation data for the RBS is currently obtained from Ryan Airport in Baton Rouge. Subsection 2.3.2.1.3 shows that monthly and annual precipitation at Ryan Airport is representative of conditions found at the RBS.

2.3.3.1.3 Meteorological Sensor Calibration and Maintenance

RBS COL 2.0-9-A Routine preventive maintenance and calibrations are performed to ensure 90 percent data recovery of all parameters and 90 percent joint data recovery of the parameters required for offsite dose assessment (i.e., wind speed, wind direction, and delta-temperature or sigma theta) in accordance with Regulatory Guide 1.23. Table 2.3-290 provides the data recovery percentages for the period December 2004 through November 2006. Procedures are in place to accomplish preventive maintenance and calibrations at least semiannually.

Plant staff in the Unit 1 main control room verify proper operation of the meteorological monitoring system by performing routine channel checks. Two sensors of each parameter (wind speed, wind direction, and temperature) are available to minimize loss of continuous data. Spare sensors and auxiliary equipment are maintained to ensure that all meteorological parameters can be made available to the Main Control Room, Technical Support Center, and Emergency Off-Site Facility in the event that any portion of the system becomes totally or partially impaired. To prevent data loss due to lightning strikes or loss of power, a lightning protection system and propane generator with an uninterruptible power supply are installed.

The Applicant has procedures in place for the routine surveillance of meteorological instrumentation to ensure attainment of the data recovery goals specified in Regulatory Guide 1.23 (March 2007).

2.3.3.1.4 Recording of Meteorological Sensor Output

RBS COL 2.0-9-A The meteorological data from the tower are collected with two digital recorders. The primary and secondary recording system utilizes an Applied Meteorology, Incorporated 80 (AMI-80) data acquisition system. The recording system hardware is located in the air-conditioned (70°F) instrument building situated in the southwest corner of the fenced-off tower site area. Voltages are transmitted from the sensors to the recording systems over a 1- to 5-V dc range and converted from an analog to a digital signal. After the AMI-80 digitally records the meteorological data, it converts it into ASCII text. The ASCII text is then sent electronically to the Unit 1 control room for display and printed every 15 min. In addition, the meteorological data are transmitted to the plant computer collection system for data screening, validation, and archival. Computer monitors in the Unit 1 main control room also display the digital output from the sensors.

The parameters of wind speed and direction, ambient temperature, and differential temperature are sampled from the sensors every 5 sec. Every 10 min. a blocked average of the past 15 min. of data is calculated for each parameter. From the 10 min. averages, an hourly blocked average is then calculated. A minimum of 15 min. of data is used to derive hourly averages for each of the parameters.

The data recorded by the digital and analog recorders meet the accuracy requirements listed in Table 2 of Regulatory Guide 1.23 (March 2007).

2.3.3.1.5 Meteorological Data Quality Assurance and Processing

RBS COL 2.0-9-A After the data is collected by the meteorological sensors, the AMI-80 transmits the data to the plant computer collection system. The data are provided to the plant computer collection system to screen data for validity and quality, perform meteorological calculations, and update the data archive. Software in the plant computer collection system performs channel comparison and quality checks. Data considered suspect are flagged for each parameter by a color change on the computer displays in the Unit 1 main control room. Plant staff evaluates the flagged data from the primary and secondary sensors and determines if at least one of the sensor's data can be used. After the validation process is completed, the processed data are archived and permanently stored electronically. A plant procedure has been established to ensure that the 90 percent recovery rate of all meteorological parameters is retained on an annual basis to assess the relative concentrations and doses resulting from accidental or routine releases. Table 2.3-290 provides recovery rates for the meteorological parameters monitored on the on-site meteorological tower. The on-site meteorological data are considered adequate to represent on-site meteorological conditions as required by 10 CFR 100.10 and 10 CFR 100.20, as well as to make estimates of atmospheric dispersion for design basis accident and routine releases from the reactor.

If the meteorological system is damaged, a procedure to obtain relevant meteorological information (i.e., wind speed, wind direction, cloud cover, cloud ceiling) from Ryan Airport in Baton Rouge is in place. This procedure uses the Stability Array (STAR) technique to type atmospheric stability, which is commonly in use in most nuclear facilities. In addition, a letter of agreement between the RBS and the NWS assures that meteorological data will be available to the RBS on a 24-hour-per-day basis. The combination of the recording of meteorological variables on-site and NWS off-site data sources essentially assures that meteorological measurements will be available for emergency preparedness use under all circumstances.

2.3.3.2 Preoperational and Operational Program

RBS COL 2.0-9-A

Under the guidance of Section 2.3.3 of NUREG-0800, the current meteorological program establishes a baseline for identifying and assessing the environmental impacts during the construction and operating stages of RBS Unit 3. Therefore, at this point, the current monitoring program will continue and be used as the basis for recording the necessary meteorological observations during the preoperation/construction phase of Unit 3, as well as the operation phase of Unit 3. Should EOI (the Applicant) choose to install a new meteorological monitoring program either during the preoperational or operational phases of Unit 3, the program will be sited, installed, and operated in accordance with the provisions of Regulatory Guide 1.23.

2.3.4 SHORT-TERM DIFFUSION ESTIMATES

RBS COL 2.0-10-A

The consequence of a design basis accident in terms of personnel exposure is a function of the atmospheric dispersion conditions at the site of the potential release. Atmospheric diffusion conditions are represented by relative air concentration (χ/Q) values. This subsection describes the development of the short-term diffusion estimates for the exclusion area and low population zone (LPZ) boundaries and the control room.

2.3.4.1 Calculation Methodology

The efficiency of diffusion is primarily dependent on winds (speed and direction) and atmospheric stability characteristics.

Relative concentrations of released gases, χ/Q values, as a function of direction for various time periods at the exclusion area boundary (EAB) and the outer boundary of the LPZ, were determined by the use of the computer code PAVAN from NUREG/CR-2858 (Reference 2.3-262). This code implements the guidance provided in Regulatory Guide 1.145. The χ/Q calculations are based on the theory that material released to the atmosphere is normally distributed (Gaussian) about the plume center line. A straight-line trajectory is assumed between the point of release and the distances for which χ/Q values are calculated, in accordance with NUREG/CR-2858 and Regulatory Guide 1.145.

Using JFDs of wind direction and wind speed by atmospheric stability, PAVAN provides the χ/Q values as functions of direction for various time periods at the EAB and the LPZ. The meteorological data needed for this calculation included wind speed, wind direction, and atmospheric stability. The meteorological data used for this analysis were collected from the on-site monitoring equipment from 2000 through 2007. The data were combined and are reported in Tables 2.3-291 through 2.3-298 for each stability class.

Other plant-specific data included the tower height at which wind speed was measured (30 ft.) and distances to the EAB and LPZ. The EAB for RBS Unit 3, shown in FSAR Figure 2.1-204, is a circle centered at the Reactor Building with a radius of 2364 ft. The LPZ for RBS Unit 3 is the same as the RBS Unit 1 LPZ, which is a 2.5-mi. radius circle centered at RBS Unit 1. This sharing of the RBS Unit 1 LPZ results in a different distance to the LPZ in each direction from RBS Unit 3. The distance between the proposed RBS Unit 3 and existing RBS Unit 1 vessel centers is 775 ft. To be conservative in the atmospheric dispersion analysis, the LPZ distance used in all directions was 2.5 mi. less the 775 ft. offset distance.

Regulatory Guide 1.145 divides release configurations into two modes: ground release and stack release. A ground release includes release points that are effectively lower than two and one-half times the height of the adjacent solid structures. Because the RBS Unit 3 release points meet this criterion, releases are considered to be ground-level releases.

The PAVAN program computes χ/Q values at the EAB and LPZ for each combination of wind speed and atmospheric stability class for each of 16 downwind direction sectors. The χ/Q values calculated for each direction sector are then ranked in descending order, and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speeds and stabilities for the complementary upwind direction sector. The χ/Q value that is equaled or exceeded 0.5 percent of the total time becomes the maximum sector-dependent χ/Q value.

The calculated χ/Q values are also ranked independently of wind direction into a cumulative frequency distribution for the entire site. The PAVAN program then selects the χ/Qs that are equaled or exceeded 5 percent of the total time.

In accordance with Regulatory Guide 1.145, the larger of the two values (i.e., the maximum sector-dependent 0.5 percent χ/Q or the overall site 5 percent χ/Q value) is used to represent the χ/Q value for a 0 to 2-hr. time period. To determine χ/Q values for longer time periods, the program calculates an annual average χ/Q value using the procedure described in Regulatory Guide 1.111. The program then uses logarithmic interpolation between the 0 to 2-hr. χ/Q values for each sector and the corresponding annual average χ/Q values to calculate the values for intermediate time periods (i.e., 0 to 8-hr., 8 to 24 hr., 1 to 4 days, and 4 to 30 days).

2.3.4.2 Calculations and Results

PAVAN requires the meteorological data in the form of JFDs of wind direction and wind speed by atmospheric stability class. These analyses were completed using data from the RBS meteorological instrumentation collected from January 2000 through December 2007.

The stability classes were based on the classification system provided in Table 2 of Regulatory Guide 1.23. JFD tables were developed from the meteorological data.

Building area is defined as the smallest vertical-plane cross-sectional area of the Reactor Building in square meters. The building height and area used in the PAVAN input was 0, thereby conservatively neglecting the building wake credit.

The tower height is the height at which the wind speed was measured. Based on the lower measurement location, the tower height used was 9.144 m.

As described in Regulatory Guide 1.145, a ground release includes all release points that are effectively lower than two and one-half times the height of adjacent solid structures. Therefore, as stated above, a ground release was assumed.

Table 2.3-299 provides the off-site atmospheric dispersion factors. The PAVAN modeling results for the maximum sector χ/Q values at the EAB and the LPZ relative to the 0 to 2-hr. time period, the annual average time period, and other intermediate time intervals evaluated by the PAVAN model are presented as follows.

RBS Unit 3 Maximum χ/Q Values (sec/m^3)

	0-2 hr.	0-8 hr.	8-24 hr.	1-4 days	4-30 days
EAB	8.12E-04	N/A	N/A	N/A	N/A
LPZ	N/A	8.23E-05	5.76E-05	2.66E-05	8.75E-06

2.3.4.3 Relative Concentration Estimates at the Control Room Intakes

The atmospheric dispersion estimates for the RBS Unit 3 control room were calculated based on the guidance provided in Regulatory Guide 1.194. The control room χ/Q values were calculated for the release points to the control room normal and emergency air intakes, as well as the Control Building louvers (representing the unfiltered inleakage location), using the ARCON96 computer code (NUREG/CR-6331) (Reference 2.3-263), based on hourly meteorological data from January 2000 through December 2007.

Four air intake locations were considered in the dispersion evaluations. These include the two redundant control room habitability area (CRHA) heating, ventilating, and air conditioning (HVAC) subsystem (CRHAVS) emergency filter unit (EFU) air intakes; the control room normal air intake; and an assumed control room inleakage location. The CRHAVS is provided with two safety-related charcoal filter trains (EFUs), and χ/Q values were determined for each of the EFU charcoal filter train intake locations. These locations are presented as "EN" and "ES" in Figure 2.3-258. For most cases, only the closest emergency air intake was evaluated. Figure 2.3-258 also shows the location of the normal air intake (Point "N"). On-site receptor and source locations are identified in Table 2.3-344.

The assumed location for unfiltered inleakage is a louver located on the Control Building east wall (shown as Point "A" in Figure 2.3-258) that is intended to provide cooling through natural circulation for the nonsafety-related equipment located at grade elevation in the Control Building. The CRHA is located entirely below grade, and the inleakage locations represent inleakage into the Control Building rather than the control room itself; thus, this assumed inleakage location is conservative.

2.3.4.3.1 Release and Receptor Locations

The release location depends on the event, the release pathway, and the event scenario. Release locations were evaluated for various design basis events as follows:

Loss-of-Coolant Accident (LOCA) - The LOCA dose calculation credits operation of the EFU charcoal filter trains; therefore, the assumed receptor locations were the emergency air intakes. The Control Building louvers were conservatively assumed as the unfiltered inleakage source. LOCA doses were also calculated for Technical Support Center (TSC) personnel. The release points associated with the design basis LOCA are as follows:

a. Containment leakage into the Reactor Building is assumed to be released from the Reactor Building as a diffuse source release through the west face of the building. The Reactor Building face was projected to the west side of the stairwell, in accordance with Regulatory Guide 1.194. The area was conservatively assumed to be 2000 m^2. Refer to Figure 2.3-258.

b. Containment leakage through the passive containment cooling system (PCCS) was assumed to be released through the moisture separators. The leakage is routed through Seismic Category I ductwork to the Reactor Building roof. Refer to Figure 2.3-258.

c. Main steam isolation valve (MSIV) leakage is released via the main condenser, which is located in the Turbine Building. The Turbine Building is designed to Seismic Category II standards; therefore, it is expected to remain intact following a safe shutdown event (SSE). This scenario evaluates a diffuse source over the entire area of the Turbine Building (conservatively assumed to be 2000 m^2), with the source/receptor reduced as appropriate. Refer to Figure 2.3-258.

Fuel Handling Accident (FHA) - No credit was taken for the control room EFU charcoal filter trains in the FHA dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake (refer to Figure 2.3-258):

a. One potential release location for an FHA is the Reactor Building, which was previously discussed for the LOCA.

b. The other postulated release location for an FHA is the Fuel Building. Two release scenarios were evaluated:

    1. Equipment (cask) doors located on the east side of the Fuel Building. The cask doors were modeled as a point. The release height is assumed to be 1 m above grade.

    2. The west side of the Fuel Building is significantly closer to the Control Building; however, a release from the west side of the building was modeled as a diffuse release.

Main Steam Line Break (MSLB) - No credit was taken for the EFU charcoal filter trains in the MSLB dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. The MSLB release location was assumed to be the Turbine Building (diffuse release). Refer to Figure 2.3-258.

Liquid Radwaste Tank Failure - No credit was taken for the EFU charcoal filter trains in the liquid radwaste tank failure dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. The release point assumed for this event is the Radwaste Building, which is east of the Turbine Building. The release was assumed to be a point source. The distance used was assumed to be the same as the Fuel Building cask doors, which is conservative because of geometric symmetry.

Instrument Line Break - No credit was taken for the EFU charcoal filter trains in the instrument line break dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. The instrument line break release location was assumed to be the Reactor Building (diffuse release).

Feedwater Line Break (FWLB) - No credit was taken for the EFU charcoal filter trains in the FWLB dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. The FWLB release location was assumed to be the Turbine Building (diffuse release).

Reactor Water Cleanup (RWCU) **Line Break** - No credit was taken for the EFU charcoal filter trains in the RWCU dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. The RWCU line break was assumed to occur in the Reactor Building (diffuse release).

1000 Failed Fuel Rods Analysis - No credit was taken for the EFU charcoal filter trains in the 1000 rods dose consequence analysis; therefore, the only receptor location evaluated was the control room normal air intake. There are two release locations for this event. One is the main condenser/Turbine Building (diffuse release), and the other is the off-gas system that vents through the main plant stack. Dispersion factors were only calculated for the Turbine Building; therefore, those values were used in the analysis.

Atmospheric dispersion was also evaluated for the TSC. The TSC intake is located north of Line E6 and east of column ED of the Electrical Building, as indicated on DCD Figure 1.2-26. Distances to the TSC were based on the shortest linear distance from the Reactor Building, Turbine Building, and PCCS vent duct to Row E6, Column ED, as appropriate.

2.3.4.3.2 Methodology

A diffuse release was assumed to occur over the area of the Reactor Building facing the Control Building. The Reactor Building height above grade is 48.05 m. The width of the building is 47 m. Thus, the total surface area of the building above grade is approximately 2258 m^2. This analysis conservatively used a value of 2000 m^2 for the building area. A review of the Turbine Building general arrangement drawings confirms that the cross-sectional area of the Turbine Building is significantly greater than that of the Reactor Building. An area of 2000 m^2 was conservatively assumed to apply to the Turbine Building as well.

For the Reactor Building releases, the release height was assumed to be at the center of the Reactor Building, or roughly 24 m above ground elevation. The release height for the Turbine Building is assumed to be 24.5 m. The PCCS release is a point source assumed to occur at the Reactor Building roofline (48.05 m).

The Control Building air intakes were assumed to be approximately 1 m below the building roof elevation of 13,500 mm, or a "height" of 8 m. The height of the Control Building louvers (and the HVAC/electrical/piping chase) was assumed to be 1 m. The intake for the TSC was assumed to be located at Elevation 27.0 m, or a height of approximately 22.0 m.

Releases from the Fuel Building were assumed to occur either as a diffuse release on the west side of the building, or through the spent fuel cask equipment doors located on the east side of the building. For the diffuse release, the assumed Fuel Building width and height were based on the east/west cross section of the building, which is conservative for all other locations. As such, the assumed width is 21.0 m, and the height is 22.5 m, based on DCD Figure 1.2-10. The release height for the diffuse source is then 11.25 m.

A release height of 5.0 m was assumed for the Fuel Building cask door release point. A release height of 8.0 m was assumed for the Radwaste Building. This value minimizes the slant path for releases from the Radwaste Building.

The distances and directions from the assumed release points to the control room HVAC intake are shown on Table 2.3-300. In all cases, the intervening structures between the release point and the control room intake were ignored for calculational simplicity, thereby conservatively underestimating the true distance to the control room intakes.

Atmospheric stability was determined by the vertical temperature difference (ΔT) measured over the difference in measurement height and the stability classes provided in Regulatory Guide 1.23. For each of the source-to-receptor combinations, the χ/Q value that is not exceeded more than 5.0 percent of the total hours in the meteorological data set (e.g., 95-percentile χ/Q) was determined.

The ARCON96 code requires values for a number of additional parameters. Regulatory Guide 1.194, Table A-2, provides useful guidance in determining reasonable values for several of them. The remaining parameters are discussed in the following paragraphs.

In ARCON96, the value of the "vertical velocity" is used only in vent and stack release models. Because these models are not used in this analysis, the vertical velocity is set to 0 m/sec. Similarly, the "stack flow" value is set to 0 m/sec as well. Because the "stack flow" is 0, the stack radius is set to 0 m in accordance with Regulatory Guide 1.194 recommendations.

ARCON96 uses the "surface roughness length" parameter to adjust wind speeds to account for differences in meteorological instrumentation height and release height. This analysis utilizes the value of 0.2 m recommended by Regulatory Guide 1.194. The default value of 90 degrees is assumed for the wind direction window. The default value for minimum wind speed (0.5 m/sec) was assumed. A value of 4.3 was used for the "averaging sector width," in accordance with Regulatory Guide 1.194.

Initial diffusion coefficients are used in modeling a diffuse source. For the point source evaluations, the values were set to 0 m. Regulatory Guide 1.194, Section 3.2.4.4, states that, for diffuse sources, the two initial diffusion coefficients should be modified as follows (in the absence of site-specific empirical data):

$$\sigma_{Y_o} = \frac{Width}{6}$$

$$\sigma_{Z_o} = \frac{Height}{6}$$

Finally, the ARCON96 code default values were used for the "hours in averages" and "minimum number of hours" parameters, in accordance with Regulatory Guide 1.194, Table A-2. The ARCON96 parameters are summarized in Tables 2.3-300 and 2.3-301.

2.3.4.3.3 Results

The χ/Q values for each source-receptor pair are shown in Table 2.3-302. The site-specific χ/Q values are less than the corresponding DCD values (refer to Table 2.0-201) in all cases.

The dose consequences to operators at other units must be determined in addition to the unit with the accident. The intent is to ensure that the "other" unit may be maintained in a safe shutdown condition. As such, dispersion factors are required so that these doses may be calculated. The Unit 3 to Unit 1 cross-unit χ/Q values were conservatively based on a simple point source model. A distance of 200 m between Unit 1 and Unit 3 was conservatively assumed (the actual distance is approximately 236 m). The release height and receptor height were both assumed to be 10 m. The Unit 1 to Unit 3 cross-unit χ/Q values were calculated based on the actual distances and directions between the specific Unit 1 release points and the Unit 3 receptor points. The Unit 3 Reactor Building is located between the Unit 1 release points and the Unit 3 receptor locations. As such, the Unit 3 Reactor Building area of 2000 m^2 was entered to credit the building wake effect. These inputs are listed in Table 2.3-300. The calculated results are presented in Table 2.3-302, while the results with a "safety factor" of 1.5 for the Unit 3 to Unit 1 release-receptor combinations are presented in Table 2.3-303. The "safety factor" is used to account for any variations in release locations.

2.3.5 LONG-TERM DIFFUSION ESTIMATES

RBS COL 2.0-11-A

For a routine release, the concentration of radioactive material in the surrounding region depends on the amount of effluent released, the height of the release, the momentum and buoyancy of the emitted plume, the wind speed, atmospheric stability, airflow patterns of the site, and various effluent removal mechanisms.

Annual average relative concentration, χ/Q, and annual average relative deposition, D/Q, for gaseous effluent routine releases were, therefore, calculated.

2.3.5.1 Calculation Methodology and Assumptions

The XOQDOQ Computer Program (discussed in NUREG/CR-2919 [Reference 2.3-265]), which implements the assumptions outlined in Regulatory Guide 1.111, was used to generate the annual average relative concentration, χ/Q, and annual average relative deposition, D/Q. The values of χ/Q and D/Q were determined at the site boundary and at points within a radial grid of sixteen 22.5-degree sectors and extending to a distance of 50 mi. Radioactive decay and dry deposition were considered.

Meteorological data from January 2000 through December 2007 were used in the analysis. Receptor locations were based on the site boundary in each of the 16 directions. Meteorological data in JFD format, consistent with the RBS Unit 3 short-term (accident) diffusion χ/Q calculation discussed in Subsection 2.3.4, were utilized. In accordance with NUREG/CR-2858 (Reference 2.3-263) and NUREG/CR-2919, the calm array was distributed into the first wind speed class.

RBS DEP 9.4-1 The analysis assumed multiple release types from the center of the facility. At ground-level locations beyond several miles from the plant, the annual average concentration of effluents are essentially independent of release mode; however, for ground-level concentrations within a few miles, the release mode is important. Gaseous effluents released from tall stacks generally produce peak ground-level air concentrations near or beyond the site boundary. Near ground-level releases usually produce concentrations that decrease from the release point to locations downwind. Guidance for selection of the release mode is provided in Regulatory Guide 1.111. In general, in order for an elevated release to be assumed, either the release height must be at least twice the height of adjacent buildings or detailed information must be known about the wind speed at the height of the release. For this analysis, both ground-level and mixed-mode releases were considered. A ground-level release was considered for releases from the Radwaste Building, while mixed-mode releases were considered for releases from the Reactor Building/Fuel Building stack and the Turbine Building stack, based on the criteria set forth in Regulatory Guide 1.111.

The building area input is conservatively set to 0 to neglect the building wake credit for the mixed-mode releases. The building area for the ground-level release is set to 350 m^2.

Consistent with Regulatory Guide 1.111 guidance regarding radiological impact evaluations, radioactive decay and deposition were considered. Terrain recirculation was considered, consistent with Regulatory Guide 1.111, by employing the default terrain correction option in XOQDOQ.

2.3.5.2 Results

Receptor locations for the RBS were evaluated. Values of χ/Q and D/Q were determined at the site boundary and at points within a radial grid of sixteen 22.5-degree sectors (centered on true north, north-northeast, northeast, etc.) and extending to a distance of 50 mi. from the station. Receptor locations included in the evaluation are provided in Table 2.3-304. A set of data points was located within each sector at increments of 0.25 mi. to a distance of 1 mi. from the plant, at increments of 0.5 mi. from a distance of 1 mi. to 5 mi., at increments of 2.5 mi. from a distance of 5 mi. to 10 mi., and at increments of 5 mi. thereafter to a distance of 50 mi. Estimates of χ/Q (undecayed and undepleted; decayed and undepleted; decayed and depleted) and D/Q are provided at each of these grid points. The results of the analysis, based on meteorological data collected on-site from 2000 to 2007, are presented in Tables 2.3-305 through 2.3-343.

2.3.6 REFERENCES

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FSAR 2.3 Figures

Due to the large file sizes of the figures for FSAR Section 2.3, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

Table 2.3-201
National Weather Service First-Order and Cooperative Observing Stations Surrounding the RBS

Station[a]	State	County	Approximate Distance from RBS (mi.)[b]	Relative Direction to RBS	Elevation (ft.)
New Roads 5ESE	LA	Pointe Coupe	5	SSW	46
Baton Rouge NWS (Ryan Field)	LA	East Baton Rouge	19	SE	67
Woodville 4ESE	MS	Wilkinson	24	NNE	400
Grand Coteau	LA	Saint Laundry	47	WSW	56
Amite	LA	Tangipohoa	48	E	171
New Orleans NWS	LA	Jefferson	84	SE	0
Lake Charles NWS	LA	Calcasieu	115	WSW	9

a) Numeric and letter designators following a station name (New Roads 5ESE) indicate the station's distance in miles and direction relative to the place name.

b) The Corpscon 6.0.1 conversion program was used to convert Lat/Long (NAD 83) to UTM (NAD 83) for each site location. Distances above are from the current RBS facility to the listed location.

Sources: References 2.3-201, 2.3-202, 2.3-203, and 2.3-204.

Table 2.3-202
Local Climatological Data Summary for Baton Rouge, Louisiana

NORMALS, MEANS, AND EXTREMES
BATON ROUGE (KBTR)

LATITUDE: 30 ° 32'N LONGITUDE: -91 ° 8 'W ELEVATION (FT): GRND: 67 BARO: 70 TIME ZONE: CENTRAL (UTC -6) WBAN: 13970

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	60.0	63.9	71.0	77.3	84.0	89.2	90.7	90.9	87.4	79.7	70.1	62.8	77.3
	MEAN DAILY MAXIMUM	77	61.8	63.7	71.3	78.0	84.6	89.5	91.1	91.2	87.0	80.1	70.2	63.8	77.7
	HIGHEST DAILY MAXIMUM	55	84	85	91	93	98	103	101	105	104	97	87	85	105
	YEAR OF OCCURRENCE		2002	1989	1963	2006	1953	1954	1960	2000	2000	2006	1986	1982	AUG 2000
	MEAN OF EXTREME MAXS.	77	77.2	79.2	83.7	87.5	92.1	95.4	96.1	96.4	94.2	89.4	83.6	79.1	87.8
	NORMAL DAILY MINIMUM	30	40.2	43.1	49.6	55.8	64.1	70.2	72.7	71.9	67.5	56.4	47.9	42.1	56.8
	MEAN DAILY MINIMUM	77	41.5	43.3	49.8	56.6	64.4	69.5	72.8	72.2	67.5	57.2	47.5	42.8	57.1
	LOWEST DAILY MINIMUM	55	9	15	20	32	44	53	58	58	43	30	21	8	8
	YEAR OF OCCURRENCE		1985	1996	1980	1987	1954	1984	1967	2004	1967	1993	1976	1989	DEC 1989
	MEAN OF EXTREME MINS.	77	23.3	26.7	32.6	41.4	52.2	61.9	68.6	66.4	55.3	41.1	31.0	24.8	43.8
	NORMAL DRY BULB	30	50.1	53.5	60.3	66.6	74.0	79.7	81.7	81.4	77.5	68.1	59.0	52.4	67.0
	MEAN DRY BULB	77	51.7	53.6	60.5	67.3	74.5	79.6	82.0	81.8	77.3	68.7	58.8	53.3	67.4
	MEAN WET BULB	23	46.9	49.8	55.2	61.2	68.4	73.3	75.4	75.0	70.9	62.6	54.9	48.5	61.8
	MEAN DEW POINT	23	42.5	45.2	50.7	57.0	65.2	71.0	73.2	72.7	68.2	59.1	51.3	44.4	58.4
	NORMAL NO. DAYS WITH:														
	MAXIMUM >= 90	30	0.0	0.0	0.0	0.2	5.6	18.9	23.9	23.2	13.0	1.5	0.0	0.0	86.3
	MAXIMUM <= 32	30	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3
	MINIMUM <= 32	30	8.1	4.2	0.9	*	0.0	0.0	0.0	0.0	0.0	*	1.6	6.3	21.1
	MINIMUM <= 0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	457	326	185	57	4	0	0	0	2	49	212	397	1689
	NORMAL COOLING DEG. DAYS	30	11	15	55	119	298	457	534	523	389	157	48	22	2628
RH	NORMAL (PERCENT)	30	75	72	72	72	74	76	77	78	77	75	76	76	75
	HOUR 00 LST	30	82	80	81	83	86	88	88	89	88	87	87	84	85
	HOUR 06 LST	30	86	85	88	89	91	92	92	93	92	90	89	87	90
	HOUR 12 LST	30	64	60	58	55	58	60	62	61	60	55	60	63	60
	HOUR 18 LST	30	67	61	60	58	62	66	69	70	70	68	71	69	66
S	PERCENT POSSIBLE SUNSHINE														
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG (VISBY <= 1/4 MI)	43	4.3	2.9	3.2	2.6	2.4	1.1	1.2	1.4	2.0	4.2	3.9	3.9	33.1
	THUNDERSTORMS	59	2.2	3.3	4.5	5.2	6.5	10.3	15.2	12.5	6.5	2.6	2.7	2.4	73.9
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)	1	6.4	6.4		5.6	5.6	4.4	4.8	2.8	3.2	4.0	4.8	6.4	
	MIDNIGHT-MIDNIGHT (OKTAS)	1	6.4	6.4		5.6	4.8	4.8	4.8	2.8	3.2	4.0	5.6	6.4	
	MEAN NO. DAYS WITH:														
	CLEAR	1	10.0	9.5	8.0	7.0	13.0	7.0	9.0	10.0	3.0	5.0	6.0	2.0	89.5
	PARTLY CLOUDY	2	3.5	5.5	3.0	6.0	6.5	17.5	7.0	8.0	2.0	3.0	3.0	2.0	67.0
	CLOUDY	2	14.5	15.0	7.5	9.0	16.5	10.0	9.0	4.0		8.0	7.0	5.0	
PR	MEAN STATION PRESSURE (IN)	23	30.08	30.04	29.97	29.93	29.90	29.90	29.95	29.92	29.91	29.97	30.03	30.04	29.97
	MEAN SEA-LEVEL PRES. (IN)	23	30.15	30.11	30.04	30.00	29.98	29.97	30.02	30.00	29.99	30.05	30.11	30.15	30.05
WINDS	MEAN SPEED (MPH)	23	7.5	7.9	7.9	7.7	6.7	5.8	5.3	4.9	5.7	5.8	6.6	6.9	6.6
	PREVAIL.DIR (TENS OF DEGS)	35	13	36	19	19	19	19	26	06	05	06	13	12	05
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	13	39	39	39	36	39	39	37	37	41	37	35	60	60
	DIR. (TENS OF DEGS)		24	17	18	19	22	19	28	31	18	15	17	29	29
	YEAR OF OCCURRENCE		1999	1998	2006	2006	1999	2003	1997	2005	2005	2002	2004	2002	DEC 2002
	MAXIMUM 5-SECOND														
	SPEED (MPH)	13	47	51	49	52	52	52	47	48	53	49	44	78	78
	DIR. (TENS OF DEGS)		23	17	29	18	25	32	28	09	19	24	22	28	28
	YEAR OF OCCURRENCE		1999	1998	1996	2006	1999	2004	1997	2000	2005	2006	1997	2002	DEC 2002
PRECIPITATION	NORMAL (IN)	30	6.19	5.10	5.07	5.56	5.34	5.33	5.96	5.86	4.84	3.81	4.76	5.26	63.08
	MAXIMUM MONTHLY (IN)	55	14.94	14.51	12.73	14.84	14.67	23.18	10.98	14.48	13.95	14.48	13.55	15.94	23.18
	YEAR OF OCCURRENCE		1998	1966	1973	1980	1989	1989	1963	1987	1977	1984	1989	1982	JUN 1989
	MINIMUM MONTHLY (IN)	55	0.52	0.64	0.30	0.38	0.35	0.12	1.94	0.38	0.09	T	0.25	1.83	T
	YEAR OF OCCURRENCE		2003	2000	2006	1976	1998	1979	2005	1999	1953	1978	1967	1996	OCT 1978
	MAXIMUM IN 24 HOURS (IN)	55	9.02	4.72	6.07	12.08	4.96	9.97	4.26	8.31	9.17	8.38	7.29	8.28	12.08
	YEAR OF OCCURRENCE		1993	1979	1973	1967	1954	2001	1969	1987	2005	1964	1989	1982	APR 1967
	NORMAL NO. DAYS WITH:														
	PRECIPITATION >= 0.01	30	10.6	8.3	9.3	7.9	8.0	10.9	12.7	12.3	9.2	5.9	8.9	9.4	113.4
	PRECIPITATION >= 1.00	30	2.1	1.7	1.8	1.8	1.8	1.5	1.8	1.7	1.5	1.4	1.5	1.7	20.3
SNOWFALL	NORMAL (IN)	30	0.*	0.2	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	0.*	0.2
	MAXIMUM MONTHLY (IN)	46	0.6	3.2	T	0.0	T	0.0	0.0	0.0	0.0	0.0	T	T	3.2
	YEAR OF OCCURRENCE		1973	1988	1993		1989						1976	1989	FEB 1988
	MAXIMUM IN 24 HOURS (IN)	45	0.5	3.2	T	0.0	T	0.0	0.0	0.0	0.0	0.0	T	T	3.2
	YEAR OF OCCURRENCE'		1973	1988	1993		1989						1976	1989	FEB 1988
	MAXIMUM SNOW DEPTH (IN)	46	2	2	0	0	0	0	0	0	0	0	T	0	2
	YEAR OF OCCURRENCE		1949	1988									1976		FEB 1988
	NORMAL NO. DAYS WITH:														
	SNOWFALL >= 1.0	30	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

published by: NCDC Asheville, NC 3 30 year Normals (1971-2000)

Source: Reference 2.3-201.

Table 2.3-203
Local Climatological Data Summary for New Orleans, Louisiana

NORMALS, MEANS, AND EXTREMES
NEW ORLEANS (KMSY)

LATITUDE: 29 ° 59'N   LONGITUDE: -90 ° 15'W   ELEVATION (FT): GRND: 0   BARO: 7   TIME ZONE: CENTRAL   (UTC -6)   WBAN: 12916

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	61.8	65.3	72.1	78.0	84.8	89.4	91.1	91.0	87.1	79.7	71.0	64.5	78.0
	MEAN DAILY MAXIMUM	68	62.2	64.4	71.3	77.8	84.8	89.1	90.8	90.6	86.5	79.7	70.3	64.3	77.7
	HIGHEST DAILY MAXIMUM	60	83	85	89	92	96	100	101	102	101	94	87	84	102
	YEAR OF OCCURRENCE		1982	1972	1982	1987	1953	1954	1981	1980	1980	1998	1997	1995	AUG 1980
	MEAN OF EXTREME MAXS.	68	77.5	79.3	82.4	86.6	91.4	94.5	95.6	95.6	93.2	88.6	83.3	79.7	87.3
	NORMAL DAILY MINIMUM	30	43.4	46.1	52.7	58.4	66.4	72.0	74.2	73.9	70.6	60.2	51.8	45.6	59.6
	MEAN DAILY MINIMUM	68	44.0	46.1	52.4	58.8	66.2	71.5	73.9	73.8	70.3	60.7	51.0	45.7	59.5
	LOWEST DAILY MINIMUM	60	14	16	25	32	41	50	60	60	42	35	24	11	11
	YEAR OF OCCURRENCE		1985	1996	1980	1971	1960	1984	1967	1968	1967	1993	1970	1989	DEC 1989
	MEAN OF EXTREME MINS.	68	26.7	30.3	35.8	44.0	54.3	63.9	69.4	68.5	60.4	44.8	35.1	28.6	46.8
	NORMAL DRY BULB	30	52.6	55.7	62.4	68.2	75.6	80.7	82.7	82.5	78.9	70.0	61.4	55.1	68.8
	MEAN DRY BULB	68	53.1	55.3	61.9	68.4	75.5	80.4	82.4	82.2	78.4	70.2	60.7	55.0	68.6
	MEAN WET BULB	23	49.0	51.9	56.7	62.6	69.5	74.2	76.0	75.9	72.6	64.7	57.2	50.8	63.4
	MEAN DEW POINT	23	44.9	47.9	52.7	58.6	66.4	72.0	73.9	73.7	69.8	61.1	53.5	47.0	60.1
	NORMAL NO. DAYS WITH:														
	MAXIMUM >= 90	30	0.0	0.0	0.0	0.3	3.9	15.8	21.5	22.3	10.2	1.1	0.0	0.0	75.1
	MAXIMUM <= 32	30	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
	MINIMUM <= 32	30	4.6	2.4	0.4	*	0.0	0.0	0.0	0.0	0.0	0.0	0.7	3.5	11.6
	MINIMUM <= 0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	403	288	150	44	1	0	0	0	0	30	169	332	1417
	NORMAL COOLING DEG. DAYS	30	12	19	62	136	320	466	538	534	413	182	62	29	2773
RH	NORMAL (PERCENT)	30	75	74	73	73	74	78	79	79	77	75	76	77	76
	HOUR 00 LST	30	81	80	81	83	85	87	88	88	86	85	85	83	84
	HOUR 06 LST	30	84	84	85	87	89	90	92	92	89	88	87	85	88
	HOUR 12 LST	30	66	63	61	59	60	64	66	65	65	60	63	65	63
	HOUR 18 LST	30	71	66	65	64	65	68	71	72	72	71	75	74	70
S	PERCENT POSSIBLE SUNSHINE	22	46	50	56	62	62	63	59	61	61	64	54	48	57
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG (VISBY <= 1/4 MI)	43	5.1	3.6	3.2	1.2	0.5	0.3	0.2	0.3	0.3	1.5	2.9	4.2	23.3
	THUNDERSTORMS	59	2.1	2.8	4.0	4.2	5.7	10.2	15.4	13.1	6.4	2.1	2.3	2.1	70.4
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)	48	5.4	5.0	5.0	4.6	4.9	4.9	5.1	4.6	4.3	3.6	4.3	5.1	4.7
	MIDNIGHT-MIDNIGHT (OKTAS)	32	5.2	4.8	4.9	4.4	4.2	4.0	4.6	4.3	4.0	3.3	4.0	4.8	4.4
	MEAN NO. DAYS WITH:														
	CLEAR	48	6.9	7.5	7.8	7.9	8.9	8.3	4.6	7.2	9.6	14.3	10.2	7.7	100.9
	PARTLY CLOUDY	48	7.1	6.4	8.0	10.4	11.2	12.5	14.6	13.8	10.6	7.9	8.2	7.4	118.1
	CLOUDY	48	16.9	14.3	15.2	11.7	10.9	9.2	11.8	10.0	9.8	8.9	11.5	15.9	146.1
PR	MEAN STATION PRESSURE (IN)	23	30.13	30.09	30.02	29.98	29.96	29.95	30.00	29.97	29.95	30.02	30.08	30.13	30.02
	MEAN SEA-LEVEL PRES. (IN)	23	30.16	30.12	30.05	30.01	29.99	29.98	30.03	30.00	29.98	30.05	30.11	30.16	30.05
WINDS	MEAN SPEED (MPH)	23	9.1	9.5	9.4	9.3	8.2	6.8	5.9	6.0	7.5	8.0	8.5	8.8	8.1
	PREVAIL.DIR (TENS OF DEGS)	28	36	36	17	17	19	19	25	05	05	05	06	36	19
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	10	48	43	39	45	44	40	46	40	46	39	39	39	48
	DIR. (TENS OF DEGS)		27	21	19	30	32	25	04	02	01	17	28	24	27
	YEAR OF OCCURRENCE		1998	1998	2006	2004	2004	2004	2005	1997	2002	2002	2004	2000	JAN 1998
	MAXIMUM 5-SECOND														
	SPEED (MPH)	10	63	51	51	55	64	64	55	48	55	51	46	51	64
	DIR. (TENS OF DEGS)		33	21	19	29	02	25	03	04	01	13	21	25	25
	YEAR OF OCCURRENCE		1998	1998	2006	2004	2004	2004	2005	1997	1998	2002	2002	2005	JUN 2004
PRECIPITATION	NORMAL (IN)	30	5.87	5.47	5.24	5.02	4.62	6.83	6.20	6.15	5.55	3.05	5.09	5.07	64.16
	MAXIMUM MONTHLY (IN)	60	19.28	12.59	19.09	16.12	21.18	17.62	13.15	16.12	18.98	13.20	19.81	10.77	21.18
	YEAR OF OCCURRENCE		1998	1983	1948	1980	1995	2001	1991	1977	1998	1985	1989	1967	MAY 1995
	MINIMUM MONTHLY (IN)	60	0.19	0.15	0.24	0.28	0.07	0.23	1.38	1.68	0.24	0.00	0.21	1.46	0.00
	YEAR OF OCCURRENCE		2003	1989	1955	1976	2000	1979	2000	1980	1953	1978	1949	1958	OCT 1978
	MAXIMUM IN 24 HOURS (IN)	60	6.08	5.60	7.87	8.08	12.40	7.40	4.43	4.96	9.55	4.51	12.66	6.81	12.66
	YEAR OF OCCURRENCE		1978	1961	1948	1988	1995	1988	1996	1992	2002	1985	1989	1990	NOV 1989
	NORMAL NO. DAYS WITH:														
	PRECIPITATION >= 0.01	30	10.5	8.4	8.6	7.2	8.0	11.8	13.9	13.2	10.2	5.9	8.6	9.4	115.7
	PRECIPITATION >= 1.00	30	1.9	1.8	2.1	1.5	1.6	2.5	1.7	1.7	1.7	1.0	1.8	1.5	20.8
SNOWFALL	NORMAL (IN)	30	0.*	0.*	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	0.0
	MAXIMUM MONTHLY (IN)	51	0.4	2.0	T	T	T	0.0	0.0	0.0	0.0	0.0	T	2.7	2.7
	YEAR OF OCCURRENCE		1985	1958	1993	1996	1989						1950	1963	DEC 1963
	MAXIMUM IN 24 HOURS (IN)	50	0.4	2.0	T	T	T	0.0	0.0	0.0	0.0	0.0	T	2.7	2.7
	YEAR OF OCCURRENCE'		1985	1958	1993	1996	1989						1950	1963	DEC 1963
	MAXIMUM SNOW DEPTH (IN)	48	2	2	0	0	0	0	0	0	0	0	0	1	2
	YEAR OF OCCURRENCE		1964	1958										1989	JAN 1964
	NORMAL NO. DAYS WITH:														
	SNOWFALL >= 1.0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

published by: NCDC Asheville, NC   3   30 year Normals (1971-2000)

Source: Reference 2.3-202.

Table 2.3-204
Local Climatological Data Summary for Lake Charles, Louisiana

NORMALS, MEANS, AND EXTREMES
LAKE CHARLES (KLCH)

LATITUDE: 30 ° 7 'N | LONGITUDE: -93 ° 13'W | ELEVATION (FT): GRND: 9 BARO: 17 | TIME ZONE: CENTRAL (UTC -6) | WBAN: 03937

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	60.6	64.5	71.3	77.4	84.1	88.9	91.0	91.3	87.7	80.5	70.6	63.3	77.6
	MEAN DAILY MAXIMUM	45	60.6	64.0	70.9	78.0	84.2	89.0	91.0	91.3	87.7	80.6	71.1	63.4	77.7
	HIGHEST DAILY MAXIMUM	42	82	83	86	95	99	99	102	107	105	94	87	82	107
	YEAR OF OCCURRENCE		2000	1972	1974	1987	2005	1990	1980	2000	2000	2006	1989	1978	AUG 2000
	MEAN OF EXTREME MAXS.	45	76.0	77.1	81.1	86.2	91.0	94.2	95.9	96.6	94.2	89.5	83.4	77.9	86.9
	NORMAL DAILY MINIMUM	30	41.2	44.3	50.8	57.2	65.7	72.1	74.3	73.6	69.1	58.6	49.7	43.3	58.3
	MEAN DAILY MINIMUM	45	42.0	44.7	51.0	58.8	66.1	71.9	74.1	73.4	69.0	58.7	50.1	43.9	58.6
	LOWEST DAILY MINIMUM	42	15	17	23	34	49	56	61	59	47	30	23	11	11
	YEAR OF OCCURRENCE		1985	1996	2002	1971	1996	1984	1967	2004	1967	1993	1976	1989	DEC 1989
	MEAN OF EXTREME MINS.	45	25.3	29.2	34.6	43.2	54.1	63.7	69.5	67.5	56.0	42.8	33.9	27.8	45.6
	NORMAL DRY BULB	30	50.9	54.4	61.0	67.3	74.9	80.5	82.6	82.4	78.4	69.5	60.1	53.3	67.9
	MEAN DRY BULB	45	51.3	54.3	61.0	68.4	75.1	80.5	82.6	82.4	78.3	69.7	60.6	53.7	68.2
	MEAN WET BULB	23	48.2	51.3	56.6	62.7	69.9	74.7	76.7	76.1	71.7	64.0	56.4	49.9	63.2
	MEAN DEW POINT	23	44.6	47.7	53.1	59.3	67.4	72.8	74.7	74.0	69.1	60.9	53.0	46.4	60.3
	NORMAL NO. DAYS WITH:														
	MAXIMUM >= 90	30	0.0	0.0	0.0	0.2	2.8	13.8	23.3	22.9	12.6	1.1	0.0	0.0	76.7
	MAXIMUM <= 32	30	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
	MINIMUM <= 32	30	5.4	2.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.9	4.1	13.5
	MINIMUM <= 0	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	434	304	163	47	1	0	0	0	1	38	191	367	1546
	NORMAL COOLING DEG. DAYS	30	9	13	49	126	312	467	544	534	399	178	54	20	2705
RH	NORMAL (PERCENT)	30	79	78	77	76	79	80	81	81	79	77	79	79	79
	HOUR 00 LST	30	86	85	87	88	91	92	92	93	91	89	88	87	89
	HOUR 06 LST	30	88	88	90	91	93	93	95	95	93	91	90	89	91
	HOUR 12 LST	30	68	64	63	60	63	64	65	63	62	57	62	66	63
	HOUR 18 LST	30	76	71	69	66	69	70	72	72	73	71	76	76	72
S	PERCENT POSSIBLE SUNSHINE	19	62	66	74	76	76	83	83	81	78	75	67	58	73
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG (VISBY <= 1/4 MI)	43	7.4	5.5	6.3	3.6	2.1	0.8	0.5	0.7	2.0	5.9	5.9	6.5	47.2
	THUNDERSTORMS	45	3.3	2.8	4.1	4.3	6.9	10.2	14.1	13.2	7.8	3.1	3.0	2.7	75.5
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)							4.0							
	MIDNIGHT-MIDNIGHT (OKTAS)														
	MEAN NO. DAYS WITH:														
	CLEAR	1	1.0	1.0	7.0		11.0	7.0							
	PARTLY CLOUDY			1.0	5.0		6.0	8.0							
	CLOUDY	1	1.0	1.0	3.0		1.0	3.0							
PR	MEAN STATION PRESSURE (IN)	23	30.13	30.09	30.01	29.97	29.94	29.94	29.99	29.97	29.96	30.02	30.08	30.12	30.02
	MEAN SEA-LEVEL PRES. (IN)	23	30.16	30.12	30.05	30.00	29.98	29.97	30.03	30.01	29.99	30.05	30.11	30.15	30.05
WINDS	MEAN SPEED (MPH)	23	9.0	9.4	9.2	9.0	7.9	6.9	5.8	5.5	6.8	7.5	8.3	8.7	7.8
	PREVAIL.DIR (TENS OF DEGS)	32	36	36	19	19	19	19	21	07	05	05	36	36	19
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	11	32	36	38	43	39	36	36	38	58	36	32	39	58
	DIR. (TENS OF DEGS)		33	16	33	03	33	12	33	02	04	34	31	13	04
	YEAR OF OCCURRENCE		2005	1998	1996	1997	1997	2006	1996	2000	2005	2002	2006	2006	SEP 2005
	MAXIMUM 5-SECOND														
	SPEED (MPH)	11	44	48	46	54	48	44	45	51	74	47	40	46	74
	DIR. (TENS OF DEGS)		18	20	12	02	33	13	32	03	04	35	31	12	04
	YEAR OF OCCURRENCE		1999	1997	2002	1997	1997	2006	1996	2000	2005	2002	2006	2006	SEP 2005
PRECIPITATION	NORMAL (IN)	30	5.52	3.28	3.54	3.64	6.06	6.07	5.13	4.85	5.95	3.94	4.61	4.60	57.19
	MAXIMUM MONTHLY (IN)	45	14.29	7.99	9.24	10.95	20.71	25.33	13.19	17.36	19.96	21.44	11.85	13.27	25.33
	YEAR OF OCCURRENCE		1991	2004	2001	1973	1980	1989	1979	1962	1973	2002	2000	1967	JUN 1989
	MINIMUM MONTHLY (IN)	45	0.78	0.43	0.19	0.40	0.04	0.84	0.48	0.77	0.43	T	0.11	2.02	T
	YEAR OF OCCURRENCE		1971	2001	2006	1999	1998	1969	1962	1999	1989	1963	1967	2000	OCT 1963
	MAXIMUM IN 24 HOURS (IN)	45	5.80	3.40	4.91	5.50	16.88	7.09	6.59	14.10	11.20	7.50	4.02	6.88	16.88
	YEAR OF OCCURRENCE		1991	1997	1973	1973	1980	1981	1987	1962	1979	1996	1993	1971	MAY 1980
	NORMAL NO. DAYS WITH:														
	PRECIPITATION >= 0.01	30	10.2	8.4	8.6	7.3	7.7	9.9	11.3	10.3	9.6	6.6	8.6	9.3	107.8
	PRECIPITATION >= 1.00	30	1.6	1.0	1.2	0.9	1.8	2.1	1.5	1.4	1.7	1.4	1.4	1.3	17.3
SNOWFALL	NORMAL (IN)	30	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.*	0.*	0.3
	MAXIMUM MONTHLY (IN)	34	4.0	1.6	T	T	T	0.0	T	0.0	0.0	0.0	T	0.2	4.0
	YEAR OF OCCURRENCE		1973	1988	1968	1993	1992		1994				1976	1989	JAN 1973
	MAXIMUM IN 24 HOURS (IN)	34	4.0	1.6	T	T	T	0.0	T	0.0	0.0	0.0	T	0.2	4.0
	YEAR OF OCCURRENCE'		1973	1988	1968	1993	1992		1994				1976	1989	JAN 1973
	MAXIMUM SNOW DEPTH (IN)	34	4	0	0	0	0	0	0	0	0	0	0	0	4
	YEAR OF OCCURRENCE		1973												JAN 1973
	NORMAL NO. DAYS WITH:														
	SNOWFALL >= 1.0	30	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

published by: NCDC Asheville, NC 3 30 year Normals (1971-2000)

Source: Reference 2.3-203.

Table 2.3-205
Climatological Means and Normals for National Weather Service First-Order and Cooperative Observation Stations in the Region Surrounding the RBS

Station	Mean Annual Temperatures (ºF)			Normal Annual Precipitation	
	Daily Maximum	Daily Minimum	Daily Mean	Rainfall (in.)	Snowfall (in.)
New Roads 5ESE	77.9 (A)	56.1 (A)	67.0 (A)	61.14 (E)	0.1 (A)
Baton Rouge NWS (Ryan Airport)	77.7 (B)	57.1 (B)	67.4 (B)	63.08 (B)	0.2 (B)
Woodville 4ESE	77.4 (A)	55.1 (A)	66.3 (A)	68.22 (E)	0.2 (A)
Grand Coteau	78.5 (A)	57.0 (A)	67.7 (A)	63.29 (E)	0.2 (A)
Amite	78.2 (A)	54.9 (A)	66.6 (A)	65.72 (E)	0.3 (A)
New Orleans NWS	77.7 (C)	59.5 (C)	68.6 (C)	64.16 (C)	0.0 (C)
Lake Charles NWS	77.7 (D)	58.6 (D)	68.2 (D)	57.19 (D)	0.3 (D)

Source A: Reference 2.3-210.
Source B: Reference 2.3-201.
Source C: Reference 2.3-202.
Source D: Reference 2.3-203.
Source E: Reference 2.3-214.

Table 2.3-206
Climatological Extremes for National Weather Service First-Order and Cooperative Observation Stations Surrounding the RBS

Parameter	New Roads (5ESE)	Baton Rouge NWS	Woodville (4ESE)	Grand Coteau	Amite	New Orleans NWS	Lake Charles NWS
Maximum Temperature (1)	105ºF (A)	105ºF (B)	108ºF (A)	106ºF (A)	105ºF (A)	102ºF (C)	107ºF (D)
Minimum Temperature (2)	8ºF (A)	8ºF (B)	4ºF (A)	8ºF (A)	5ºF (A)	11ºF (C)	11ºF (D)
Max 24-hr. Rainfall (in.)	9.85 (A)	12.08 (B)	10.82 (A)	10.52 (A)	8.77 (A)	12.66 (C)	16.88 (D)
Max Monthly Rainfall (in.)	21.26 (A)	23.18 (B)	19.38 (A)	19.80 (A)	20.99 (A)	21.18 (C)	25.33 (D)
Max 24-hr. Snowfall (in.) (3)	3.2 (E)	3.2 (B)	6.0 (E)	5.5 (E)	6.0 (E)	2.7 (C)	4.0 (D)
Max Monthly Snowfall (in.) (4)	3.2 (E)	3.2 (B)	6.0 (E)	5.6 (E)	6.0 (E)	2.7 (C)	4.0 (D)

(1), (F) A high temperature of 110ºF was recorded at the old weather station in the southern Baton Rouge business district in August 1909.

(2), (F) A low temperature of 2ºF was measured in February 1899 on the old Louisiana State University campus.

(3), (E) A maximum 24-hr. snowfall of 9.0 in. occurred during February 1960 at Simmesport in Avoyelles Parish and Clinton in East Feliciana Parish.

(4), (E) A maximum monthly snowfall of 12.5 in. was reported in 1899 at the Baton Rouge Government recording stations.

Source A: Reference 2.3-210.
Source B: Reference 2.3-201.
Source C: Reference 2.3-202.
Source D: Reference 2.3-203.
Source E: Reference 2.3-215.
Source F: Reference 2.3-209.

Table 2.3-207
Monthly and Annual Dew Point Temperature (°F) Summaries for Ryan Airport in Baton Rouge, Louisiana (1961 - 1995)

	Mean Dew Point	Measured Dew Point Extremes		Mean Dew Point Diurnal Range
		Maximum	Minimum	
January	40.7	71.1	-9.0	13.8
February	42.7	72.0	-2.9	13.0
March	49.8	75.0	10.0	12.2
April	57.0	77.0	21.9	10.0
May	64.1	82.0	33.1	7.8
June	69.9	81.0	36.0	6.4
July	72.5	82.9	44.1	5.8
August	72.0	81.0	50.0	5.8
September	67.8	80.1	33.1	6.9
October	57.4	79.0	10.9	10.0
November	49.9	75.9	6.1	12.2
December	43.7	75.0	-7.1	13.5
Annual	57.3	82.9	-9.0	9.8

Sources: References 2.3-211 and 2.3-212.

Table 2.3-208 (Sheet 1 of 2)
Annual Summaries of Hours with Dust Reported for Ryan Airport During the Period 1961 - 1995

Year	Annual Hours of Dust	Annual Frequency of Occurrence[a]
1961	0	--
1962	10	0.11%
1963	0	--
1964	0	--
1965	3	0.03%
1966	6	0.07%
1967	0	--
1968	0	--
1969	0	--
1970	0	--
1971	1	0.01%
1972	0	--
1973	0	--
1974	0	--
1975	0	--
1976	0	--
1977	90	1.03%
1978	0	--
1979	2	0.02%
1980[b]	5	0.06%
1981	0	--
1982	3	0.03%
1983	0	--
1984	0	--
1985	0	--
1986	0	--

**Table 2.3-208 (Sheet 2 of 2)
Annual Summaries of Hours with Dust Reported for
Ryan Airport During the Period 1961 - 1995**

Year	Annual Hours of Dust	Annual Frequency of Occurrence[(a)]
1987	0	--
1988	0	--
1989	0	--
1990	0	--
1991	0	--
1992	0	--
1993	0	--
1994	0	--
1995	0	--

a) Refers to percentage of total hours for the year.

b) Calculations for leap years add an additional day to the calendar year.

Source: References 2.3-211 and 2.3-212.

Table 2.3-209
Distribution for Duration of Discrete Dust Events at Ryan Airport (1961 - 1995)

Month	Duration of Discrete Events (Hr.)								
	1	2	3	4	5	6	7	10+	Annual Total of Occurrences
1962	1	1					1		3
1965	3								3
1966	6								6
1971	1								1
1977		1		2				2[a]	5
1979		1							1
1980		1	1						2
1982			1						1
Total Occurrences by Duration	11	4	2	2	0	0	1	2	22

a) The longest stretches of consecutive hours with dust at Ryan Airport during the 1961 - 1965 time period are 41 and 39 hours, occurring in February and March, respectively, of 1977.

Source: References 2.3-211 and 2.3-212.

Table 2.3-210 (Sheet 1 of 2)
Freezing Rain Event Summaries for the Seven-Parish Area Surrounding the RBS During the Period 1993 - 2007

Event 1	
Event Type	Ice Storm
State	Louisiana
Parish/County	Avoyelles
Begin Date	01 Feb 1996, 06:00:00 PM CST
End Date	03 Feb 1996, 09:00:00 AM CST
Fatalities	0
Injuries	0
Property Damage	$200,000
Description	The worst ice storm in 10 years, according to electric companies, caused numerous power lines and trees to snap and fall. Between 1/4 and 1/2 inch of ice accumulated.

Event 2	
Event Type	Ice Storm
State	Louisiana
Parish/County	Allen, Avoyelles, Beauregard, Calcasieu, Jefferson, Davis, Lafayette
Begin Date	12 Jan 1997, 08:00:00 AM CST
End Date	14 Jan 1997, 09:00:00 AM CST
Fatalities	2
Injuries	15
Property Damage	$11.9 Million
Description	A record ice storm hit southwest Louisiana and southeast Texas. The hardest hit area was Calcasieu Parish. More than 40,000 electric customers were without power for up to 6 days because of the number of downed trees and power lines. Numerous traffic accidents were attributed to icy roadways. One 54-year-old woman was killed in an accident in Avoyelles Parish, and one 41-year-old man was killed in an accident in Beauregard Parish. Millions of tons of debris were removed, taking more than 2 months to pick up in some areas. Hundreds of homes received minor roof damage due to trees and tree limbs falling on them.

Table 2.3-210 (Sheet 2 of 2)
Freezing Rain Event Summaries for the Seven-Parish Area Surrounding the RBS During the Period 1993 - 2007

Event 3	
Event Type	Winter Storm
State	Louisiana
Parish/County	East Baton Rouge, East Feliciana, Iberville, Livingston, Pointe Coupee, St. Helena, St. Tammany, Tangipahoa, Washington, West Baton Rouge, West Feliciana
Begin Date	01 Jan 2002, 03:00:00 PM CST
End Date	02 Jan 2002, 05:00:00 AM CST
Fatalities	0
Injuries	0
Property Damage	$0
Description	A mixture of rain and sleet began to fall during the afternoon of January 1st over some areas of southeast Louisiana to the north and west of Lake Pontchartrain before changing to a mix of snow and sleet during the evening hours. Snow continued to fall through the night until daybreak on the 2nd in an area extending from Washington and northern St. Tammany Parishes west to Pointe Coupee and Iberville Parishes. In this area, 1/2 to 2 in. of snow accumulated, resulting in automobile accidents on icy roadways and the closing of some bridges.

Source: Reference 2.3-222.

Table 2.3-211
Ambient Temperature and Humidity Statistics for Baton Rouge, Louisiana

Minimum Annual Dry-Bulb Heating Exceedance	99.0%	30.6ºF
	99.6%	27.0ºF
	0%	9.0°F
Maximum Annual Dry-Bulb/MCWB Cooling Exceedance	2%	91.2ºF/77.0ºF
	1.0%	92.6ºF/77.3ºF
	0%	105°F/77.9°F
Maximum Annual Wet-Bulb Cooling Exceedance	2%	78.8ºF
	1.0%	79.6ºF
	0%	85.2°F
Probable 100-year Exceedance	Maximum Dry-Bulb	105.9ºF
	Minimum Dry-Bulb	2.1ºF
	Maximum Wet-Bulb	86.4ºF

Notes:

1. Data for the maximum annual dry-bulb and MCWB temperatures are taken from the *2005 ASHRAE Handbook*.

2. Probable maximum 100-year exceedance values were calculated via Gumbel distributions using meteorological data from Ryan Airport (1961-2006).

Sources: References 2.3-211, 2.3-212, 2.3-236, 2.3-240, and 2.3-241.

Table 2.3-212 (Sheet 1 of 2)
Monthly and Annual Temperature Data (°F) for Ryan Airport and the RBS
(December 2004 - November 2006)

Period		Upper Level - 150 ft. RBS[A]	Lower Level – 30 ft. RBS	Single Level – 30 ft. Ryan Airport [A]
January	Mean	56.2	56.1	56.5
	Maximum	78.0	78.3	81.0
	Minimum	26.5	26.7	27.0
February	Mean	55.0	54.9	55.7
	Maximum	79.9	80.3	82.0
	Minimum	30.7	28.0	27.0
March	Mean	61.3	61.2	61.4
	Maximum	84.8	84.6	84.0
	Minimum	37.8	35.1	34.0
April	Mean	69.4	69.1	69.4
	Maximum	91.7	91.1	91.0
	Minimum	47.7	44.2	41.0
May	Mean	74.2	73.9	74.3
	Maximum	92.6	92.7	93.0
	Minimum	49.4	49.1	48.0
June	Mean	80.6	80.3	80.7
	Maximum	96.5	95.9	99.0
	Minimum	66.9	66.4	63.0
July	Mean	81.2	81.0	81.5
	Maximum	96.1	96.5	97.0
	Minimum	70.7	70.6	70.0
August	Mean	82.1	81.8	82.1
	Maximum	98.2	98.6	98.0
	Minimum	68.2	68.1	68.0
September	Mean	79.4	79.1	78.9
	Maximum	96.3	96.6	97.0
	Minimum	56.3	55.3	55.0
October	Mean	68.7	68.3	68.6
	Maximum	94.7	95.2	95.0
	Minimum	42.5	41.0	36.0
November	Mean	60.4	59.9	59.2
	Maximum	83.5	83.7	85.0
	Minimum	31.9	31.2	30.0

Table 2.3-212 (Sheet 2 of 2)
Monthly and Annual Temperature Data (°F) for Ryan Airport and the RBS
(December 2004 - November 2006)

Period		Upper Level - 150 ft. RBS[(A)]	Lower Level – 30 ft. RBS	Single Level – 30 ft. Ryan Airport [(A)]
December	Mean	50.8	50.4	51.1
	Maximum	78.0	78.4	79.0
	Minimum	26.3	26.1	25.0
Annual	Mean	68.2	67.9	68.4
	Maximum	98.3	98.6	99.0
	Minimum	26.3	26.1	25.0

Source A: Reference 2.3-236.

Table 2.3-213
Hours with Precipitation and Hourly Rainfall Rate Distribution for Ryan Airport at Baton Rouge, Louisiana (2002 - 2006)

Month	Trace	0.01-0.09 in.	0.10-0.24 in.	0.25-0.49 in.	0.50-0.99 in.	≥1.00 in.	Hours with Precipitation	Number of Observations
January	161	111	44	11	1	1	329	3720
February	250	203	57	20	7	2	539	3389
March	211	87	19	14	4	2	337	3720
April	104	90	28	11	9	3	245	3600
May	116	72	29	11	8	1	237	3720
June	220	155	37	20	9	2	443	3600
July	207	111	28	7	10	2	365	3720
August	146	83	27	13	4	7	280	3720
September	141	102	34	17	12	3	309	3600
October	215	169	41	32	8	1	466	3720
November	142	125	32	22	8	0	329	3600
December	140	109	44	18	7	2	320	3720
Annual	2053	1417	420	196	87	26	4199	43,829
Percent of Total Hours	4.68%	3.23%	0.96%	0.45%	0.20%	0.06%	9.58%	

Source: Reference 2.3-246.

Table 2.3-214
Estimated Maximum Precipitation Amounts (in.) for Durations 1 Hr. to 24 Hr. and Recurrence Intervals 1 Year to 100 Years for Baton Rouge, Louisiana

Duration	Recurrence Interval (Years)						
	1	2	5	10	25	50	100
1	1.95(C)	2.40(A)	2.90(A)	3.26(A)	3.78(A)	4.19(A)	4.60(A)
2	2.36(C)	2.75(C)	3.44(C)	3.77(C)	4.44(C)	4.91(C)	5.38(C)
3	2.61(C)	3.13(B)	4.13(B)	5.10(B)	6.25(B)	7.10(B)	8.10(B)
6	3.16(C)	3.70(B)	5.20(B)	6.10(B)	7.20(B)	8.10(B)	9.10(B)
12	3.67(C)	4.65(B)	6.10(B)	7.00(B)	8.75(B)	9.15(B)	11.00(B)
24	4.25(C)	5.00(B)	7.05(B)	8.00(B)	9.00(B)	11.00(B)	12.00(B)

Source A: Reference 2.3-237.
Source B: Reference 2.3-231.
Source C: Reference 2.3-247.

Table 2.3-215
Observed Maximum Precipitation Events at Baton Rouge, Louisiana, for Durations from 1 Hr. to 24 Hr.

Duration	Maximum Precipitation Amounts			
	Amount[a]	Date	Amount[b]	Date
1	2.41	8/1/1959	2.28	8/21/2005
2	3.65	5/2/1954	3.07	9/24/2005
3	4.55	5/2/1954	3.76	9/24/2005
6	4.86	5/2/1954	4.21	9/24/2005
12	4.96	5/2/1954	6.86	9/24/2005
24[c]	8.40	3/12/1947	9.17	9/24/2005

a) Data period of 1948 - 1961 at Baton Rouge Harding Field.

b) Data period of 2002 - 2006 at Ryan Airport.

c) Maximum 24-hr. rainfall of 12.08 in. occurred at Baton Rouge in April 1967.

Source A: Reference 2.3-248.
Source B: Reference 2.3-246.

Table 2.3-216
Mean Monthly and Annual Summaries (hr.) of Fog, Smoke, and Haze for Baton Rouge, Louisiana (1961 - 1995)

Month	Mean Number of Hours and Frequency of Hours					
	Fog		Heavy Fog		Smoke and/or Haze	
January	135	18.1%	13	1.7%	60	8.1%
February	91	13.5%	8	1.2%	65	9.6%
March	96	12.9%	7	0.9%	65	8.8%
April	88	12.2%	5	0.8%	63	8.8%
May	92	12.4%	4	0.5%	101	13.5%
June	66	9.2%	1	0.2%	91	12.7%
July	70	9.3%	2	0.3%	96	12.9%
August	87	11.7%	2	0.3%	126	17.0%
September	96	13.4%	5	0.7%	95	13.2%
October	95	12.8%	10	1.4%	70	9.5%
November	104	14.5%	10	1.4%	58	8.1%
December	127	17.1%	13	1.8%	51	6.9%
Annual	1147	13.1%	80	0.9%	941	10.8%

Source: References 2.3-211 and 2.3-212.

Table 2.3-217
Monthly and Annual Mean Wind Speeds (mph) for Ryan Airport and the RBS
(December 2004 - November 2006)

Period	Upper Level - 150 ft. RBS[A]	Lower Level – 30 ft. RBS	Single Level – 30 ft. Ryan Airport[A]
January	8.43	4.76	7.24
February	8.34	4.71	7.38
March	8.54	4.86	7.27
April	7.90	4.43	7.18
May	6.59	3.41	5.34
June	5.99	3.19	3.99
July	5.54	2.97	4.77
August	5.49	2.98	4.29
September	7.31	3.62	5.23
October	7.47	3.67	4.79
November	7.66	3.67	5.41
December	7.87	3.98	6.13
Annual	7.26	3.85	5.73

Source A: Reference 2.3-236.

Table 2.3-218
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, All Winds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	141	144	124	112	76	83	133	108	120	117	67	72	110	105	121	129	**55.22**
3	72	62	49	32	18	27	61	46	59	39	17	25	22	27	33	60	**20.34**
4	35	38	22	11	5	9	36	18	27	14	6	15	10	13	23	31	**9.81**
5	20	19	13	2	0	7	18	12	21	11	1	2	3	4	10	16	**4.98**
6	12	13	7	4	0	6	10	9	10	6	1	0	1	2	4	14	**3.10**
7	10	6	3	3	0	2	5	8	7	6	2	0	0	1	2	3	**1.82**
8	8	2	2	3	1	0	12	6	8	5	0	0	0	1	1	9	**1.82**
9	6	3	3	1	0	2	1	2	3	2	0	0	0	3	2	2	**0.94**
10	2	0	1	0	0	0	1	1	3	1	0	0	0	1	0	3	**0.41**
11	4	1	0	1	0	1	1	1	1	0	0	0	0	0	0	2	**0.38**
12	4	2	0	0	0	1	2	0	0	0	0	0	0	0	1	1	**0.34**
13	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**0.09**
14	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	**0.09**
15	3	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	**0.19**
16	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.03**
17	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**0.13**
18	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.06**
19	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.03**
20	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.03**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.03**
25	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.06**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.03**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.06**
% of Persistent Direction	**10.15**	**9.12**	**7.05**	**5.30**	**3.13**	**4.32**	**9.15**	**6.68**	**8.12**	**6.30**	**2.95**	**3.57**	**4.58**	**4.92**	**6.17**	**8.49**	
Average Persistant Hours	**3.82**	**3.21**	**3.04**	**2.74**	**2.34**	**2.96**	**3.96**	**3.34**	**3.36**	**3.02**	**2.49**	**2.54**	**2.38**	**2.72**	**2.84**	**3.42**	

*** The longest persistent wind was from the north and lasted 70 hr.**

Table 2.3-219
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 3 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	83	91	47	27	22	32	81	91	106	88	40	47	67	55	50	81	**51.48**
3	44	43	26	14	2	13	41	31	51	34	10	16	14	9	19	39	**20.74**
4	29	23	13	6	2	3	24	12	23	10	5	9	7	7	10	18	**10.27**
5	16	10	10	2	0	2	10	10	20	10	1	0	2	3	7	12	**5.87**
6	7	5	4	2	0	2	5	10	7	5	1	0	0	3	4	11	**3.37**
7	10	3	5	1	0	1	5	5	8	6	2	0	0	0	1	2	**2.50**
8	6	2	2	2	0	0	7	6	6	5	0	0	0	1	1	8	**2.35**
9	7	1	1	0	0	0	0	2	2	1	0	0	0	1	1	2	**0.92**
10	2	0	0	0	0	0	3	1	3	1	0	0	0	0	0	3	**0.66**
11	2	0	0	1	0	0	1	1	1	0	0	0	0	0	0	2	**0.41**
12	5	1	0	0	0	0	2	0	0	0	0	0	0	0	1	0	**0.46**
13	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**0.10**
14	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	**0.20**
15	3	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.26**
16	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.05**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.05**
20	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.05**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.10**
26	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.05**
27	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.05**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.05**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**11.0**	**9.2**	**5.6**	**2.8**	**1.3**	**2.7**	**9.6**	**8.7**	**11.6**	**8.2**	**3.0**	**3.7**	**4.6**	**4.0**	**4.8**	**9.1**	

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Table 2.3-220
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 6 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	40	8	5	2	1	2	6	27	50	29	4	8	8	15	25	43	**48.15**
3	16	3	4	0	0	0	8	9	23	10	4	3	2	3	7	18	**19.40**
4	14	5	1	1	0	0	4	7	6	7	1	0	0	5	6	12	**12.17**
5	5	2	1	2	0	0	0	5	9	5	1	0	0	3	2	10	**7.94**
6	6	1	0	0	0	0	1	4	2	1	2	0	0	1	1	4	**4.06**
7	2	0	0	1	0	0	0	4	0	5	1	0	0	0	1	1	**2.65**
8	3	0	0	0	0	0	1	4	2	1	0	0	0	0	1	2	**2.47**
9	2	0	0	0	0	0	1	0	1	1	0	0	0	0	1	3	**1.59**
10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	**0.35**
11	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	**0.71**
12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.18**
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
14	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.18**
15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.18**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**15.9**	**3.4**	**2.1**	**1.1**	**0.2**	**0.4**	**3.7**	**11.1**	**16.6**	**10.4**	**2.3**	**1.9**	**1.8**	**4.8**	**7.9**	**16.6**	

Table 2.3-221
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 9 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	3	1	1	1	0	0	2	9	10	5	1	0	1	2	6	7	48.04
3	0	0	0	0	0	0	2	1	6	2	0	0	0	1	1	3	15.69
4	1	0	0	0	0	0	0	2	3	0	1	0	0	0	2	4	12.75
5	1	0	0	0	0	0	0	2	1	3	1	0	0	1	0	1	9.80
6	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	4.90
7	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	3.92
8	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	3.92
9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.98
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	4.90	0.98	0.98	0.98	0.00	0.00	3.92	18.63	22.55	11.76	2.94	0.00	0.98	3.92	10.78	16.67	

Table 2.3-222
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 12 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	1	0	0	0	0	0	0	4	4	1	0	0	1	1	0	0	60.00
3	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	15.00
4	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	15.00
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5.00
7	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	5.00
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	5.00	0.00	0.00	0.00	0.00	0.00	0.00	35.00	25.00	15.00	0.00	0.00	5.00	5.00	5.00	5.00	

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Table 2.3-223
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 15 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**33.33**
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**33.33**
5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**33.33**
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.33**	**33.33**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**33.33**	

Table 2.3-224
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, All Winds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	104	88	102	101	96	77	80	78	84	69	76	72	60	88	104	98	**30.39**
3	55	60	61	59	58	40	53	49	49	45	48	41	50	51	55	58	**18.36**
4	33	36	43	29	35	35	42	35	36	32	21	37	28	36	40	35	**12.20**
5	30	27	37	29	11	26	23	34	30	12	15	23	24	29	22	26	**8.78**
6	18	20	26	13	15	14	24	20	17	16	10	10	12	15	17	18	**5.85**
7	11	25	15	11	2	13	17	18	10	9	4	8	11	6	11	18	**4.17**
8	14	15	9	12	2	8	8	12	12	7	2	7	10	6	11	8	**3.16**
9	12	10	11	4	4	10	6	9	9	11	4	6	10	4	9	9	**2.82**
10	4	6	6	4	5	6	11	4	9	7	4	1	5	7	10	9	**2.16**
11	8	4	4	3	2	1	4	5	6	7	0	0	6	3	4	10	**1.48**
12	10	7	3	2	2	3	3	4	7	4	1	0	4	4	4	7	**1.43**
13	9	7	3	0	0	3	6	7	6	7	1	0	0	3	3	3	**1.28**
14	4	1	7	3	0	2	6	6	6	3	1	0	3	1	6	4	**1.17**
15	2	4	1	1	0	1	5	5	6	3	3	0	1	0	2	5	**0.86**
16	3	3	4	0	0	1	6	7	4	2	0	1	0	3	1	4	**0.86**
17	8	0	0	0	0	0	5	3	3	2	0	0	0	0	3	3	**0.60**
18	4	3	1	0	0	1	3	1	3	0	0	0	1	1	2	3	**0.51**
19	1	4	1	0	0	0	2	2	1	2	1	0	0	2	1	3	**0.44**
20	5	2	0	0	0	0	1	2	1	2	1	0	0	1	1	1	**0.38**
21	2	1	2	0	0	2	0	1	0	0	0	0	0	0	1	0	**0.20**
22	5	2	1	0	0	0	0	0	0	1	0	0	0	1	1	1	**0.26**
23	2	3	0	1	0	0	0	0	1	1	0	0	0	0	0	3	**0.24**
24	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	**0.09**
25	3	4	1	0	0	1	0	0	0	0	0	0	0	0	1	1	**0.24**
26	1	1	1	0	0	0	2	1	1	0	0	0	0	0	1	0	**0.18**
27	3	0	0	0	0	0	2	1	0	0	0	0	0	1	0	0	**0.15**
28	1	2	0	0	0	1	0	0	0	0	0	0	0	0	1	1	**0.13**
29	0	2	0	0	0	0	0	2	1	0	0	0	0	0	0	0	**0.11**
30	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	**0.11**
31	5	2	0	0	0	0	1	0	2	0	0	0	0	2	0	0	**0.26**
32	2	0	0	0	0	0	2	1	0	0	0	0	0	0	0	3	**0.18**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.02**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	**0.07**
36	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.02**
37	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.02**
38	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.07**
39	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	**0.07**
40	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.04**
41	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**0.02**
42	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	**0.09**
43	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.04**
44	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.07**
45	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.02**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	6	2	0	0	0	1	2	2	0	0	0	0	0	0	0	4	**0.38**
% of Persistent Direction	**8.14**	**7.61**	**7.48**	**6.00**	**5.14**	**5.50**	**7.06**	**6.86**	**6.84**	**5.41**	**4.24**	**4.55**	**4.97**	**5.83**	**6.86**	**7.50**	
Average Persistant Hours	**7.23**	**6.67**	**4.97**	**4.06**	**3.59**	**5.18**	**6.55**	**6.19**	**6.61**	**5.93**	**3.95**	**3.8**	**4.71**	**4.82**	**5.14**	**6.29**	

*** The longest persistent wind was from the north-northwest and lasted 139 hr.**

Table 2.3-225
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 3 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	46	49	39	30	16	32	69	55	62	49	50	43	36	49	41	42	**27.57**
3	30	18	25	21	18	16	37	34	55	37	26	25	29	20	32	30	**17.64**
4	21	12	21	6	13	13	28	22	28	22	11	27	21	21	21	20	**11.95**
5	19	9	13	9	3	12	28	30	23	8	9	19	10	11	12	22	**9.23**
6	16	19	12	7	1	5	19	19	12	15	4	8	10	12	4	5	**6.54**
7	9	14	5	3	1	5	10	14	6	9	2	5	14	3	10	8	**4.60**
8	8	6	5	3	1	3	3	13	10	5	2	8	8	4	7	8	**3.66**
9	8	9	6	3	0	3	1	7	11	8	3	0	3	2	3	8	**2.92**
10	10	8	3	2	1	3	6	5	11	9	3	0	3	0	9	10	**3.23**
11	3	6	5	1	1	1	4	3	6	2	0	0	2	0	5	10	**1.91**
12	8	6	1	0	0	1	1	2	4	4	1	0	0	3	3	2	**1.40**
13	10	5	3	1	0	1	3	2	6	5	1	0	0	1	0	4	**1.64**
14	0	4	3	1	0	1	4	3	1	2	0	0	0	0	2	3	**0.93**
15	6	2	0	0	0	0	2	5	3	2	1	0	0	0	1	0	**0.86**
16	2	2	2	0	0	0	2	4	2	0	0	0	0	0	2	2	**0.70**
17	3	0	0	0	0	0	3	3	3	1	0	0	0	1	1	2	**0.66**
18	2	3	1	0	0	0	1	0	2	1	1	0	0	0	0	3	**0.55**
19	1	3	1	0	0	1	1	2	0	1	0	0	0	0	1	1	**0.47**
20	3	0	0	0	0	0	0	2	1	2	0	0	0	0	0	2	**0.39**
21	0	2	2	0	0	0	0	3	0	0	0	0	0	0	0	1	**0.31**
22	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	**0.12**
23	1	4	0	0	0	0	2	0	1	1	0	0	0	0	1	1	**0.43**
24	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.04**
25	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.23**
26	2	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	**0.23**
27	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	**0.12**
28	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	**0.08**
29	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	**0.19**
30	1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	1	**0.19**
31	3	0	0	0	0	0	2	0	2	0	0	0	0	0	0	1	**0.31**
32	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.12**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.12**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.04**
38	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.04**
39	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	**0.12**
40	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**0.04**
41	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.04**
42	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**0.12**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
47	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
48+	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	**0.19**
% of Persistent Direction	**8.61**	**7.20**	**5.80**	**3.39**	**2.18**	**3.97**	**9.03**	**9.03**	**10.01**	**7.20**	**4.44**	**5.26**	**5.30**	**5.02**	**6.07**	**7.48**	

Table 2.3-226
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 6 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	31	4	8	1	0	3	7	22	27	21	4	4	5	9	13	24	**25.81**
3	19	1	6	1	1	1	10	9	30	11	5	1	7	6	8	10	**17.77**
4	10	3	1	1	0	0	2	15	10	10	1	4	0	9	9	10	**11.99**
5	7	4	1	1	0	0	3	7	11	4	2	1	4	4	5	15	**9.73**
6	11	4	1	1	0	0	2	3	10	2	4	2	1	2	3	6	**7.33**
7	3	8	0	2	0	1	0	8	4	5	1	1	0	1	4	11	**6.91**
8	8	1	1	0	0	0	3	2	7	4	0	0	0	0	6	4	**5.08**
9	5	2	0	0	0	0	1	0	4	2	0	0	0	0	2	4	**2.82**
10	4	0	0	0	0	1	1	3	3	2	1	0	0	0	4	6	**3.53**
11	2	1	0	0	0	0	2	2	1	3	0	0	0	0	1	2	**1.97**
12	1	0	0	0	0	0	0	2	1	3	2	0	0	1	0	2	**1.69**
13	2	0	0	0	0	0	0	1	4	0	0	0	0	1	1	3	**1.69**
14	0	0	0	0	0	0	0	2	2	0	0	0	0	1	2	0	**0.99**
15	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	**0.56**
16	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	**0.56**
17	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	**0.42**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.14**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**0.14**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.14**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.14**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.14**
28	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.14**
29	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**0.28**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**14.81**	**3.95**	**2.68**	**0.99**	**0.14**	**0.85**	**4.51**	**11.42**	**16.64**	**9.45**	**2.82**	**1.83**	**2.40**	**4.94**	**8.60**	**13.96**	

Table 2.3-227
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 9 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	2	1	1	0	0	0	0	3	3	6	2	0	0	6	4	3	**25.41**
3	1	0	0	1	0	0	1	1	3	1	0	0	1	2	4	4	**15.57**
4	0	0	0	0	0	0	0	5	3	0	0	0	0	0	4	3	**12.30**
5	2	0	0	0	0	0	0	1	2	3	1	0	0	1	1	4	**12.30**
6	0	0	0	0	0	0	1	0	3	1	1	0	0	0	3	4	**10.66**
7	0	0	0	0	0	1	0	2	2	2	0	0	0	1	1	0	**7.38**
8	1	0	0	0	0	0	0	3	3	1	0	0	0	0	0	0	**6.56**
9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	**1.64**
10	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	**2.46**
11	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.82**
12	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**1.64**
13	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**1.64**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.82**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.82**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**4.92**	**0.82**	**0.82**	**0.82**	**0.00**	**0.82**	**3.28**	**16.39**	**18.85**	**11.48**	**3.28**	**0.00**	**0.82**	**8.20**	**14.75**	**14.75**	

Table 2.3-228
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 12 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	0	0	0	0	0	0	0	4	1	1	0	0	1	1	1	0	**36.00**
3	0	0	0	0	0	0	0	2	1	1	0	0	0	0	1	0	**20.00**
4	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	**12.00**
5	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1	**16.00**
6	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**8.00**
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
10	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	**8.00**
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**4.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.00**	**40.00**	**16.00**	**12.00**	**0.00**	**0.00**	**4.00**	**4.00**	**12.00**	**4.00**	

Table 2.3-229
Wind Direction Persistence Summaries - RBS 30-Ft. Level

December 2004 through November 2006 Lower Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 15 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	40.00
5	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	40.00
6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	20.00
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	20.00	0.00	0.00	0.00	0.00	0.00	20.00	20.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	

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Table 2.3-230
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, All Winds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	109	133	124	108	80	118	132	96	148	118	82	95	93	89	87	94	**49.02**
3	48	59	54	52	24	68	61	52	62	48	28	39	51	29	36	44	**21.70**
4	33	33	51	31	11	43	26	19	22	29	15	20	15	12	14	30	**11.61**
5	16	23	28	12	4	22	21	11	15	15	7	5	10	7	6	10	**6.09**
6	8	13	17	9	4	19	7	11	7	8	0	2	5	6	5	6	**3.65**
7	5	7	15	7	1	9	4	5	8	6	2	2	2	2	2	4	**2.33**
8	10	5	5	4	1	9	3	8	5	3	1	0	2	0	2	7	**1.87**
9	3	3	3	3	0	7	2	1	5	5	0	0	0	1	1	2	**1.03**
10	2	3	7	3	0	4	2	1	4	4	0	0	0	0	2	2	**0.98**
11	3	1	1	2	0	6	2	1	1	1	0	0	0	0	0	0	**0.52**
12	4	2	1	1	0	1	0	0	1	1	0	0	1	1	0	1	**0.40**
13	2	0	2	0	0	1	0	0	0	0	0	0	0	0	0	1	**0.17**
14	0	0	0	0	0	1	0	1	2	1	1	0	0	0	0	1	**0.20**
15	1	1	0	0	0	3	0	1	1	0	0	0	0	0	0	0	**0.20**
16	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	**0.06**
17	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.06**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.03**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.03**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.03**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.03**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**7.04**	**8.13**	**8.85**	**6.70**	**3.59**	**9.02**	**7.47**	**5.95**	**8.10**	**6.87**	**3.91**	**4.68**	**5.14**	**4.25**	**4.45**	**5.83**	
Average Persistant Hours	**3.77**	**3.41**	**3.72**	**3.45**	**2.68**	**4.08**	**3.12**	**3.4**	**3.37**	**3.38**	**2.79**	**2.69**	**2.91**	**2.96**	**2.95**	**3.51**	

*** The longest persistent wind was from the north-northwest and lasted 26 hr.**

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Table 2.3-231
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 3 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	104	130	118	98	69	113	129	90	141	116	76	92	90	86	84	93	**48.57**
3	47	54	50	50	19	62	58	50	59	49	26	38	49	28	34	43	**21.35**
4	33	34	50	29	11	43	26	19	23	28	15	19	13	12	14	30	**11.90**
5	16	22	28	12	4	22	20	11	13	14	7	5	10	7	6	10	**6.17**
6	8	13	17	9	4	19	7	11	7	8	0	2	5	6	5	6	**3.79**
7	5	7	15	7	1	9	4	5	8	6	2	2	2	2	2	4	**2.42**
8	10	5	6	4	1	9	3	8	5	3	1	0	2	0	2	7	**1.97**
9	4	3	2	3	0	7	2	1	5	5	0	0	0	1	1	2	**1.07**
10	1	3	7	3	0	4	2	1	4	4	0	0	0	0	2	2	**0.98**
11	3	1	1	2	0	6	2	1	1	1	0	0	0	0	0	0	**0.54**
12	4	2	1	1	0	1	0	0	2	1	0	0	1	1	0	1	**0.45**
13	2	0	2	0	0	1	0	0	0	0	0	0	0	0	0	1	**0.18**
14	0	0	0	0	0	1	0	1	2	1	1	0	0	0	0	1	**0.21**
15	1	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	**0.18**
16	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	**0.06**
17	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.06**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.03**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.03**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.03**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.03**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**7.1**	**8.2**	**8.9**	**6.5**	**3.2**	**9.0**	**7.5**	**5.9**	**8.1**	**7.0**	**3.8**	**4.7**	**5.1**	**4.3**	**4.5**	**6.0**	

Table 2.3-232
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 6 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	84	87	70	57	31	76	85	65	99	63	20	36	43	47	52	70	**44.09**
3	38	42	45	29	11	44	51	23	45	33	13	16	18	16	22	36	**21.58**
4	30	26	41	20	4	28	23	16	19	18	8	9	4	6	7	25	**12.71**
5	13	14	22	10	3	16	12	11	9	10	6	2	7	5	6	13	**7.12**
6	5	10	13	5	1	20	8	11	6	4	0	0	1	3	4	6	**4.34**
7	6	7	14	5	0	9	2	3	6	6	1	0	3	2	2	3	**3.09**
8	9	3	6	4	1	6	2	6	4	5	0	0	0	1	2	6	**2.46**
9	2	3	2	1	0	8	1	1	4	4	0	0	0	0	2	1	**1.30**
10	1	2	6	3	0	4	2	1	4	2	0	0	0	0	1	2	**1.25**
11	4	0	0	2	0	5	2	1	0	0	0	0	0	0	0	0	**0.63**
12	2	2	1	1	0	1	0	0	1	1	0	0	0	1	0	1	**0.49**
13	2	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	**0.22**
14	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	1	**0.22**
15	1	1	0	0	0	2	0	1	0	0	0	0	0	0	0	0	**0.22**
16	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.04**
17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.04**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.04**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.04**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.04**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**8.8**	**8.8**	**9.8**	**6.2**	**2.3**	**10.0**	**8.4**	**6.3**	**8.9**	**6.6**	**2.2**	**2.8**	**3.4**	**3.7**	**4.4**	**7.4**	

Table 2.3-233
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 9 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	35	19	49	29	9	50	31	23	34	21	8	8	6	13	20	34	**46.70**
3	8	9	25	16	3	22	20	12	17	11	5	0	0	6	11	19	**22.09**
4	5	1	15	8	1	8	8	5	4	7	2	2	0	2	3	8	**9.48**
5	2	3	12	2	0	9	6	9	3	3	2	0	1	4	3	5	**7.68**
6	3	4	7	5	0	5	0	6	2	2	0	0	0	1	3	2	**4.80**
7	2	0	4	4	0	1	1	2	3	4	1	0	0	3	0	2	**3.24**
8	3	0	0	1	1	5	0	1	0	2	0	0	0	1	1	0	**1.80**
9	0	0	0	1	0	2	0	1	2	2	0	0	0	0	1	2	**1.32**
10	0	0	1	2	0	2	0	0	1	1	0	0	0	0	1	1	**1.08**
11	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	**0.36**
12	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.24**
13	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	**0.24**
14	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	**0.24**
15	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	**0.36**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.12**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.12**
21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.12**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**7.08**	**4.32**	**13.57**	**8.40**	**1.68**	**13.21**	**8.04**	**7.44**	**7.92**	**6.48**	**2.16**	**1.20**	**0.84**	**3.72**	**5.16**	**8.76**	

Table 2.3-234
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 12 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	5	1	7	14	4	5	2	11	6	8	3	0	0	6	12	10	**44.98**
3	2	1	2	2	0	5	5	4	4	4	1	0	0	6	4	2	**20.10**
4	0	0	0	3	0	5	0	5	4	1	1	0	0	1	2	2	**11.48**
5	0	0	0	4	0	2	0	3	0	0	0	0	0	1	3	3	**7.66**
6	1	0	0	3	0	4	0	2	0	2	0	0	0	3	0	3	**8.61**
7	0	0	0	1	0	1	0	1	2	0	0	0	0	0	0	0	**2.39**
8	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	**1.44**
9	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	**1.44**
10	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	**1.44**
11	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.48**
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**3.83**	**0.96**	**4.31**	**13.40**	**1.91**	**11.48**	**3.83**	**12.92**	**8.61**	**8.61**	**2.39**	**0.00**	**0.00**	**8.13**	**10.05**	**9.57**	

Table 2.3-235
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 15 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	1	0	1	1	1	1	2	1	2	1	1	0	0	1	7	3	**40.35**
3	1	0	0	1	0	0	2	1	4	1	0	0	0	1	2	1	**24.56**
4	0	0	0	1	0	1	0	1	2	0	0	0	0	2	0	0	**12.28**
5	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	**5.26**
6	0	0	0	0	0	2	0	2	0	1	0	0	0	0	0	0	**8.77**
7	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	**3.51**
8	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	**3.51**
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**1.75**
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**3.51**	**0.00**	**1.75**	**8.77**	**1.75**	**8.77**	**8.77**	**14.04**	**14.04**	**7.02**	**1.75**	**0.00**	**0.00**	**7.02**	**15.79**	**7.02**	

Table 2.3-236
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, All Winds

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	59	52	65	75	75	73	83	76	80	73	69	78	60	58	64	63	**25.60**
3	30	33	38	44	41	47	41	51	54	49	47	35	46	41	40	39	**15.69**
4	32	21	35	36	32	47	30	33	38	31	26	33	27	32	27	28	**11.79**
5	14	25	19	29	15	40	25	32	31	24	15	28	26	21	17	13	**8.68**
6	18	21	19	21	19	29	17	30	25	19	17	16	19	16	12	15	**7.26**
7	7	9	12	10	12	14	25	14	8	11	9	11	11	12	17	9	**4.43**
8	7	16	6	11	11	14	9	16	14	7	4	10	8	5	5	10	**3.55**
9	8	11	14	12	5	14	9	5	12	6	7	5	6	7	5	7	**3.09**
10	10	9	10	7	7	6	13	6	9	7	5	6	10	6	8	7	**2.92**
11	14	4	18	4	7	7	3	6	4	12	4	4	8	5	6	8	**2.65**
12	7	4	11	3	6	9	5	8	6	5	3	2	4	2	2	2	**1.83**
13	4	8	4	7	2	6	3	4	5	3	1	3	2	1	5	4	**1.44**
14	7	7	8	2	3	3	10	4	1	6	0	1	6	2	2	4	**1.53**
15	5	5	7	2	2	2	2	6	4	3	1	2	2	1	0	4	**1.11**
16	2	2	3	2	0	2	3	4	6	3	0	1	2	0	1	2	**0.77**
17	4	4	4	2	1	4	5	3	5	6	0	0	2	1	4	2	**1.09**
18	3	4	5	3	1	4	3	3	5	1	0	1	0	1	1	3	**0.88**
19	2	5	2	3	1	3	2	1	2	2	1	0	0	3	2	3	**0.74**
20	2	0	3	0	0	1	3	0	3	0	3	1	0	1	2	1	**0.46**
21	2	2	2	0	0	0	1	0	1	0	1	0	1	0	0	2	**0.28**
22	1	4	1	1	1	1	2	1	0	1	0	0	1	0	1	0	**0.35**
23	0	3	1	0	0	2	4	1	3	2	0	0	1	0	0	0	**0.39**
24	1	3	2	0	0	1	1	2	1	0	0	0	0	1	1	1	**0.32**
25	1	2	0	0	0	1	2	1	0	0	1	0	0	0	0	1	**0.21**
26	1	2	2	0	1	3	0	1	2	1	0	1	0	0	1	0	**0.35**
27	0	1	2	0	0	0	2	0	0	0	1	0	0	0	1	0	**0.16**
28	2	1	2	0	0	0	3	1	0	0	0	0	0	0	0	2	**0.26**
29	3	1	0	0	1	0	1	1	1	1	0	0	0	1	0	1	**0.26**
30	0	0	0	2	1	0	1	0	0	1	0	0	0	2	1	1	**0.21**
31	0	2	0	0	0	1	1	0	2	0	0	0	0	0	0	1	**0.16**
32	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	**0.09**
33	1	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	**0.12**
34	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.05**
35	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.09**
36	2	0	0	0	0	0	1	1	1	0	0	0	0	1	0	1	**0.16**
37	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	**0.09**
38	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	**0.07**
39	1	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	**0.12**
40	1	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	**0.12**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.02**
42	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.02**
43	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	**0.05**
44	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.07**
45	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	**0.07**
46	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.09**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	1	4	2	0	0	1	2	1	1	1	0	0	0	0	0	0	**0.30**
% of Persistent Direction	**5.96**	**6.29**	**6.94**	**6.45**	**5.69**	**7.89**	**7.29**	**7.24**	**7.68**	**6.45**	**4.99**	**5.55**	**5.64**	**5.13**	**5.24**	**5.57**	
Average Persistant hours	**8.42**	**8.50**	**7.45**	**5.77**	**5.41**	**6.60**	**7.18**	**6.07**	**7.04**	**6.30**	**4.78**	**4.87**	**5.53**	**5.63**	**5.87**	**7.31**	

*** The longest persistent wind was from the east-southeast and lasted 91 hr.**

Table 2.3-237
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 3 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	58	50	61	69	62	68	83	73	71	71	62	72	53	49	49	58	**24.80**
3	27	26	35	45	38	54	37	52	47	47	45	34	45	39	42	36	**15.95**
4	31	21	34	28	28	49	27	31	37	34	26	34	26	29	25	25	**11.92**
5	13	22	18	31	16	32	25	30	32	21	14	23	23	17	16	13	**8.50**
6	17	19	20	22	15	26	18	28	21	16	15	16	15	16	12	15	**7.15**
7	6	9	13	7	10	13	23	16	10	12	8	9	11	12	15	9	**4.50**
8	6	15	8	11	11	14	9	12	13	4	4	11	8	4	5	10	**3.56**
9	9	12	14	10	3	11	8	5	10	7	7	5	8	7	5	6	**3.12**
10	10	7	8	8	8	5	14	5	8	7	5	7	10	6	8	8	**3.05**
11	14	4	16	5	5	7	3	5	4	10	4	5	8	5	7	8	**2.70**
12	6	5	13	3	4	10	4	8	7	5	3	1	3	2	2	2	**1.92**
13	4	7	4	6	2	5	4	4	5	4	1	2	2	1	5	3	**1.45**
14	7	7	7	2	3	3	7	5	1	6	0	0	6	2	2	4	**1.52**
15	5	5	7	1	2	2	2	5	4	3	1	2	2	1	0	4	**1.13**
16	2	2	3	2	1	3	3	4	6	2	0	1	2	0	1	2	**0.84**
17	4	4	4	2	0	4	5	3	5	5	0	0	2	1	3	2	**1.08**
18	3	4	5	3	1	4	3	3	6	1	0	1	0	1	1	4	**0.98**
19	2	5	2	2	1	3	2	1	1	2	1	0	0	3	2	2	**0.71**
20	2	0	2	0	0	1	3	0	4	0	3	1	0	1	2	1	**0.49**
21	2	2	2	0	0	0	1	0	0	0	1	1	0	0	0	2	**0.27**
22	1	4	1	1	1	0	2	1	0	1	0	0	1	0	1	0	**0.34**
23	0	3	1	0	0	2	5	1	2	2	0	0	1	0	0	0	**0.42**
24	1	3	1	0	0	1	0	2	1	0	0	0	0	1	1	1	**0.29**
25	1	2	0	0	0	1	2	1	0	0	1	0	0	0	0	1	**0.22**
26	1	2	2	0	1	3	0	1	2	1	0	0	0	0	1	0	**0.34**
27	0	1	2	0	0	0	2	0	0	0	1	0	0	0	1	0	**0.17**
28	2	1	2	0	0	0	3	1	0	0	0	0	0	0	0	2	**0.27**
29	3	1	0	0	1	0	1	1	1	1	0	0	0	1	0	1	**0.27**
30	0	0	0	2	1	0	2	0	0	1	0	0	0	2	1	1	**0.25**
31	0	2	0	0	0	1	0	0	2	0	0	0	0	0	0	1	**0.15**
32	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	2	**0.10**
33	1	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	**0.12**
34	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.05**
35	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.10**
36	2	0	0	0	0	0	1	1	1	0	0	0	0	1	0	1	**0.17**
37	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	**0.10**
38	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	**0.07**
39	1	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	**0.12**
40	1	0	0	0	1	0	0	0	2	1	0	0	0	0	0	0	**0.12**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.02**
42	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.02**
43	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	**0.05**
44	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.07**
45	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	**0.07**
46	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.10**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	1	4	2	0	0	1	2	1	1	1	0	0	0	0	0	0	**0.32**
% of Persistent Direction	**6.09**	**6.27**	**7.10**	**6.44**	**5.28**	**8.06**	**7.45**	**7.37**	**7.59**	**6.56**	**4.96**	**5.55**	**5.58**	**4.96**	**5.11**	**5.60**	

Table 2.3-238
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 6 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	35	42	47	41	27	54	63	52	50	52	22	24	28	36	30	41	**25.23**
3	34	18	27	23	16	34	37	38	33	19	14	16	19	19	26	21	**15.43**
4	21	15	32	13	14	24	20	20	25	20	7	16	13	12	19	19	**11.36**
5	10	22	9	13	9	17	13	15	21	14	4	12	13	6	12	15	**8.03**
6	14	15	16	15	6	21	11	16	9	5	4	9	11	4	8	10	**6.82**
7	8	12	8	6	3	9	9	7	3	6	3	5	3	4	13	4	**4.03**
8	7	11	8	9	8	9	11	10	10	7	2	3	3	2	3	10	**4.43**
9	11	12	8	11	1	11	4	5	7	2	2	0	1	3	4	8	**3.53**
10	9	6	9	2	4	3	10	3	7	5	2	2	1	2	6	7	**3.06**
11	5	6	12	1	3	4	2	1	4	4	2	1	3	1	3	5	**2.23**
12	6	3	10	3	1	3	3	3	4	3	1	0	1	2	4	4	**2.00**
13	3	7	7	2	0	7	2	4	3	3	2	0	1	2	1	2	**1.80**
14	2	6	2	0	4	6	2	3	1	5	1	0	0	0	1	2	**1.37**
15	2	4	3	1	0	3	3	4	4	2	2	1	3	2	1	4	**1.53**
16	3	3	2	1	1	3	4	2	5	1	0	1	0	1	1	2	**1.18**
17	4	2	3	1	0	3	4	3	1	1	0	0	0	1	2	1	**1.02**
18	2	3	4	2	0	3	2	2	3	1	1	0	0	2	1	2	**1.10**
19	1	0	1	0	0	0	3	0	1	3	0	0	0	1	1	0	**0.43**
20	3	1	0	0	0	1	1	0	1	1	0	0	0	1	0	1	**0.39**
21	2	1	0	1	1	0	0	0	0	1	0	0	0	0	0	1	**0.27**
22	1	3	2	0	0	1	2	1	0	0	0	0	1	0	0	0	**0.43**
23	3	1	0	0	0	0	4	1	1	0	0	0	0	0	0	0	**0.39**
24	1	3	0	0	1	0	0	2	2	0	0	0	0	0	1	3	**0.51**
25	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.16**
26	1	0	2	0	0	2	1	0	1	0	0	0	1	0	1	1	**0.39**
27	0	3	1	0	0	0	2	0	0	0	1	0	0	0	1	0	**0.31**
28	1	1	2	0	0	0	1	1	1	0	0	0	0	2	0	1	**0.39**
29	1	1	0	1	1	0	1	1	1	0	0	0	0	1	0	1	**0.35**
30	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	**0.12**
31	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	1	**0.20**
32	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	**0.16**
33	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
34	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.12**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	**0.08**
36	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	**0.16**
37	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	**0.08**
38	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	**0.12**
39	1	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	**0.20**
40	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.08**
41	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.04**
42	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.04**
43	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.12**
44	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
45	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.04**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	2	0	0	1	2	1	0	0	0	0	0	0	0	0	**0.24**
% of Persistent Direction	**7.72**	**8.07**	**8.54**	**5.84**	**3.96**	**8.77**	**8.62**	**7.68**	**8.03**	**6.19**	**2.74**	**3.53**	**4.00**	**4.11**	**5.48**	**6.74**	

Table 2.3-239
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 9 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	27	16	42	20	11	43	27	24	19	12	4	5	7	7	14	20	**30.50**
3	9	9	19	11	5	17	14	10	10	12	4	1	1	4	11	10	**15.05**
4	11	9	16	11	7	11	10	10	5	7	1	2	3	4	8	10	**12.79**
5	6	7	10	7	1	10	9	4	6	3	0	0	2	4	3	10	**8.39**
6	4	9	8	4	0	3	4	6	7	0	4	0	2	2	5	6	**6.55**
7	2	5	5	5	0	3	1	3	4	6	2	2	1	4	1	6	**5.12**
8	2	3	5	5	3	3	1	0	6	3	0	1	0	1	4	3	**4.09**
9	2	2	8	1	1	3	3	2	2	1	0	0	0	1	1	6	**3.38**
10	1	2	5	2	1	4	2	2	2	1	1	0	0	2	4	2	**3.17**
11	0	0	3	2	0	3	2	0	1	3	0	0	0	0	1	0	**1.54**
12	2	1	1	0	1	3	0	2	1	1	2	0	0	0	2	2	**1.84**
13	1	0	3	0	0	1	3	1	3	3	1	0	0	1	0	0	**1.74**
14	1	0	1	0	2	0	1	2	2	0	0	0	0	1	1	0	**1.13**
15	0	0	0	0	0	1	1	3	0	0	0	0	1	2	1	0	**0.92**
16	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.10**
17	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	**0.41**
18	1	0	0	0	0	0	0	1	1	2	0	0	0	0	1	0	**0.61**
19	0	0	0	1	1	0	0	1	1	0	0	0	0	0	1	1	**0.61**
20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.10**
21	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	**0.20**
22	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.10**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**0.10**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0.10**
25	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.20**
26	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	**0.20**
27	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.20**
28	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.10**
29	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	**0.31**
30	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	**0.20**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.10**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.10**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**7.06**	**6.55**	**13.20**	**7.27**	**3.48**	**11.46**	**8.29**	**7.47**	**7.57**	**5.53**	**1.94**	**1.13**	**1.74**	**3.48**	**5.94**	**7.88**	

Table 2.3-240
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 12 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	6	1	10	12	7	5	2	7	4	4	2	1	0	3	7	5	**30.16**
3	1	1	2	2	0	5	0	3	2	6	0	0	0	4	3	3	**12.70**
4	0	0	0	4	0	6	0	6	3	1	0	0	2	0	5	4	**12.30**
5	1	0	0	3	1	4	0	2	2	0	1	0	0	4	3	6	**10.71**
6	2	1	2	3	2	2	0	1	0	2	1	0	1	2	1	5	**9.92**
7	0	0	1	2	0	2	1	0	3	1	0	0	0	1	4	2	**6.75**
8	0	0	0	0	2	0	2	0	5	2	1	0	0	1	2	0	**5.95**
9	0	0	1	0	0	1	2	2	0	1	0	0	0	0	1	0	**3.17**
10	0	0	0	0	0	1	1	2	0	0	0	0	0	1	0	0	**1.98**
11	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	**1.19**
12	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	**1.59**
13	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	**1.19**
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**0.40**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.40**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.79**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.40**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.40**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**3.97**	**1.19**	**6.75**	**10.71**	**4.76**	**11.51**	**3.97**	**10.71**	**8.73**	**6.75**	**1.98**	**0.40**	**1.19**	**6.75**	**10.71**	**9.92**	

Table 2.3-241
Wind Direction Persistence Summaries - RBS 150-Ft. Level

December 2004 through November 2006 Upper Tower Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 15 mph or Greater

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	1	0	0	1	0	2	1	2	2	2	0	0	0	1	3	2	25.37
3	0	0	0	0	0	0	0	1	4	1	1	0	0	1	2	1	16.42
4	0	1	0	1	0	2	0	2	0	0	0	0	0	2	0	2	14.93
5	1	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	7.46
6	0	0	0	1	0	0	2	1	2	1	0	0	0	1	1	0	13.43
7	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2.99
8	0	0	0	0	1	0	2	1	1	1	0	0	0	0	1	0	10.45
9	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	4.48
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1.49
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
14	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1.49
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1.49
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	2.99	1.49	2.99	5.97	1.49	8.96	8.96	16.42	14.93	7.46	1.49	0.00	0.00	7.46	11.94	7.46	

Table 2.3-242
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5º Direction, All Winds[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	341	240	272	329	422	252	219	214	243	158	159	149	202	134	103	61	**59.12**
3	94	90	101	99	163	82	79	89	126	65	46	48	81	41	18	14	**20.89**
4	37	33	40	42	87	30	25	41	76	29	24	21	38	26	12	7	**9.60**
5	31	12	16	19	39	17	18	17	34	16	8	5	18	8	5	3	**4.50**
6	12	5	10	12	28	11	3	10	15	5	6	2	8	4	4	1	**2.30**
7	6	3	6	3	24	3	3	6	14	6	1	4	8	1	1	0	**1.50**
8	1	4	3	1	8	3	1	0	11	2	0	2	3	1	1	0	**0.69**
9	6	1	1	2	8	0	0	2	8	2	0	1	2	0	1	0	**0.57**
10	2	0	1	2	2	2	0	1	3	0	0	0	0	0	0	0	**0.22**
11	0	0	0	0	3	0	0	0	3	0	0	0	1	0	0	0	**0.12**
12	0	0	0	0	3	1	0	0	6	0	0	0	0	0	0	0	**0.17**
13	0	0	0	0	1	1	0	3	3	0	0	0	0	0	0	0	**0.14**
14	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	**0.07**
15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**0.02**
16	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	**0.07**
17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.02**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
23	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.02**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**8.96**	**6.56**	**7.61**	**8.60**	**13.42**	**6.79**	**5.88**	**6.47**	**9.19**	**4.78**	**4.12**	**3.92**	**6.15**	**3.63**	**2.45**	**1.45**	
Average Persistant hours	**2.76**	**2.66**	**2.74**	**2.67**	**3.21**	**2.76**	**2.62**	**2.91**	**3.49**	**2.87**	**2.6**	**2.66**	**2.99**	**2.67**	**2.63**	**2.48**	

*** The longest persistent wind was from the south and lasted 23 hr.**

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-243
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5° Direction, Winds 3 mph or Greater[a]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	341	240	272	329	422	252	219	214	243	158	159	149	202	134	103	61	59.12
3	94	90	101	99	163	82	79	89	126	65	46	48	81	41	18	14	20.89
4	37	33	40	42	87	30	25	41	76	29	24	21	38	26	12	7	9.60
5	31	12	16	19	39	17	18	17	34	16	8	5	18	8	5	3	4.50
6	12	5	10	12	28	11	3	10	15	5	6	2	8	4	4	1	2.30
7	6	3	6	3	24	3	3	6	14	6	1	4	8	1	1	0	1.50
8	1	4	3	1	8	3	1	0	11	2	0	2	3	1	1	0	0.69
9	6	1	1	2	8	0	0	2	8	2	0	1	2	0	1	0	0.57
10	2	0	1	2	2	2	0	1	3	0	0	0	0	0	0	0	0.22
11	0	0	0	0	3	0	0	0	3	0	0	0	1	0	0	0	0.12
12	0	0	0	0	3	1	0	0	6	0	0	0	0	0	0	0	0.17
13	0	0	0	0	1	1	0	3	3	0	0	0	0	0	0	0	0.14
14	0	0	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0.07
15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.02
16	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0.07
17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.02
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.02
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	8.96	6.56	7.61	8.60	13.42	6.79	5.88	6.47	9.19	4.78	4.12	3.92	6.15	3.63	2.45	1.45	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-244
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5° Direction, Winds 6 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	129	106	121	136	202	145	128	155	203	124	116	103	115	82	70	49	57.54
3	45	47	44	53	77	48	44	61	104	61	32	28	43	19	13	10	21.14
4	27	8	13	23	50	24	17	26	60	25	17	18	19	17	11	6	10.47
5	15	5	6	8	19	10	11	15	32	16	8	4	6	6	4	2	4.84
6	7	2	5	7	16	7	2	9	9	5	3	0	4	4	3	0	2.41
7	1	1	2	0	10	2	1	4	13	6	1	3	3	0	1	0	1.39
8	1	1	0	0	2	2	1	0	8	1	0	0	2	1	1	0	0.58
9	2	0	0	2	2	0	0	3	7	2	0	1	1	0	1	0	0.61
10	2	0	1	0	2	0	0	0	2	0	0	0	1	0	0	0	0.23
11	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0.12
12	0	0	0	0	2	1	0	0	6	0	0	0	0	0	0	0	0.26
13	0	0	0	0	1	1	0	2	2	0	0	0	0	0	0	0	0.17
14	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0.09
15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.03
16	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0.06
17	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.03
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.03
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	6.64	4.93	5.57	6.64	11.28	6.96	5.92	7.98	13.05	6.96	5.13	4.55	5.68	3.74	3.02	1.94	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-245
Wind Direction Persistence Summaries - 30-Ft. Level

December 2004 through November 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 9 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	66	65	58	74	102	79	70	89	151	91	62	64	60	53	40	24	**57.83**
3	21	9	14	29	47	21	26	50	74	48	20	16	25	13	8	6	**21.51**
4	12	2	6	10	13	20	5	16	36	20	9	8	13	8	8	2	**9.47**
5	5	0	5	3	8	4	5	10	29	16	5	2	4	4	3	0	**5.19**
6	1	1	2	2	10	3	2	6	8	3	3	0	4	1	1	0	**2.37**
7	1	0	1	0	1	3	0	3	12	1	1	2	2	0	0	0	**1.36**
8	1	0	0	0	0	0	0	0	6	2	0	0	0	1	2	0	**0.60**
9	0	0	0	0	1	0	0	2	5	1	0	1	2	0	0	0	**0.60**
10	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	**0.10**
11	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	**0.15**
12	0	0	0	0	1	0	0	0	4	0	0	0	1	0	0	0	**0.30**
13	0	0	0	0	2	1	0	2	1	0	0	0	0	0	0	0	**0.30**
14	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	**0.10**
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
16	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.05**
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
22	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.05**
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
% of Persistent Direction	**5.39**	**3.88**	**4.33**	**5.94**	**9.42**	**6.60**	**5.44**	**8.97**	**16.73**	**9.17**	**5.04**	**4.69**	**5.64**	**4.03**	**3.12**	**1.61**	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-246
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 12 mph or Greater[a]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	16	5	11	17	23	27	21	42	93	46	27	18	25	22	12	3	59.30
3	4	1	3	3	13	3	7	23	33	20	5	5	11	4	2	2	20.20
4	2	1	2	0	4	2	2	5	26	11	5	2	5	0	1	0	9.88
5	0	0	1	0	3	1	0	1	11	6	2	2	1	1	1	0	4.36
6	0	0	1	0	0	1	0	3	7	1	0	0	3	2	0	0	2.62
7	0	0	0	0	0	0	0	2	6	0	0	0	0	0	0	0	1.16
8	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0.44
9	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0.58
10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.15
11	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0.44
12	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0.29
13	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0.44
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.15
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	3.20	1.02	2.62	2.91	6.25	5.09	4.36	11.19	27.33	12.21	5.67	3.92	6.83	4.22	2.47	0.73	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-247
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 22.5º Direction, Winds 15 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	5	2	1	2	2	5	6	17	37	20	5	4	8	5	3	1	53.71
3	0	0	1	2	2	2	4	10	23	10	4	3	6	1	0	0	29.69
4	0	0	0	0	0	2	0	1	8	2	1	0	2	0	1	0	7.42
5	0	0	2	0	0	0	0	1	5	1	1	0	1	0	0	0	4.80
6	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	1.75
7	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0.87
8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.44
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.44
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
13	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0.87
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	2.18	0.87	1.75	1.75	1.75	3.93	4.37	13.10	35.81	14.41	4.80	3.06	7.42	2.62	1.75	0.44	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-248
Wind Direction Persistence Summaries - 30-Ft. Level

2002 Through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5º Direction, All Winds[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	210	230	250	313	317	208	211	155	165	104	172	137	174	136	120	74	**34.77**
3	98	99	169	145	175	124	93	105	104	73	73	79	99	61	43	47	**18.54**
4	50	85	96	102	115	79	67	77	87	54	51	40	51	34	31	27	**12.22**
5	40	57	61	68	67	53	52	46	53	49	36	34	35	23	18	17	**8.28**
6	25	38	40	53	58	37	32	37	27	26	22	26	27	14	10	10	**5.63**
7	14	23	23	31	31	23	27	34	26	17	13	18	17	14	9	11	**3.87**
8	7	24	24	22	24	24	20	27	23	10	10	11	9	13	9	7	**3.08**
9	13	18	20	31	29	12	13	15	20	10	9	6	14	5	6	5	**2.64**
10	6	9	9	22	16	14	14	6	10	8	12	6	10	3	3	1	**1.74**
11	6	10	16	6	16	12	6	12	11	16	5	10	6	6	3	3	**1.68**
12	3	5	15	8	15	8	6	7	6	5	4	5	3	5	4	1	**1.17**
13	1	4	6	13	7	5	7	5	17	4	4	3	5	4	1	4	**1.05**
14	6	3	5	4	8	6	5	2	4	6	2	5	4	2	0	3	**0.76**
15	1	6	1	6	12	4	2	10	11	4	2	2	0	1	1	5	**0.79**
16	3	0	6	6	9	6	1	3	7	3	2	2	3	3	0	1	**0.64**
17	1	3	2	3	6	3	0	1	6	5	2	2	0	2	2	0	**0.44**
18	2	2	5	3	7	2	1	3	4	8	2	2	4	0	1	0	**0.54**
19	0	0	0	5	3	5	1	5	3	1	0	0	0	0	1	0	**0.28**
20	0	1	0	2	2	5	4	2	5	1	1	0	0	2	1	0	**0.30**
21	1	1	0	2	2	1	1	2	1	2	0	3	0	2	0	0	**0.21**
22	1	0	0	3	4	0	1	3	2	0	1	1	0	1	0	0	**0.20**
23	0	0	0	1	0	0	0	1	2	0	0	2	2	1	0	1	**0.12**
24	2	1	0	1	0	0	0	1	1	1	0	0	2	1	0	0	**0.12**
25	0	1	2	0	0	1	0	1	1	2	1	0	1	0	0	0	**0.12**
26	1	0	1	1	2	1	0	0	2	0	0	0	0	0	0	0	**0.09**
27	0	0	0	0	0	1	1	1	1	2	0	1	0	0	0	0	**0.08**
28	0	0	0	0	2	0	0	2	1	2	1	0	1	0	0	0	**0.11**
29	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	**0.05**
30	0	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	**0.06**
31	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	**0.05**
32	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	**0.04**
33	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.01**
34	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	**0.02**
35	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	**0.02**
36	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	**0.02**
37	0	0	0	1	1	2	0	0	0	0	1	0	0	0	0	0	**0.06**
38	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	**0.02**
39	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.01**
40	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**0.01**
41	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.01**
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0.00**
43	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	**0.01**
44	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	**0.01**
45	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	**0.01**
46	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	**0.01**
47	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	**0.01**
48+	0	0	0	2	0	1	0	1	1	0	0	0	0	0	0	0	**0.06**
% of Persistent Direction	**5.75**	**7.24**	**8.78**	**10.01**	**10.94**	**7.47**	**6.61**	**6.67**	**7.12**	**4.84**	**4.99**	**4.62**	**5.47**	**3.89**	**3.07**	**2.54**	
Average Persistant hours	**4.18**	**4.43**	**4.49**	**4.86**	**5.23**	**5.11**	**4.6**	**5.69**	**6.03**	**5.84**	**4.52**	**4.79**	**4.54**	**4.57**	**4.04**	**4.53**	

*** The longest persistent wind was from the south and lasted 88 hr.**

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-249
Wind Direction Persistence Summaries - 30-Ft. Level

2002 Through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5º Direction, Winds 3 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	210	230	250	313	317	208	211	155	165	104	172	137	174	136	120	74	34.77
3	98	99	169	145	175	124	93	105	104	73	73	79	99	61	43	47	18.54
4	50	85	96	102	115	79	67	77	87	54	51	40	51	34	31	27	12.22
5	40	57	61	68	67	53	52	46	53	49	36	34	35	23	18	17	8.28
6	25	38	40	53	58	37	32	37	27	26	22	26	27	14	10	10	5.63
7	14	23	23	31	31	23	27	34	26	17	13	18	17	14	9	11	3.87
8	7	24	24	22	24	24	20	27	23	10	10	11	9	13	9	7	3.08
9	13	18	20	31	29	12	13	15	20	10	9	6	14	5	6	5	2.64
10	6	9	9	22	16	14	14	6	10	8	12	6	10	3	3	1	1.74
11	6	10	16	6	16	12	6	12	11	16	5	10	6	6	3	3	1.68
12	3	5	15	8	15	8	6	7	6	5	4	5	3	5	4	1	1.17
13	1	4	6	13	7	5	7	5	17	4	4	3	5	4	1	4	1.05
14	6	3	5	4	8	6	5	2	4	6	2	5	4	2	0	3	0.76
15	1	6	1	6	12	4	2	10	11	4	2	2	0	1	1	5	0.79
16	3	0	6	6	9	6	1	3	7	3	2	2	3	3	0	1	0.64
17	1	3	2	3	6	3	0	1	6	5	2	2	0	2	2	0	0.44
18	2	2	5	3	7	2	1	3	4	8	2	2	4	0	1	0	0.54
19	0	0	0	5	3	5	1	5	3	1	0	0	0	0	1	0	0.28
20	0	1	0	2	2	5	4	2	5	1	1	0	0	2	1	0	0.30
21	1	1	0	2	2	1	1	2	1	2	0	3	0	2	0	0	0.21
22	1	0	0	3	4	0	1	3	2	0	1	1	0	1	0	0	0.20
23	0	0	0	1	0	0	0	1	2	0	0	2	2	1	0	1	0.12
24	2	1	0	1	0	0	0	1	1	1	0	0	2	1	0	0	0.12
25	0	1	2	0	0	1	0	1	1	2	1	0	1	0	0	0	0.12
26	1	0	1	1	2	1	0	0	2	0	0	0	0	0	0	0	0.09
27	0	0	0	0	0	1	1	1	1	2	0	1	0	0	0	0	0.08
28	0	0	0	0	2	0	0	2	1	2	1	0	1	0	0	0	0.11
29	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0.05
30	0	0	0	1	0	0	0	1	1	1	1	0	0	0	0	0	0.06
31	0	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0	0.05
32	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0.04
33	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.01
34	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0.02
35	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0.02
36	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0.02
37	0	0	0	1	1	2	0	0	0	0	1	0	0	0	0	0	0.06
38	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0.02
39	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.01
40	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.01
41	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.01
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.01
44	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.01
45	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.01
46	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0.01
47	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0.01
48+	0	0	0	2	0	1	0	1	1	0	0	0	0	0	0	0	0.06
% of Persistent Direction	5.75	7.24	8.78	10.01	10.94	7.47	6.61	6.67	7.12	4.84	4.99	4.62	5.47	3.89	3.07	2.54	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-250
Wind Direction Persistence Summaries - 30-Ft. Level

2002 Through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5° Direction, Winds 6 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	102	97	112	126	147	144	121	129	143	92	117	93	105	80	70	52	33.94
3	60	53	90	71	109	68	57	79	86	60	50	53	59	34	35	30	19.50
4	41	42	44	48	60	47	51	46	58	38	39	30	30	23	26	23	12.67
5	13	32	15	34	37	36	30	36	44	45	28	25	19	14	11	14	8.50
6	16	16	14	17	29	20	27	27	27	21	14	18	22	11	9	5	5.75
7	7	10	14	12	21	19	19	21	26	14	9	9	5	9	7	12	4.20
8	6	4	8	9	16	9	10	18	20	17	10	6	11	8	8	5	3.24
9	6	11	8	16	16	8	6	12	12	7	9	8	3	3	2	7	2.63
10	6	3	7	7	4	9	7	5	12	1	4	4	8	5	3	4	1.75
11	5	5	5	7	8	3	1	7	14	10	3	1	3	1	2	1	1.49
12	1	2	3	4	3	3	2	3	5	5	3	3	0	5	0	1	0.84
13	1	3	0	3	3	1	3	8	12	5	1	0	2	4	2	3	1.00
14	0	2	0	0	0	2	4	3	5	5	5	4	0	0	0	0	0.59
15	0	1	0	3	3	2	2	5	7	2	1	1	1	2	1	3	0.67
16	2	1	1	1	4	4	1	2	4	1	2	1	2	0	1	0	0.53
17	1	0	1	2	2	2	0	1	6	6	0	2	0	0	1	0	0.47
18	0	0	2	3	5	0	0	4	2	4	1	0	1	0	1	0	0.45
19	1	0	0	1	0	0	0	5	3	2	0	1	1	0	1	0	0.29
20	0	0	0	1	1	2	2	1	2	1	0	1	0	0	0	0	0.22
21	0	0	1	0	0	0	0	3	1	1	0	0	0	2	0	0	0.16
22	1	0	0	1	3	1	1	1	1	0	1	0	1	0	0	0	0.22
23	1	0	0	0	0	0	0	0	3	0	0	0	1	1	0	0	0.12
24	0	0	0	0	1	0	1	0	1	3	0	0	1	0	0	0	0.14
25	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0.08
26	0	0	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0.10
27	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0.08
28	0	0	0	1	1	0	0	2	1	1	0	0	0	0	0	0	0.12
29	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0.04
30	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.02
31	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.02
32	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0.04
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.02
36	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.02
37	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0.02
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.02
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0.04
46	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0.04
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	5.30	5.53	6.40	7.26	9.34	7.49	6.79	8.32	9.87	6.71	5.87	5.10	5.40	3.96	3.53	3.14	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-251
Wind Direction Persistence Summaries - 30-Ft. Level

2002 Through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5° Direction, Winds 9 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	69	61	53	67	91	71	97	71	95	64	74	64	56	57	38	34	36.30
3	38	23	28	34	58	48	36	47	56	52	25	35	30	23	14	22	19.45
4	21	16	23	25	23	29	26	29	56	31	25	17	18	14	20	8	13.02
5	10	8	11	14	14	11	16	20	32	26	17	9	13	12	6	10	7.83
6	6	8	7	12	9	10	15	17	18	14	8	8	13	4	6	4	5.43
7	4	3	2	9	9	7	7	19	24	8	3	7	7	4	7	3	4.20
8	3	4	2	1	11	2	4	13	12	11	4	3	3	5	3	4	2.90
9	1	3	2	4	5	6	3	5	16	6	3	2	2	1	0	3	2.12
10	0	1	2	1	1	5	4	6	6	10	4	1	4	4	5	1	1.88
11	1	0	2	4	1	1	0	3	9	7	2	2	0	0	0	0	1.09
12	0	0	1	0	2	0	1	2	8	4	2	1	0	2	0	1	0.82
13	0	0	1	0	2	1	2	4	8	3	0	1	2	2	2	0	0.96
14	0	0	0	0	1	2	5	2	8	2	3	3	1	0	1	0	0.96
15	0	0	0	3	3	1	1	5	3	0	0	0	1	1	0	0	0.62
16	0	0	0	0	1	1	0	2	3	3	0	1	0	0	0	0	0.38
17	0	0	1	2	2	0	0	1	2	3	1	1	1	0	0	0	0.48
18	0	0	1	0	2	0	0	3	3	3	0	0	1	0	0	0	0.44
19	0	0	0	1	0	0	0	3	1	1	0	0	2	0	0	0	0.27
20	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0.14
21	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0.10
22	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0.14
23	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.03
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0.07
27	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.03
28	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0.10
29	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.03
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.03
36	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0.07
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.03
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.03
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0.03
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	5.26	4.34	4.65	6.05	8.07	6.70	7.45	8.89	12.58	8.54	5.91	5.30	5.26	4.44	3.49	3.08	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-252
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5° Direction, Winds 12 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	13	6	21	22	26	22	27	30	84	40	28	20	20	18	13	7	39.78
3	6	2	4	9	10	14	12	24	32	21	12	7	11	8	3	3	17.84
4	6	2	2	2	7	7	11	16	24	22	9	4	8	1	6	1	12.83
5	0	0	2	0	3	3	4	8	19	14	3	3	3	5	2	3	7.21
6	0	1	0	1	3	6	4	15	6	7	5	2	4	4	1	0	5.91
7	0	0	0	0	1	1	2	7	6	7	3	0	1	1	1	0	3.01
8	0	0	0	1	2	0	0	8	7	5	1	2	4	2	1	0	3.31
9	0	0	1	0	0	0	4	3	13	5	2	0	1	0	0	0	2.91
10	0	0	0	1	1	1	1	2	6	3	3	0	1	1	1	0	2.10
11	0	0	0	0	0	0	0	3	4	1	0	2	1	0	0	0	1.10
12	0	0	0	0	0	0	0	0	3	0	0	0	1	0	0	1	0.50
13	0	0	0	0	0	0	0	4	5	1	0	0	1	0	0	0	1.10
14	0	0	0	0	0	0	1	1	2	0	0	1	0	0	0	0	0.50
15	0	0	1	0	1	0	0	3	1	1	0	0	0	0	0	0	0.70
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0.30
18	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0.20
19	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0.30
20	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0.30
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0.10
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	2.51	1.10	3.11	3.71	5.51	5.51	6.61	12.73	21.64	12.83	6.71	4.11	5.61	4.01	2.81	1.50	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-253
Wind Direction Persistence Summaries - 30-Ft. Level

2002 through 2006 Ryan Airport Number of Occurrences where Winds Blew from the Same 67.5° Direction, Winds 15 mph or Greater[(a)]

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	% of Persistent Occurrences
2	3	3	2	2	2	6	6	10	30	16	14	5	6	4	4	1	36.54
3	2	0	2	1	2	1	6	6	22	14	3	2	5	0	0	1	21.47
4	1	1	0	0	1	2	3	8	13	6	3	1	4	2	2	0	15.06
5	0	0	2	0	0	1	1	6	10	6	2	2	3	0	0	0	10.58
6	0	0	0	1	0	0	0	7	6	4	0	1	0	0	0	0	6.09
7	0	0	0	0	0	0	0	2	4	1	0	1	0	1	0	0	2.88
8	0	0	0	0	0	0	0	0	3	2	1	0	0	0	0	0	1.92
9	0	0	0	0	0	0	1	0	3	1	1	0	0	0	0	0	1.92
10	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0.64
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
12	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.32
13	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0.96
14	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0.96
15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.32
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
17	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.32
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
48+	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00
% of Persistent Direction	1.92	1.28	1.92	1.60	2.24	3.53	5.77	13.46	30.13	16.03	7.69	3.85	5.77	2.24	1.92	0.64	

a) Hourly wind speeds of 3 knots or less (3.45 mph) are reported as calm hours.

Source: Reference 2.3-236.

Table 2.3-254
Mean Monthly and Annual Mixing Heights (M) at Lake Charles, Louisiana (2002 - 2006)

Month	Morning	Afternoon
January	353	763
February	404	832
March	364	1048
April	341	1203
May	370	1362
June	319	1430
July	347	1310
August	295	1458
September	296	1406
October	316	1038
November	301	838
December	275	745
Annual	331	1124

Source: Reference 2.3-251.

Table 2.3-255
Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

Annual		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	170	18.0
2	88	27.2
3	60	33.6
4	51	39.0
5	31	42.2
6	38	46.3
7	25	48.9
8	30	52.1
9	29	55.1
10	25	57.8
11	34	61.4
12	42	65.8
13	69	73.1
14	72	80.7
15	65	87.5
16	37	91.4
17	22	93.8
18	12	95.0
19	10	96.1
20	6	96.7
21	8	97.6
22	6	98.2
23	2	98.4
24	1	98.5
25+	14	100.0

Notes:

1. The longest inversion lasted 63 hr.

2. An inversion was present a total of 8151 hr. of a possible 16,609 hr. during the 2-year period.

3. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-256
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

January		
Duration (hr.)	Number of Observations	Percent Probability (%)
1	13	20.3
2	7	31.3
3	7	42.2
4	4	48.4
5	3	53.1
6	3	57.8
7	2	60.9
8	2	64.1
9	3	68.8
10	1	70.3
11	1	71.9
12	2	75.0
13	1	76.6
14	5	84.4
15	3	89.1
16	3	93.8
17	0	93.8
18	0	93.8
19	0	93.8
20	1	95.3
21	0	95.3
22	2	98.4
23	0	98.4
24	0	98.4
25+	1	100.0

Notes:

1. The longest inversion lasted 27 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-257
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

February		
Duration (hr.)	Number of Observations	Percent Probability (%)
1	12	20.0
2	5	28.3
3	5	36.7
4	6	46.7
5	4	53.3
6	6	63.3
7	1	65.0
8	1	66.7
9	2	70.0
10	1	71.7
11	1	73.3
12	2	76.7
13	2	80.0
14	4	86.7
15	3	91.7
16	1	93.3
17	0	96.3
18	0	93.3
19	1	95.0
20	1	96.7
21	0	96.7
22	1	98.3
23	0	98.3
24	0	98.3
25+	1	100.0

Notes:

1. The longest inversion lasted 48 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-258
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

March		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	14	16.1
2	12	29.9
3	8	39.1
4	7	47.1
5	2	49.4
6	6	56.3
7	5	62.1
8	1	63.2
9	6	70.1
10	1	71.3
11	3	74.7
12	4	49.3
13	5	85.1
14	9	95.4
15	2	97.7
16	0	97.7
17	0	97.7
18	1	98.9
19	0	98.9
20	0	98.9
21	1	100.0
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 21 hr.
2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-259
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

April		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	12	16.7
2	4	22.2
3	6	30.6
4	3	34.7
5	1	36.1
6	0	36.1
7	5	43.1
8	4	48.6
9	1	50.0
10	5	56.9
11	2	59.7
12	5	66.7
13	6	75.0
14	7	84.7
15	1	86.1
16	1	87.5
17	0	87.5
18	2	90.3
19	1	91.7
20	0	91.7
21	2	94.4
22	1	95.8
23	0	95.8
24	0	95.8
25+	3	100.0

Notes:

1. The longest inversion lasted 37 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-260
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

May		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	12	12.9
2	9	22.6
3	5	28.0
4	4	32.3
5	3	35.5
6	1	36.6
7	2	38.7
8	4	43.0
9	6	49.5
10	3	52.7
11	8	61.3
12	6	67.7
13	8	76.3
14	5	81.7
15	0	81.7
16	5	87.1
17	3	90.3
18	2	92.5
19	2	94.6
20	1	95.7
21	2	97.8
22	1	98.9
23	0	98.9
24	0	98.9
25+	1	100.0

Notes:

1. The longest inversion lasted 28 hr.
2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-261
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

June		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	18	19.6
2	11	31.5
3	3	34.8
4	3	38.0
5	2	40.2
6	6	46.7
7	2	48.9
8	3	52.2
9	3	55.4
10	6	62.0
11	4	66.3
12	9	76.1
13	7	83.7
14	5	89.1
15	3	92.4
16	1	93.5
17	0	93.5
18	0	93.5
19	1	94.6
20	0	94.6
21	2	96.7
22	1	97.8
23	0	97.8
24	0	97.8
25+	2	100.0

Notes:

1. The longest inversion lasted 34 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-262
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

July		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	22	22.2
2	12	34.3
3	7	41.4
4	8	49.5
5	3	52.5
6	5	57.6
7	3	60.6
8	6	66.7
9	5	71.7
10	1	72.7
11	3	75.8
12	3	78.8
13	4	82.8
14	2	84.8
15	1	85.9
16	0	85.9
17	2	87.9
18	2	89.9
19	0	89.9
20	1	90.9
21	0	90.9
22	0	90.9
23	2	92.9
24	1	93.9
25+	6	100.0

Notes:

1. The longest inversion lasted 63 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-263
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

August		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	26	24.8
2	12	36.2
3	3	39.0
4	7	45.7
5	3	48.6
6	2	50.5
7	0	50.5
8	3	53.3
9	1	54.3
10	3	57.1
11	5	61.9
12	4	65.7
13	17	81.9
14	9	90.5
15	2	92.4
16	0	92.4
17	4	96.2
18	2	98.1
19	1	99.0
20	0	99.0
21	1	100.0
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 21 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-264
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

September		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	14	19.7
2	6	28.2
3	2	31.0
4	2	33.8
5	2	36.6
6	1	38.0
7	1	39.4
8	1	40.8
9	0	40.8
10	1	42.3
11	2	45.1
12	4	50.7
13	11	66.2
14	11	81.7
15	8	93.0
16	2	95.8
17	1	97.2
18	1	98.6
19	1	100.0
20	--	--
21	--	--
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 19 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

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Table 2.3-265
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

October		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	14	17.5
2	4	22.5
3	8	32.5
4	4	37.5
5	2	40.0
6	2	42.5
7	0	42.5
8	2	45.0
9	1	46.3
10	1	47.5
11	2	50.0
12	1	51.3
13	3	55.0
14	9	66.3
15	18	88.8
16	2	91.3
17	6	98.8
18	0	98.8
19	1	100.0
20	--	--
21	--	--
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 19 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-266
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

November		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	7	11.7
2	2	15.0
3	1	16.7
4	0	16.7
5	4	23.3
6	5	31.7
7	1	33.3
8	1	35.0
9	0	35.0
10	2	38.3
11	2	41.7
12	1	43.3
13	2	46.7
14	4	53.3
15	11	71.7
16	9	86.7
17	2	90.0
18	2	93.3
19	2	96.7
20	2	100.0
21	--	--
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 20 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-267
Monthly Temperature Inversion Frequency and Persistence at the RBS (December 2004 - November 2006)

December		
Duration (hr.)	**Number of Observations**	**Percent Probability (%)**
1	6	9.4
2	4	15.6
3	5	23.4
4	3	28.1
5	2	31.3
6	1	32.8
7	3	37.5
8	2	40.6
9	1	42.2
10	0	42.2
11	1	43.8
12	1	45.3
13	3	50.0
14	2	53.1
15	13	73.4
16	13	93.8
17	4	100.0
18	--	--
19	--	--
20	--	--
21	--	--
22	--	--
23	--	--
24	--	--
25+	--	--

Notes:

1. The longest inversion lasted 17 hr.

2. Percent probability represents that, if an inversion occurs, its duration would be less than or equal to the number of hours specified.

Table 2.3-268
Monthly and Annual Vertical Stability Class and Mean 30-Ft. Wind Speed Distributions for the RBS (December 2004 - November 2006)

Period	Vertical Stability Categories						
	A	B	C	D	E	F	G
January							
Frequency (%)	0.0	0.5	0.8	33.4	53.6	6.4	5.3
Wind Speed (knots)	0.00	3.59	4.91	4.87	4.22	1.91	1.31
February							
Frequency (%)	0.1	0.1	0.6	38.2	49.4	6.5	5.1
Wind Speed (knots)	5.54	4.72	5.21	4.94	3.95	2.19	1.40
March							
Frequency (%)	0.1	0.6	0.9	31.5	54.3	7.0	5.6
Wind Speed (knots)	4.68	4.81	5.56	5.24	4.19	1.94	1.29
April							
Frequency (%)	0.0	0.0	0.1	24.8	55.2	13.6	6.3
Wind Speed (knots)	0.00	0.00	4.85	5.48	3.77	2.52	1.00
May							
Frequency (%)	0.1	0.1	0.5	22.3	52.1	18.4	6.7
Wind Speed (knots)	5.78	4.31	4.71	4.11	3.03	2.00	1.18
June							
Frequency (%)	0.0	0.1	0.2	18.5	54.5	22.0	4.7
Wind Speed (knots)	0.00	1.04	1.19	3.84	2.90	1.96	1.16
July							
Frequency (%)	0.1	0.0	0.1	19.8	60.8	17.9	1.2
Wind Speed (knots)	4.02	0.00	4.97	3.80	2.41	1.87	1.13
August							
Frequency (%)	0.4	0.1	0.4	23.5	52.5	19.9	3.2
Wind Speed (knots)	4.38	3.20	4.86	3.93	2.53	1.32	1.04
September							
Frequency (%)	1.2	0.5	1.9	27.5	48.2	12.8	8.0
Wind Speed (knots)	4.67	4.98	4.99	4.40	3.02	1.69	1.20
October							
Frequency (%)	2.1	0.9	1.9	27.2	37.5	15.6	14.8
Wind Speed (knots)	4.83	4.96	4.73	4.67	3.30	1.81	1.14
November							
Frequency (%)	3.2	0.4	1.3	23.0	42.8	12.6	16.6
Wind Speed (knots)	4.2	5.92	5.27	4.87	3.27	1.79	1.28
December							
Frequency (%)	1.9	0.7	0.6	31.5	39.6	11.0	14.7
Wind Speed (knots)	4.73	3.71	4.10	5.00	3.45	1.78	1.25
Annual							
Frequency (%)	0.7	0.3	0.8	26.8	50.1	13.6	7.7
Wind Speed (knots)	4.57	4.47	4.87	4.67	3.33	1.87	1.21

River Bend Station, Unit 3
COL Application
Part 2, FSAR

Table 2.3-269
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

All Pasquill Stability Categories

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm	1	4		9	6	12	4	3		2				1	2		44
Calm-2	287	362	255	372	355	308	353	396	84	170	106	84	106	193	277	137	3845
2-4	249	327	382	615	394	635	320	223	308	737	331	321	222	231	277	207	5779
4-6	48	133	122	505	298	371	319	171	443	511	320	267	135	223	155	204	4225
6-8		31	8	343	54	85	254	123	261	91	188	156	47	46	66	51	1804
8-10	2	6	2	61	5	6	110	64	88	12	86	81	18	1	41	2	585
10-13				4			33	24	55	4	58	25	9	2	13		227
13-17				2			1	5	7	1	15	2					33
17-21						1	4		2		2	1					10
21+			1														1
All Speeds	587	863	770	1911	1112	1418	1398	1009	1248	1528	1106	937	537	697	831	601	16,553

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 44
Number of Variables: 0
Number of Observations: 16,553

Table 2.3-270
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class A
Extremely Unstable ($\Delta T \leq 1.9°C/100$ m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2																	0
2-4	8	4	3	1	3				1	4							24
4-6	3	7	8	5	11	14	7			17	2					1	75
6-8			2	3	4	5				6	1			1	2		24
8-10																	0
10-13																	0
13-17																	0
17-21																	0
21+			1														1
All Speeds	11	11	14	9	18	19	7	0	1	27	3	0	0	1	2	1	124

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 124

Table 2.3-271
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class B
Moderately Unstable (-1.9°C/100 m < $\Delta T \leq$ -1.7°C/100 m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm						1											1
Calm-2		1		1													2
2-4			1				1			3						1	6
4-6	2	3	2	2	9	4	1		1	3				1			28
6-8		2		4		2		1	1	3	1				1		15
8-10				1						1							2
10-13																	0
13-17																	0
17-21																	0
21+																	0
All Speeds	2	6	3	8	9	7	2	1	2	10	1	0	0	1	1	1	54

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 1
Number of Variables: 0
Number of Observations: 54

Table 2.3-272
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class C
Slightly Unstable (-1.7°C/100 m < ΔT ≤ -1.5°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2	1		1				1			1							4
2-4		1	1		1	1			1	3				1		1	10
4-6	2	10	11	6	15	5	1	1	5	6	2		1		1	4	70
6-8		1	1	8	6	13	3	2	1	4	1				1	2	43
8-10						1											1
10-13																	0
13-17																	0
17-21									1								1
21+																	0
All Speeds	3	12	14	14	22	20	5	3	8	14	3	0	1	1	2	7	129

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 129

Table 2.3-273
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004-November 2006
30-Ft. Tower

Pasquill Stability Class D
Neutral (-1.5°C/100 m < ΔT ≤ -0.5°C/100 m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2	9	6	9	5	2	3	3	2		3	1	3	4	4	7	2	63
2-4	75	66	114	91	94	105	44	36	22	122	38	54	49	75	44	44	1073
4-6	20	76	50	268	115	205	162	93	133	207	127	92	50	134	83	120	1935
6-8		9	2	199	18	49	155	73	99	39	82	53	24	30	48	25	905
8-10			1	38	2	3	81	45	35	4	44	30	11	1	36	2	333
10-13							27	21	19	3	19	14	7	2	11		123
13-17							1	5	1		6	1					14
17-21						1					1	1					3
21+																	0
All Speeds	104	157	176	601	231	366	473	275	309	378	318	248	145	246	229	193	4449

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 4449

Table 2.3-274
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class E
Slightly Stable (-0.5°C/100 m < ΔT $\leq$ 1.5°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm					1	1				1							3
Calm-2	135	104	170	82	92	72	59	71	57	123	70	49	65	75	81	84	1389
2-4	131	200	221	336	253	448	177	144	248	543	255	242	147	136	187	133	3801
4-6	21	36	48	221	144	143	144	74	252	275	165	135	66	84	67	66	1941
6-8		19	3	129	26	15	96	47	141	39	101	91	19	15	14	23	778
8-10	2	6	1	22	3	2	29	19	52	7	42	51	7		5		248
10-13				4			6	3	36	1	39	11	2		2		104
13-17				2					6	1	9	1					19
17-21							4		1		1						6
21+																	0
All Speeds	289	365	443	796	519	681	515	358	793	990	682	580	306	310	356	306	8289

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 3
Number of Variables: 0
Number of Observations: 8289

Table 2.3-275
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class F
Moderately Stable (1.5°C/100 m < ΔT $\leq$ 4.0°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm	1			5	4	6	2	2						1	1		22
Calm-2	95	100	64	127	97	117	120	153	23	38	30	29	33	82	126	38	1272
2-4	25	32	39	156	40	78	78	29	35	57	37	25	25	18	41	25	740
4-6		1	3	3	4		4	3	52	3	24	40	18	4	4	13	176
6-8						1			19		2	12	4			1	39
8-10									1								1
10-13																	0
13-17																	0
17-21																	0
21+																	0
All Speeds	121	133	106	291	145	202	204	187	130	98	93	106	80	105	172	77	2250

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 18
Number of Variables: 0
Number of Observations: 2250

Table 2.3-276
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
30-Ft. Tower

Pasquill Stability Class G
Extremely Stable ($\Delta T > 4.0°C/100$ m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm		4		4	1	4	2	1		1					1		18
Calm-2	47	151	11	157	164	116	170	170	4	5	5	3	4	32	63	13	1115
2-4	10	24	3	31	3	3	20	14	1	5	1		1	1	5	3	125
4-6																	0
6-8																	0
8-10																	0
10-13																	0
13-17																	0
17-21																	0
21+																	0
All Speeds	57	179	14	192	168	123	192	185	5	11	6	3	5	33	69	16	1258

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 22
Number of Variables: 0
Number of Observations: 1258

Table 2.3-277
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

All Pasquill Stability Classes

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm				1		1				1							3
Calm-2	15	14	11	10	13	8	5	12	6	8	9	11	11	7	9	15	164
2-4	156	147	130	78	103	93	81	87	125	101	107	95	97	134	96	121	1751
4-6	202	253	274	204	260	284	142	165	296	248	249	321	269	344	209	297	4017
6-8	128	244	425	452	348	494	291	207	421	367	286	324	153	256	190	180	4766
8-10	78	180	407	328	444	288	255	118	288	322	199	170	57	69	96	63	3362
10-13	47	172	263	129	217	83	150	98	119	121	144	133	42	24	76	25	1843
13-17	12	60	73	14	17	6	54	45	54	25	64	56	11	3	38	1	533
17-21		13	6	1	2		4	7	7	10	16	5			7		78
21+	2	6	7	2	2		2	2	5	4	7	1			3		43
All Speeds	640	1089	1596	1219	1406	1257	984	741	1321	1207	1081	1116	640	837	724	702	16,560

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 3
Number of Variables: 0
Number of Observations: 16,560

Table 2.3-278
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class A
Extremely Unstable ($\Delta T \leq -1.9°C/100$ m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2																	0
2-4	1	1	1														3
4-6	2	4	5		1					1							13
6-8	6	4	3		14	5				3	1					1	37
8-10	4	10	9	1	8	5				2				1			40
10-13	4	5	5		5	2				2				1	1		25
13-17		1	2		2												5
17-21																	0
21+			1														1
All Speeds	17	25	26	1	30	12	0	0	0	8	1	0	0	2	1	1	124

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 124

Table 2.3-279
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class B
Moderately Unstable (-1.9°C/100 m < ΔT ≤ -1.7°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm										1							1
Calm-2							1										1
2-4		1	1							1							3
4-6		1	1		2	1				1	1			1		1	9
6-8		1			2	1											4
8-10	2	3	3		4	5				1	2						20
10-13		5	4		1	2		1						1			14
13-17		1															1
17-21			1														1
21+																	0
All Speeds	2	12	10	0	9	9	1	1	0	4	3	0	0	2	0	1	54

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 1
Number of Variables: 0
Number of Observations: 54

Table 2.3-280
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class C
Slightly Unstable (-1.7°C/100 m < ΔT ≤ -1.5°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2		1															1
2-4	1									1							2
4-6	1		3	2							1	1		1		2	11
6-8		3	1	2	4	4	1	1	3	3					1	4	27
8-10	7	5	2	4	6	6	1	2	3	5					1	2	44
10-13	3	9	4	1	10	4		2		1							34
13-17		1	2		3	2				1							9
17-21																	0
21+									1								1
All Speeds	12	19	12	9	23	16	2	5	7	11	1	1	0	1	2	8	129

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 129

Table 2.3-281
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class D
Neutral ($-1.5°C/100\ m < \Delta T \leq -0.5°C/100\ m$)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2		1	1	1	1					1			1		1		7
2-4	23	13	15	17	24	22	16	13	11	5	8	9	12	19	12	22	241
4-6	42	53	65	69	76	89	47	35	42	46	39	58	60	100	45	70	936
6-8	38	62	96	153	96	149	92	67	100	68	59	55	27	105	49	84	1300
8-10	18	53	104	128	81	72	114	52	85	58	66	43	18	38	37	32	999
10-13	10	46	58	69	46	37	94	53	41	28	57	37	18	14	58	11	677
13-17	3	18	19	5	6		39	32	21	12	25	27	9	3	28	1	248
17-21			1		1		4	6	2	2	2	4			6		28
21+	1		2							2	4	1			2		12
All Speeds	135	246	361	442	331	369	406	258	302	222	260	234	145	279	238	220	4448

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 4448

Table 2.3-282
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class E
Slightly Stable (-0.5°C/100 m < ΔT ≤ 1.5°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2	3	6	7	6	5	2	1	3	3	3	5	3	1	2	2	6	58
2-4	79	86	58	28	63	43	42	41	53	46	39	43	40	59	54	56	830
4-6	95	139	138	92	123	131	57	78	153	131	115	161	125	147	82	137	1904
6-8	54	119	264	220	133	241	128	63	248	201	148	216	99	93	71	67	2365
8-10	39	82	209	147	231	149	104	58	188	201	122	116	39	27	43	28	1783
10-13	24	98	167	59	123	30	56	42	78	84	85	96	24	8	17	14	1005
13-17	9	36	50	9	6	3	15	13	33	12	39	29	2		10		266
17-21		13	4	1	1			1	5	8	14	1			1		49
21+	1	6	4	2	2		2	2	4	2	3				1		29
All Speeds	304	585	901	564	687	599	405	301	765	688	570	665	330	336	281	308	8289

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 8289

Table 2.3-283
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class F
Moderately Stable (1.5°C/100 m < ΔT $\leq$ 4.0°C/100 m)

Wind Speed (mph)[(a)]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2	6	3	2	1	3	1	2	7	2	2	2	5	3	3	3	5	50
2-4	29	27	37	19	9	12	14	21	40	34	43	29	35	37	22	31	439
4-6	33	39	50	23	28	30	18	26	69	41	57	71	63	55	43	58	704
6-8	13	28	46	47	59	55	32	34	62	56	51	44	20	22	32	8	609
8-10	7	23	59	38	89	46	18	2	12	41	8	11		3	8	1	366
10-13	6	8	18		30	8				6	2						78
13-17		3				1											4
17-21																	0
21+																	0
All Speeds	94	131	212	128	218	153	84	90	185	180	163	160	121	120	108	103	2250

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 2250

Table 2.3-284
Annual JFD of Wind Direction, Wind Speed, and Stability Class

RBS
December 2004 - November 2006
150-Ft. Tower

Pasquill Stability Class G
Extremely Stable (ΔT > 4.0°C/100 m)

Wind Speed (mph)[a]	Wind Direction From																
	E	ENE	ESE	N	NE	NNE	NNW	NW	S	SE	SSE	SSW	SW	W	WNW	WSW	All Directions
Calm																	0
Calm-2	6	3	1	2	4	5	1	2	1	2	2	3	5	2	3	4	46
2-4	22	19	18	14	7	16	9	12	21	14	16	14	10	18	8	12	230
4-6	29	17	12	17	30	33	20	26	32	28	36	30	21	40	39	29	439
6-8	17	27	15	30	40	39	38	42	8	36	27	9	7	36	37	16	424
8-10	1	4	21	10	25	5	18	4		14	1				7		110
10-13		1	7		2												10
13-17																	0
17-21																	0
21+																	0
All Speeds	75	71	74	73	108	98	86	86	62	94	82	56	43	96	94	61	1259

a) Calm represents wind speeds less than or equal to 0.50 mph.

Number of Calms: 0
Number of Variables: 0
Number of Observations: 1259

Table 2.3-285
Average Plume Lengths During NDCT Operation

	Winter		Spring		Summer		Fall		Annual	
Direction	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**
S	1.88	3.02	0.82	1.32	0.62	1.00	1.32	2.13	1.52	2.45
SSW	1.79	2.88	0.81	1.31	0.49	0.78	0.94	1.51	1.32	2.12
SW	1.62	2.61	1.06	1.71	0.59	0.95	0.92	1.48	1.17	1.88
WSW	1.47	2.36	0.99	1.59	0.81	1.30	0.95	1.52	1.09	1.76
W	1.54	2.48	1.44	2.32	0.74	1.19	0.97	1.56	1.24	1.99
WNW	1.34	2.15	1.34	2.16	0.79	1.27	1.35	2.17	1.28	2.06
NW	1.08	1.74	0.95	1.53	0.68	1.10	1.13	1.83	1.00	1.60
NNW	1.01	1.62	0.88	1.41	0.59	0.95	0.94	1.51	0.90	1.46
N	1.31	2.11	0.87	1.40	0.63	1.02	0.89	1.44	1.01	1.63
NNE	1.17	1.88	1.14	1.83	0.40	0.64	1.06	1.71	1.04	1.68
NE	1.21	1.95	1.19	1.92	0.55	0.88	1.50	2.41	1.17	1.89
ENE	1.24	2.00	1.20	1.94	0.41	0.66	1.08	1.73	1.03	1.66
E	1.64	2.64	1.05	1.69	0.68	1.10	1.22	1.96	1.23	1.99
ESE	1.38	2.23	1.43	2.29	0.66	1.06	1.41	2.27	1.29	2.08
SE	1.80	2.90	1.48	2.38	0.54	0.87	1.38	2.23	1.50	2.41
SSE	2.09	3.36	1.19	1.92	0.87	1.40	1.57	2.53	1.74	2.81
All	1.56	2.51	1.11	1.79	0.67	1.07	1.16	1.86	1.25	2.01

Note: Plume moving in the indicated direction.

Source: Reference 2.3-251.

Table 2.3-286
Average Plume Lengths During MDCT Operation

	Winter		Spring		Summer		Fall		Annual	
Direction	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**	**Mi.**	**Km**
S	1.84	2.96	0.96	1.55	0.87	1.39	1.50	2.42	1.62	2.61
SSW	1.80	2.89	0.95	1.53	0.46	0.74	1.11	1.79	1.47	2.36
SW	1.73	2.78	1.36	2.19	0.68	1.10	1.06	1.71	1.39	2.23
WSW	1.72	2.77	1.11	1.78	1.14	1.83	1.12	1.80	1.35	2.17
W	1.73	2.78	1.65	2.65	0.89	1.43	1.26	2.02	1.51	2.43
WNW	1.52	2.44	1.43	2.29	0.93	1.50	1.49	2.40	1.45	2.33
NW	1.18	1.89	1.14	1.84	0.77	1.24	1.41	2.26	1.19	1.91
NNW	1.24	1.99	1.02	1.64	0.57	0.91	1.10	1.78	1.11	1.79
N	1.52	2.45	1.04	1.67	0.73	1.18	1.16	1.86	1.25	2.00
NNE	1.45	2.33	1.38	2.23	0.36	0.58	1.34	2.16	1.30	2.09
NE	1.43	2.30	1.70	2.74	0.78	1.25	1.57	2.52	1.45	2.34
ENE	1.38	2.23	1.52	2.45	0.30	0.49	1.29	2.07	1.27	2.04
E	1.95	3.14	1.38	2.21	0.83	1.33	1.38	2.22	1.55	2.49
ESE	1.68	2.71	1.55	2.49	0.79	1.28	1.58	2.55	1.51	2.43
SE	1.91	3.08	1.53	2.47	0.52	0.84	1.73	2.78	1.71	2.76
SSE	2.06	3.31	1.57	2.52	1.07	1.72	1.64	2.64	1.85	2.98
All	1.70	2.73	1.33	2.14	0.81	1.30	1.36	2.19	1.47	2.36

Note: Plume moving in the indicated direction.

Source: Reference 2.3-251.

Table 2.3-287 (Sheet 1 of 2)
Annual Plume Length Frequency During NDCT Operation

Distance from Tower (m)	Values in percent																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
100.	8.17	7.12	7.75	6.42	5.79	9.13	6.46	5.55	10.96	5.66	3.38	3.71	6.63	4.17	4.05	5.06	100.00
200.	8.17	7.12	7.75	6.42	5.79	9.13	6.46	5.55	10.96	5.66	3.38	3.71	6.63	4.17	4.05	5.06	100.00
300.	7.24	6.40	7.10	5.81	5.24	8.53	5.94	5.03	9.17	4.77	2.71	2.72	4.85	3.59	3.60	4.47	87.19
400.	5.75	5.31	5.86	4.76	4.29	7.38	4.88	3.77	6.10	3.15	1.98	1.87	3.32	2.72	2.73	3.57	67.44
500.	4.69	4.43	4.97	4.00	3.57	6.30	3.87	2.95	4.35	2.13	1.46	1.32	2.50	2.17	2.17	2.92	53.80
600.	4.17	4.00	4.42	3.63	3.21	5.84	3.55	2.52	3.75	1.76	1.21	1.12	2.18	2.00	1.93	2.54	47.85
700.	3.92	3.78	4.24	3.46	3.04	5.65	3.38	2.34	3.46	1.57	1.09	1.00	2.07	1.92	1.82	2.44	45.19
800.	3.92	3.78	4.24	3.46	3.04	5.65	3.38	2.34	3.46	1.57	1.09	1.00	2.07	1.92	1.82	2.44	45.19
900.	3.73	3.50	3.94	3.25	2.90	5.40	3.15	2.15	3.18	1.39	0.98	0.89	1.91	1.81	1.69	2.35	42.24
1000.	3.73	3.50	3.94	3.25	2.90	5.40	3.15	2.15	3.18	1.39	0.98	0.89	1.91	1.81	1.69	2.35	42.24
1100.	3.73	3.50	3.94	3.25	2.90	5.40	3.15	2.15	3.18	1.39	0.98	0.89	1.91	1.81	1.69	2.35	42.24
1200.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1300.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1400.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1500.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1600.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1700.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1800.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
1900.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
2000.	3.49	3.27	3.64	2.98	2.66	5.14	2.95	1.95	2.91	1.25	0.91	0.83	1.81	1.69	1.61	2.25	39.36
2100.	3.21	3.00	3.42	2.83	2.50	4.69	2.70	1.80	2.72	1.19	0.85	0.76	1.68	1.57	1.51	2.17	36.60
2200.	2.93	2.77	3.15	2.60	2.32	4.34	2.43	1.74	2.52	1.11	0.78	0.71	1.61	1.43	1.39	2.04	33.89
2300.	2.63	2.61	2.83	2.38	2.19	3.83	2.15	1.58	2.29	1.02	0.73	0.63	1.45	1.25	1.28	1.88	30.73
2400.	2.46	2.37	2.51	2.16	2.02	3.48	1.91	1.38	2.10	0.92	0.68	0.57	1.28	1.13	1.16	1.73	27.86
2500.	1.94	1.69	1.63	1.40	1.35	2.53	1.12	0.84	1.29	0.60	0.47	0.43	0.93	0.86	0.75	1.42	19.26
2600.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
2700.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
2800.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
2900.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3000.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3100.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3200.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3300.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52

Table 2.3-287 (Sheet 2 of 2)
Annual Plume Length Frequency During NDCT Operation

Distance from Tower (m)	Values in percent																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
3400.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3500.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3600.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3700.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3800.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
3900.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
4000.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
4100.	1.26	1.02	0.79	0.64	0.75	1.44	0.52	0.27	0.57	0.27	0.28	0.21	0.57	0.46	0.50	0.99	10.52
4200.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4300.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4400.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4500.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4600.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4700.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4800.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
4900.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70
5000.	1.02	0.74	0.51	0.43	0.54	1.03	0.33	0.18	0.41	0.20	0.19	0.14	0.44	0.33	0.39	0.82	7.70

Note: Plume moving in the indicated direction.

Source: Reference 2.3-251.

Table 2.3-288 (Sheet 1 of 2)
Annual Plume Length Frequency During MDCT Operation

Distance from Tower (m)	Values in percent																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
100.	8.17	7.12	7.75	6.42	5.79	9.13	6.46	5.55	10.96	5.66	3.38	3.71	6.63	4.16	4.05	5.06	100.00
200.	4.73	4.38	5.70	4.21	4.23	6.34	4.50	2.97	4.66	2.00	1.64	1.25	2.98	2.18	2.49	2.77	57.03
300.	3.76	3.53	4.16	3.34	3.07	5.40	3.38	2.11	3.12	1.38	1.02	0.85	1.98	1.74	1.82	2.35	42.99
400.	3.14	2.66	3.06	2.46	2.16	4.60	2.51	1.29	2.28	0.86	0.75	0.65	1.48	1.46	1.44	1.87	32.66
500.	2.62	2.20	2.23	1.74	1.53	3.67	1.81	0.98	1.47	0.66	0.56	0.51	1.14	1.17	1.05	1.69	25.03
600.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
700.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
800.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
900.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1000.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1100.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1200.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1300.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1400.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1500.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1600.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1700.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1800.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
1900.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2000.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2100.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2200.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2300.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2400.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2500.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2600.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2700.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2800.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
2900.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
3000.	2.46	1.96	1.88	1.49	1.39	3.30	1.54	0.78	1.27	0.57	0.51	0.45	1.01	1.05	0.92	1.54	22.11
3100.	2.46	1.96	1.88	1.26	1.39	2.98	1.54	0.78	1.27	0.57	0.51	0.39	1.01	0.91	0.92	1.54	21.36
3200.	2.16	1.57	1.58	1.06	1.21	2.50	1.25	0.53	1.06	0.40	0.43	0.32	0.91	0.73	0.80	1.26	17.76
3300.	1.57	1.26	1.08	0.68	1.07	1.53	0.74	0.40	0.69	0.33	0.33	0.19	0.75	0.47	0.58	1.16	12.83
3400.	1.00	0.95	0.79	0.43	0.91	1.01	0.55	0.30	0.40	0.27	0.23	0.14	0.63	0.32	0.48	1.00	9.42

Table 2.3-288 (Sheet 2 of 2)
Annual Plume Length Frequency During MDCT Operation

Distance from Tower (m)	Values in percent																
	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	SUM
3500.	1.00	0.72	0.51	0.43	0.70	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.50	0.32	0.39	0.82	7.85
3600.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
3700.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
3800.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
3900.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4000.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4100.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4200.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4300.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4400.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4500.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4600.	1.00	0.72	0.51	0.43	0.54	1.01	0.32	0.18	0.40	0.20	0.19	0.14	0.44	0.32	0.39	0.82	7.62
4700.	1.00	0.72	0.51	0.22	0.54	0.59	0.32	0.18	0.40	0.20	0.19	0.08	0.44	0.22	0.39	0.82	6.83
4800.	0.71	0.40	0.32	0.22	0.54	0.59	0.15	0.08	0.25	0.12	0.12	0.08	0.44	0.22	0.31	0.57	5.13
4900.	0.71	0.40	0.32	0.22	0.34	0.59	0.15	0.08	0.25	0.12	0.12	0.08	0.30	0.22	0.31	0.57	4.79
5000.	0.71	0.40	0.32	0.22	0.34	0.59	0.15	0.08	0.25	0.12	0.12	0.08	0.30	0.22	0.31	0.57	4.79

Note: Plume moving in the indicated direction.

Source: Reference 2.3-251.

Table 2.3-289
RBS On-Site Meteorological Tower Sensor Characteristics

Parameter	Teledyne Geotech Model Number	Sensor Characteristics
Wind Speed	52.1 (cup assembly) 50.1 (transmitter)	Threshold Speed--0.75 mph (transmitter) Accuracy--±1% or 0.15 mph (whichever is greater) Range--0 to 50 mph
Wind Direction	53.2 (vane assembly) 50.2 (transmitter)	Threshold Speed--0.93 mph at 10 degrees (transmitter) Accuracy--±2 degrees Range--0 to 540 degrees
Temperature	104 MB	Accuracy--0.2°F Range--0°F to 120°F
Temperature Difference	104 MB	Accuracy--±0.2°F Range--±12°F
Dew Point	N/A	Accuracy--N/A Range--N/A
Precipitation	N/A	Accuracy--N/A

Source: Reference 2.3-261.

Table 2.3-290
Data Recovery Percentages for the RBS On-Site Meteorological Tower Instruments for the Period December 2004 through December 2006

Recorded Parameter	Recovery Percentages
Wind Speed	
30-ft.	94.6%
150-ft.	94.6%
Wind Direction	
30-ft.	94.5%
150-ft.	94.5%
Temperature	
30-ft.	94.8%
30-ft. to 150-ft. Difference (ΔT)	94.8%
Dew Point	
30-ft.	N/A
150-ft.	N/A
Precipitation	N/A

Table 2.3-291
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class A

Wind Speed (m/sec)

DIR	0.22-0.50	0.51-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	1	0	3	7	23	117	136	0	0	0	0	0	287
NNE	1	4	1	16	54	213	67	0	0	0	0	0	356
NE	0	1	2	15	93	215	16	0	0	0	0	0	342
ENE	2	1	6	16	86	169	9	0	1	0	0	1	291
E	0	0	1	19	70	62	1	0	0	1	0	0	154
ESE	0	5	4	21	116	170	12	0	0	0	0	0	328
SE	1	3	9	19	118	438	77	0	0	0	0	1	666
SSE	0	3	3	6	37	173	120	7	0	0	0	1	350
S	0	0	3	10	26	108	161	13	1	0	0	0	322
SSW	0	0	5	9	14	58	33	3	0	0	0	0	122
SW	1	1	1	10	20	34	14	0	1	0	0	0	82
WSW	0	2	1	3	25	79	6	0	0	0	0	0	116
W	0	0	2	8	17	54	12	0	0	0	0	0	93
WNW	0	0	4	6	8	29	30	1	0	0	0	0	78
NW	1	0	2	6	8	27	56	4	0	0	0	0	104
NNW	0	0	0	5	14	40	72	9	0	0	0	0	140
TOTAL	7	20	47	176	729	1986	822	37	3	1	0	3	3831

Notes:
1. Number of Hours of Calms = 3
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-292
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class B

	Wind Speed (m/sec)												
DIR	0.22-0.50	0.51-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	0	0	3	11	32	155	144	2	0	0	0	0	347
NNE	0	0	1	24	75	123	18	0	0	0	0	0	241
NE	0	2	4	30	110	78	3	1	0	0	0	0	228
ENE	0	0	4	21	59	30	1	0	0	0	0	0	115
E	0	1	2	36	49	15	0	0	0	0	0	0	103
ESE	0	2	7	39	70	39	5	0	0	0	0	0	162
SE	0	1	5	33	115	190	24	0	0	0	0	0	368
SSE	0	0	1	15	49	117	129	8	0	0	0	0	319
S	0	1	1	7	34	113	159	12	0	0	0	0	327
SSW	1	1	2	12	22	64	37	6	0	0	0	0	145
SW	2	1	1	12	30	67	13	0	0	0	0	0	126
WSW	0	0	3	12	63	104	10	0	0	0	0	0	192
W	0	0	1	13	50	119	5	0	0	0	0	0	188
WNW	0	0	2	7	30	90	29	1	0	0	0	0	159
NW	1	1	3	9	20	66	99	5	0	0	0	0	204
NNW	2	0	0	6	19	103	158	4	0	0	0	0	292
TOTAL	6	10	40	287	827	1473	834	39	0	0	0	0	3516

Notes:
1. Number of Hours of Calms = 1
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-293
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class C

	Wind Speed (m/sec)												
DIR	**0.22-0.50**	**0.51-0.75**	**0.76-1.0**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**>18**	**TOTAL**
N	0	0	2	8	37	100	64	0	0	0	0	1	212
NNE	0	1	1	22	71	72	10	1	0	0	0	0	178
NE	0	3	5	27	72	48	0	0	0	0	0	0	155
ENE	0	2	2	27	32	15	0	0	0	0	0	0	78
E	1	0	1	27	24	6	0	0	0	0	0	0	59
ESE	0	2	2	27	37	12	3	0	0	0	0	0	83
SE	0	0	5	26	87	83	9	0	0	0	0	0	210
SSE	0	1	1	5	26	72	81	2	0	0	0	0	188
S	1	0	3	10	23	73	125	13	0	0	0	0	248
SSW	0	0	2	8	14	37	49	1	1	0	0	0	112
SW	1	1	3	5	24	32	14	1	0	0	0	0	81
WSW	0	1	2	16	34	40	14	0	0	0	0	0	107
W	0	3	0	16	42	70	6	0	0	0	0	0	137
WNW	0	1	3	13	29	47	22	2	0	0	0	0	117
NW	2	1	0	11	16	67	46	3	0	0	0	0	146
NNW	1	0	6	9	18	71	79	4	0	0	0	0	188
TOTAL	6	16	38	257	586	845	522	27	1	0	0	1	2299

Notes:
1. Number of Hours of Calms = 0
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-294
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class D

	Wind Speed (m/sec)												
DIR	0.22-0.50	0.51-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
N	1	19	57	272	521	995	532	7	0	0	0	13	2417
NNE	1	17	52	320	509	457	59	1	0	0	0	3	1419
NE	4	27	88	251	363	270	23	0	0	0	0	0	1026
ENE	4	31	72	246	157	122	47	0	0	0	0	0	679
E	8	31	85	258	131	40	3	0	0	0	0	0	556
ESE	4	42	106	345	225	147	23	0	0	1	1	0	894
SE	3	27	113	506	708	656	122	5	0	0	0	0	2140
SSE	1	13	40	206	322	807	615	69	9	0	0	0	2082
S	3	7	38	175	287	850	602	51	2	0	0	0	2015
SSW	4	17	43	191	290	421	289	12	0	0	0	0	1267
SW	4	13	39	190	244	216	64	1	0	0	0	0	771
WSW	1	17	54	194	251	249	33	0	0	0	0	0	799
W	2	24	46	242	285	293	30	2	0	0	0	0	924
WNW	3	22	62	211	233	311	167	10	0	0	0	0	1019
NW	2	14	37	183	248	447	339	27	1	0	0	1	1299
NNW	4	11	48	170	298	730	596	22	1	0	0	1	1881
TOTAL	49	332	980	3960	5072	7011	3544	207	13	1	1	18	21,188

Notes:
1. Number of Hours of Calms = 5
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-295
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class E

	Wind Speed (m/sec)												
DIR	**0.22-0.50**	**0.51-0.75**	**0.76-1.0**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**>18**	**TOTAL**
N	28	103	160	478	408	305	77	1	1	0	0	0	1561
NNE	27	103	171	581	477	233	20	0	0	0	0	0	1612
NE	31	97	198	391	336	254	14	0	0	0	0	0	1321
ENE	30	141	199	301	126	86	29	0	0	0	0	0	912
E	45	159	219	243	119	27	3	1	0	0	0	0	816
ESE	40	220	356	372	169	133	16	0	0	0	0	0	1306
SE	40	162	410	1042	832	521	56	1	0	0	0	0	3064
SSE	19	101	176	531	447	482	193	26	0	0	0	0	1975
S	16	77	135	450	533	519	195	26	1	0	0	0	1952
SSW	17	72	166	400	248	189	109	8	0	0	0	0	1209
SW	19	88	156	205	79	59	26	1	0	0	0	0	633
WSW	19	98	147	127	65	73	9	0	0	0	0	0	538
W	23	102	110	136	74	82	14	0	0	0	0	0	541
WNW	31	113	143	204	107	73	18	1	0	0	0	0	690
NW	22	79	108	197	104	136	62	2	1	0	0	0	711
NNW	30	65	114	250	243	214	51	1	1	0	0	0	969
TOTAL	437	1780	2968	5908	4367	3386	892	68	4	0	0	0	19,810

Notes:
1. Number of Hours of Calms = 42
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-296
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class F

	Wind Speed (m/sec)												
DIR	**0.22-0.50**	**0.51-0.75**	**0.76-1.0**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**>18**	**TOTAL**
N	99	125	180	371	59	11	1	0	0	0	0	0	846
NNE	81	112	137	393	47	9	0	0	0	0	0	0	779
NE	80	117	80	164	65	19	0	0	0	0	0	0	525
ENE	82	138	113	121	41	9	0	0	0	0	0	0	504
E	67	176	109	48	8	1	0	0	0	0	0	0	409
ESE	45	185	171	87	25	1	0	0	0	0	0	0	514
SE	50	140	165	268	93	23	0	0	0	0	0	0	739
SSE	31	74	100	182	85	64	5	0	0	0	0	0	541
S	20	66	67	97	60	119	42	1	0	0	0	0	472
SSW	29	55	59	74	32	81	34	0	0	0	0	0	364
SW	25	63	74	53	34	32	2	0	0	0	0	0	283
WSW	28	89	75	28	35	29	2	0	0	0	0	0	286
W	45	139	78	40	24	32	0	0	0	0	0	0	358
WNW	65	186	127	66	22	13	0	0	0	0	0	0	479
NW	105	190	130	107	23	7	0	0	0	0	0	0	562
NNW	99	125	98	161	43	20	3	0	0	0	0	0	549
TOTAL	951	1980	1763	2260	696	470	89	1	0	0	0	0	8210

Notes:
1. Number of Hours of Calms = 89
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-297
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - Stability Class G

DIR	0.22-0.50	0.51-0.75	0.76-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-5.0	5.1-7.0	7.1-10.0	10.1-13.0	13.1-18.0	>18	TOTAL
	Wind Speed (m/sec)												
N	324	355	146	189	13	1	0	0	0	0	0	0	1028
NNE	357	255	88	44	2	3	0	0	0	0	0	0	749
NE	378	340	66	29	7	5	0	0	0	0	0	0	825
ENE	241	481	170	34	2	0	0	0	0	0	0	0	928
E	106	168	115	25	0	0	0	0	0	0	0	0	414
ESE	37	88	50	19	2	2	0	0	0	0	0	0	198
SE	30	35	56	62	7	3	1	0	0	0	0	0	194
SSE	20	39	30	41	15	5	3	0	0	0	0	0	153
S	13	31	21	13	12	26	4	1	0	0	0	0	121
SSW	13	36	19	12	15	18	1	0	0	0	0	0	114
SW	15	38	14	13	6	9	0	0	0	0	0	0	95
WSW	37	50	26	14	8	0	1	0	0	0	0	0	136
W	45	134	43	8	3	0	0	0	0	0	0	0	233
WNW	96	286	103	26	4	2	0	0	0	0	0	0	517
NW	191	577	244	39	5	1	0	0	0	1	0	0	1058
NNW	227	444	227	112	12	3	0	0	0	0	0	0	1025
TOTAL	2130	3357	1418	680	113	78	10	1	0	1	0	0	7788

Notes:
1. Number of Hours of Calms = 147
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-298
Joint Frequency Distribution in Hours of Wind Speed and Direction by Atmospheric Stability Class - All Stability Classes

	Wind Speed (m/sec)												
DIR	**0.22-0.50**	**0.51-0.75**	**0.76-1.0**	**1.1-1.5**	**1.6-2.0**	**2.1-3.0**	**3.1-5.0**	**5.1-7.0**	**7.1-10.0**	**10.1-13.0**	**13.1-18.0**	**>18**	**TOTAL**
N	453	602	551	1336	1093	1684	954	10	1	0	0	14	6698
NNE	467	492	451	1400	1235	1110	174	2	0	0	0	3	5334
NE	493	587	443	907	1046	889	56	1	0	0	0	0	4422
ENE	359	794	566	766	503	431	86	0	1	0	0	1	3507
E	227	535	532	656	401	151	7	1	0	1	0	0	2511
ESE	126	544	696	910	644	504	59	0	0	1	1	0	3485
SE	124	368	763	1956	1960	1914	289	6	0	0	0	1	7381
SSE	71	231	351	986	981	1720	1146	112	9	0	0	1	5608
S	53	182	268	762	975	1808	1288	117	4	0	0	0	5457
SSW	64	181	296	706	635	868	552	30	1	0	0	0	3333
SW	67	205	288	488	437	449	133	3	1	0	0	0	2071
WSW	85	257	308	394	481	574	75	0	0	0	0	0	2174
W	115	402	280	463	495	650	67	2	0	0	0	0	2474
WNW	195	608	444	533	433	565	266	15	0	0	0	0	3059
NW	324	862	524	552	424	751	602	41	2	1	0	1	4084
NNW	363	645	493	713	647	1181	959	40	2	0	0	1	5044
TOTAL	3586	7495	7254	13528	12390	15249	6713	380	21	3	1	22	66,642

Notes:
1. Number of Hours of Calms = 287
2. Data from 30-ft. sensor.
3. Data from 2000 - 2007.

Table 2.3-299
RBS Unit 3 Off-Site Short-Term Atmospheric Dispersion Factors

	Exclusion Area Boundary χ/Q (sec/m^3)		
	Direction Dependent χ/Q		Direction Independent χ/Q
Time Period	**0.5% Max Sector χ/Q**	**Sector/Distance**	**5% Overall Site Limit**
0-2 hr.	8.12E-04	SW/720.5 m	6.80E-04

	Low Population Zone χ/Q (sec/m^3)		
	Direction Dependent χ/Q		Direction Independent χ/Q
Time Period	**0.5% Max Sector χ/Q**	**Sector/Distance**	**5% Overall Site Limit**
0-8 hr.	8.23E-05	S & SW/3786 m	7.15E-05
8-24 hr.	5.76E-05	S/3786 m	5.08E-05
1-4 days	2.66E-05	S/3786 m	2.41E-05
4-30 days	8.75E-06	S/3786 m	8.30E-06

Table 2.3-300 (Sheet 1 of 2)
ARCON96 Release-Receptor Combination Inputs

Release Location (Type)	Receptor Location	Release Height (m)	Building Area (m^2)	σ_{yo}/σ_{zo} (m)	Distance (m)	Direction (deg)	Intake Height (m)
Reactor Building (Diffuse)	Control Building Louvers	24.00	2000	7.83/7.96	10.0	84	1.0
Reactor Building (Diffuse)	Emergency Intake North	24.00	2000	7.83/7.96	30.0	66	8.0
Reactor Building (Diffuse)	Emergency Intake South	24.00	2000	7.83/7.96	30.0	102	8.0
Reactor Building (Diffuse)	Normal Air Intake	24.00	2000	7.83/7.96	30.0	112	8.0
Reactor Building (Diffuse)	TSC	24.00	2000	7.83/7.96	80.0	53	22.0
Turbine Building (Diffuse)	Control Building Louvers	24.50	2000	18.60/8.1	30.0	174	1.0
Turbine Building (Diffuse)	Emergency Intake North	24.50	2000	18.60/8.1	30.0	134	8.0
Turbine Building (Diffuse)	Emergency Intake South	24.50	2000	18.60/8.1	50.0	140	8.0
Turbine Building (Diffuse)	Normal Air Intake	24.50	2000	18.60/8.1	50.0	147	8.0
Turbine Building (Diffuse)	TSC	24.50	2000	13.00/8.17	20.0	84	22.0
PCCS (Point)	Control Building Louvers	48.05	0.01	0/0	32.5	122	1.0
PCCS (Point)	Emergency Intake North	48.05	0.01	0/0	40.0	102	8.0
PCCS (Point)	Emergency Intake South	48.05	0.01	0/0	50.0	124	8.0
PCCS (Point)	Normal Air Intake	48.05	0.01	0/0	50.0	130	8.0
PCCS (Point)	TSC	48.05[a]	0.01	0/0	80.0	53	22.0
Fuel Building Cask Door (Point)	Normal Air Intake	5.00	0.01	0/0	70.0	70	8.0
Fuel Building (Diffuse)	Normal Air Intake	11.25	472.5	3.50/3.75	30.0	67	8.0
Radwaste Building (Point)	Normal Air Intake	8.00	0.01	0/0	70.0	114	8.0
Proposed Unit 3 (Point)	Existing Unit 1	10.00	0.01	0/0	200.0	247	10.00
Existing Unit 1 Plant Stack (Point)	Control Building Louvers	58.8	2000	0/0	309.4	60	1.0
Existing Unit 1 Plant Stack (Point)	Emergency Intake North	58.8	2000	0/0	315.7	58	8.0

Table 2.3-300 (Sheet 2 of 2)
ARCON96 Release-Receptor Combination Inputs

Release Location (Type)	Receptor Location	Release Height (m)	Building Area (m^2)	σ_{yo}/σ_{zo} (m)	Distance (m)	Direction (deg)	Intake Height (m)
Existing Unit 1 Plant Stack (Point)	Emergency Intake South	58.8	2000	0/0	317.8	62	58.8
Existing Unit 1 Plant Stack (Point)	Normal Air Intake	58.8	2000	0/0	315.5	63	58.8
Existing Unit 1 Turbine Building (Point)	Control Building Louvers	27.3	2000	0/0	299	68	27.3
Existing Unit 1 Turbine Building (Point)	Emergency Intake North	27.3	2000	0/0	302.8	66	27.3
Existing Unit 1 Turbine Building (Point)	Emergency Intake South	27.3	2000	0/0	308.3	69	27.3
Existing Unit 1 Turbine Building (Point)	Normal Air Intake	27.3	2000	0/0	306.7	70	27.3

a) The release height for the PCCS/TSC evaluation was assumed to be 24.0 m (same elevation as the TSC air intake to minimize the "slant path").

Table 2.3-301
ARCON96 Input Parameters

Parameter	Value
Lower Instrument Height (m)	9.1
Upper Instrument Height (m)	45.7
Release Type (Point/Diffuse/Stack)	Table 2.3-300
Release Height (m)	Table 2.3-300
Diffuse Source Area (m^2)	Table 2.3-300
Vertical Velocity (m/s)	0.0
Stack Flow (m^3/s)	0.0
Stack Radius (m)	0.0
Direction – Receptor to Source	Table 2.3-300
Wind Direction Window (deg)	90.0
Distance to Receptor (m)	Table 2.3-300
Intake Height (m)	Table 2.3-300
Elevation Difference (m)	0.0
Surface Roughness Length (m)	0.2
Sector Averaging Constant	4.3
Initial Value of Sigma y	Table 2.3-300
Initial Value of Sigma z	Table 2.3-300

Table 2.3-302 (Sheet 1 of 2)
On-Site χ/Q Factors from ARCON96 Runs

Release Location (Type)	Receptor Location	0-2 hr χ/Q (sec/m^3)	2-8 hr χ/Q (sec/m^3)	8-24 hr χ/Q (sec/m^3)	1-4 days χ/Q (sec/m^3)	4-30 days χ/Q (sec/m^3)
Reactor Building (Diffuse)	Control Building Louvers	1.72E-03	1.11E-03	3.76E-04	3.55E-04	2.85E-04
Reactor Building (Diffuse)	Emergency Intake North	1.26E-03	8.38E-04	2.94E-04	2.68E-04	2.20E-04
Reactor Building (Diffuse)	Emergency Intake South	1.26E-03	9.51E-04	3.71E-04	3.21E-04	2.44E-04
Reactor Building (Diffuse)	Normal Air Intake	1.26E-03	9.80E-04	4.10E-04	3.55E-04	2.49E-04
Reactor Building (Diffuse)	TSC	4.61E-04	3.47E-04	1.41E-04	1.19E-04	9.37E-05
Turbine Building (Diffuse)	Control Building Louvers	8.59E-04	5.24E-04	2.44E-04	2.31E-04	1.84E-04
Turbine Building (Diffuse)	Emergency Intake North	9.60E-04	6.45E-04	2.85E-04	2.61E-04	1.90E-04
Turbine Building (Diffuse)	Emergency Intake South	6.08E-04	4.84E-04	2.26E-04	1.96E-04	1.41E-04
Turbine Building (Diffuse)	Normal Air Intake	6.06E-04	4.81E-04	2.28E-04	2.02E-04	1.47E-04
Turbine Building (Diffuse)	TSC	1.89E-03	1.01E-03	3.49E-04	3.50E-04	2.75E-04
PCCS (Point)	Control Building Louvers	2.42E-03	2.07E-03	8.86E-04	6.84E-04	4.74E-04
PCCS (Point)	Emergency Intake North	2.50E-03	2.08E-03	8.48E-04	6.79E-04	4.77E-04
PCCS (Point)	Emergency Intake South	1.96E-03	1.67E-03	7.25E-04	5.54E-04	3.91E-04
PCCS (Point)	Normal Air Intake	1.96E-03	1.68E-03	7.38E-04	5.63E-04	4.04E-04
PCCS (Point)	TSC	8.72E-04	6.16E-04	2.63E-04	2.15E-04	1.57E-04
Fuel Building Cask Door (Point)	Normal Air Intake	8.73E-04	5.26E-04	2.20E-04	1.88E-04	1.39E-04
Fuel Building (Diffuse)	Normal Air Intake	2.44E-03	1.62E-03	5.95E-04	5.27E-04	4.14E-04
Radwaste Building (Point)	Normal Air Intake	1.03E-03	8.00E-04	3.78E-04	2.66E-04	1.91E-04
Proposed Unit 3 (Point)	Existing Unit 1	1.40E-04	8.55E-05	3.94E-05	3.07E-05	2.48E-05
Existing Unit 1 Plant Stack (Point)	Control Building Louvers	9.14E-05	7.62E-05	2.83E-05	2.64E-05	2.19E-05
Existing Unit 1 Plant Stack (Point)	Emergency Intake North	9.02E-05	7.32E-05	2.76E-05	2.56E-05	2.11E-05

Table 2.3-302 (Sheet 2 of 2)
On-Site χ/Q Factors from ARCON96 Runs

Release Location (Type)	Receptor Location	0-2 hr χ/Q (sec/m^3)	2-8 hr χ/Q (sec/m^3)	8-24 hr χ/Q (sec/m^3)	1-4 days χ/Q (sec/m^3)	4-30 days χ/Q (sec/m^3)
Existing Unit 1 Plant Stack (Point)	Emergency Intake South	8.95E-05	7.18E-05	2.67E-05	2.52E-05	2.11E-05
Existing Unit 1 Plant Stack (Point)	Normal Air Intake	9.03E-05	7.25E-05	2.70E-05	2.54E-05	2.13E-05
Existing Unit 1 Turbine Building (Point)	Control Building Louvers	8.17E-05	5.84E-05	1.88E-05	1.72E-05	1.39E-05
Existing Unit 1 Turbine Building (Point)	Emergency Intake North	8.11E-05	5.84E-05	1.87E-05	1.78E-05	1.43E-05
Existing Unit 1 Turbine Building (Point)	Emergency Intake South	7.70E-05	5.59E-05	1.80E-05	1.64E-05	1.32E-05
Existing Unit 1 Turbine Building (Point)	Normal Air Intake	7.88E-05	5.58E-05	1.80E-05	1.65E-05	1.32E-05

Table 2.3-303
Cross-Unit χ/Q Factors

Release-Receptor Combination	Time Period	χ/Q with Safety Factor = 1.5 (sec/m^3)
Proposed Unit 3 (Point) to Existing Unit 1	0-2 hr.	2.10E-04
	2-8 hr.	1.28E-04
	8-24 hr.	5.91E-05
	1-4 days	4.61E-05
	4-30 days	3.72E-05

Table 2.3-304
Distances to Site Boundary

Downwind Sector	Distance to Site Boundary (m)
S	1737
SSW	3535
SW	3108
WSW	1554
W	1554
WNW	1798
NW	1219
NNW	1280
N	1219
NNE	1066
NE	1066
ENE	1127
E	1341
ESE	1158
SE	1524
SSE	1676

Table 2.3-305
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (0.25 to 4.5 mi.) for Ground-Level Release

	Distance (miles)										
Sector	**0.25**	**0.5**	**0.75**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
S	2.647E-04	7.675E-05	3.705E-05	1.775E-05	6.768E-06	3.596E-06	2.263E-06	1.575E-06	1.173E-06	9.160E-07	7.410E-07
SSW	2.418E-04	7.012E-05	3.384E-05	1.621E-05	6.184E-06	3.287E-06	2.068E-06	1.440E-06	1.073E-06	8.378E-07	6.779E-07
SW	2.376E-04	6.880E-05	3.314E-05	1.588E-05	6.066E-06	3.229E-06	2.034E-06	1.418E-06	1.057E-06	8.266E-07	6.693E-07
WSW	2.111E-04	6.113E-05	2.945E-05	1.412E-05	5.395E-06	2.873E-06	1.811E-06	1.263E-06	9.422E-07	7.368E-07	5.967E-07
W	1.291E-04	3.759E-05	1.822E-05	8.723E-06	3.317E-06	1.759E-06	1.104E-06	7.671E-07	5.703E-07	4.446E-07	3.592E-07
WNW	1.105E-04	3.230E-05	1.578E-05	7.538E-06	2.848E-06	1.500E-06	9.362E-07	6.472E-07	4.790E-07	3.719E-07	2.993E-07
NW	1.524E-04	4.463E-05	2.189E-05	1.044E-05	3.928E-06	2.060E-06	1.281E-06	8.827E-07	6.513E-07	5.044E-07	4.050E-07
NNW	9.643E-05	2.821E-05	1.382E-05	6.596E-06	2.482E-06	1.302E-06	8.098E-07	5.581E-07	4.119E-07	3.190E-07	2.562E-07
N	8.204E-05	2.401E-05	1.178E-05	5.618E-06	2.110E-06	1.105E-06	6.857E-07	4.719E-07	3.477E-07	2.690E-07	2.158E-07
NNE	6.705E-05	1.964E-05	9.630E-06	4.597E-06	1.730E-06	9.075E-07	5.644E-07	3.890E-07	2.870E-07	2.223E-07	1.785E-07
NE	5.421E-05	1.585E-05	7.748E-06	3.699E-06	1.394E-06	7.325E-07	4.562E-07	3.148E-07	2.326E-07	1.804E-07	1.450E-07
ENE	6.353E-05	1.850E-05	9.007E-06	4.303E-06	1.626E-06	8.567E-07	5.349E-07	3.700E-07	2.739E-07	2.128E-07	1.713E-07
E	8.447E-05	2.458E-05	1.193E-05	5.706E-06	2.162E-06	1.142E-06	7.146E-07	4.953E-07	3.673E-07	2.858E-07	2.304E-07
ESE	1.358E-04	3.946E-05	1.909E-05	9.144E-06	3.481E-06	1.847E-06	1.160E-06	8.067E-07	6.000E-07	4.681E-07	3.783E-07
SE	2.146E-04	6.215E-05	2.992E-05	1.435E-05	5.483E-06	2.920E-06	1.841E-06	1.284E-06	9.575E-07	7.487E-07	6.064E-07
SSE	2.186E-04	6.331E-05	3.051E-05	1.463E-05	5.583E-06	2.970E-06	1.871E-06	1.304E-06	9.714E-07	7.591E-07	6.145E-07

Table 2.3-306
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (5 to 50 mi.) for Ground-Level Release

	Distance (miles)										
Sector	**5.0**	**7.5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
S	6.159E-07	3.232E-07	2.132E-07	1.258E-07	8.703E-08	6.557E-08	5.212E-08	4.297E-08	3.638E-08	3.143E-08	2.759E-08
SSW	5.636E-07	2.958E-07	1.953E-07	1.153E-07	7.977E-08	6.012E-08	4.779E-08	3.941E-08	3.337E-08	2.883E-08	2.531E-08
SW	5.568E-07	2.932E-07	1.939E-07	1.149E-07	7.965E-08	6.013E-08	4.787E-08	3.952E-08	3.350E-08	2.897E-08	2.545E-08
WSW	4.966E-07	2.616E-07	1.732E-07	1.026E-07	7.118E-08	5.375E-08	4.279E-08	3.533E-08	2.995E-08	2.591E-08	2.276E-08
W	2.982E-07	1.557E-07	1.023E-07	6.003E-08	4.135E-08	3.105E-08	2.461E-08	2.025E-08	1.711E-08	1.475E-08	1.293E-08
WNW	2.477E-07	1.276E-07	8.303E-08	4.803E-08	3.274E-08	2.439E-08	1.920E-08	1.570E-08	1.320E-08	1.134E-08	9.895E-09
NW	3.344E-07	1.708E-07	1.104E-07	6.327E-08	4.285E-08	3.175E-08	2.489E-08	2.028E-08	1.699E-08	1.455E-08	1.266E-08
NNW	2.116E-07	1.081E-07	6.995E-08	4.012E-08	2.719E-08	2.016E-08	1.581E-08	1.289E-08	1.081E-08	9.255E-09	8.060E-09
N	1.780E-07	9.061E-08	5.846E-08	3.339E-08	2.256E-08	1.669E-08	1.307E-08	1.064E-08	8.904E-09	7.617E-09	6.627E-09
NNE	1.474E-07	7.528E-08	4.869E-08	2.791E-08	1.891E-08	1.401E-08	1.099E-08	8.953E-09	7.505E-09	6.426E-09	5.596E-09
NE	1.198E-07	6.145E-08	3.987E-08	2.296E-08	1.561E-08	1.160E-08	9.115E-09	7.443E-09	6.249E-09	5.359E-09	4.673E-09
ENE	1.418E-07	7.323E-08	4.775E-08	2.771E-08	1.894E-08	1.414E-08	1.115E-08	9.135E-09	7.691E-09	6.613E-09	5.779E-09
E	1.910E-07	9.908E-08	6.483E-08	3.781E-08	2.594E-08	1.942E-08	1.535E-08	1.260E-08	1.063E-08	9.152E-09	8.010E-09
ESE	3.142E-07	1.643E-07	1.082E-07	6.360E-08	4.388E-08	3.300E-08	2.618E-08	2.156E-08	1.823E-08	1.573E-08	1.380E-08
SE	5.046E-07	2.659E-07	1.760E-07	1.043E-07	7.235E-08	5.463E-08	4.350E-08	3.592E-08	3.045E-08	2.634E-08	2.314E-08
SSE	5.111E-07	2.688E-07	1.776E-07	1.051E-07	7.281E-08	5.494E-08	4.371E-08	3.607E-08	3.057E-08	2.643E-08	2.321E-08

Table 2.3-307
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (Segment Boundaries) for Ground-Level Release

	Segment Boundaries in Miles from the Site									
Sector	0.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	3.729E-05	7.799E-06	2.343E-06	1.190E-06	7.465E-07	3.394E-07	1.280E-07	6.591E-08	4.307E-08	3.148E-08
SSW	3.407E-05	7.125E-06	2.142E-06	1.088E-06	6.829E-07	3.106E-07	1.173E-07	6.043E-08	3.950E-08	2.887E-08
SW	3.339E-05	6.987E-06	2.106E-06	1.073E-06	6.742E-07	3.077E-07	1.168E-07	6.043E-08	3.961E-08	2.901E-08
WSW	2.967E-05	6.212E-06	1.875E-06	9.557E-07	6.011E-07	2.745E-07	1.043E-07	5.401E-08	3.542E-08	2.594E-08
W	1.830E-05	3.826E-06	1.144E-06	5.787E-07	3.619E-07	1.636E-07	6.112E-08	3.122E-08	2.030E-08	1.478E-08
WNW	1.579E-05	3.291E-06	9.709E-07	4.863E-07	3.017E-07	1.345E-07	4.901E-08	2.454E-08	1.575E-08	1.136E-08
NW	2.185E-05	4.545E-06	1.329E-06	6.615E-07	4.083E-07	1.803E-07	6.467E-08	3.196E-08	2.034E-08	1.457E-08
NNW	1.381E-05	2.872E-06	8.404E-07	4.183E-07	2.583E-07	1.141E-07	4.100E-08	2.029E-08	1.293E-08	9.272E-09
N	1.176E-05	2.443E-06	7.119E-07	3.532E-07	2.176E-07	9.575E-08	3.415E-08	1.681E-08	1.067E-08	7.632E-09
NNE	9.618E-06	2.001E-06	5.857E-07	2.915E-07	1.800E-07	7.949E-08	2.853E-08	1.411E-08	8.982E-09	6.438E-09
NE	7.748E-06	1.612E-06	4.733E-07	2.362E-07	1.461E-07	6.483E-08	2.345E-08	1.167E-08	7.466E-09	5.369E-09
ENE	9.026E-06	1.879E-06	5.547E-07	2.781E-07	1.727E-07	7.715E-08	2.826E-08	1.422E-08	9.161E-09	6.624E-09
E	1.198E-05	2.496E-06	7.408E-07	3.728E-07	2.322E-07	1.043E-07	3.854E-08	1.953E-08	1.264E-08	9.167E-09
ESE	1.920E-05	4.013E-06	1.202E-06	6.088E-07	3.812E-07	1.727E-07	6.474E-08	3.318E-08	2.161E-08	1.576E-08
SE	3.016E-05	6.314E-06	1.906E-06	9.712E-07	6.109E-07	2.790E-07	1.060E-07	5.490E-08	3.600E-08	2.637E-08
SSE	3.074E-05	6.431E-06	1.937E-06	9.854E-07	6.190E-07	2.821E-07	1.069E-07	5.521E-08	3.616E-08	2.646E-08

Table 2.3-308
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (0.25 to 4.5 mi.) for Ground-Level Release

	Distance in Miles from the Site										
Sector	**.250**	**.500**	**.750**	**1.000**	**1.500**	**2.000**	**2.500**	**3.000**	**3.500**	**4.000**	**4.500**
S	2.633E-04	7.591E-05	3.645E-05	1.737E-05	6.553E-06	3.445E-06	2.145E-06	1.478E-06	1.089E-06	8.422E-07	6.746E-07
SSW	2.403E-04	6.927E-05	3.324E-05	1.583E-05	5.967E-06	3.135E-06	1.950E-06	1.342E-06	9.886E-07	7.636E-07	6.111E-07
SW	2.361E-04	6.791E-05	3.251E-05	1.548E-05	5.839E-06	3.070E-06	1.910E-06	1.316E-06	9.693E-07	7.489E-07	5.994E-07
WSW	2.099E-04	6.045E-05	2.896E-05	1.381E-05	5.221E-06	2.751E-06	1.716E-06	1.185E-06	8.747E-07	6.771E-07	5.431E-07
W	1.284E-04	3.719E-05	1.794E-05	8.542E-06	3.215E-06	1.687E-06	1.049E-06	7.215E-07	5.312E-07	4.102E-07	3.283E-07
WNW	1.101E-04	3.206E-05	1.561E-05	7.426E-06	2.785E-06	1.456E-06	9.023E-07	6.194E-07	4.551E-07	3.510E-07	2.805E-07
NW	1.520E-04	4.438E-05	2.170E-05	1.032E-05	3.863E-06	2.015E-06	1.246E-06	8.540E-07	6.267E-07	4.828E-07	3.856E-07
NNW	9.617E-05	2.807E-05	1.371E-05	6.527E-06	2.443E-06	1.275E-06	7.889E-07	5.409E-07	3.971E-07	3.061E-07	2.446E-07
N	8.185E-05	2.390E-05	1.170E-05	5.566E-06	2.081E-06	1.084E-06	6.702E-07	4.591E-07	3.368E-07	2.594E-07	2.072E-07
NNE	6.684E-05	1.952E-05	9.544E-06	4.542E-06	1.699E-06	8.860E-07	5.478E-07	3.753E-07	2.754E-07	2.121E-07	1.693E-07
NE	5.401E-05	1.573E-05	7.664E-06	3.646E-06	1.364E-06	7.118E-07	4.403E-07	3.017E-07	2.214E-07	1.705E-07	1.362E-07
ENE	6.325E-05	1.834E-05	8.893E-06	4.230E-06	1.585E-06	8.282E-07	5.128E-07	3.518E-07	2.583E-07	1.991E-07	1.590E-07
E	8.410E-05	2.436E-05	1.178E-05	5.607E-06	2.106E-06	1.103E-06	6.844E-07	4.704E-07	3.459E-07	2.670E-07	2.135E-07
ESE	1.351E-04	3.909E-05	1.883E-05	8.974E-06	3.385E-06	1.779E-06	1.108E-06	7.636E-07	5.630E-07	4.354E-07	3.490E-07
SE	2.135E-04	6.152E-05	2.947E-05	1.406E-05	5.321E-06	2.807E-06	1.752E-06	1.211E-06	8.946E-07	6.932E-07	5.564E-07
SSE	2.174E-04	6.264E-05	3.003E-05	1.432E-05	5.411E-06	2.849E-06	1.776E-06	1.226E-06	9.045E-07	7.001E-07	5.614E-07

Table 2.3-309

Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (5 to 50 mi.) for Ground-Level Release

	Distance in Miles from the Site										
Sector	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	5.554E-07	2.782E-07	1.758E-07	9.599E-08	6.195E-08	4.381E-08	3.282E-08	2.558E-08	2.053E-08	1.683E-08	1.404E-08
SSW	5.026E-07	2.506E-07	1.577E-07	8.544E-08	5.476E-08	3.849E-08	2.867E-08	2.223E-08	1.775E-08	1.448E-08	1.203E-08
SW	4.931E-07	2.459E-07	1.547E-07	8.364E-08	5.350E-08	3.751E-08	2.788E-08	2.157E-08	1.717E-08	1.398E-08	1.158E-08
WSW	4.476E-07	2.252E-07	1.428E-07	7.826E-08	5.062E-08	3.584E-08	2.687E-08	2.094E-08	1.679E-08	1.375E-08	1.146E-08
W	2.700E-07	1.349E-07	8.508E-08	4.634E-08	2.986E-08	2.109E-08	1.578E-08	1.228E-08	9.839E-09	8.057E-09	6.712E-09
WNW	2.306E-07	1.150E-07	7.257E-08	3.967E-08	2.569E-08	1.823E-08	1.371E-08	1.073E-08	8.637E-09	7.110E-09	5.954E-09
NW	3.167E-07	1.578E-07	9.964E-08	5.467E-08	3.557E-08	2.538E-08	1.920E-08	1.511E-08	1.225E-08	1.015E-08	8.555E-09
NNW	2.010E-07	1.003E-07	6.344E-08	3.491E-08	2.277E-08	1.629E-08	1.234E-08	9.737E-09	7.906E-09	6.563E-09	5.544E-09
N	1.701E-07	8.480E-08	5.363E-08	2.952E-08	1.927E-08	1.380E-08	1.048E-08	8.277E-09	6.732E-09	5.597E-09	4.735E-09
NNE	1.390E-07	6.915E-08	4.362E-08	2.388E-08	1.551E-08	1.106E-08	8.353E-09	6.569E-09	5.319E-09	4.404E-09	3.710E-09
NE	1.118E-07	5.556E-08	3.500E-08	1.909E-08	1.236E-08	8.771E-09	6.600E-09	5.169E-09	4.168E-09	3.436E-09	2.883E-09
ENE	1.306E-07	6.496E-08	4.090E-08	2.226E-08	1.436E-08	1.016E-08	7.617E-09	5.945E-09	4.777E-09	3.925E-09	3.281E-09
E	1.756E-07	8.770E-08	5.538E-08	3.027E-08	1.958E-08	1.388E-08	1.042E-08	8.138E-09	6.541E-09	5.374E-09	4.492E-09
ESE	2.874E-07	1.444E-07	9.159E-08	5.031E-08	3.264E-08	2.318E-08	1.743E-08	1.362E-08	1.096E-08	9.002E-09	7.524E-09
SE	4.590E-07	2.318E-07	1.475E-07	8.141E-08	5.296E-08	3.768E-08	2.836E-08	2.219E-08	1.785E-08	1.468E-08	1.227E-08
SSE	4.626E-07	2.327E-07	1.476E-07	8.106E-08	5.255E-08	3.730E-08	2.802E-08	2.190E-08	1.760E-08	1.446E-08	1.208E-08

Table 2.3-310
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (Segment Boundaries) for Ground-Level Release

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	3.674E-05	7.575E-06	2.225E-06	1.106E-06	6.801E-07	2.943E-07	9.860E-08	4.425E-08	2.572E-08	1.689E-08
SSW	3.351E-05	6.900E-06	2.023E-06	1.004E-06	6.161E-07	2.653E-07	8.787E-08	3.890E-08	2.236E-08	1.454E-08
SW	3.281E-05	6.751E-06	1.982E-06	9.844E-07	6.043E-07	2.603E-07	8.602E-08	3.792E-08	2.170E-08	1.404E-08
WSW	2.923E-05	6.032E-06	1.780E-06	8.880E-07	5.474E-07	2.380E-07	8.031E-08	3.619E-08	2.105E-08	1.380E-08
W	1.804E-05	3.720E-06	1.088E-06	5.395E-07	3.310E-07	1.428E-07	4.762E-08	2.130E-08	1.235E-08	8.087E-09
WNW	1.563E-05	3.226E-06	9.369E-07	4.624E-07	2.829E-07	1.218E-07	4.077E-08	1.841E-08	1.078E-08	7.135E-09
NW	2.169E-05	4.477E-06	1.294E-06	6.368E-07	3.889E-07	1.673E-07	5.617E-08	2.562E-08	1.519E-08	1.018E-08
NNW	1.371E-05	2.832E-06	8.193E-07	4.035E-07	2.466E-07	1.063E-07	3.585E-08	1.644E-08	9.785E-09	6.583E-09
N	1.169E-05	2.413E-06	6.962E-07	3.422E-07	2.089E-07	8.992E-08	3.032E-08	1.393E-08	8.317E-09	5.614E-09
NNE	9.538E-06	1.969E-06	5.690E-07	2.798E-07	1.708E-07	7.334E-08	2.455E-08	1.116E-08	6.603E-09	4.418E-09
NE	7.671E-06	1.581E-06	4.573E-07	2.250E-07	1.373E-07	5.892E-08	1.963E-08	8.859E-09	5.197E-09	3.448E-09
ENE	8.921E-06	1.837E-06	5.325E-07	2.625E-07	1.604E-07	6.886E-08	2.289E-08	1.026E-08	5.978E-09	3.939E-09
E	1.183E-05	2.438E-06	7.104E-07	3.514E-07	2.153E-07	9.287E-08	3.110E-08	1.401E-08	8.181E-09	5.393E-09
ESE	1.895E-05	3.913E-06	1.149E-06	5.717E-07	3.518E-07	1.527E-07	5.163E-08	2.340E-08	1.369E-08	9.033E-09
SE	2.975E-05	6.146E-06	1.817E-06	9.082E-07	5.608E-07	2.448E-07	8.346E-08	3.802E-08	2.230E-08	1.473E-08
SSE	3.030E-05	6.252E-06	1.842E-06	9.184E-07	5.659E-07	2.460E-07	8.318E-08	3.765E-08	2.201E-08	1.451E-08

Table 2.3-311
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (0.25 to 4.5 mi.) for Ground-Level Release

	Distance in Miles from the Site										
Sector	**.250**	**.500**	**.750**	**1.000**	**1.500**	**2.000**	**2.500**	**3.000**	**3.500**	**4.000**	**4.500**
S	2.501E-04	6.987E-05	3.286E-05	1.544E-05	5.694E-06	2.941E-06	1.804E-06	1.228E-06	8.954E-07	6.857E-07	5.446E-07
SSW	2.285E-04	6.381E-05	3.001E-05	1.410E-05	5.198E-06	2.684E-06	1.647E-06	1.121E-06	8.170E-07	6.256E-07	4.968E-07
SW	2.245E-04	6.259E-05	2.937E-05	1.380E-05	5.095E-06	2.635E-06	1.618E-06	1.102E-06	8.041E-07	6.161E-07	4.895E-07
WSW	1.995E-04	5.565E-05	2.612E-05	1.228E-05	4.539E-06	2.350E-06	1.444E-06	9.847E-07	7.192E-07	5.515E-07	4.386E-07
W	1.220E-04	3.422E-05	1.617E-05	7.590E-06	2.792E-06	1.439E-06	8.809E-07	5.984E-07	4.357E-07	3.332E-07	2.643E-07
WNW	1.045E-04	2.944E-05	1.402E-05	6.570E-06	2.403E-06	1.231E-06	7.502E-07	5.075E-07	3.681E-07	2.806E-07	2.220E-07
NW	1.441E-04	4.069E-05	1.946E-05	9.110E-06	3.320E-06	1.695E-06	1.029E-06	6.944E-07	5.024E-07	3.822E-07	3.017E-07
NNW	9.120E-05	2.573E-05	1.229E-05	5.756E-06	2.098E-06	1.072E-06	6.510E-07	4.393E-07	3.179E-07	2.419E-07	1.910E-07
N	7.759E-05	2.190E-05	1.048E-05	4.905E-06	1.785E-06	9.097E-07	5.518E-07	3.718E-07	2.688E-07	2.043E-07	1.612E-07
NNE	6.340E-05	1.791E-05	8.560E-06	4.010E-06	1.462E-06	7.462E-07	4.532E-07	3.057E-07	2.212E-07	1.683E-07	1.328E-07
NE	5.125E-05	1.444E-05	6.883E-06	3.224E-06	1.177E-06	6.015E-07	3.657E-07	2.470E-07	1.789E-07	1.362E-07	1.076E-07
ENE	6.005E-05	1.685E-05	7.997E-06	3.748E-06	1.371E-06	7.024E-07	4.280E-07	2.896E-07	2.101E-07	1.601E-07	1.267E-07
E	7.984E-05	2.239E-05	1.059E-05	4.970E-06	1.822E-06	9.361E-07	5.716E-07	3.875E-07	2.816E-07	2.150E-07	1.703E-07
ESE	1.283E-04	3.594E-05	1.695E-05	7.961E-06	2.932E-06	1.513E-06	9.271E-07	6.305E-07	4.595E-07	3.517E-07	2.792E-07
SE	2.028E-04	5.659E-05	2.655E-05	1.249E-05	4.617E-06	2.390E-06	1.470E-06	1.002E-06	7.323E-07	5.617E-07	4.468E-07
SSE	2.065E-04	5.764E-05	2.707E-05	1.273E-05	4.699E-06	2.430E-06	1.492E-06	1.017E-06	7.421E-07	5.688E-07	4.521E-07

Table 2.3-312
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (5 to 50 mi.) for Ground-Level Release

	Distance in Miles from the Site										
Sector	**5.000**	**7.500**	**10.000**	**15.000**	**20.000**	**25.000**	**30.000**	**35.000**	**40.000**	**45.000**	**50.000**
S	4.449E-07	2.174E-07	1.346E-07	7.140E-08	4.510E-08	3.134E-08	2.314E-08	1.782E-08	1.415E-08	1.150E-08	9.533E-09
SSW	4.058E-07	1.980E-07	1.225E-07	6.478E-08	4.080E-08	2.828E-08	2.082E-08	1.599E-08	1.267E-08	1.028E-08	8.494E-09
SW	4.001E-07	1.956E-07	1.212E-07	6.418E-08	4.045E-08	2.804E-08	2.065E-08	1.586E-08	1.256E-08	1.019E-08	8.417E-09
WSW	3.587E-07	1.760E-07	1.094E-07	5.828E-08	3.694E-08	2.574E-08	1.904E-08	1.469E-08	1.169E-08	9.516E-09	7.895E-09
W	2.157E-07	1.049E-07	6.479E-08	3.423E-08	2.156E-08	1.496E-08	1.103E-08	8.486E-09	6.734E-09	5.473E-09	4.533E-09
WNW	1.807E-07	8.709E-08	5.345E-08	2.804E-08	1.760E-08	1.219E-08	8.985E-09	6.912E-09	5.487E-09	4.462E-09	3.699E-09
NW	2.452E-07	1.175E-07	7.181E-08	3.749E-08	2.348E-08	1.625E-08	1.197E-08	9.208E-09	7.313E-09	5.952E-09	4.938E-09
NNW	1.553E-07	7.446E-08	4.556E-08	2.382E-08	1.494E-08	1.035E-08	7.634E-09	5.880E-09	4.675E-09	3.808E-09	3.162E-09
N	1.309E-07	6.259E-08	3.822E-08	1.994E-08	1.249E-08	8.648E-09	6.376E-09	4.910E-09	3.904E-09	3.180E-09	2.641E-09
NNE	1.079E-07	5.169E-08	3.158E-08	1.648E-08	1.031E-08	7.130E-09	5.249E-09	4.036E-09	3.204E-09	2.606E-09	2.161E-09
NE	8.747E-08	4.199E-08	2.570E-08	1.343E-08	8.409E-09	5.814E-09	4.278E-09	3.288E-09	2.608E-09	2.120E-09	1.757E-09
ENE	1.031E-07	4.973E-08	3.053E-08	1.601E-08	1.004E-08	6.950E-09	5.116E-09	3.931E-09	3.117E-09	2.532E-09	2.097E-09
E	1.388E-07	6.725E-08	4.142E-08	2.183E-08	1.375E-08	9.540E-09	7.040E-09	5.420E-09	4.305E-09	3.503E-09	2.904E-09
ESE	2.280E-07	1.113E-07	6.892E-08	3.658E-08	2.315E-08	1.612E-08	1.193E-08	9.202E-09	7.323E-09	5.967E-09	4.954E-09
SE	3.655E-07	1.796E-07	1.118E-07	5.972E-08	3.795E-08	2.651E-08	1.966E-08	1.520E-08	1.212E-08	9.886E-09	8.217E-09
SSE	3.697E-07	1.812E-07	1.125E-07	5.989E-08	3.795E-08	2.645E-08	1.958E-08	1.511E-08	1.202E-08	9.797E-09	8.132E-09

Table 2.3-313
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (Segment Boundaries) for Ground-Level Release

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	3.334E-05	6.637E-06	1.877E-06	9.105E-07	5.495E-07	2.312E-07	7.376E-08	3.173E-08	1.794E-08	1.156E-08
SSW	3.045E-05	6.058E-06	1.713E-06	8.308E-07	5.012E-07	2.106E-07	6.694E-08	2.863E-08	1.610E-08	1.032E-08
SW	2.983E-05	5.936E-06	1.683E-06	8.176E-07	4.939E-07	2.080E-07	6.630E-08	2.840E-08	1.597E-08	1.023E-08
WSW	2.653E-05	5.286E-06	1.502E-06	7.312E-07	4.425E-07	1.870E-07	6.015E-08	2.605E-08	1.479E-08	9.559E-09
W	1.637E-05	3.257E-06	9.167E-07	4.432E-07	2.667E-07	1.117E-07	3.539E-08	1.515E-08	8.546E-09	5.498E-09
WNW	1.413E-05	2.808E-06	7.815E-07	3.746E-07	2.241E-07	9.294E-08	2.905E-08	1.235E-08	6.961E-09	4.483E-09
NW	1.958E-05	3.884E-06	1.073E-06	5.115E-07	3.046E-07	1.256E-07	3.889E-08	1.646E-08	9.275E-09	5.980E-09
NNW	1.237E-05	2.455E-06	6.785E-07	3.236E-07	1.929E-07	7.957E-08	2.471E-08	1.049E-08	5.922E-09	3.826E-09
N	1.054E-05	2.089E-06	5.752E-07	2.737E-07	1.627E-07	6.694E-08	2.069E-08	8.764E-09	4.945E-09	3.195E-09
NNE	8.615E-06	1.710E-06	4.723E-07	2.252E-07	1.341E-07	5.525E-08	1.709E-08	7.226E-09	4.065E-09	2.618E-09
NE	6.936E-06	1.376E-06	3.811E-07	1.821E-07	1.086E-07	4.485E-08	1.392E-08	5.892E-09	3.312E-09	2.130E-09
ENE	8.077E-06	1.602E-06	4.458E-07	2.138E-07	1.279E-07	5.306E-08	1.658E-08	7.042E-09	3.960E-09	2.544E-09
E	1.071E-05	2.128E-06	5.952E-07	2.865E-07	1.719E-07	7.167E-08	2.259E-08	9.662E-09	5.458E-09	3.519E-09
ESE	1.717E-05	3.419E-06	9.646E-07	4.673E-07	2.817E-07	1.184E-07	3.780E-08	1.631E-08	9.264E-09	5.993E-09
SE	2.698E-05	5.376E-06	1.528E-06	7.445E-07	4.508E-07	1.908E-07	6.161E-08	2.682E-08	1.530E-08	9.929E-09
SSE	2.749E-05	5.474E-06	1.552E-06	7.546E-07	4.562E-07	1.925E-07	6.182E-08	2.677E-08	1.521E-08	9.840E-09

Table 2.3-314
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance (miles)										
Sector	0.25	0.5	0.75	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
S	1.150E-06	5.353E-07	4.969E-07	4.408E-07	2.903E-07	2.059E-07	1.552E-07	1.226E-07	1.003E-07	8.441E-08	7.260E-08
SSW	7.856E-07	3.639E-07	3.343E-07	3.237E-07	2.327E-07	1.715E-07	1.318E-07	1.053E-07	8.675E-08	7.333E-08	6.327E-08
SW	7.184E-07	3.290E-07	2.808E-07	2.599E-07	1.845E-07	1.361E-07	1.051E-07	8.440E-08	6.998E-08	5.951E-08	5.164E-08
WSW	4.100E-07	1.792E-07	1.569E-07	1.616E-07	1.277E-07	9.989E-08	8.017E-08	6.627E-08	5.618E-08	4.864E-08	4.283E-08
W	2.007E-07	1.061E-07	1.059E-07	1.264E-07	1.096E-07	8.862E-08	7.194E-08	5.956E-08	5.033E-08	4.333E-08	3.788E-08
WNW	4.672E-07	2.129E-07	1.943E-07	2.125E-07	1.716E-07	1.332E-07	1.050E-07	8.495E-08	7.040E-08	5.956E-08	5.129E-08
NW	1.490E-06	6.376E-07	5.612E-07	5.404E-07	3.827E-07	2.766E-07	2.084E-07	1.632E-07	1.320E-07	1.095E-07	1.040E-07
NNW	1.580E-06	6.729E-07	5.635E-07	4.670E-07	3.195E-07	2.326E-07	1.663E-07	1.259E-07	1.060E-07	9.134E-08	7.583E-08
N	1.776E-06	7.368E-07	5.984E-07	4.790E-07	2.882E-07	1.931E-07	1.597E-07	1.348E-07	1.106E-07	9.309E-08	7.643E-08
NNE	8.296E-07	3.384E-07	2.610E-07	2.079E-07	1.775E-07	1.496E-07	1.084E-07	8.280E-08	7.035E-08	6.100E-08	5.378E-08
NE	3.212E-07	1.583E-07	1.505E-07	1.483E-07	1.082E-07	7.996E-08	7.315E-08	6.665E-08	5.295E-08	4.339E-08	3.642E-08
ENE	3.202E-07	1.704E-07	1.370E-07	1.131E-07	1.054E-07	9.550E-08	7.151E-08	5.593E-08	4.917E-08	4.403E-08	4.005E-08
E	3.192E-07	1.856E-07	1.753E-07	1.636E-07	1.166E-07	8.643E-08	6.675E-08	5.344E-08	4.407E-08	3.721E-08	3.203E-08
ESE	3.579E-07	1.920E-07	1.885E-07	1.812E-07	1.318E-07	9.936E-08	7.791E-08	6.324E-08	5.280E-08	4.509E-08	3.922E-08
SE	5.630E-07	2.673E-07	2.203E-07	1.744E-07	1.339E-07	1.108E-07	8.605E-08	6.991E-08	5.871E-08	5.055E-08	4.437E-08
SSE	9.013E-07	4.098E-07	3.324E-07	2.570E-07	1.667E-07	1.191E-07	9.053E-08	7.207E-08	5.942E-08	5.033E-08	4.354E-08

Table 2.3-315
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (5 to 50 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance (miles)										
Sector	**5.0**	**7.5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
S	6.356E-08	3.979E-08	2.923E-08	1.968E-08	1.478E-08	1.181E-08	9.806E-09	8.373E-09	7.297E-09	6.459E-09	5.789E-09
SSW	5.551E-08	3.493E-08	2.571E-08	1.735E-08	1.305E-08	1.043E-08	8.671E-09	7.410E-09	6.462E-09	5.724E-09	5.133E-09
SW	4.556E-08	2.936E-08	2.199E-08	1.520E-08	1.161E-08	9.392E-09	7.878E-09	6.780E-09	5.947E-09	5.294E-09	4.768E-09
WSW	3.825E-08	2.562E-08	1.958E-08	1.381E-08	1.066E-08	8.665E-09	7.292E-09	6.289E-09	5.524E-09	4.923E-09	4.437E-09
W	3.358E-08	2.167E-08	1.606E-08	1.082E-08	8.091E-09	6.423E-09	5.304E-09	4.505E-09	3.907E-09	3.443E-09	3.073E-09
WNW	4.485E-08	2.744E-08	1.959E-08	1.253E-08	9.042E-09	6.990E-09	5.653E-09	4.718E-09	4.032E-09	3.509E-09	3.097E-09
NW	9.888E-08	5.547E-08	3.768E-08	2.276E-08	1.586E-08	1.197E-08	9.504E-09	7.820E-09	6.604E-09	5.689E-09	4.978E-09
NNW	6.433E-08	3.577E-08	2.420E-08	1.456E-08	1.014E-08	7.645E-09	6.070E-09	4.994E-09	4.217E-09	3.633E-09	3.180E-09
N	6.425E-08	3.466E-08	2.305E-08	1.359E-08	9.347E-09	6.991E-09	5.515E-09	4.515E-09	3.797E-09	3.259E-09	2.844E-09
NNE	4.808E-08	2.643E-08	1.777E-08	1.062E-08	7.358E-09	5.532E-09	4.382E-09	3.599E-09	3.034E-09	2.611E-09	2.282E-09
NE	3.119E-08	1.787E-08	1.230E-08	7.554E-09	5.322E-09	4.048E-09	3.234E-09	2.674E-09	2.268E-09	1.961E-09	1.721E-09
ENE	3.691E-08	2.106E-08	1.450E-08	8.930E-09	6.315E-09	4.821E-09	3.864E-09	3.205E-09	2.725E-09	2.362E-09	2.078E-09
E	2.803E-08	1.732E-08	1.250E-08	8.160E-09	5.981E-09	4.682E-09	3.826E-09	3.222E-09	2.775E-09	2.431E-09	2.159E-09
ESE	3.464E-08	2.220E-08	1.645E-08	1.112E-08	8.342E-09	6.643E-09	5.501E-09	4.683E-09	4.069E-09	3.593E-09	3.212E-09
SE	3.955E-08	2.646E-08	2.026E-08	1.434E-08	1.108E-08	9.022E-09	7.599E-09	6.557E-09	5.762E-09	5.135E-09	4.629E-09
SSE	3.834E-08	2.460E-08	1.842E-08	1.276E-08	9.784E-09	7.933E-09	6.670E-09	5.751E-09	5.053E-09	4.505E-09	4.063E-09

Table 2.3-316
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (Segment Boundaries) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Segment Boundaries in Miles from the Site									
Sector	0.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.805E-07	2.862E-07	1.557E-07	1.006E-07	7.275E-08	4.038E-08	1.963E-08	1.180E-08	8.373E-09	6.459E-09
SSW	3.362E-07	2.257E-07	1.318E-07	8.693E-08	6.338E-08	3.541E-08	1.729E-08	1.042E-08	7.409E-09	5.724E-09
SW	2.822E-07	1.797E-07	1.051E-07	7.011E-08	5.172E-08	2.969E-08	1.511E-08	9.379E-09	6.776E-09	5.292E-09
WSW	1.639E-07	1.229E-07	7.987E-08	5.619E-08	4.285E-08	2.574E-08	1.369E-08	8.647E-09	6.284E-09	4.921E-09
W	1.151E-07	1.040E-07	7.143E-08	5.030E-08	3.790E-08	2.182E-08	1.077E-08	6.420E-09	4.505E-09	3.443E-09
WNW	2.065E-07	1.636E-07	1.045E-07	7.043E-08	5.136E-08	2.782E-08	1.255E-08	7.002E-09	4.724E-09	3.511E-09
NW	5.689E-07	3.706E-07	2.085E-07	1.323E-07	1.037E-07	5.721E-08	2.301E-08	1.202E-08	7.838E-09	5.697E-09
NNW	5.449E-07	3.137E-07	1.678E-07	1.061E-07	7.617E-08	3.697E-08	1.474E-08	7.679E-09	5.005E-09	3.638E-09
N	5.761E-07	2.883E-07	1.587E-07	1.108E-07	7.686E-08	3.608E-08	1.381E-08	7.029E-09	4.527E-09	3.265E-09
NNE	2.546E-07	1.719E-07	1.092E-07	7.034E-08	5.381E-08	2.740E-08	1.076E-08	5.559E-09	3.607E-09	2.615E-09
NE	1.513E-07	1.046E-07	7.237E-08	5.322E-08	3.655E-08	1.835E-08	7.617E-09	4.062E-09	2.679E-09	1.963E-09
ENE	1.338E-07	1.027E-07	7.167E-08	4.914E-08	4.007E-08	2.167E-08	9.005E-09	4.837E-09	3.211E-09	2.365E-09
E	1.724E-07	1.136E-07	6.667E-08	4.413E-08	3.208E-08	1.756E-08	8.157E-09	4.686E-09	3.224E-09	2.432E-09
ESE	1.861E-07	1.284E-07	7.776E-08	5.285E-08	3.927E-08	2.241E-08	1.107E-08	6.640E-09	4.683E-09	3.593E-09
SE	2.103E-07	1.326E-07	8.618E-08	5.880E-08	4.441E-08	2.661E-08	1.421E-08	9.003E-09	6.552E-09	5.133E-09
SSE	3.161E-07	1.656E-07	9.076E-08	5.957E-08	4.363E-08	2.491E-08	1.270E-08	7.922E-09	5.748E-09	4.504E-09

Table 2.3-317
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance in Miles from the Site										
Sector	**.250**	**.500**	**.750**	**1.000**	**1.500**	**2.000**	**2.500**	**3.000**	**3.500**	**4.000**	**4.500**
S	1.150E-06	5.348E-07	4.962E-07	4.400E-07	2.894E-07	2.050E-07	1.542E-07	1.216E-07	9.934E-08	8.343E-08	7.161E-08
SSW	7.852E-07	3.635E-07	3.338E-07	3.230E-07	2.319E-07	1.706E-07	1.309E-07	1.044E-07	8.587E-08	7.244E-08	6.236E-08
SW	7.180E-07	3.287E-07	2.803E-07	2.593E-07	1.838E-07	1.354E-07	1.043E-07	8.362E-08	6.918E-08	5.870E-08	5.081E-08
WSW	4.098E-07	1.790E-07	1.566E-07	1.612E-07	1.272E-07	9.927E-08	7.951E-08	6.556E-08	5.545E-08	4.789E-08	4.206E-08
W	2.005E-07	1.060E-07	1.057E-07	1.261E-07	1.091E-07	8.800E-08	7.127E-08	5.885E-08	4.961E-08	4.258E-08	3.713E-08
WNW	4.669E-07	2.127E-07	1.939E-07	2.119E-07	1.709E-07	1.324E-07	1.042E-07	8.410E-08	6.954E-08	5.872E-08	5.045E-08
NW	1.489E-06	6.369E-07	5.603E-07	5.393E-07	3.814E-07	2.753E-07	2.071E-07	1.620E-07	1.308E-07	1.083E-07	1.027E-07
NNW	1.579E-06	6.723E-07	5.628E-07	4.662E-07	3.186E-07	2.316E-07	1.654E-07	1.250E-07	1.051E-07	9.041E-08	7.493E-08
N	1.775E-06	7.361E-07	5.976E-07	4.781E-07	2.874E-07	1.923E-07	1.589E-07	1.339E-07	1.097E-07	9.217E-08	7.556E-08
NNE	8.291E-07	3.381E-07	2.607E-07	2.075E-07	1.769E-07	1.489E-07	1.078E-07	8.217E-08	6.968E-08	6.029E-08	5.304E-08
NE	3.211E-07	1.582E-07	1.502E-07	1.480E-07	1.078E-07	7.952E-08	7.260E-08	6.599E-08	5.232E-08	4.278E-08	3.583E-08
ENE	3.200E-07	1.702E-07	1.368E-07	1.129E-07	1.050E-07	9.495E-08	7.096E-08	5.538E-08	4.857E-08	4.338E-08	3.935E-08
E	3.190E-07	1.854E-07	1.751E-07	1.632E-07	1.162E-07	8.594E-08	6.624E-08	5.292E-08	4.354E-08	3.668E-08	3.150E-08
ESE	3.577E-07	1.918E-07	1.883E-07	1.808E-07	1.313E-07	9.879E-08	7.730E-08	6.260E-08	5.215E-08	4.443E-08	3.855E-08
SE	5.627E-07	2.670E-07	2.200E-07	1.741E-07	1.334E-07	1.102E-07	8.542E-08	6.925E-08	5.802E-08	4.983E-08	4.362E-08
SSE	9.009E-07	4.094E-07	3.320E-07	2.566E-07	1.662E-07	1.186E-07	8.999E-08	7.151E-08	5.884E-08	4.973E-08	4.293E-08

Table 2.3-318
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (5 to 50 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance in Miles from the Site										
Sector	**5.000**	**7.500**	**10.000**	**15.000**	**20.000**	**25.000**	**30.000**	**35.000**	**40.000**	**45.000**	**50.000**
S	6.256E-08	3.872E-08	2.809E-08	1.843E-08	1.349E-08	1.049E-08	8.490E-09	7.066E-09	6.005E-09	5.186E-09	4.537E-09
SSW	5.460E-08	3.396E-08	2.467E-08	1.620E-08	1.185E-08	9.213E-09	7.450E-09	6.194E-09	5.257E-09	4.535E-09	3.962E-09
SW	4.472E-08	2.843E-08	2.099E-08	1.408E-08	1.043E-08	8.181E-09	6.657E-09	5.561E-09	4.737E-09	4.097E-09	3.586E-09
WSW	3.746E-08	2.474E-08	1.864E-08	1.277E-08	9.574E-09	7.564E-09	6.190E-09	5.194E-09	4.441E-09	3.855E-09	3.385E-09
W	3.282E-08	2.087E-08	1.524E-08	9.973E-09	7.240E-09	5.586E-09	4.487E-09	3.709E-09	3.133E-09	2.691E-09	2.342E-09
WNW	4.401E-08	2.663E-08	1.879E-08	1.174E-08	8.279E-09	6.258E-09	4.950E-09	4.044E-09	3.384E-09	2.885E-09	2.496E-09
NW	9.738E-08	5.414E-08	3.643E-08	2.159E-08	1.477E-08	1.095E-08	8.541E-09	6.907E-09	5.735E-09	4.859E-09	4.184E-09
NNW	6.347E-08	3.499E-08	2.347E-08	1.389E-08	9.499E-09	7.044E-09	5.501E-09	4.453E-09	3.701E-09	3.139E-09	2.706E-09
N	6.342E-08	3.395E-08	2.240E-08	1.300E-08	8.797E-09	6.478E-09	5.033E-09	4.059E-09	3.363E-09	2.846E-09	2.448E-09
NNE	4.731E-08	2.575E-08	1.714E-08	1.003E-08	6.815E-09	5.025E-09	3.906E-09	3.148E-09	2.607E-09	2.204E-09	1.894E-09
NE	3.061E-08	1.734E-08	1.180E-08	7.077E-09	4.872E-09	3.624E-09	2.833E-09	2.293E-09	1.905E-09	1.614E-09	1.389E-09
ENE	3.615E-08	2.037E-08	1.383E-08	8.298E-09	5.715E-09	4.252E-09	3.324E-09	2.691E-09	2.234E-09	1.892E-09	1.627E-09
E	2.750E-08	1.679E-08	1.196E-08	7.605E-09	5.432E-09	4.147E-09	3.306E-09	2.718E-09	2.286E-09	1.957E-09	1.699E-09
ESE	3.396E-08	2.148E-08	1.570E-08	1.033E-08	7.544E-09	5.852E-09	4.723E-09	3.921E-09	3.325E-09	2.866E-09	2.503E-09
SE	3.878E-08	2.559E-08	1.932E-08	1.328E-08	9.985E-09	7.907E-09	6.483E-09	5.449E-09	4.667E-09	4.057E-09	3.568E-09
SSE	3.772E-08	2.390E-08	1.767E-08	1.191E-08	8.888E-09	7.017E-09	5.747E-09	4.830E-09	4.139E-09	3.600E-09	3.170E-09

Table 2.3-319
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (Segment Boundaries) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.798E-07	2.854E-07	1.547E-07	9.964E-08	7.176E-08	3.929E-08	1.838E-08	1.049E-08	7.069E-09	5.188E-09
SSW	3.356E-07	2.249E-07	1.309E-07	8.604E-08	6.247E-08	3.442E-08	1.615E-08	9.211E-09	6.196E-09	4.537E-09
SW	2.817E-07	1.791E-07	1.043E-07	6.931E-08	5.089E-08	2.874E-08	1.399E-08	8.172E-09	5.560E-09	4.097E-09
WSW	1.636E-07	1.223E-07	7.920E-08	5.546E-08	4.208E-08	2.486E-08	1.266E-08	7.550E-09	5.192E-09	3.855E-09
W	1.148E-07	1.035E-07	7.076E-08	4.957E-08	3.715E-08	2.103E-08	9.930E-09	5.587E-09	3.712E-09	2.693E-09
WNW	2.061E-07	1.629E-07	1.037E-07	6.958E-08	5.052E-08	2.701E-08	1.177E-08	6.274E-09	4.052E-09	2.889E-09
NW	5.680E-07	3.693E-07	2.073E-07	1.311E-07	1.024E-07	5.588E-08	2.186E-08	1.100E-08	6.927E-09	4.868E-09
NNW	5.442E-07	3.128E-07	1.669E-07	1.052E-07	7.527E-08	3.620E-08	1.407E-08	7.082E-09	4.466E-09	3.145E-09
N	5.753E-07	2.875E-07	1.578E-07	1.099E-07	7.599E-08	3.536E-08	1.322E-08	6.518E-09	4.072E-09	2.852E-09
NNE	2.543E-07	1.713E-07	1.085E-07	6.967E-08	5.307E-08	2.672E-08	1.018E-08	5.054E-09	3.159E-09	2.209E-09
NE	1.510E-07	1.042E-07	7.180E-08	5.259E-08	3.596E-08	1.783E-08	7.146E-09	3.640E-09	2.299E-09	1.617E-09
ENE	1.336E-07	1.023E-07	7.113E-08	4.854E-08	3.936E-08	2.097E-08	8.380E-09	4.271E-09	2.698E-09	1.895E-09
E	1.721E-07	1.132E-07	6.617E-08	4.361E-08	3.156E-08	1.702E-08	7.608E-09	4.153E-09	2.721E-09	1.959E-09
ESE	1.858E-07	1.279E-07	7.715E-08	5.219E-08	3.859E-08	2.169E-08	1.029E-08	5.852E-09	3.923E-09	2.868E-09
SE	2.100E-07	1.321E-07	8.556E-08	5.811E-08	4.367E-08	2.573E-08	1.316E-08	7.891E-09	5.446E-09	4.056E-09
SSE	3.157E-07	1.651E-07	9.022E-08	5.899E-08	4.302E-08	2.420E-08	1.185E-08	7.008E-09	4.829E-09	3.601E-09

Table 2.3-320
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance in Miles from the Site										
Sector	.250	.500	.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	1.100E-06	5.038E-07	4.734E-07	4.251E-07	2.805E-07	1.986E-07	1.493E-07	1.176E-07	9.608E-08	8.069E-08	6.927E-08
SSW	7.565E-07	3.450E-07	3.197E-07	3.141E-07	2.267E-07	1.670E-07	1.281E-07	1.021E-07	8.396E-08	7.084E-08	6.101E-08
SW	6.930E-07	3.126E-07	2.680E-07	2.516E-07	1.794E-07	1.324E-07	1.020E-07	8.180E-08	6.770E-08	5.747E-08	4.978E-08
WSW	3.983E-07	1.714E-07	1.507E-07	1.575E-07	1.251E-07	9.782E-08	7.842E-08	6.472E-08	5.478E-08	4.735E-08	4.164E-08
W	1.960E-07	1.026E-07	1.028E-07	1.243E-07	1.081E-07	8.731E-08	7.075E-08	5.846E-08	4.930E-08	4.235E-08	3.696E-08
WNW	4.542E-07	2.040E-07	1.871E-07	2.077E-07	1.686E-07	1.307E-07	1.029E-07	8.305E-08	6.867E-08	5.798E-08	4.983E-08
NW	1.434E-06	6.020E-07	5.345E-07	5.233E-07	3.724E-07	2.690E-07	2.023E-07	1.580E-07	1.275E-07	1.055E-07	1.003E-07
NNW	1.508E-06	6.296E-07	5.319E-07	4.467E-07	3.076E-07	2.239E-07	1.596E-07	1.205E-07	1.014E-07	8.724E-08	7.216E-08
N	1.692E-06	6.876E-07	5.628E-07	4.563E-07	2.753E-07	1.841E-07	1.526E-07	1.289E-07	1.056E-07	8.864E-08	7.240E-08
NNE	7.898E-07	3.158E-07	2.444E-07	1.974E-07	1.711E-07	1.448E-07	1.046E-07	7.961E-08	6.757E-08	5.850E-08	5.148E-08
NE	3.079E-07	1.501E-07	1.441E-07	1.440E-07	1.055E-07	7.781E-08	7.122E-08	6.487E-08	5.139E-08	4.198E-08	3.514E-08
ENE	3.085E-07	1.632E-07	1.308E-07	1.090E-07	1.026E-07	9.311E-08	6.949E-08	5.418E-08	4.757E-08	4.255E-08	3.865E-08
E	3.072E-07	1.773E-07	1.685E-07	1.589E-07	1.135E-07	8.397E-08	6.468E-08	5.164E-08	4.246E-08	3.576E-08	3.071E-08
ESE	3.427E-07	1.821E-07	1.808E-07	1.759E-07	1.284E-07	9.667E-08	7.566E-08	6.129E-08	5.107E-08	4.354E-08	3.780E-08
SE	5.373E-07	2.517E-07	2.083E-07	1.666E-07	1.289E-07	1.069E-07	8.296E-08	6.731E-08	5.645E-08	4.855E-08	4.256E-08
SSE	8.593E-07	3.847E-07	3.135E-07	2.447E-07	1.592E-07	1.136E-07	8.618E-08	6.845E-08	5.631E-08	4.760E-08	4.111E-08

Table 2.3-321
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (5 to 50 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance in Miles from the Site										
Sector	**5.000**	**7.500**	**10.000**	**15.000**	**20.000**	**25.000**	**30.000**	**35.000**	**40.000**	**45.000**	**50.000**
S	6.054E-08	3.763E-08	2.749E-08	1.833E-08	1.363E-08	1.079E-08	8.875E-09	7.506E-09	6.447E-09	5.633E-09	4.974E-09
SSW	5.344E-08	3.339E-08	2.443E-08	1.630E-08	1.213E-08	9.601E-09	7.901E-09	6.682E-09	5.738E-09	5.011E-09	4.424E-09
SW	4.385E-08	2.806E-08	2.089E-08	1.428E-08	1.079E-08	8.631E-09	7.161E-09	6.095E-09	5.260E-09	4.614E-09	4.087E-09
WSW	3.713E-08	2.472E-08	1.879E-08	1.312E-08	1.002E-08	8.067E-09	6.722E-09	5.740E-09	4.966E-09	4.365E-09	3.874E-09
W	3.270E-08	2.094E-08	1.541E-08	1.026E-08	7.578E-09	5.950E-09	4.861E-09	4.085E-09	3.488E-09	3.031E-09	2.664E-09
WNW	4.348E-08	2.638E-08	1.869E-08	1.181E-08	8.420E-09	6.440E-09	5.156E-09	4.262E-09	3.590E-09	3.084E-09	2.683E-09
NW	9.532E-08	5.258E-08	3.514E-08	2.058E-08	1.391E-08	1.023E-08	7.941E-09	6.398E-09	5.281E-09	4.457E-09	3.819E-09
NNW	6.100E-08	3.328E-08	2.212E-08	1.287E-08	8.648E-09	6.336E-09	4.905E-09	3.943E-09	3.250E-09	2.738E-09	2.344E-09
N	6.053E-08	3.166E-08	2.040E-08	1.130E-08	7.249E-09	5.114E-09	3.833E-09	2.994E-09	2.410E-09	1.986E-09	1.667E-09
NNE	4.587E-08	2.449E-08	1.598E-08	8.988E-09	5.830E-09	4.146E-09	3.127E-09	2.456E-09	1.985E-09	1.642E-09	1.383E-09
NE	3.000E-08	1.694E-08	1.151E-08	6.904E-09	4.752E-09	3.543E-09	2.781E-09	2.261E-09	1.880E-09	1.597E-09	1.376E-09
ENE	3.552E-08	1.975E-08	1.324E-08	7.730E-09	5.159E-09	3.750E-09	2.880E-09	2.296E-09	1.879E-09	1.572E-09	1.336E-09
E	2.681E-08	1.641E-08	1.175E-08	7.563E-09	5.476E-09	4.239E-09	3.427E-09	2.856E-09	2.422E-09	2.094E-09	1.832E-09
ESE	3.333E-08	2.121E-08	1.562E-08	1.045E-08	7.757E-09	6.117E-09	5.018E-09	4.231E-09	3.624E-09	3.159E-09	2.783E-09
SE	3.790E-08	2.523E-08	1.924E-08	1.350E-08	1.034E-08	8.345E-09	6.965E-09	5.956E-09	5.159E-09	4.539E-09	4.032E-09
SSE	3.614E-08	2.304E-08	1.716E-08	1.178E-08	8.954E-09	7.197E-09	5.998E-09	5.126E-09	4.444E-09	3.914E-09	3.482E-09

Table 2.3-322
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (Segment Boundaries) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.587E-07	2.762E-07	1.498E-07	9.638E-08	6.942E-08	3.822E-08	1.828E-08	1.078E-08	7.494E-09	5.630E-09
SSW	3.228E-07	2.196E-07	1.280E-07	8.414E-08	6.112E-08	3.386E-08	1.626E-08	9.597E-09	6.670E-09	5.009E-09
SW	2.706E-07	1.745E-07	1.020E-07	6.783E-08	4.986E-08	2.839E-08	1.420E-08	8.619E-09	6.081E-09	4.610E-09
WSW	1.583E-07	1.202E-07	7.811E-08	5.479E-08	4.166E-08	2.484E-08	1.300E-08	8.050E-09	5.726E-09	4.361E-09
W	1.123E-07	1.025E-07	7.025E-08	4.927E-08	3.698E-08	2.110E-08	1.021E-08	5.949E-09	4.079E-09	3.031E-09
WNW	2.000E-07	1.605E-07	1.024E-07	6.871E-08	4.989E-08	2.676E-08	1.183E-08	6.454E-09	4.261E-09	3.085E-09
NW	5.445E-07	3.600E-07	2.024E-07	1.278E-07	1.000E-07	5.432E-08	2.085E-08	1.029E-08	6.413E-09	4.465E-09
NNW	5.158E-07	3.013E-07	1.611E-07	1.015E-07	7.249E-08	3.448E-08	1.305E-08	6.380E-09	3.954E-09	2.744E-09
N	5.432E-07	2.750E-07	1.515E-07	1.058E-07	7.282E-08	3.307E-08	1.152E-08	5.171E-09	3.011E-09	1.993E-09
NNE	2.394E-07	1.652E-07	1.053E-07	6.756E-08	5.148E-08	2.545E-08	9.137E-09	4.187E-09	2.468E-09	1.648E-09
NE	1.454E-07	1.017E-07	7.044E-08	5.166E-08	3.526E-08	1.743E-08	6.971E-09	3.561E-09	2.265E-09	1.599E-09
ENE	1.283E-07	9.978E-08	6.966E-08	4.755E-08	3.865E-08	2.036E-08	7.810E-09	3.778E-09	2.304E-09	1.576E-09
E	1.662E-07	1.105E-07	6.461E-08	4.253E-08	3.076E-08	1.665E-08	7.566E-09	4.244E-09	2.854E-09	2.094E-09
ESE	1.789E-07	1.248E-07	7.551E-08	5.112E-08	3.785E-08	2.142E-08	1.040E-08	6.115E-09	4.225E-09	3.158E-09
SE	1.994E-07	1.275E-07	8.310E-08	5.654E-08	4.261E-08	2.539E-08	1.337E-08	8.326E-09	5.941E-09	4.535E-09
SSE	2.988E-07	1.580E-07	8.640E-08	5.646E-08	4.119E-08	2.334E-08	1.172E-08	7.186E-09	5.115E-09	3.911E-09

Table 2.3-323
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance (miles)										
Sector	**0.25**	**0.5**	**0.75**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
S	1.418E-06	5.767E-07	4.153E-07	3.158E-07	2.029E-07	1.451E-07	1.100E-07	8.720E-08	7.145E-08	6.011E-08	5.164E-08
SSW	9.957E-07	4.084E-07	2.870E-07	2.234E-07	1.548E-07	1.158E-07	9.032E-08	7.286E-08	6.044E-08	5.130E-08	4.436E-08
SW	8.867E-07	3.651E-07	2.479E-07	1.845E-07	1.250E-07	9.334E-08	7.289E-08	5.893E-08	4.900E-08	4.168E-08	3.613E-08
WSW	4.674E-07	1.901E-07	1.283E-07	1.035E-07	7.942E-08	6.352E-08	5.179E-08	4.317E-08	3.674E-08	3.185E-08	2.804E-08
W	2.308E-07	1.106E-07	8.099E-08	7.387E-08	6.474E-08	5.483E-08	4.597E-08	3.889E-08	3.337E-08	2.904E-08	2.560E-08
WNW	5.309E-07	2.246E-07	1.541E-07	1.304E-07	1.052E-07	8.540E-08	6.969E-08	5.778E-08	4.877E-08	4.185E-08	3.644E-08
NW	1.870E-06	7.276E-07	4.886E-07	3.725E-07	2.570E-07	1.913E-07	1.479E-07	1.182E-07	9.706E-08	8.152E-08	7.792E-08
NNW	1.922E-06	7.347E-07	4.912E-07	3.457E-07	2.258E-07	1.665E-07	1.217E-07	9.359E-08	7.947E-08	6.894E-08	5.770E-08
N	2.165E-06	8.115E-07	5.344E-07	3.659E-07	2.132E-07	1.447E-07	1.200E-07	1.023E-07	8.481E-08	7.210E-08	5.969E-08
NNE	1.028E-06	3.830E-07	2.449E-07	1.641E-07	1.246E-07	1.055E-07	7.847E-08	6.103E-08	5.238E-08	4.578E-08	4.064E-08
NE	3.955E-07	1.690E-07	1.234E-07	1.008E-07	7.253E-08	5.506E-08	5.086E-08	4.684E-08	3.781E-08	3.136E-08	2.658E-08
ENE	3.855E-07	1.790E-07	1.228E-07	8.680E-08	7.264E-08	6.546E-08	5.008E-08	3.976E-08	3.505E-08	3.141E-08	2.858E-08
E	3.858E-07	1.888E-07	1.443E-07	1.158E-07	8.056E-08	6.043E-08	4.721E-08	3.813E-08	3.164E-08	2.685E-08	2.319E-08
ESE	4.355E-07	1.977E-07	1.507E-07	1.227E-07	8.704E-08	6.636E-08	5.257E-08	4.297E-08	3.604E-08	3.088E-08	2.691E-08
SE	6.623E-07	2.791E-07	1.923E-07	1.337E-07	9.446E-08	7.563E-08	5.836E-08	4.705E-08	3.921E-08	3.351E-08	2.923E-08
SSE	1.091E-06	4.420E-07	2.979E-07	2.027E-07	1.246E-07	8.855E-08	6.726E-08	5.345E-08	4.393E-08	3.707E-08	3.194E-08

Table 2.3-324
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (5 to 50 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance (miles)										
Sector	5.0	7.5	10	15	20	25	30	35	40	45	50
S	4.514E-08	2.805E-08	2.049E-08	1.374E-08	1.032E-08	8.255E-09	6.872E-09	5.882E-09	5.138E-09	4.559E-09	4.096E-09
SSW	3.898E-08	2.455E-08	1.804E-08	1.216E-08	9.152E-09	7.330E-09	6.107E-09	5.231E-09	4.573E-09	4.059E-09	3.648E-09
SW	3.184E-08	2.031E-08	1.510E-08	1.036E-08	7.911E-09	6.406E-09	5.386E-09	4.648E-09	4.089E-09	3.650E-09	3.296E-09
WSW	2.502E-08	1.668E-08	1.273E-08	9.003E-09	6.987E-09	5.716E-09	4.839E-09	4.197E-09	3.705E-09	3.317E-09	3.002E-09
W	2.283E-08	1.501E-08	1.123E-08	7.652E-09	5.761E-09	4.599E-09	3.815E-09	3.253E-09	2.830E-09	2.502E-09	2.239E-09
WNW	3.216E-08	2.025E-08	1.467E-08	9.546E-09	6.952E-09	5.408E-09	4.393E-09	3.680E-09	3.154E-09	2.751E-09	2.434E-09
NW	7.460E-08	4.300E-08	2.963E-08	1.818E-08	1.278E-08	9.705E-09	7.740E-09	6.388E-09	5.409E-09	4.669E-09	4.094E-09
NNW	4.930E-08	2.801E-08	1.918E-08	1.170E-08	8.206E-09	6.221E-09	4.958E-09	4.090E-09	3.462E-09	2.988E-09	2.620E-09
N	5.052E-08	2.785E-08	1.874E-08	1.119E-08	7.752E-09	5.825E-09	4.611E-09	3.784E-09	3.189E-09	2.742E-09	2.396E-09
NNE	3.658E-08	2.060E-08	1.403E-08	8.509E-09	5.945E-09	4.494E-09	3.574E-09	2.944E-09	2.489E-09	2.146E-09	1.879E-09
NE	2.295E-08	1.349E-08	9.415E-09	5.874E-09	4.176E-09	3.196E-09	2.566E-09	2.129E-09	1.811E-09	1.569E-09	1.380E-09
ENE	2.637E-08	1.542E-08	1.076E-08	6.739E-09	4.815E-09	3.702E-09	2.984E-09	2.485E-09	2.120E-09	1.843E-09	1.626E-09
E	2.036E-08	1.270E-08	9.211E-09	6.049E-09	4.455E-09	3.500E-09	2.869E-09	2.422E-09	2.090E-09	1.835E-09	1.633E-09
ESE	2.381E-08	1.533E-08	1.139E-08	7.745E-09	5.842E-09	4.675E-09	3.888E-09	3.323E-09	2.898E-09	2.566E-09	2.301E-09
SE	2.591E-08	1.706E-08	1.300E-08	9.218E-09	7.177E-09	5.886E-09	4.993E-09	4.336E-09	3.832E-09	3.434E-09	3.110E-09
SSE	2.800E-08	1.762E-08	1.301E-08	8.870E-09	6.755E-09	5.463E-09	4.590E-09	3.960E-09	3.483E-09	3.110E-09	2.809E-09

Table 2.3-325
Annual Average χ/Q (sec/m^3) for No Decay, Undepleted (Segment Boundaries) for Mixed-Mode Release from the Turbine Building Stack

	Segment Boundaries in Miles from the Site									
Sector	0.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.070E-07	2.023E-07	1.102E-07	7.163E-08	5.174E-08	2.849E-08	1.372E-08	8.253E-09	5.881E-09	4.559E-09
SSW	2.857E-07	1.527E-07	9.013E-08	6.051E-08	4.442E-08	2.486E-08	1.213E-08	7.327E-09	5.231E-09	4.059E-09
SW	2.458E-07	1.241E-07	7.276E-08	4.905E-08	3.619E-08	2.055E-08	1.032E-08	6.400E-09	4.646E-09	3.649E-09
WSW	1.310E-07	7.770E-08	5.147E-08	3.671E-08	2.805E-08	1.678E-08	8.935E-09	5.704E-09	4.193E-09	3.315E-09
W	8.440E-08	6.236E-08	4.550E-08	3.330E-08	2.559E-08	1.507E-08	7.607E-09	4.595E-09	3.252E-09	2.502E-09
WNW	1.592E-07	1.020E-07	6.911E-08	4.871E-08	3.646E-08	2.042E-08	9.532E-09	5.414E-09	3.683E-09	2.753E-09
NW	4.901E-07	2.534E-07	1.476E-07	9.718E-08	7.776E-08	4.408E-08	1.833E-08	9.740E-09	6.401E-09	4.675E-09
NNW	4.807E-07	2.261E-07	1.224E-07	7.949E-08	5.792E-08	2.882E-08	1.181E-08	6.245E-09	4.099E-09	2.992E-09
N	5.211E-07	2.166E-07	1.195E-07	8.495E-08	5.997E-08	2.884E-08	1.134E-08	5.854E-09	3.794E-09	2.747E-09
NNE	2.397E-07	1.249E-07	7.871E-08	5.234E-08	4.066E-08	2.123E-08	8.597E-09	4.513E-09	2.951E-09	2.149E-09
NE	1.235E-07	7.104E-08	5.038E-08	3.794E-08	2.665E-08	1.378E-08	5.906E-09	3.205E-09	2.133E-09	1.571E-09
ENE	1.193E-07	7.260E-08	5.005E-08	3.501E-08	2.860E-08	1.578E-08	6.778E-09	3.711E-09	2.489E-09	1.845E-09
E	1.415E-07	7.944E-08	4.710E-08	3.167E-08	2.323E-08	1.285E-08	6.043E-09	3.502E-09	2.423E-09	1.836E-09
ESE	1.487E-07	8.577E-08	5.241E-08	3.605E-08	2.694E-08	1.546E-08	7.709E-09	4.671E-09	3.323E-09	2.566E-09
SE	1.855E-07	9.482E-08	5.844E-08	3.928E-08	2.927E-08	1.722E-08	9.151E-09	5.873E-09	4.332E-09	3.432E-09
SSE	2.876E-07	1.259E-07	6.741E-08	4.404E-08	3.200E-08	1.788E-08	8.849E-09	5.458E-09	3.958E-09	3.109E-09

Table 2.3-326
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance in Miles from the Site										
Sector	**.250**	**.500**	**.750**	**1.000**	**1.500**	**2.000**	**2.500**	**3.000**	**3.500**	**4.000**	**4.500**
S	1.417E-06	5.761E-07	4.147E-07	3.152E-07	2.024E-07	1.445E-07	1.095E-07	8.662E-08	7.088E-08	5.953E-08	5.106E-08
SSW	9.951E-07	4.080E-07	2.866E-07	2.229E-07	1.543E-07	1.153E-07	8.980E-08	7.234E-08	5.992E-08	5.077E-08	4.383E-08
SW	8.862E-07	3.647E-07	2.475E-07	1.841E-07	1.246E-07	9.290E-08	7.244E-08	5.846E-08	4.853E-08	4.121E-08	3.565E-08
WSW	4.671E-07	1.899E-07	1.280E-07	1.032E-07	7.912E-08	6.317E-08	5.142E-08	4.278E-08	3.633E-08	3.143E-08	2.761E-08
W	2.306E-07	1.104E-07	8.085E-08	7.369E-08	6.448E-08	5.450E-08	4.560E-08	3.850E-08	3.295E-08	2.861E-08	2.516E-08
WNW	5.306E-07	2.244E-07	1.538E-07	1.301E-07	1.048E-07	8.495E-08	6.920E-08	5.728E-08	4.825E-08	4.133E-08	3.593E-08
NW	1.869E-06	7.268E-07	4.878E-07	3.717E-07	2.562E-07	1.904E-07	1.471E-07	1.174E-07	9.626E-08	8.074E-08	7.704E-08
NNW	1.921E-06	7.340E-07	4.906E-07	3.451E-07	2.252E-07	1.659E-07	1.211E-07	9.302E-08	7.889E-08	6.833E-08	5.712E-08
N	2.164E-06	8.107E-07	5.336E-07	3.652E-07	2.126E-07	1.441E-07	1.195E-07	1.017E-07	8.420E-08	7.148E-08	5.910E-08
NNE	1.027E-06	3.826E-07	2.445E-07	1.638E-07	1.243E-07	1.051E-07	7.805E-08	6.062E-08	5.195E-08	4.533E-08	4.017E-08
NE	3.953E-07	1.689E-07	1.232E-07	1.005E-07	7.228E-08	5.479E-08	5.053E-08	4.645E-08	3.743E-08	3.099E-08	2.622E-08
ENE	3.853E-07	1.788E-07	1.226E-07	8.662E-08	7.240E-08	6.514E-08	4.975E-08	3.943E-08	3.469E-08	3.102E-08	2.816E-08
E	3.856E-07	1.886E-07	1.441E-07	1.155E-07	8.029E-08	6.014E-08	4.691E-08	3.782E-08	3.133E-08	2.653E-08	2.287E-08
ESE	4.353E-07	1.975E-07	1.505E-07	1.224E-07	8.676E-08	6.604E-08	5.222E-08	4.261E-08	3.567E-08	3.050E-08	2.652E-08
SE	6.620E-07	2.788E-07	1.920E-07	1.335E-07	9.419E-08	7.531E-08	5.801E-08	4.669E-08	3.883E-08	3.313E-08	2.883E-08
SSE	1.091E-06	4.416E-07	2.975E-07	2.023E-07	1.243E-07	8.820E-08	6.691E-08	5.310E-08	4.358E-08	3.671E-08	3.157E-08

Table 2.3-327
Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (5 to 50 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance in Miles from the Site										
Sector	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	4.456E-08	2.743E-08	1.985E-08	1.303E-08	9.573E-09	7.489E-09	6.099E-09	5.107E-09	4.366E-09	3.793E-09	3.337E-09
SSW	3.845E-08	2.399E-08	1.745E-08	1.150E-08	8.467E-09	6.626E-09	5.395E-09	4.516E-09	3.858E-09	3.349E-09	2.944E-09
SW	3.135E-08	1.979E-08	1.454E-08	9.734E-09	7.246E-09	5.719E-09	4.687E-09	3.943E-09	3.383E-09	2.946E-09	2.596E-09
WSW	2.459E-08	1.620E-08	1.221E-08	8.420E-09	6.372E-09	5.085E-09	4.200E-09	3.556E-09	3.067E-09	2.683E-09	2.374E-09
W	2.239E-08	1.454E-08	1.074E-08	7.127E-09	5.230E-09	4.071E-09	3.296E-09	2.744E-09	2.333E-09	2.016E-09	1.764E-09
WNW	3.164E-08	1.973E-08	1.415E-08	9.023E-09	6.441E-09	4.913E-09	3.915E-09	3.219E-09	2.708E-09	2.320E-09	2.016E-09
NW	7.363E-08	4.211E-08	2.879E-08	1.738E-08	1.203E-08	8.986E-09	7.056E-09	5.737E-09	4.785E-09	4.071E-09	3.518E-09
NNW	4.873E-08	2.750E-08	1.869E-08	1.123E-08	7.764E-09	5.801E-09	4.557E-09	3.707E-09	3.094E-09	2.635E-09	2.279E-09
N	4.996E-08	2.736E-08	1.828E-08	1.077E-08	7.359E-09	5.456E-09	4.262E-09	3.452E-09	2.872E-09	2.438E-09	2.104E-09
NNE	3.609E-08	2.015E-08	1.361E-08	8.108E-09	5.567E-09	4.138E-09	3.237E-09	2.623E-09	2.183E-09	1.853E-09	1.598E-09
NE	2.259E-08	1.315E-08	9.084E-09	5.554E-09	3.870E-09	2.905E-09	2.287E-09	1.863E-09	1.555E-09	1.324E-09	1.145E-09
ENE	2.592E-08	1.499E-08	1.035E-08	6.336E-09	4.426E-09	3.329E-09	2.626E-09	2.141E-09	1.789E-09	1.524E-09	1.318E-09
E	2.004E-08	1.237E-08	8.872E-09	5.697E-09	4.102E-09	3.153E-09	2.529E-09	2.091E-09	1.768E-09	1.521E-09	1.326E-09
ESE	2.341E-08	1.491E-08	1.095E-08	7.271E-09	5.357E-09	4.190E-09	3.407E-09	2.848E-09	2.431E-09	2.108E-09	1.851E-09
SE	2.551E-08	1.660E-08	1.249E-08	8.637E-09	6.559E-09	5.250E-09	4.348E-09	3.689E-09	3.187E-09	2.793E-09	2.475E-09
SSE	2.763E-08	1.721E-08	1.257E-08	8.376E-09	6.231E-09	4.923E-09	4.043E-09	3.411E-09	2.935E-09	2.564E-09	2.268E-09

Table 2.3-328

Annual Average χ/Q (sec/m^3) for 2.26-Day Decay, Undepleted (Segment Boundaries) for Mixed-Mode Release from the Turbine Building Stack

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	4.064E-07	2.017E-07	1.097E-07	7.105E-08	5.116E-08	2.787E-08	1.301E-08	7.489E-09	5.108E-09	3.794E-09
SSW	2.853E-07	1.522E-07	8.961E-08	5.998E-08	4.389E-08	2.430E-08	1.148E-08	6.625E-09	4.517E-09	3.350E-09
SW	2.454E-07	1.237E-07	7.230E-08	4.858E-08	3.571E-08	2.002E-08	9.696E-09	5.713E-09	3.942E-09	2.946E-09
WSW	1.308E-07	7.739E-08	5.110E-08	3.631E-08	2.762E-08	1.629E-08	8.352E-09	5.074E-09	3.554E-09	2.682E-09
W	8.424E-08	6.209E-08	4.513E-08	3.288E-08	2.516E-08	1.459E-08	7.086E-09	4.070E-09	2.745E-09	2.016E-09
WNW	1.590E-07	1.016E-07	6.863E-08	4.820E-08	3.594E-08	1.990E-08	9.015E-09	4.921E-09	3.223E-09	2.322E-09
NW	4.893E-07	2.526E-07	1.468E-07	9.638E-08	7.687E-08	4.319E-08	1.754E-08	9.025E-09	5.751E-09	4.078E-09
NNW	4.800E-07	2.255E-07	1.218E-07	7.891E-08	5.734E-08	2.830E-08	1.135E-08	5.827E-09	3.716E-09	2.639E-09
N	5.203E-07	2.161E-07	1.189E-07	8.434E-08	5.939E-08	2.835E-08	1.092E-08	5.486E-09	3.462E-09	2.443E-09
NNE	2.393E-07	1.245E-07	7.829E-08	5.190E-08	4.019E-08	2.079E-08	8.202E-09	4.159E-09	2.631E-09	1.856E-09
NE	1.233E-07	7.079E-08	5.003E-08	3.755E-08	2.628E-08	1.344E-08	5.590E-09	2.915E-09	1.867E-09	1.326E-09
ENE	1.191E-07	7.233E-08	4.973E-08	3.465E-08	2.818E-08	1.536E-08	6.379E-09	3.340E-09	2.145E-09	1.527E-09
E	1.413E-07	7.916E-08	4.680E-08	3.135E-08	2.290E-08	1.252E-08	5.694E-09	3.157E-09	2.093E-09	1.522E-09
ESE	1.485E-07	8.548E-08	5.206E-08	3.568E-08	2.655E-08	1.504E-08	7.238E-09	4.188E-09	2.849E-09	2.108E-09
SE	1.853E-07	9.452E-08	5.810E-08	3.890E-08	2.887E-08	1.675E-08	8.570E-09	5.238E-09	3.686E-09	2.792E-09
SSE	2.872E-07	1.256E-07	6.706E-08	4.368E-08	3.163E-08	1.746E-08	8.354E-09	4.920E-09	3.410E-09	2.564E-09

Table 2.3-329
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (0.25 to 4.5 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance in Miles from the Site										
Sector	**.250**	**.500**	**.750**	**1.000**	**1.500**	**2.000**	**2.500**	**3.000**	**3.500**	**4.000**	**4.500**
S	1.350E-06	5.371E-07	3.867E-07	2.985E-07	1.934E-07	1.383E-07	1.047E-07	8.278E-08	6.766E-08	5.677E-08	4.866E-08
SSW	9.523E-07	3.834E-07	2.683E-07	2.119E-07	1.484E-07	1.112E-07	8.667E-08	6.980E-08	5.779E-08	4.894E-08	4.224E-08
SW	8.494E-07	3.438E-07	2.317E-07	1.745E-07	1.195E-07	8.942E-08	6.980E-08	5.634E-08	4.676E-08	3.970E-08	3.435E-08
WSW	4.506E-07	1.803E-07	1.207E-07	9.876E-08	7.666E-08	6.147E-08	5.010E-08	4.170E-08	3.544E-08	3.066E-08	2.695E-08
W	2.232E-07	1.059E-07	7.709E-08	7.134E-08	6.315E-08	5.355E-08	4.485E-08	3.787E-08	3.242E-08	2.816E-08	2.477E-08
WNW	5.121E-07	2.134E-07	1.454E-07	1.249E-07	1.020E-07	8.296E-08	6.764E-08	5.599E-08	4.716E-08	4.038E-08	3.509E-08
NW	1.788E-06	6.809E-07	4.541E-07	3.516E-07	2.456E-07	1.833E-07	1.417E-07	1.130E-07	9.258E-08	7.758E-08	7.427E-08
NNW	1.828E-06	6.813E-07	4.531E-07	3.227E-07	2.133E-07	1.578E-07	1.150E-07	8.820E-08	7.489E-08	6.495E-08	5.421E-08
N	2.057E-06	7.510E-07	4.914E-07	3.401E-07	1.996E-07	1.356E-07	1.130E-07	9.648E-08	7.992E-08	6.786E-08	5.599E-08
NNE	9.762E-07	3.545E-07	2.247E-07	1.519E-07	1.180E-07	1.007E-07	7.473E-08	5.796E-08	4.971E-08	4.342E-08	3.852E-08
NE	3.772E-07	1.587E-07	1.158E-07	9.605E-08	6.980E-08	5.303E-08	4.910E-08	4.524E-08	3.640E-08	3.010E-08	2.544E-08
ENE	3.688E-07	1.694E-07	1.155E-07	8.221E-08	6.993E-08	6.330E-08	4.828E-08	3.821E-08	3.364E-08	3.012E-08	2.738E-08
E	3.687E-07	1.788E-07	1.366E-07	1.109E-07	7.765E-08	5.823E-08	4.539E-08	3.655E-08	3.024E-08	2.558E-08	2.204E-08
ESE	4.150E-07	1.856E-07	1.417E-07	1.171E-07	8.378E-08	6.393E-08	5.058E-08	4.126E-08	3.453E-08	2.952E-08	2.567E-08
SE	6.300E-07	2.603E-07	1.787E-07	1.253E-07	8.977E-08	7.221E-08	5.564E-08	4.478E-08	3.724E-08	3.177E-08	2.766E-08
SSE	1.037E-06	4.108E-07	2.756E-07	1.890E-07	1.172E-07	8.341E-08	6.326E-08	5.015E-08	4.112E-08	3.461E-08	2.974E-08

Table 2.3-330
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (5 to 50 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance in Miles from the Site										
Sector	**5.000**	**7.500**	**10.000**	**15.000**	**20.000**	**25.000**	**30.000**	**35.000**	**40.000**	**45.000**	**50.000**
S	4.244E-08	2.615E-08	1.898E-08	1.259E-08	9.374E-09	7.434E-09	6.138E-09	5.210E-09	4.500E-09	3.953E-09	3.509E-09
SSW	3.705E-08	2.316E-08	1.691E-08	1.127E-08	8.408E-09	6.672E-09	5.510E-09	4.678E-09	4.040E-09	3.548E-09	3.150E-09
SW	3.021E-08	1.912E-08	1.412E-08	9.590E-09	7.250E-09	5.815E-09	4.843E-09	4.140E-09	3.597E-09	3.175E-09	2.831E-09
WSW	2.402E-08	1.591E-08	1.207E-08	8.458E-09	6.505E-09	5.275E-09	4.428E-09	3.807E-09	3.322E-09	2.942E-09	2.630E-09
W	2.206E-08	1.438E-08	1.069E-08	7.195E-09	5.359E-09	4.235E-09	3.480E-09	2.939E-09	2.525E-09	2.207E-09	1.951E-09
WNW	3.090E-08	1.929E-08	1.388E-08	8.914E-09	6.421E-09	4.945E-09	3.979E-09	3.304E-09	2.797E-09	2.414E-09	2.109E-09
NW	7.119E-08	4.060E-08	2.773E-08	1.678E-08	1.166E-08	8.755E-09	6.915E-09	5.654E-09	4.722E-09	4.028E-09	3.484E-09
NNW	4.618E-08	2.595E-08	1.760E-08	1.058E-08	7.328E-09	5.496E-09	4.338E-09	3.545E-09	2.960E-09	2.525E-09	2.185E-09
N	4.724E-08	2.568E-08	1.708E-08	1.002E-08	6.831E-09	5.065E-09	3.963E-09	3.215E-09	2.670E-09	2.266E-09	1.952E-09
NNE	3.465E-08	1.927E-08	1.300E-08	7.749E-09	5.337E-09	3.986E-09	3.134E-09	2.554E-09	2.128E-09	1.811E-09	1.564E-09
NE	2.190E-08	1.273E-08	8.806E-09	5.414E-09	3.801E-09	2.877E-09	2.285E-09	1.877E-09	1.574E-09	1.347E-09	1.168E-09
ENE	2.525E-08	1.460E-08	1.010E-08	6.233E-09	4.397E-09	3.342E-09	2.665E-09	2.196E-09	1.846E-09	1.584E-09	1.377E-09
E	1.929E-08	1.190E-08	8.558E-09	5.541E-09	4.031E-09	3.133E-09	2.542E-09	2.125E-09	1.811E-09	1.573E-09	1.381E-09
ESE	2.267E-08	1.448E-08	1.069E-08	7.192E-09	5.373E-09	4.262E-09	3.515E-09	2.979E-09	2.567E-09	2.250E-09	1.994E-09
SE	2.449E-08	1.603E-08	1.216E-08	8.556E-09	6.611E-09	5.380E-09	4.528E-09	3.902E-09	3.410E-09	3.025E-09	2.708E-09
SSE	2.602E-08	1.623E-08	1.190E-08	8.035E-09	6.065E-09	4.865E-09	4.056E-09	3.472E-09	3.029E-09	2.685E-09	2.405E-09

Table 2.3-331
Annual Average χ/Q (sec/m^3) for 8.0-Day Decay, Depleted (Segment Boundaries) for Mixed-Mode Release from the Turbine Building Stack

Direction from Site	Segment Boundaries in Miles from the Site									
	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	3.809E-07	1.923E-07	1.049E-07	6.783E-08	4.876E-08	2.658E-08	1.258E-08	7.433E-09	5.205E-09	3.950E-09
SSW	2.688E-07	1.460E-07	8.648E-08	5.785E-08	4.230E-08	2.347E-08	1.125E-08	6.670E-09	4.673E-09	3.546E-09
SW	2.312E-07	1.183E-07	6.965E-08	4.681E-08	3.440E-08	1.936E-08	9.558E-09	5.809E-09	4.134E-09	3.172E-09
WSW	1.242E-07	7.482E-08	4.977E-08	3.541E-08	2.696E-08	1.601E-08	8.393E-09	5.264E-09	3.800E-09	2.939E-09
W	8.093E-08	6.070E-08	4.438E-08	3.235E-08	2.477E-08	1.445E-08	7.155E-09	4.233E-09	2.936E-09	2.207E-09
WNW	1.514E-07	9.864E-08	6.707E-08	4.710E-08	3.511E-08	1.947E-08	8.909E-09	4.952E-09	3.304E-09	2.414E-09
NW	4.590E-07	2.415E-07	1.413E-07	9.270E-08	7.411E-08	4.168E-08	1.694E-08	8.793E-09	5.659E-09	4.032E-09
NNW	4.459E-07	2.129E-07	1.157E-07	7.491E-08	5.442E-08	2.673E-08	1.069E-08	5.521E-09	3.549E-09	2.528E-09
N	4.818E-07	2.024E-07	1.124E-07	8.006E-08	5.627E-08	2.665E-08	1.017E-08	5.095E-09	3.221E-09	2.269E-09
NNE	2.212E-07	1.179E-07	7.496E-08	4.967E-08	3.854E-08	1.990E-08	7.843E-09	4.006E-09	2.558E-09	1.814E-09
NE	1.166E-07	6.818E-08	4.861E-08	3.653E-08	2.551E-08	1.303E-08	5.451E-09	2.887E-09	1.878E-09	1.348E-09
ENE	1.127E-07	6.971E-08	4.826E-08	3.360E-08	2.740E-08	1.496E-08	6.276E-09	3.352E-09	2.197E-09	1.585E-09
E	1.345E-07	7.640E-08	4.528E-08	3.026E-08	2.207E-08	1.206E-08	5.541E-09	3.136E-09	2.125E-09	1.573E-09
ESE	1.405E-07	8.236E-08	5.041E-08	3.454E-08	2.570E-08	1.462E-08	7.162E-09	4.259E-09	2.975E-09	2.249E-09
SE	1.731E-07	8.986E-08	5.571E-08	3.731E-08	2.771E-08	1.619E-08	8.493E-09	5.368E-09	3.894E-09	3.022E-09
SSE	2.672E-07	1.182E-07	6.339E-08	4.122E-08	2.981E-08	1.648E-08	8.019E-09	4.862E-09	3.470E-09	2.683E-09

Table 2.3-332
Annual Average D/Q (m^{-2}) (0.25 to 4.5 mi.) for Ground-Level Release

	Distance (miles)										
Sector	0.25	0.5	0.75	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
S	2.330E-07	7.879E-08	4.045E-08	1.923E-08	6.908E-09	3.426E-09	2.017E-09	1.321E-09	9.294E-10	6.888E-10	5.308E-10
SSW	1.858E-07	6.283E-08	3.226E-08	1.534E-08	5.509E-09	2.732E-09	1.609E-09	1.053E-09	7.412E-10	5.493E-10	4.233E-10
SW	1.543E-07	5.218E-08	2.679E-08	1.274E-08	4.575E-09	2.269E-09	1.336E-09	8.748E-10	6.155E-10	4.562E-10	3.515E-10
WSW	1.223E-07	4.137E-08	2.124E-08	1.010E-08	3.627E-09	1.799E-09	1.059E-09	6.936E-10	4.880E-10	3.617E-10	2.787E-10
W	8.754E-08	2.960E-08	1.520E-08	7.226E-09	2.596E-09	1.287E-09	7.579E-10	4.963E-10	3.492E-10	2.588E-10	1.994E-10
WNW	1.210E-07	4.091E-08	2.100E-08	9.986E-09	3.587E-09	1.779E-09	1.047E-09	6.858E-10	4.826E-10	3.576E-10	2.756E-10
NW	2.558E-07	8.650E-08	4.441E-08	2.112E-08	7.585E-09	3.761E-09	2.215E-09	1.450E-09	1.020E-09	7.562E-10	5.828E-10
NNW	1.943E-07	6.570E-08	3.373E-08	1.604E-08	5.760E-09	2.857E-09	1.682E-09	1.101E-09	7.750E-10	5.743E-10	4.426E-10
N	1.890E-07	6.391E-08	3.281E-08	1.560E-08	5.604E-09	2.779E-09	1.636E-09	1.071E-09	7.539E-10	5.587E-10	4.306E-10
NNE	1.155E-07	3.907E-08	2.006E-08	9.536E-09	3.426E-09	1.699E-09	1.000E-09	6.550E-10	4.609E-10	3.415E-10	2.632E-10
NE	7.187E-08	2.430E-08	1.248E-08	5.933E-09	2.131E-09	1.057E-09	6.223E-10	4.075E-10	2.867E-10	2.125E-10	1.637E-10
ENE	7.548E-08	2.552E-08	1.310E-08	6.230E-09	2.238E-09	1.110E-09	6.535E-10	4.279E-10	3.011E-10	2.231E-10	1.719E-10
E	8.595E-08	2.906E-08	1.492E-08	7.095E-09	2.548E-09	1.264E-09	7.441E-10	4.873E-10	3.429E-10	2.541E-10	1.958E-10
ESE	1.064E-07	3.598E-08	1.848E-08	8.783E-09	3.155E-09	1.565E-09	9.213E-10	6.033E-10	4.245E-10	3.146E-10	2.424E-10
SE	1.422E-07	4.809E-08	2.469E-08	1.174E-08	4.217E-09	2.091E-09	1.231E-09	8.062E-10	5.673E-10	4.204E-10	3.240E-10
SSE	1.755E-07	5.935E-08	3.047E-08	1.449E-08	5.204E-09	2.581E-09	1.520E-09	9.951E-10	7.002E-10	5.189E-10	3.999E-10

Table 2.3-333
Annual Average D/Q (m^{-2}) (5 to 50 mi.) for Ground-Level Release

	Distance (miles)										
Sector	5.0	7.5	10	15	20	25	30	35	40	45	50
S	4.217E-10	1.873E-10	1.135E-10	5.735E-11	3.471E-11	2.327E-11	1.668E-11	1.252E-11	9.737E-12	7.778E-12	6.349E-12
SSW	3.363E-10	1.494E-10	9.049E-11	4.574E-11	2.768E-11	1.856E-11	1.330E-11	9.987E-12	7.765E-12	6.203E-12	5.063E-12
SW	2.793E-10	1.241E-10	7.515E-11	3.798E-11	2.299E-11	1.541E-11	1.105E-11	8.294E-12	6.449E-12	5.151E-12	4.205E-12
WSW	2.214E-10	9.837E-11	5.959E-11	3.012E-11	1.823E-11	1.222E-11	8.758E-12	6.576E-12	5.113E-12	4.084E-12	3.334E-12
W	1.584E-10	7.038E-11	4.264E-11	2.155E-11	1.304E-11	8.745E-12	6.266E-12	4.705E-12	3.659E-12	2.922E-12	2.385E-12
WNW	2.190E-10	9.727E-11	5.892E-11	2.978E-11	1.803E-11	1.209E-11	8.660E-12	6.503E-12	5.056E-12	4.039E-12	3.297E-12
NW	4.630E-10	2.057E-10	1.246E-10	6.297E-11	3.811E-11	2.555E-11	1.831E-11	1.375E-11	1.069E-11	8.540E-12	6.970E-12
NNW	3.516E-10	1.562E-10	9.462E-11	4.783E-11	2.895E-11	1.941E-11	1.391E-11	1.044E-11	8.119E-12	6.486E-12	5.294E-12
N	3.421E-10	1.520E-10	9.205E-11	4.653E-11	2.816E-11	1.888E-11	1.353E-11	1.016E-11	7.899E-12	6.309E-12	5.150E-12
NNE	2.091E-10	9.289E-11	5.627E-11	2.844E-11	1.721E-11	1.154E-11	8.270E-12	6.210E-12	4.828E-12	3.857E-12	3.148E-12
NE	1.301E-10	5.779E-11	3.501E-11	1.769E-11	1.071E-11	7.180E-12	5.145E-12	3.863E-12	3.004E-12	2.399E-12	1.959E-12
ENE	1.366E-10	6.068E-11	3.676E-11	1.858E-11	1.125E-11	7.540E-12	5.403E-12	4.057E-12	3.154E-12	2.520E-12	2.057E-12
E	1.556E-10	6.910E-11	4.186E-11	2.116E-11	1.281E-11	8.586E-12	6.152E-12	4.620E-12	3.592E-12	2.869E-12	2.342E-12
ESE	1.926E-10	8.555E-11	5.182E-11	2.619E-11	1.585E-11	1.063E-11	7.617E-12	5.720E-12	4.447E-12	3.552E-12	2.900E-12
SE	2.574E-10	1.143E-10	6.926E-11	3.501E-11	2.119E-11	1.421E-11	1.018E-11	7.644E-12	5.944E-12	4.748E-12	3.875E-12
SSE	3.177E-10	1.411E-10	8.549E-11	4.321E-11	2.615E-11	1.753E-11	1.256E-11	9.434E-12	7.335E-12	5.860E-12	4.783E-12

Table 2.3-334
Annual Average D/Q (m^{-2}) (Segment Boundaries) for Ground-Level Release

Sector	Segment Boundaries in Miles from the Site									
	0.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	3.954E-08	8.099E-09	2.114E-09	9.496E-10	5.372E-10	2.066E-10	5.976E-11	2.369E-11	1.265E-11	7.829E-12
SSW	3.153E-08	6.459E-09	1.686E-09	7.573E-10	4.284E-10	1.647E-10	4.766E-11	1.889E-11	1.009E-11	6.244E-12
SW	2.619E-08	5.364E-09	1.400E-09	6.289E-10	3.558E-10	1.368E-10	3.958E-11	1.569E-11	8.377E-12	5.185E-12
WSW	2.076E-08	4.253E-09	1.110E-09	4.986E-10	2.821E-10	1.085E-10	3.138E-11	1.244E-11	6.642E-12	4.111E-12
W	1.486E-08	3.043E-09	7.944E-10	3.568E-10	2.018E-10	7.762E-11	2.245E-11	8.900E-12	4.753E-12	2.942E-12
WNW	2.053E-08	4.205E-09	1.098E-09	4.931E-10	2.789E-10	1.073E-10	3.103E-11	1.230E-11	6.568E-12	4.065E-12
NW	4.341E-08	8.892E-09	2.321E-09	1.043E-09	5.898E-10	2.268E-10	6.562E-11	2.601E-11	1.389E-11	8.596E-12
NNW	3.297E-08	6.753E-09	1.763E-09	7.918E-10	4.479E-10	1.723E-10	4.983E-11	1.975E-11	1.055E-11	6.528E-12
N	3.207E-08	6.570E-09	1.715E-09	7.703E-10	4.358E-10	1.676E-10	4.848E-11	1.921E-11	1.026E-11	6.351E-12
NNE	1.961E-08	4.016E-09	1.048E-09	4.709E-10	2.664E-10	1.024E-10	2.964E-11	1.175E-11	6.272E-12	3.882E-12
NE	1.220E-08	2.498E-09	6.522E-10	2.929E-10	1.657E-10	6.373E-11	1.844E-11	7.307E-12	3.902E-12	2.415E-12
ENE	1.281E-08	2.624E-09	6.849E-10	3.076E-10	1.740E-10	6.692E-11	1.936E-11	7.673E-12	4.098E-12	2.536E-12
E	1.459E-08	2.988E-09	7.800E-10	3.503E-10	1.982E-10	7.621E-11	2.205E-11	8.738E-12	4.666E-12	2.888E-12
ESE	1.806E-08	3.699E-09	9.656E-10	4.337E-10	2.453E-10	9.435E-11	2.729E-11	1.082E-11	5.777E-12	3.576E-12
SE	2.414E-08	4.944E-09	1.291E-09	5.796E-10	3.279E-10	1.261E-10	3.648E-11	1.446E-11	7.721E-12	4.779E-12
SSE	2.979E-08	6.101E-09	1.593E-09	7.154E-10	4.047E-10	1.556E-10	4.502E-11	1.784E-11	9.529E-12	5.898E-12

Table 2.3-335
Annual Average D/Q (m^{-2}) (0.25 to 4.5 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance (miles)										
Sector	**0.25**	**0.5**	**0.75**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
S	1.789E-08	1.273E-08	8.533E-09	4.895E-09	2.131E-09	1.168E-09	7.327E-10	5.022E-10	3.652E-10	2.773E-10	2.175E-10
SSW	1.061E-08	8.240E-09	5.346E-09	3.045E-09	1.311E-09	7.304E-10	4.650E-10	3.219E-10	2.358E-10	1.799E-10	1.415E-10
SW	8.813E-09	6.841E-09	4.406E-09	2.479E-09	1.043E-09	5.793E-10	3.686E-10	2.553E-10	1.871E-10	1.429E-10	1.125E-10
WSW	5.596E-09	4.365E-09	2.828E-09	1.598E-09	6.738E-10	3.758E-10	2.399E-10	1.665E-10	1.222E-10	9.341E-11	7.360E-11
W	3.174E-09	2.473E-09	1.713E-09	1.021E-09	4.465E-10	2.577E-10	1.682E-10	1.184E-10	8.767E-11	6.733E-11	5.319E-11
WNW	6.496E-09	5.030E-09	3.321E-09	1.910E-09	8.166E-10	4.608E-10	2.964E-10	2.067E-10	1.521E-10	1.164E-10	9.182E-11
NW	1.756E-08	1.340E-08	8.571E-09	4.835E-09	2.065E-09	1.146E-09	7.279E-10	5.032E-10	3.683E-10	2.808E-10	2.321E-10
NNW	2.084E-08	1.348E-08	8.754E-09	4.893E-09	2.078E-09	1.180E-09	7.257E-10	4.914E-10	3.562E-10	2.956E-10	2.402E-10
N	2.314E-08	1.417E-08	9.065E-09	5.018E-09	2.115E-09	1.136E-09	7.296E-10	5.209E-10	3.902E-10	3.149E-10	2.613E-10
NNE	9.496E-09	5.053E-09	4.243E-09	2.457E-09	1.076E-09	6.406E-10	3.978E-10	2.711E-10	1.982E-10	1.630E-10	1.429E-10
NE	4.343E-09	3.373E-09	2.311E-09	1.368E-09	6.088E-10	3.442E-10	2.403E-10	1.689E-10	1.244E-10	9.638E-11	7.759E-11
ENE	5.032E-09	3.220E-09	2.806E-09	1.619E-09	7.035E-10	4.353E-10	2.721E-10	1.861E-10	1.357E-10	1.073E-10	9.091E-11
E	5.093E-09	4.434E-09	2.979E-09	1.742E-09	7.672E-10	4.324E-10	2.772E-10	1.927E-10	1.415E-10	1.081E-10	8.509E-11
ESE	5.957E-09	4.586E-09	3.145E-09	1.849E-09	8.199E-10	4.585E-10	2.919E-10	2.020E-10	1.478E-10	1.126E-10	8.854E-11
SE	9.954E-09	5.493E-09	4.551E-09	2.614E-09	1.138E-09	6.242E-10	3.920E-10	2.688E-10	1.956E-10	1.485E-10	1.165E-10
SSE	1.471E-08	8.053E-09	6.778E-09	3.878E-09	1.682E-09	9.154E-10	5.713E-10	3.900E-10	2.830E-10	2.145E-10	1.681E-10

Table 2.3-336
Annual Average D/Q (m^{-2}) (5 to 50 mi.) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Distance (miles)										
Sector	**5.0**	**7.5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**
S	1.750E-10	8.021E-11	4.787E-11	2.450E-11	1.547E-11	1.105E-11	8.565E-12	7.021E-12	5.993E-12	5.221E-12	4.673E-12
SSW	1.141E-10	5.314E-11	3.223E-11	1.690E-11	1.082E-11	7.903E-12	6.258E-12	5.232E-12	4.544E-12	4.017E-12	3.647E-12
SW	9.080E-11	4.259E-11	2.600E-11	1.376E-11	8.855E-12	6.542E-12	5.219E-12	4.386E-12	3.821E-12	3.383E-12	3.076E-12
WSW	5.942E-11	2.794E-11	1.709E-11	9.068E-12	5.855E-12	4.369E-12	3.539E-12	3.030E-12	2.689E-12	2.421E-12	2.240E-12
W	4.298E-11	2.041E-11	1.255E-11	6.675E-12	4.295E-12	3.203E-12	2.584E-12	2.203E-12	1.945E-12	1.745E-12	1.610E-12
WNW	7.413E-11	3.494E-11	2.140E-11	1.135E-11	7.291E-12	5.381E-12	4.278E-12	3.578E-12	3.101E-12	2.734E-12	2.474E-12
NW	2.294E-10	1.306E-10	9.003E-11	5.299E-11	3.418E-11	2.345E-11	1.719E-11	1.321E-11	1.058E-11	8.711E-12	7.354E-12
NNW	2.024E-10	1.119E-10	7.600E-11	4.405E-11	2.822E-11	1.922E-11	1.398E-11	1.065E-11	8.434E-12	6.877E-12	5.746E-12
N	2.253E-10	1.343E-10	9.493E-11	5.682E-11	3.653E-11	2.463E-11	1.763E-11	1.318E-11	1.022E-11	8.165E-12	6.667E-12
NNE	1.316E-10	8.094E-11	5.792E-11	3.496E-11	2.245E-11	1.506E-11	1.073E-11	7.982E-12	6.171E-12	4.912E-12	4.002E-12
NE	6.443E-11	3.368E-11	2.203E-11	1.237E-11	7.902E-12	5.465E-12	4.053E-12	3.161E-12	2.567E-12	2.141E-12	1.833E-12
ENE	8.563E-11	5.002E-11	3.485E-11	2.068E-11	1.332E-11	9.044E-12	6.535E-12	4.931E-12	3.870E-12	3.120E-12	2.572E-12
E	6.859E-11	3.197E-11	1.937E-11	1.012E-11	6.441E-12	4.647E-12	3.609E-12	2.946E-12	2.495E-12	2.155E-12	1.908E-12
ESE	7.131E-11	3.298E-11	1.982E-11	1.023E-11	6.484E-12	4.668E-12	3.650E-12	3.021E-12	2.601E-12	2.284E-12	2.063E-12
SE	9.375E-11	4.302E-11	2.569E-11	1.316E-11	8.323E-12	5.975E-12	4.675E-12	3.879E-12	3.352E-12	2.955E-12	2.679E-12
SSE	1.352E-10	6.174E-11	3.670E-11	1.868E-11	1.176E-11	8.363E-12	6.456E-12	5.269E-12	4.478E-12	3.886E-12	3.465E-12

Table 2.3-337
Annual Average D/Q (m^{-2}) (Segment Boundaries) for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

	Segment Boundaries in Miles from the Site									
Sector	**0.5-1**	**1-2**	**2-3**	**3-4**	**4-5**	**5-10**	**10-20**	**20-30**	**30-40**	**40-50**
S	7.848E-09	2.317E-09	7.565E-10	3.708E-10	2.194E-10	8.689E-11	2.568E-11	1.123E-11	7.070E-12	5.247E-12
SSW	4.966E-09	1.438E-09	4.785E-10	2.391E-10	1.427E-10	5.739E-11	1.761E-11	8.023E-12	5.263E-12	4.036E-12
SW	4.091E-09	1.156E-09	3.795E-10	1.898E-10	1.135E-10	4.593E-11	1.430E-11	6.630E-12	4.409E-12	3.399E-12
WSW	2.623E-09	7.468E-10	2.468E-10	1.239E-10	7.422E-11	3.011E-11	9.422E-12	4.433E-12	3.045E-12	2.433E-12
W	1.574E-09	4.903E-10	1.721E-10	8.870E-11	5.360E-11	2.193E-11	6.922E-12	3.247E-12	2.214E-12	1.754E-12
WNW	3.074E-09	9.013E-10	3.043E-10	1.541E-10	9.257E-11	3.763E-11	1.178E-11	5.449E-12	3.596E-12	2.746E-12
NW	7.985E-09	2.272E-09	7.495E-10	3.735E-10	2.455E-10	1.345E-10	5.286E-11	2.381E-11	1.335E-11	8.764E-12
NNW	8.088E-09	2.304E-09	7.531E-10	3.717E-10	2.426E-10	1.161E-10	4.411E-11	1.952E-11	1.076E-11	6.919E-12
N	8.400E-09	2.325E-09	7.545E-10	3.989E-10	2.638E-10	1.370E-10	5.627E-11	2.500E-11	1.332E-11	8.220E-12
NNE	3.629E-09	1.189E-09	4.119E-10	2.056E-10	1.447E-10	8.197E-11	3.450E-11	1.530E-11	8.077E-12	4.948E-12
NE	2.128E-09	6.599E-10	2.394E-10	1.265E-10	7.828E-11	3.534E-11	1.253E-11	5.550E-12	3.189E-12	2.153E-12
ENE	2.371E-09	7.878E-10	2.812E-10	1.393E-10	9.381E-11	5.119E-11	2.056E-11	9.180E-12	4.985E-12	3.139E-12
E	2.752E-09	8.349E-10	2.848E-10	1.434E-10	8.580E-11	3.451E-11	1.054E-11	4.710E-12	2.964E-12	2.164E-12
ESE	2.889E-09	8.879E-10	3.003E-10	1.499E-10	8.930E-11	3.565E-11	1.070E-11	4.745E-12	3.041E-12	2.296E-12
SE	3.899E-09	1.238E-09	4.047E-10	1.986E-10	1.176E-10	4.659E-11	1.380E-11	6.081E-12	3.906E-12	2.970E-12
SSE	5.772E-09	1.829E-09	5.905E-10	2.875E-10	1.697E-10	6.694E-11	1.961E-11	8.506E-12	5.307E-12	3.905E-12

Table 2.3-338
Annual Average D/Q (m^{-2}) (0.25 to 4.5 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance (miles)										
Sector	**0.25**	**0.5**	**0.75**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
S	1.716E-08	1.049E-08	7.029E-09	4.149E-09	1.833E-09	1.046E-09	6.760E-10	4.725E-10	3.479E-10	2.661E-10	2.095E-10
SSW	1.138E-08	6.838E-09	4.658E-09	2.740E-09	1.179E-09	6.760E-10	4.398E-10	3.089E-10	2.283E-10	1.752E-10	1.383E-10
SW	9.799E-09	5.878E-09	4.012E-09	2.319E-09	9.685E-10	5.487E-10	3.545E-10	2.481E-10	1.831E-10	1.404E-10	1.109E-10
WSW	6.009E-09	3.796E-09	2.630E-09	1.525E-09	6.374E-10	3.605E-10	2.326E-10	1.626E-10	1.200E-10	9.201E-11	7.266E-11
W	3.430E-09	2.288E-09	1.660E-09	1.005E-09	4.369E-10	2.537E-10	1.664E-10	1.175E-10	8.722E-11	6.709E-11	5.306E-11
WNW	6.942E-09	4.419E-09	3.090E-09	1.820E-09	7.738E-10	4.429E-10	2.879E-10	2.023E-10	1.496E-10	1.149E-10	9.077E-11
NW	1.929E-08	1.127E-08	7.621E-09	4.434E-09	1.884E-09	1.072E-09	6.937E-10	4.858E-10	3.585E-10	2.748E-10	2.272E-10
NNW	2.067E-08	1.184E-08	7.668E-09	4.358E-09	2.146E-09	1.155E-09	7.162E-10	4.871E-10	3.614E-10	2.729E-10	2.134E-10
N	2.241E-08	1.266E-08	7.963E-09	4.463E-09	1.890E-09	1.046E-09	7.276E-10	5.063E-10	3.646E-10	2.789E-10	2.193E-10
NNE	9.703E-09	4.706E-09	3.206E-09	2.174E-09	9.618E-10	6.121E-10	3.853E-10	2.645E-10	2.002E-10	1.515E-10	1.185E-10
NE	4.523E-09	2.789E-09	1.977E-09	1.211E-09	5.439E-10	3.174E-10	2.256E-10	1.674E-10	1.216E-10	9.230E-11	7.238E-11
ENE	5.339E-09	3.266E-09	2.329E-09	1.432E-09	6.241E-10	4.021E-10	2.565E-10	1.778E-10	1.376E-10	1.044E-10	8.189E-11
E	5.492E-09	3.460E-09	2.484E-09	1.518E-09	6.731E-10	3.930E-10	2.583E-10	1.826E-10	1.355E-10	1.042E-10	8.230E-11
ESE	5.900E-09	3.771E-09	2.656E-09	1.614E-09	7.242E-10	4.189E-10	2.733E-10	1.921E-10	1.420E-10	1.089E-10	8.585E-11
SE	9.204E-09	4.766E-09	3.304E-09	2.275E-09	1.003E-09	5.687E-10	3.662E-10	2.552E-10	1.876E-10	1.433E-10	1.128E-10
SSE	1.360E-08	6.841E-09	4.706E-09	3.329E-09	1.465E-09	8.264E-10	5.301E-10	3.685E-10	2.705E-10	2.064E-10	1.623E-10

Table 2.3-339
Annual Average D/Q (m^{-2}) (5 to 50 mi.) for Mixed-Mode Release from the Turbine Building Stack

	Distance (miles)										
Sector	5.0	7.5	10	15	20	25	30	35	40	45	50
S	1.687E-10	7.892E-11	4.800E-11	2.504E-11	1.583E-11	1.137E-11	8.784E-12	7.144E-12	6.027E-12	5.194E-12	4.596E-12
SSW	1.116E-10	5.297E-11	3.259E-11	1.728E-11	1.103E-11	8.109E-12	6.384E-12	5.280E-12	4.515E-12	3.937E-12	3.524E-12
SW	8.963E-11	4.271E-11	2.636E-11	1.406E-11	8.997E-12	6.683E-12	5.290E-12	4.387E-12	3.754E-12	3.273E-12	2.927E-12
WSW	5.874E-11	2.799E-11	1.726E-11	9.199E-12	5.903E-12	4.421E-12	3.545E-12	2.988E-12	2.601E-12	2.304E-12	2.096E-12
W	4.289E-11	2.049E-11	1.264E-11	6.735E-12	4.313E-12	3.211E-12	2.561E-12	2.148E-12	1.862E-12	1.643E-12	1.490E-12
WNW	7.337E-11	3.499E-11	2.158E-11	1.150E-11	7.359E-12	5.458E-12	4.317E-12	3.578E-12	3.060E-12	2.668E-12	2.386E-12
NW	1.912E-10	8.756E-11	5.243E-11	2.711E-11	1.729E-11	1.244E-11	9.728E-12	8.020E-12	6.882E-12	6.014E-12	5.391E-12
NNW	1.715E-10	7.783E-11	4.616E-11	2.346E-11	1.476E-11	1.046E-11	8.035E-12	6.512E-12	5.495E-12	4.736E-12	4.187E-12
N	1.776E-10	8.331E-11	5.075E-11	2.655E-11	1.677E-11	1.177E-11	8.916E-12	7.114E-12	5.911E-12	5.026E-12	4.383E-12
NNE	9.813E-11	4.627E-11	2.819E-11	1.470E-11	9.254E-12	6.485E-12	4.919E-12	3.942E-12	3.294E-12	2.818E-12	2.479E-12
NE	5.825E-11	2.666E-11	1.588E-11	8.119E-12	5.129E-12	3.658E-12	2.829E-12	2.308E-12	1.960E-12	1.699E-12	1.512E-12
ENE	6.617E-11	3.050E-11	1.831E-11	9.490E-12	6.039E-12	4.319E-12	3.336E-12	2.708E-12	2.286E-12	1.968E-12	1.734E-12
E	6.646E-11	3.160E-11	1.943E-11	1.028E-11	6.530E-12	4.756E-12	3.688E-12	2.991E-12	2.504E-12	2.141E-12	1.875E-12
ESE	6.922E-11	3.257E-11	1.986E-11	1.039E-11	6.582E-12	4.762E-12	3.705E-12	3.037E-12	2.580E-12	2.238E-12	1.995E-12
SE	9.083E-11	4.237E-11	2.571E-11	1.338E-11	8.465E-12	6.096E-12	4.743E-12	3.895E-12	3.322E-12	2.894E-12	2.590E-12
SSE	1.306E-10	6.075E-11	3.676E-11	1.905E-11	1.197E-11	8.450E-12	6.354E-12	4.982E-12	4.036E-12	3.342E-12	2.821E-12

Table 2.3-340
Annual Average D/Q (m^{-2}) (Segment Boundaries) for Mixed-Mode Release from the Turbine Building Stack

	Segment Boundaries in Miles from the Site									
Sector	0.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	6.518E-09	1.998E-09	6.932E-10	3.523E-10	2.112E-10	8.513E-11	2.605E-11	1.152E-11	7.187E-12	5.219E-12
SSW	4.290E-09	1.302E-09	4.504E-10	2.311E-10	1.393E-10	5.695E-11	1.790E-11	8.197E-12	5.304E-12	3.955E-12
SW	3.674E-09	1.082E-09	3.637E-10	1.854E-10	1.118E-10	4.587E-11	1.454E-11	6.743E-12	4.404E-12	3.287E-12
WSW	2.398E-09	7.116E-10	2.387E-10	1.215E-10	7.324E-11	3.005E-11	9.525E-12	4.466E-12	3.000E-12	2.315E-12
W	1.508E-09	4.816E-10	1.702E-10	8.821E-11	5.345E-11	2.198E-11	6.972E-12	3.245E-12	2.157E-12	1.651E-12
WNW	2.821E-09	8.592E-10	2.950E-10	1.514E-10	9.147E-11	3.756E-11	1.190E-11	5.509E-12	3.592E-12	2.680E-12
NW	7.015E-09	2.089E-09	7.113E-10	3.630E-10	2.280E-10	9.497E-11	2.837E-11	1.265E-11	8.074E-12	6.040E-12
NNW	7.124E-09	2.197E-09	7.416E-10	3.636E-10	2.155E-10	8.457E-11	2.464E-11	1.064E-11	6.560E-12	4.758E-12
N	7.450E-09	2.087E-09	7.241E-10	3.724E-10	2.215E-10	8.979E-11	2.758E-11	1.196E-11	7.170E-12	5.050E-12
NNE	3.081E-09	1.076E-09	3.975E-10	2.000E-10	1.207E-10	4.976E-11	1.528E-11	6.597E-12	3.974E-12	2.834E-12
NE	1.817E-09	5.914E-10	2.268E-10	1.235E-10	7.305E-11	2.889E-11	8.515E-12	3.718E-12	2.324E-12	1.707E-12
ENE	2.139E-09	7.050E-10	2.639E-10	1.364E-10	8.273E-11	3.301E-11	9.917E-12	4.384E-12	2.727E-12	1.976E-12
E	2.272E-09	7.363E-10	2.639E-10	1.370E-10	8.291E-11	3.394E-11	1.065E-11	4.802E-12	3.005E-12	2.150E-12
ESE	2.441E-09	7.862E-10	2.797E-10	1.437E-10	8.652E-11	3.506E-11	1.080E-11	4.825E-12	3.054E-12	2.249E-12
SE	3.172E-09	1.093E-09	3.758E-10	1.901E-10	1.137E-10	4.574E-11	1.393E-11	6.187E-12	3.919E-12	2.908E-12
SSE	4.568E-09	1.595E-09	5.445E-10	2.741E-10	1.636E-10	6.562E-11	1.984E-11	8.550E-12	5.014E-12	3.355E-12

Table 2.3-341
Annual Average χ/Q (sec/m^3) and D/Q (m^{-2}) at the Site Boundary for Ground-Level Release

Sector	Distance (miles)	Undecayed, Undepleted χ/Q	2.26-Day Decay, Undepleted χ/Q	8-Day Decay, Depleted χ/Q	D/Q
S	1.08	1.50E-05	1.40E-05	1.30E-05	1.60E-08
SSW	2.20	2.70E-06	2.60E-06	2.20E-06	2.20E-09
SW	1.93	3.50E-06	3.30E-06	2.80E-06	2.50E-09
WSW	0.97	1.50E-05	1.50E-05	1.30E-05	1.10E-08
W	0.97	9.50E-06	9.30E-06	8.30E-06	7.90E-09
WNW	1.12	5.70E-06	5.60E-06	5.00E-06	7.50E-09
NW	0.76	2.10E-05	2.10E-05	1.90E-05	4.40E-08
NNW	0.80	1.20E-05	1.20E-05	1.10E-05	2.90E-08
N	0.76	1.20E-05	1.10E-05	1.00E-05	3.20E-08
NNE	0.66	1.20E-05	1.20E-05	1.10E-05	2.50E-08
NE	0.66	9.60E-06	9.50E-06	8.60E-06	1.50E-08
ENE	0.70	1.00E-05	1.00E-05	9.00E-06	1.50E-08
E	0.83	9.10E-06	9.00E-06	8.00E-06	1.10E-08
ESE	0.72	2.10E-05	2.00E-05	1.80E-05	2.00E-08
SE	0.95	1.60E-05	1.60E-05	1.40E-05	1.40E-08
SSE	1.04	1.30E-05	1.30E-05	1.10E-05	1.30E-08

Table 2.3-342
Annual Average χ/Q (sec/m^3) and D/Q (m^{-2}) at the Site Boundary for Mixed-Mode Release from the Reactor Building/Fuel Building Stack

Sector	Distance (miles)	Undecayed, Undepleted χ/Q	2.26-Day Decay, Undepleted χ/Q	8-Day Decay, Depleted χ/Q	D/Q
S	1.08	4.10E-07	4.10E-07	4.00E-07	4.20E-09
SSW	2.20	1.50E-07	1.50E-07	1.50E-07	6.00E-10
SW	1.93	1.40E-07	1.40E-07	1.40E-07	6.20E-10
WSW	0.97	1.60E-07	1.60E-07	1.50E-07	1.70E-09
W	0.97	1.20E-07	1.20E-07	1.20E-07	1.10E-09
WNW	1.12	2.00E-07	2.00E-07	2.00E-07	1.50E-09
NW	0.76	5.60E-07	5.60E-07	5.30E-07	8.50E-09
NNW	0.80	5.40E-07	5.40E-07	5.10E-07	7.80E-09
N	0.76	6.00E-07	6.00E-07	5.60E-07	8.90E-09
NNE	0.66	2.70E-07	2.70E-07	2.50E-07	3.90E-09
NE	0.66	1.40E-07	1.40E-07	1.40E-07	2.60E-09
ENE	0.70	1.40E-07	1.40E-07	1.30E-07	2.40E-09
E	0.83	1.70E-07	1.70E-07	1.60E-07	2.50E-09
ESE	0.72	1.80E-07	1.80E-07	1.80E-07	3.30E-09
SE	0.95	1.80E-07	1.80E-07	1.70E-07	2.90E-09
SSE	1.04	2.50E-07	2.50E-07	2.30E-07	3.60E-09

Table 2.3-343
Annual Average χ/Q (sec/m^3) and D/Q (m^{-2}) at the Site Boundary for Mixed-Mode Release from the Turbine Building Stack

Sector	Distance (miles)	Undecayed, Undepleted χ/Q	2.26-Day Decay, Undepleted χ/Q	8-Day Decay, Depleted χ/Q	D/Q
S	1.08	2.90E-07	2.90E-07	2.70E-07	3.60E-09
SSW	2.20	1.00E-07	1.00E-07	1.00E-07	5.60E-10
SW	1.93	9.70E-08	9.60E-08	9.30E-08	5.90E-10
WSW	0.97	1.00E-07	1.00E-07	9.90E-08	1.60E-09
W	0.97	7.30E-08	7.30E-08	7.00E-08	1.10E-09
WNW	1.12	1.20E-07	1.20E-07	1.20E-07	1.40E-09
NW	0.76	4.80E-07	4.80E-07	4.50E-07	7.50E-09
NNW	0.80	4.50E-07	4.50E-07	4.20E-07	6.90E-09
N	0.76	5.30E-07	5.30E-07	4.90E-07	7.90E-09
NNE	0.66	2.70E-07	2.70E-07	2.50E-07	3.60E-09
NE	0.66	1.30E-07	1.30E-07	1.20E-07	2.20E-09
ENE	0.70	1.30E-07	1.30E-07	1.20E-07	2.50E-09
E	0.83	1.30E-07	1.30E-07	1.20E-07	2.10E-09
ESE	0.72	1.50E-07	1.50E-07	1.40E-07	2.70E-09
SE	0.95	1.40E-07	1.40E-07	1.30E-07	2.50E-09
SSE	1.04	1.90E-07	1.90E-07	1.80E-07	3.10E-09

Table 2.3-344
On-Site Receptor/Source Locations

	Designation
Receptors	
Control Building Louvers	CB Louvers
Normal and Emergency Air Intakes on the West Face of Control Building near the South End	EN
Normal and Emergency Air Intakes on the West Face of Control Building near the North End	ES
Normal Air Intake on the North Face of Control Building	N
Technical Support Center (TSC) Intake	TSC
Sources	
Reactor Building	RB
Passive Containment Cooling System (Vent on Reactor Building Roof)	PCCS
Turbine Building	TB
Fuel Building	FB
Radwaste Building	RW

2.4 HYDROLOGIC ENGINEERING

2.4.1 HYDROLOGIC DESCRIPTION

2.4.1.1 Site and Facilities

RBS COL 2.0-12-A
RBS SUP 2.4.1-1

A description of the RBS site is presented in Section 2.1. Figure 2.1-203 identifies the property boundary and features in the RBS site area. Figure 2.1-204 shows the RBS site plan with the location and orientation of principal plant structures.

The RBS site includes two general levels of terrace. The alluvial floodplain on the east side of the river varies from 3000 to 4000 ft. wide and is at approximately 35 ft. msl. The upper terrace has an average elevation of more than 100 ft. msl. The RBS buildings and all safety-related equipment are located on the upper terrace. The original ground grade in this area was approximately 110 ft. msl. The finished ground grade is nominal Elevation 95 ft. National Geodetic Vertical Datum (NGVD). Grade varies from 97 ft. NGVD maximum to 90 ft. NGVD minimum.

The RBS site is drained by Grants Bayou on the east and Alligator Bayou on the west. Numerous unnamed intermittent streams cross the RBS site and drain to either Grants or Alligator Bayou. Grants Bayou enters Alligator Bayou to the south of the RBS site. It then flows south into Thompson Creek, which enters the Mississippi River approximately 7 mi. downstream of the RBS embayment.

The maximum postulated floods that can occur at the RBS site are identified in Subsection 2.4.3. Section 3.4 describes the design considerations in regard to these floods. The safety-related systems and components of the ESBWR standard plant are located in the Seismic Category I structures that provide protection against external flood and groundwater damage.

The Plant Drainage System and the ability of the RBS site to withstand a local intense Probable Maximum Precipitation (PMP) event are discussed in Subsection 2.4.2.3.

2.4.1.2 Hydrosphere

RBS SUP 2.4.1-2

The hydrologic behavior of nearby rivers, streams, and ponds has a strong influence on plant siting and elevations. Other hydrologic features considered in siting are dams, levees, and floodways, as well as the present users of surface and groundwater.

2.4.1.2.1 Mississippi River

The RBS is located adjacent to the Mississippi River at approximately River Mile (RM) 262. The river at St. Francisville (RM 266) has a contributing area of approximately 1,129,400 mi^2. This area includes 41 percent of the conterminous United States. The major tributary rivers above Red River Landing (RM 302), with their respective contributing and noncontributing drainage areas and major subdivisions, are listed in Table 2.4.1-201 and shown in Figure 2.4.1-201.

The western limit of the drainage area is the Rocky Mountains. The eastern limit is the Appalachian Mountain chain. Approximately 13,000 mi^2 of the drainage area are in Canada.

The Mississippi River rises in northern Minnesota and flows in a southerly direction to discharge into the Gulf of Mexico at the Head of Passes. Among the principal influents are the Missouri River at RM 1159, the Ohio River at RM 964, the White River at RM 583, and the Arkansas River at RM 575.

The Red and Ouachita Rivers do not physically join the main stem of the Mississippi River, but discharge directly to the Gulf through the Atchafalaya River. At RM 315, part of the discharge leaves the main stem of the Mississippi River and flows through the Old River control structures to the Atchafalaya River.

The valley walls on both sides of the floodplain converge at the latitude of Red River Landing near Torras, Louisiana (RM 302). This section marks the beginning of the deltaic plain and of the Atchafalaya River.

The average annual precipitation over the entire Mississippi River Basin is approximately 30.8 in. and varies from 21.8 in. over the Missouri River Basin to 48.5 in. over the Lower Mississippi River Basin.

River discharge and stage measurement stations are maintained at numerous locations by the U.S. Army Corps of Engineers (USACE) and the U.S. Geological Survey (USGS). A few of the stations have records beginning in the 1870s, but most of the records started in the 1920s. The runoff volume for the entire basin averages 480 million acre-feet (ac.-ft.) annually. This runoff is equivalent to a mean annual discharge of 660,000 cubic feet per second (cfs) for the entire basin. Based on USACE flow records at Tarbert Landing, Mississippi, and Red River Landing, Louisiana, the estimated mean annual discharge at the site is approximately 503,000 cfs. Annual maximum, minimum, and mean flow rates for the Mississippi River at the RBS site are provided in Table 2.4.1-202. The construction of flow control structures in the Mississippi River Basin since 1956 has altered hydrologic relationships from the historical precedent. This development has tended to increase the low flows and decrease the periods of high flow. This is supported by Table 2.4.1-202. For the period 1956 through 2006, the average annual peak flow has decreased, and the average annual low flow has increased, as compared to the period 1900 through 1955. Table 2.4.1-203 lists monthly and annual runoff for the drainage areas shown in Figure 2.4.1-201.

The Mississippi River and its tributaries have many flow control structures, such as levees, floodways, and dams. The following discussion provides a description of these structures.

Levees

The alluvial valley of the Mississippi River extends from Cape Girardeau, Missouri, approximately 50 miles upstream of Cairo, Illinois (RM 956) to the Gulf of Mexico. It varies in width from 20 to 80 mi., with an average width of 45 mi. During a flood, the river goes out of its banks in some areas and deposits sediment, forming banks generally 10 to 15 ft. above the floodplain. This building of natural levees occurred, for the most part, before the present levee system was constructed. The river has almost uninterrupted man-made levees on the west bank from Cape Girardeau to the Gulf. On the east side of the river, levees alternate with high bluffs from Cairo to Baton Rouge (RM 230); from Baton Rouge to the Gulf, there are continuous levees.

The Floodway System

When all the control structures in the Mississippi River Basin are considered, the floodway system and associated structures in the river delta have the most direct bearing on river flood stage at the RBS site. The system consists of three major floodways, which are the West Atchafalaya Floodway, the Morganza Floodway, and the Bonnet Carre Spillway, plus the Atchafalaya River proper. This system is shown in Figure 2.4.1-202.

The Atchafalaya River is a continuation of the Red River. It starts at the latitude of Red River Landing (RM 302) and discharges into Atchafalaya Bay at the Gulf of Mexico. Acting as a distributary, it also receives water from the Mississippi River through the Old River control structures (RM 315).

The West Atchafalaya Floodway also starts at the latitude of Red River Landing and parallels the Atchafalaya River. The Morganza Floodway leaves the main stem of the Mississippi River at approximately RM 285. It flows west and then merges with them to become the Lower Atchafalaya Floodway. The Bonnet Carre Spillway leaves the main stem of the Mississippi River at approximately RM 128 and directs floodwaters into Lake Pontchartrain and then to the Gulf.

The chronological sequences of floodway operation during a severe flood would be as follows:

1. As the river discharge approaches 1,250,000 cfs, the Bonnet Carre Spillway is opened. The spillway is operated to prevent the Carrolton (New Orleans) Stage from exceeding 20 ft. As the flow increases, the Old River control structures would be operated to allow water from the Mississippi River to flow into the Atchafalaya River. The Morganza Floodway is the next flood relief structure that would be operated.

2. The West Atchafalaya Floodway is protected at its upper end by a fuse-plug, making the West Atchafalaya Floodway operational. The remaining flood flow is discharged by the Mississippi River and the Bonnet Carre Spillway.

The combined discharge of the three parallel floodways is approximately one-half of the USACE project design flood (PDF) at the latitude of Red River Landing. The maximum postulated flood flow that has been calculated by the USACE is officially defined as the lower Mississippi River PDF (refer to Subsection 2.4.3).

Dams

Dams are discussed in Subsection 2.4.4.

2.4.1.2.2 Local Streams

The RBS Unit 3 site is located above the Mississippi River floodplain on elevated, gently sloping terrain approximately 2 mi. east of the Mississippi River at RM 262. Local streams are intermittent or have a low base flow, with a tendency to rise and fall rapidly, dependent upon local rainstorms. Peak flows in these streams are discussed in Subsection 2.4.2.

The RBS site lies within the approximately 15.6 mi^2 Grants Bayou drainage basin, shown in Figure 2.4.1-203. Approximately 8.4 mi^2 of the basin (Upper Grants Bayou) lie upstream from the RBS site.

Just south of the RBS site, a small tributary of Grants Bayou enters from the west. This stream, called West Creek, drains approximately 1 mi^2, including portions of the RBS site.

The RBS Unit 3 power block is situated between Grants Bayou and West Creek (refer to Figure 2.4.1-203). Flooding of these two streams is the chief flooding concern for the RBS site and is discussed in Subsection 2.4.3.

The adjacent Alligator Bayou drainage basin drains a portion of the RBS site property. Above the river floodplain, this same stream is called Alexander Creek. Since 1953, the USGS has maintained a crest-stage gage on Alexander Creek and has collected peak stage data on an annual basis noncontinuously to the present. The area of Alexander Creek Basin above the gage is approximately 23.9 mi^2. The area of the Alligator Bayou Basin, north of the southern RBS property line, is approximately 30.4 mi^2.

Grants Bayou joins Alligator Bayou in the river floodplain just south of the RBS property. Alligator Bayou joins Thompson Creek approximately 3 mi. above the point where Thompson Creek flows into the Mississippi River.

Stream Control Structures

There are no control structures on Grants Bayou. Plant construction would have no significant effect upon flood flows or stages. During RBS Unit 1 construction, West Creek was confined in a 2850 ft. long Fabriform-lined channel slightly west of the Unit 1 plant area. For RBS Unit 3, the Fabriform-lined channel would be relocated just west of its present location. Storm runoff would be directed into the channel through a concrete drop structure at the upstream end.

Bridges on local streams are discussed in Subsection 2.4.3.

2.4.1.2.3 Lakes

There are a number of small farm ponds in the local watershed area, but few natural lakes. Twenty-four ponds existed within the site boundary prior to the construction of Unit 1, with a total surface area of 28.6 ac. (refer to Figure 2.4.1-204). Five ponds were removed during RBS Unit 1 construction, having a combined total surface area of approximately 1.7 ac. An additional pond with a surface area of 0.5 ac. would be removed during Unit 3 construction. Following Unit 3 construction, 18 small farm ponds would exist in the local watershed area, with a total surface area of 26.4 ac. The impact of local ponds on site flooding is discussed in Subsection 2.4.3.

The water level of Pond No. 11 is 111.1 ft. msl, which is higher than the average site grade of 95.0 ft. msl. An analysis determined that an instantaneous and complete failure of this pond would not affect the design basis water level at the RBS (Reference 2.4.1-201).

2.4.1.2.4 Users of River Water

The neighboring and nearest downstream users of Mississippi River water are power/industrial users, including the Big Cajun Power Plant and the Tembec Coated Paper Plant. According to the USGS, approximately 29.8 million gallons per day (mgd) of Mississippi River water was used for paper products in 2000 in West Feliciana Parish, and a total of 274 mgd was withdrawn for power generation in the Point Coupee Parish where the Big Cajun Power Plant is located (Reference 2.4.1-202). Industrial and power generation water usage does not vary significantly seasonally, so daily usage can be used to indicate monthly usage estimates. The continuing use of water by the Tembec facility is uncertain because of a shutdown of that facility as of July 31, 2007.

Summary data in Table 2.4.1-204 show significantly lower surface water withdrawals in the immediately downstream parishes of East Feliciana and East Baton Rouge.

A tabulation of groundwater users is presented in Subsection 2.4.13.

2.4.1.3 References

2.4.1-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report," through Revision 19, July 2006.

2.4.1-202 U.S. Geological Survey and Louisiana Department of Transportation and Development, "Water Use in Louisiana, 2000."

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Table 2.4.1-201 (Sheet 1 of 3) Mississippi River Basin Drainage Areas of Subdivisions

Area No.[a]	Sub-Area Designation	Area (mi^2)	Limiting Stations
1	A-1	1060	Golconda to mouth of Ohio River
	A-2	24,130	Golconda to Louisville, Kentucky
	B-1	19,500	Chattanooga to Mouth of Tennessee River
	B-2	21,400	Tennessee River above Chattanooga
	C	18,080	Cumberland River above Smithland
	D	28,600	Wabash River above Mount Carmel
	E	35,270	Louisville, Kentucky, to Huntington
	F	55,900	Ohio River above Huntington
	Total	203,940	
2	G-1	8030	Alton, Illinois, to Lock & Dam No. 22, Illinois
	G-2	17,170	Meredosia to Marseilles, Illinois
	G-3	7630	Illinois River above Marseilles
	H-1	13,610	Lock & Dam No. 22 to Keokuk, Iowa
	H-2	5490	Des Moines River above Boone, Iowa
	I	51,500	Keokuk, Iowa to McGregor, Iowa
	J	67,500	Mississippi River above McGregor, Iowa
	Total	171,470	
3	K-1	1150	Mouth to Hermann, Missouri
	K-2	22,500	Hermann, Missouri, to Boonville, Missouri
	K-3	21,510	Boonville, Missouri, to St. Joseph, Missouri
	L	59,890	Kansas River above Bonner Springs, Kansas
	M	103,870	Missouri River above St. Joseph up to Fort Randall and Brady
	N	56,900	Platte River above Brady
	O	263,530	Missouri River above Fort Randall
	Total	529,350	

Table 2.4.1-201 (Sheet 2 of 3) Mississippi River Basin Drainage Areas of Subdivisions

RBS USAR

Area No.[a]	Sub-Area Designation	Area (mi^2)	Limiting Stations
4	P-1	7715	Little Rock, Arkansas, to Van Buren, Arkansas
	P-2	4573	Van Buren to Whitefield and Muskogee and mouth of Illinois River
	Q-1	23,719	Muskogee to Tulsa and above mouth of Illinois River
	Q-2	22,460	Tulsa to Hutchinson, Kansas, to Waynoka and Mouth of Cow Creek
	Q-3	9129	From Hutchison, Waynoka to Bridgeport, Mocane, Great Bend, and Canton plus area above Cow Creek
	R	9859	Whitefield to Bridgeport and Canton
	S	80,743	Above Bridgeport, Mocane, Great Bend, and Canton
	Total	158,198	
5	T	25,497	White River above Clarendon, Louisiana
	Total	25,497	
6	V-1	15,120	Alexandria, Louisiana, to Fulton, Arkansas
	V-2	12,661	Fulton, Arkansas to Denison, Texas
	U-1	33,022	Denison, Texas, to Longitude 101 14'
	U-2	6697	Red River above Longitude 101 14'
	Total	67,500	
7	Y	17,200	Middle Mississippi River Cairo to Alton and mouth of Missouri River
	X-1	8080	Arkansas City, Little Rock, Clarendon, Riverfront, Parkin to Memphis
	X-2	6408	Above Riverfront and Parkin
	X-3	11,442	Memphis to Cairo

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Table 2.4.1-201 (Sheet 3 of 3)
Mississippi River Basin Drainage Areas of Subdivisions

Area No.[a]	Sub-Area Designation	Area (mi^2)	Limiting Stations
	W-1	1900	Tarbert Landing to Natchez
	W-2	10,622	Red River to Tarbert Landing and Alexandria and Monroe
	W-3	15,298	Ouachita River above Monroe, Natchez to Vicksburg
	W-4	4900	Natchez to Vicksburg
	W-5	6350	Vicksburg to Arkansas City and Greenwood
	W-6	7450	Yazoo River above Greenwood
	Total	89,650	

a) Refer to Figure 2.4.1-201 for locations.

Source: U.S. Government Printing Office, Mississippi River and Tributaries Project, Volume 2, 88th Congress, 2nd Session, House Document No. 308. Washington, D.C., 1964. (Includes contributing and noncontributing drainage areas.)

Table 2.4.1-202 (Sheet 1 of 4)
Mississippi River Flow (1900 - 2006)
(Thousand Cubic Feet per Second)

Year	Max.	Min.	Mean
1900	796	157	434
1901	822	104	377
1902	861	198	461
1903	1206	116	639
1904	1018	119	465
1905	918	165	576
1906	1116	253	592
1907	1275	198	676
1908	1218	138	667
1909	1163	157	581
1910	853	130	473
1911	1007	174	459
1912	1499	198	646
1913	1272	167	584
1914	903	137	409
1915	934	298	653
1916	1327	157	641
1917	1218	110	510
1918	727	110	400
1919	960	154	602
1920	1223	181	657
1921	992	156	527
1922	1437	133	566
1923	1126	226	590
1924	928	154	549
1925	656	104	368
1926	813	143	477
1927	1779	173	867
1928	1035	236	601
1929	1301	163	643

**Table 2.4.1-202 (Sheet 2 of 4)
Mississippi River Flow (1900 - 2006)
(Thousand Cubic Feet per Second)**

Year	Max.	Min.	Mean
1930	911	125	419
1931	672	119	283
1932	1244	158	516
1933	1076	130	522
1934	720	130	292
1935	1087	112	574
1936	973	92	346
1937	1467	128	514
1938	1062	131	511
1939	1124	75	445
1940	872	93	313
1941	749	146	376
1942	973	242	499
1943	1280	133	520
1944	1282	125	475
1945	1520	179	683
1946	1085	145	509
1947	898	114	426
1948	959	126	448
1949	1208	176	555
1950	1458	194	696
1951	986	221	625
1952	1011	107	466
1953	852	100	373
1954	583	121	262
1955	1022	120	363
1956	894	99	332
1957	994	180	548
1958	984	157	482
1959	765	130	382
1960	826	148	409

Table 2.4.1-202 (Sheet 3 of 4)
Mississippi River Flow (1900 - 2006)
(Thousand Cubic Feet per Second)

Year	Max.	Min.	Mean
1961	1107	183	514
1962	1081	151	475
1963	881	123	268
1964	1018	119	367
1965	942	160	416
1966	1154	155	371
1967	824	180	385
1968	861	158	434
1969	1064	182	457
1970	980	178	437
1971	1036	174	388
1972	938	218	480
1973	1498	204	721
1974	1174	187	586
1975	1216	230	563
1976	721	158	364
1977	746	171	379
1978	977	187	470
1979	1419	187	680
1980	1049	247	494
1981	773	145	354
1982	873	209	492
1983	1470	200	697
1984	1199	172	595
1985	1128	201	564
1986	1023	207	502
1987	974	176	512
1988	1000	111	378
1989	1138	124	561
1990	1230	188	599
1991	1303	208	629

**Table 2.4.1-202 (Sheet 4 of 4)
Mississippi River Flow (1900 - 2006)
(Thousand Cubic Feet per Second)**

Year	Max.	Min.	Mean
1992	855	181	465
1993	1202	196	729
1994	1164	185	623
1995	1167	186	532
1996	1026	204	492
1997	1480	198	672
1998	1080	185	579
1999	1179	155	540
2000	684	138	321
2001	1120	157	455
2002	1116	181	548
2003	1015	224	495
2004	889	205	522
2005	1229	167	536
2006	735	145	302
Ave.	**1053**	**162**	**503**
	1900 - 1955		
Ave.	**1062**	**151**	**513**
	1956 - 2006		
Ave.	**1043**	**175**	**492**

Source: U.S. Army Corps of Engineers
1900 - 1962 Discharge at Red River Landing, Louisiana (RM 300.6)
1963 - 2006 Discharge at Tarbert Landing, Mississippi (RM 306.3)

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Table 2.4.1-203
Mississippi River Watershed Runoff Characteristics

Area No. [a]	Area (mi^2)	Annual Runoff (in.)			Monthly Runoff (in.)		
		Minimum	Average	Maximum	Minimum	Average	Maximum
1	203,940	7.8	17.6	29.8	0.11	1.47	6.15
2	171,470	3.5	7.7	12.0	0.14	0.65	1.95
3	529,350	0.8	2.0	3.9	0.02	0.17	0.98
4	158,198	1.0	3.8	9.1	0.01	0.32	2.79
5	25,497	6.5	17.2	32.3	0.14	1.43	5.24
6	67,500	2.0	6.7	14.6	0.02	0.56	3.48
7	89,650	-	16.8	-	-	1.40	-
1-7	1,245,605	3.7	7.1	11.9	0.09	0.59	2.04

a) Refer to Figure 2.4.1-201 for locations.

Source: U.S. Government Printing Office, Mississippi River and Tributaries Project, Vol. 2, 88th Congress, 2nd Session, House Document N. 308
Washington, D.C., 1964.

Table 2.4.1-204
2000 Water Use Totals, Louisiana Parishes Surrounding the RBS Site

Parish	Groundwater Withdrawals	Surface Water Withdrawals	Total Withdrawals	Consumptive Use
West Feliciana	6.17	44.29	50.46	18.24
East Feliciana	3.46	0.19	3.65	3.21
East Baton Rouge	135.66	18.50	154.16	100.10

Note:

Water quantities expressed in million gallons per day (mgd).

Source: Reference 2.4.1-202.

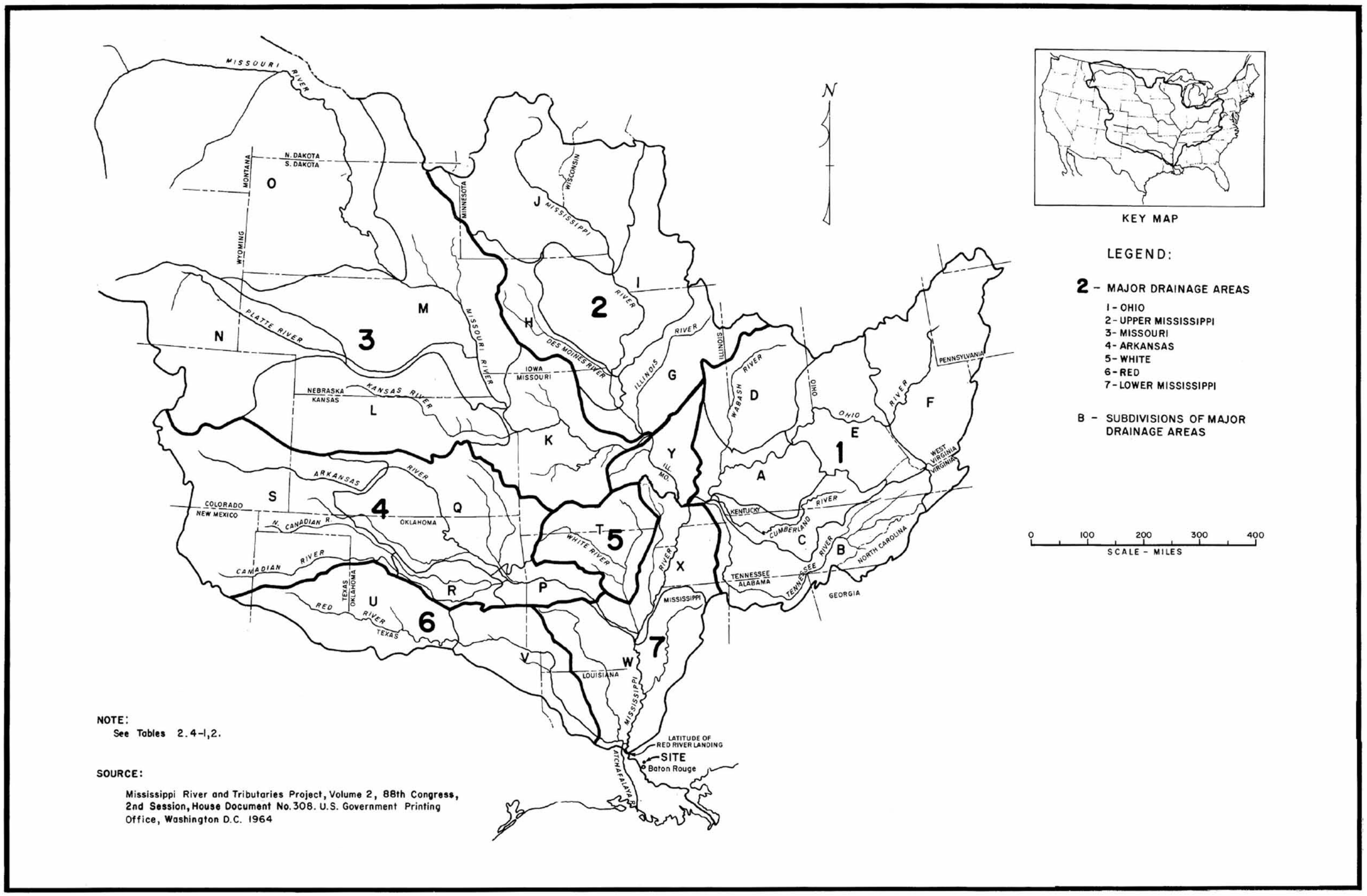


Figure 2.4.1-201. Drainage Area above Red River Landing

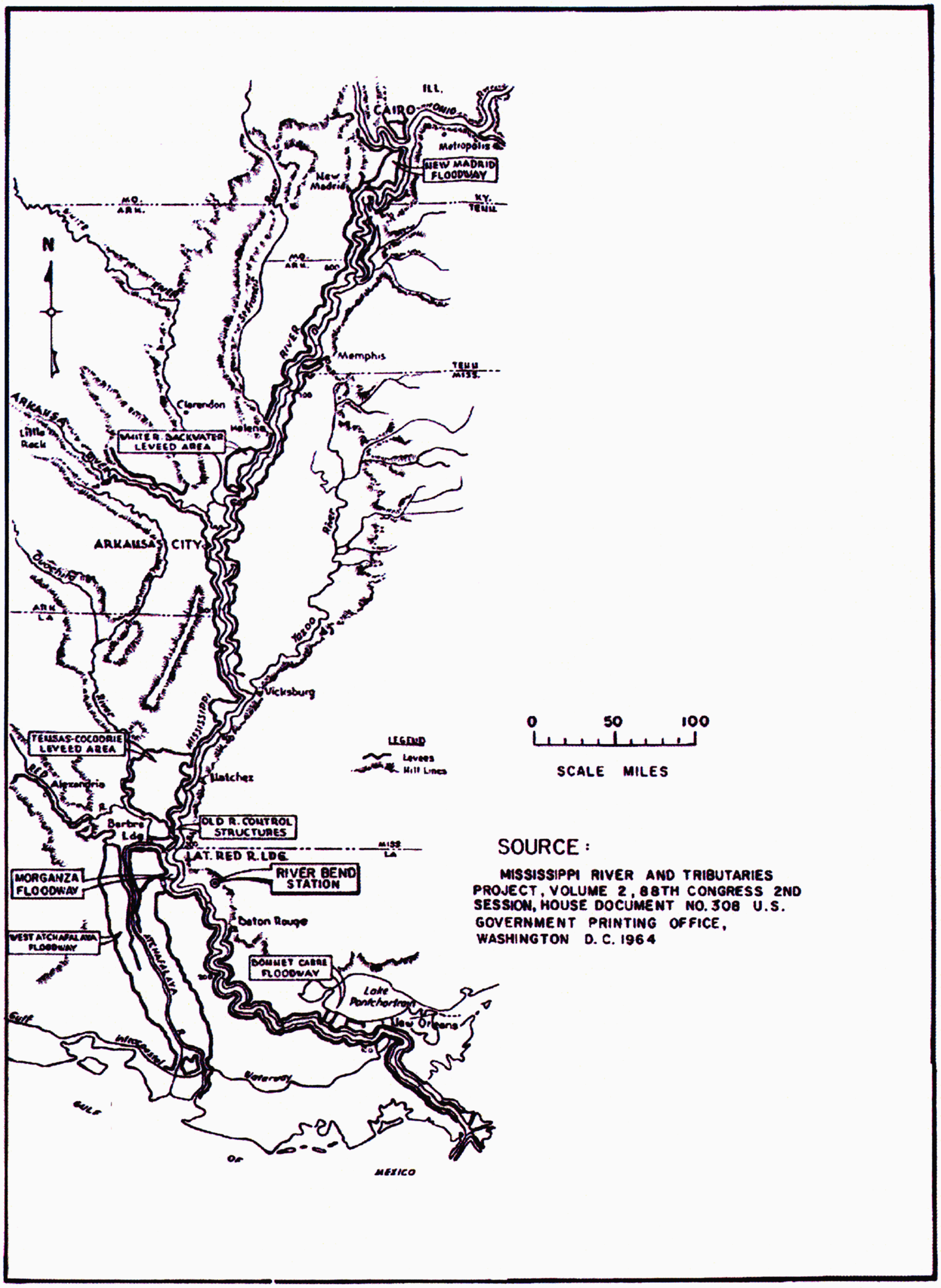


Figure 2.4.1-202. Existing Flood Control Structures

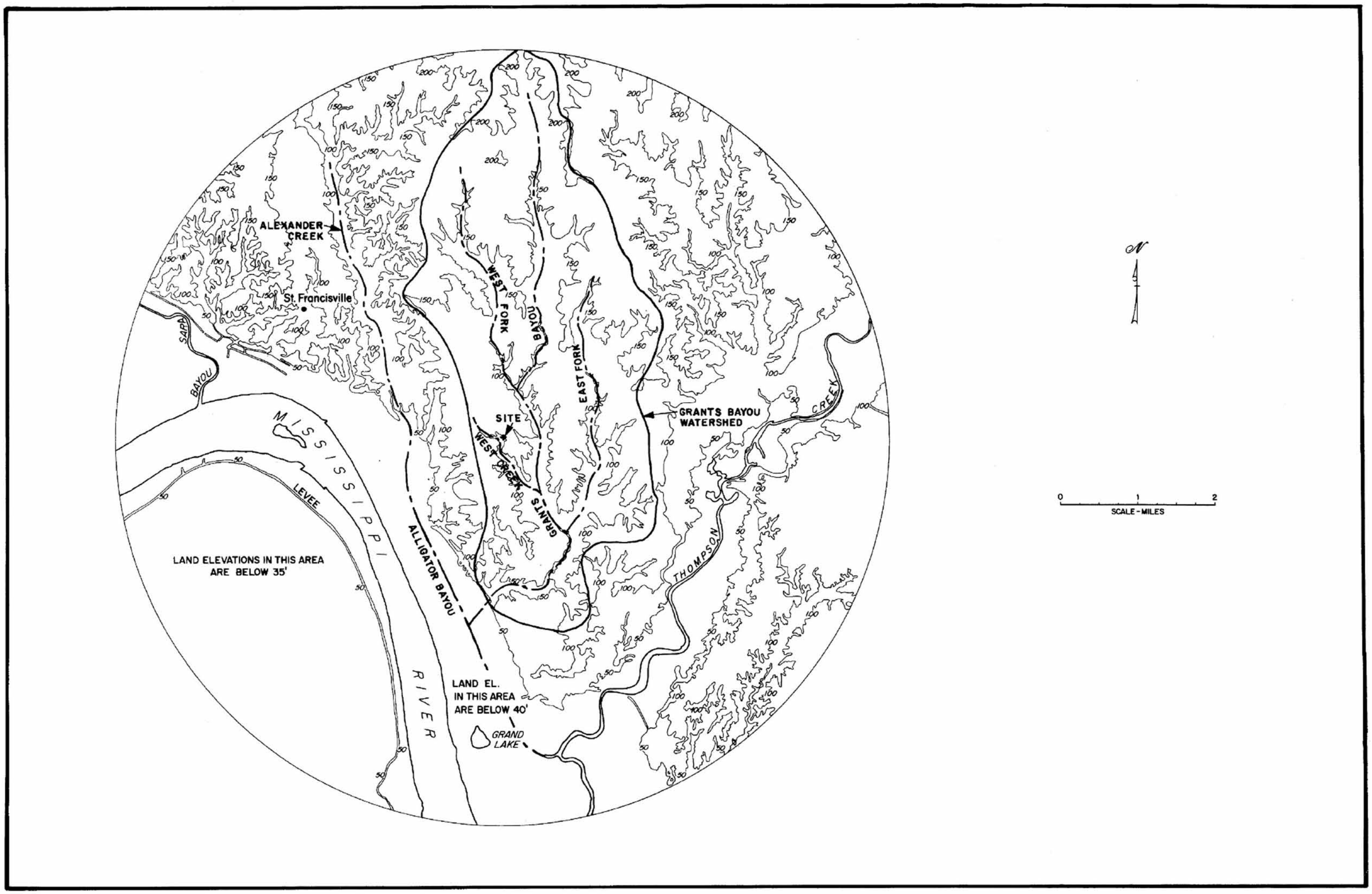
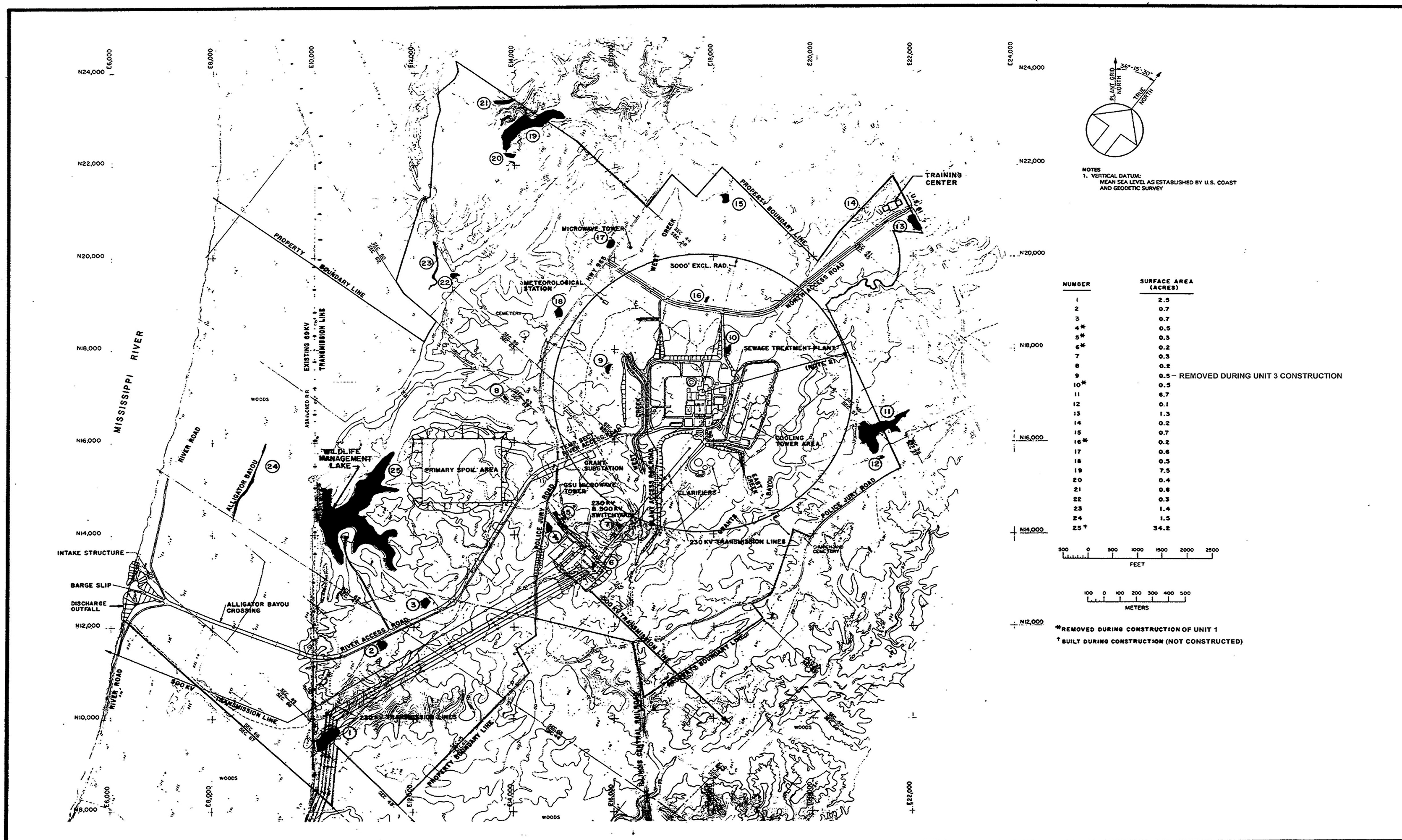


Figure 2.4.1-203. Local Drainage



NUMBER	SURFACE AREA (ACRES)
1	2.5
2	0.7
3	0.7
4*	0.5
5*	0.3
6*	0.2
7	0.3
8	0.2
9	0.5 – REMOVED DURING UNIT 3 CONSTRUCTION
10*	0.5
11	6.7
12	0.1
13	1.3
14	0.2
15	0.7
16*	0.2
17	0.6
18	0.3
19	7.5
20	0.4
21	0.8
22	0.3
23	1.4
24	1.5
25†	34.2

*REMOVED DURING CONSTRUCTION OF UNIT 1

† BUILT DURING CONSTRUCTION (NOT CONSTRUCTED)

Figure 2.4.1-204. Site Area Ponds

2.4.2 FLOODS

2.4.2.1 Flood History

2.4.2.1.1 Mississippi River

RBS COL 2.0-13-A Major floods on the Lower Mississippi River (below the confluence with the Ohio River) generally occur when floods of the major tributaries coincide. A substantial contribution from the Ohio River is required to produce a major flood.

Major floods on the Ohio River generally occur between the middle of January and the middle of April. On the Upper Mississippi and Missouri Rivers, floods occur between mid-April and July, and on the Arkansas and White Rivers, between April and June. The flood season on the Lower Mississippi includes the flood seasons of the individual influents and extends from mid-January to July (Reference 2.4.2-201).

The first Mississippi River flood in recorded history occurred in 1543. There are fragmentary records of great floods occurring in 1782, 1785, 1796, 1809, 1815, 1823, 1844, 1849, 1858, 1862, 1867, and 1882. More recently, there are records of floods occurring in 1903, 1912, 1913, 1916, 1922, 1927, 1937, 1945, 1950, 1973, 1979, 1991, and 1997. Most of the flood data collected before 1913 are of doubtful accuracy and, therefore, not useful for comparison with later data (Reference 2.4.2-202). A detailed description of the modern floods, with the exception of the 1973 and 1979 floods, has been prepared by the USACE Reference 2.4.2-203). A description is given in this subsection of the origins and course of the 1973 flood, for the purpose of presenting river flood response to a major storm. Although the 1979 flood produced a greater water level at the RBS site, a description of this flood is not provided because this event has no bearing on the design basis flooding at the RBS site, which is approximately 40 ft. above the peak flood elevation. A description of the 1997 flood is also provided in this subsection. Annual maximum, minimum, and mean flows for the Mississippi River near the RBS site are provided in Table 2.4.1-202.

The flood of 1927 was the most disastrous in the history of the Lower Mississippi Valley. It was the result of a series of storms from the fall of 1926 through April 1927. There were flood waves on the Lower Mississippi in January, February, and April, each increasing in magnitude. Approximately 14.7 million ac. of the alluvial valley were inundated. The major storm occurred April 12 to 16 and produced extremely high stages on the Upper Mississippi and Missouri Rivers. The storm was even more severe over the Arkansas and Red River Basins. With the rivers on the rise, another intense storm followed April 18 to 24. Crevasses and breaks in the levees occurred all along the Lower Mississippi.

The 1973 flood was among the greatest recorded on the Mississippi River. During December 1972, more than 4 in. of precipitation fell over most of the Ohio Basin, and more than 8 in. over large portions of the Tennessee and Cumberland Basins. Widespread rainfall occurred throughout much of January 1973, and precipitation in the White, Lower Missouri, and Lower Arkansas Basins reached or exceeded 150 percent of normal.

During March, most of the area that contributes to Mississippi River flooding experienced precipitation in excess of 150 percent of normal, the principal exception being the Upper Ohio Basin. Large areas received more than 200 percent excess, and areas of the Arkansas and Missouri Basins received more than 400 percent of normal rainfall.

During April, precipitation in excess of 150 percent of normal fell over the Upper Mississippi, the Upper Ohio, and the Lower Mississippi Basins and parts of the Arkansas-Red Basins. In May, heavy rains fell over the Upper Mississippi Valley and over the Ohio River southward to the Gulf. There was also considerable above-normal precipitation in June.

The cause of flooding in 1973 was not one or two large storms, but rather a long, continued excess of precipitation.

In early December 1972, the Middle Mississippi was falling, and the Lower Ohio, Tennessee, and Cumberland Rivers were rising. The crest inflow to the Cairo, Illinois reach at the upstream portion of the Lower Mississippi (RM 956) was approximately 1,100,000 cfs, of which the Middle Mississippi contributed only approximately 175,000 cfs.

By the end of January 1973, the Middle Mississippi had risen to a crest of approximately 450,000 cfs, but, because of a flow reduction on the Lower Ohio and its tributaries, the simultaneous crest inflow to the Cairo reach was less than 900,000 cfs. The Mississippi River flow at Helena, Arkansas (RM 663) remained above 1,000,000 cfs until the middle of January, but the Arkansas and White Rivers were not unusually high, so that the crest inflow below the mouth of the Arkansas River (RM 584) did not exceed 1,200,000 cfs.

During February, the Middle Mississippi produced discharges that again exceeded 450,000 cfs. However, the Lower Ohio and its tributaries contributed only moderately, so that the crest inflow to the Cairo reach had a peak of approximately 950,000 cfs. At Helena, the crest discharge exceeded 1,000,000 cfs, but Arkansas-White contributions were not excessive, and the peak inflow below the mouth of the Arkansas was less than 1,200,000 cfs.

By the beginning of March, flow from all the major tributaries was reduced, and the Middle Mississippi was discharging less than 250,000 cfs. The unusually small contributions from the Lower Ohio and tributaries brought the total main stem flow at Cairo to less than 450,000 cfs. At this time, a general rise began. By the end of March, the Middle Mississippi was discharging approximately 700,000 cfs, and other contributions brought the Cairo discharge to more than 1,500,000 cfs. This proved to be the Cairo crest. However, the Middle Mississippi continued to rise, reaching a crest at St. Louis of approximately 850,000 cfs on April 29, resulting from nearly, but not quite, coincident crests of 450,000 cfs on the Missouri River and 530,000 cfs from the Upper Mississippi system.

In the middle of April, the Cairo discharges eased a little, but began to rise again. In early May, a second crest occurred, nearly as great as the first. In the meantime, during April, rises occurred on the Arkansas and White Rivers, culminating near the end of April in a combined discharge of approximately 540,000 cfs. These flood waves were timed so as to combine with the second Cairo crest to produce a crest discharge of approximately 1,880,000 cfs below the mouth of the Arkansas in early May.

The Red-Ouachita River system produced a flood wave with timing so as to combine with the Mississippi in early May to produce a crest flow of approximately 2,150,000 cfs below the latitude of the mouth of Red River. This flow was distributed to the Mississippi River and the Atchafalaya River and floodway system.

Approximately 12.5 million ac. were inundated along the Middle and Lower Mississippi. From St. Louis to New Orleans, the river was generally out of banks from mid-March until June 1973. The 1973 flood crest would be expected to recur approximately once in 20 years at Cairo. Due to the coincidence of flooding from the St. Francis, White, Arkansas, and Yazoo Basins, the recurrence frequency at Vicksburg, Mississippi (RM 437) is estimated at 40 years.

Except for some problems in the unleveed backwater areas and in the Atchafalaya Basin, the flood was successfully contained within the main stem levees. However, in the middle reach of the river where levee cutoffs were made in the 1930s and 1940s, there was evidence of a reduction in channel capacity. Stages in this reach were considerably higher than had been expected for the discharged experienced. No abnormal trend of this sort was observed below Red River Landing (RM 301) (Reference 2.4.2-204).

Record stages were not set near the RBS site (RM 262.5) because of operation of the Bonnet Carré Spillway (RM 128) and the Morganza Spillway (RM 286), as well as the Old River control structures (RM 315). In 1973, the peak stage at Bayou Sara, approximately 2 mi. upstream from the RBS site, was 50.7 ft. msl. This compares to the record of 55.5 ft. msl in 1927, and to stages of 51.2, 53.2, 52.7, 53.7, 50.7, 52.5, 53.9, and 53.5 ft. msl in 1912, 1922, 1937, 1945, 1950, 1979, 1983, and 1997, respectively (Reference 2.4.2-205). Annual stage data at Bayou Sara for the period 1889 - 2006 are provided in Table 2.4.11-201.

The stage remained continuously above bankfull stage of 32 ft. msl at Bayou Sara from March 19 to July 5, 1973, a period of 109 days. Water was continuously present on floodplain portions of the RBS property for approximately this same period.

The last major flood that prompted the seventh opening of the Bonnet Carré Spillway happened during the spring of 1997 as a result of headwater flow along the main stem of the Mississippi River. This headwater flow was caused by several storm systems that generated heavy rains over the upper and central Mississippi River valley during February and early March 1997. The Morganza (RM 278.2) and Baton Rouge (RM 228.4) gages both peaked on March 26 with peak stages of 58.35 ft. NGVD and 43.79 ft. NGVD, respectively. The maximum discharge recorded for this 1997 flood was 1,475,000 cfs on March 19 at the Tarbert Landing Station.

2.4.2.1.1.1 Flood History

Historical flooding on the Lower Mississippi River and local streams is discussed in this subsection. Surge and seiche flooding is discussed in Subsection 2.4.5. Flooding caused by a tsunami is discussed in Subsection 2.4.6, and ice jam flooding is discussed in Subsection 2.4.7.

2.4.2.1.2 Streams

No flood records are available for streams that potentially could flood the RBS site. The USGS has collected data on two other watersheds in the region: Alexander Creek and West Fork Thompson Creek.

A crest-stage gaging station was maintained on Alexander Creek near St. Francisville, Louisiana, from May 18, 1953 to April 6, 1983 by the USGS. The flow on Alexander Creek has varied from 13,200 cfs, occurring in 1953, to zero, which has occurred several times during the period of record. The stream is subject to periods of high runoff and extreme drought periods of zero flow. Table 2.4.2-201 presents the maximum flows and gage heights that have occurred during the period of record (Reference 2.4.2-206).

The USGS also had a water stage recorder on West Fork Thompson Creek near Wakefield, Louisiana, from January 6, 1950 to June 2, 1970. The peak recorded flow of 18,100 cfs occurred in May 1953. Table 2.4.2-202 presents the maximum flows and gauge heights that have occurred during the period of record (Reference 2.4.2-207).

2.4.2.2 Flood Design Considerations

Safety-related structures, systems, and components (SSCs) for a new facility would be designed to withstand the worst flooding caused by an appropriate combination of several hypothetical events. The events to be considered would include: probable maximum flood (PMF) of the Mississippi River coincident with wind-generated waves (refer to Subsection 2.4.3.6); seismic failure of upstream dams coincident with the USACE PDF (refer to Subsection 2.4.4); ice flooding (refer to Subsection 2.4.7); and PMF of the small streams adjacent to the RBS (refer to Subsection 2.4.3.3). The elevation of the structures of a new facility would be well above the Mississippi River PMF, eliminating Mississippi River flooding concerns from the design of SSCs. Therefore, the event that would control the facility flood design is the PMP on the watersheds for the site (Subsection 2.4.2.3).

The USACE has conducted extensive studies of Mississippi River flood hydrology and has determined a PDF (Reference 2.4.2-203). The PDF is based upon floods predicted by the U.S. Weather Bureau as the "maximum possible" and by the Mississippi River Commission as the "maximum probable" (Reference 2.4.2-201). The PDF constitutes the basis for a determination of the PMF at the RBS site (refer to Subsection 2.4.3).

The PMF flows for Grants Bayou and West Creek were computed. These basins and the estimated design basis flood levels are described in Subsection 2.4.3. The Grants Bayou PMF was conservatively assumed to coincide with the PDF on the Mississippi River. The peak river stage elevation is 54.5 ft. msl, as determined by the USACE (Reference 2.4.2-201). This was used as the starting elevation for the Grants Bayou backwater profile calculations.

The flood flows for West Creek and Grants Bayou below West Creek were reduced in the upstream direction at each cross section to account for the reduction in contributing drainage area. The flow for Grants Bayou above West Creek was conservatively assumed to exist undiminished upstream.

An analysis of the computed flood hydrographs was conducted to determine the flow and water level in Grants Bayou that would occur simultaneously with the West Creek peak flow. This Grants Bayou level was used as the starting elevation for the West Creek backwater profile. A similar comparison was conducted to determine the flow contribution from West Creek for the times of peak flow in Grants Bayou at the West Creek confluence and in Grants Bayou at the outlet to the river floodplain.

The local streams are spanned by railroad and road bridges, with piers located adjacent to and in the stream bed. These streams are subject to debris accumulation. For these reasons, each bridge crossing downstream of the RBS was assumed to be 50 percent clogged at the occurrence of the PMF and 1/2 PMF + operational basis earthquake (OBE), and 100 percent clogged for the 25-year flood + safe shutdown earthquake (SSE).

Three West Creek crossings were built to facilitate RBS Unit 1 construction. One is located upstream of the West Creek drop structure, and one is located along the Fabriform-lined portion of West Creek. The third crossing, also located along the Fabriform-lined portion of West Creek, was removed prior to Unit 1 operation. A description of the two remaining crossings is provided in Subsection 2.4.3.5.2. For both the PMF and 25-year flood + SSE, 100 percent culvert clogging is assumed at these crossings.

Flow through bridges or embankment conveyances upstream of the RBS was conservatively assumed to enter the study area undiminished in magnitude.

Backwater calculations were performed on West Creek flows assuming creek conditions as they will exist during plant operation.

Combinations of extreme local flooding and seismic events were also investigated. An OBE combined with a 1/2 PMF and an SSE combined with a 25-year flood were assumed to occur. Neither occurrence would produce water levels higher than the PMF.

The SSE was assumed to cause the following:

1. Fail all local slopes to a maximum inclination of 20H:1V and fully clog all bridges downstream of the RBS.

2. Leave bridges upstream of the RBS intact, allowing floodwater to enter the RBS site undiminished.

It is unlikely that an OBE would fail site area slopes. Specifically, the Donaldsonville Earthquake of 1930 is used as the basis for determining OBE and SSE seismic intensities (Reference 2.4.2-201). This earthquake had an epicenter approximately 50 mi. south-southeast of the RBS and an epicentral intensity of VI Modified Mercalli (MM). There was no bank caving associated with the Donaldsonville Earthquake. The foundation conditions at the RBS are better than most areas that felt the Donaldsonville Earthquake and better than the recent floodplain deposits in the immediate Donaldsonville vicinity. Therefore, the intensity felt at Donaldsonville due to the Donaldsonville event would be more highly amplified than a similar event occurring at the RBS. It is conservative to apply a Donaldsonville intensity VI (MM) at the RBS site for determining OBE and SSE intensities. However, assuming that an intensity VI earthquake did occur, no bank caving would result.

The Donaldsonville Earthquake was determined to have a maximum ground motion of approximately 0.07 g. The OBE at the RBS is conservatively assumed to have a maximum ground motion of 0.05 g. Therefore, it can be inferred that an OBE would not cause bank caving at the RBS. It is unlikely that an SSE, with a conservatively assumed maximum ground motion of 0.1 g, would cause bank caving. However, this has been assumed for the flood analysis. Because channel conditions for the 1/2 PMF + OBE would be the same as for the PMF, it is assumed that the PMF would produce higher water levels. Therefore, the 1/2 PMF + OBE can be eliminated from further discussion (Reference 2.4.2-201).

2.4.2.3 Effects of Local Intense Precipitation

An analysis of plant drainage was performed to determine whether safety-related equipment could be flooded during an occurrence of the PMP. The following discussion pertains to flooding in the immediate plant area. Flooding of local streams, in combination with severe seismic events, is discussed in Subsection 2.4.3.

Figure 2.4.2-201 shows the Unit 3 power block area and drainage patterns. The Unit 3 power block area is drained by directing surface runoff away from structures. Culverts are used to convey stormwater runoff under roads. In the event that the culverts are plugged, stormwater runoff would pass over the roads without flooding safety-related equipment. All stormwater runoff from the Unit 3 power block is conveyed to West Creek. As discussed in Subsection 2.4.3, there are no postulated flood conditions that would inhibit this runoff path. The safety-related systems and components of the ESBWR standard plant are located in the Seismic Category I structures that provide protection against external flood and groundwater damage. Flood protection is further discussed in FSAR Subsection 2.4.10 and DCD Section 3.4.1.2.

All ditch side slopes are 3:1. All roads are crowned at the center line with a 2 pecent slope. Road elevations range from Elevation 94 ft. NGVD to 97.25 ft. NGVD around the perimeter of the power block. Spot elevations around the perimeter road are provided in Figure 2.4.2-201.

The Unit 3 power block area is divided into 11 drainage areas, as shown in Figure 2.4.2-201. Each area is described in this subsection, including drainage area, surface cover, elevations, and slopes. Culverts associated with each area are also identified.

Area 1

Area 1 has a drainage area of 2.1 ac., with 49.7 percent structures, 8.5 percent asphalt, and 41.7 percent gravel. The grade slopes away from the structures at 0.5 to 7 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to Elevation 97 ft. NGVD. The grade then slopes at approximately 0.8 percent to Elevation 96 ft. NGVD, where stormwater enters Trench Drain TD-1 to Area 5.

Area 2

Area 2 has a drainage area of 1.6 ac., with 51.8 percent structures, 16.6 percent asphalt, and 31.6 percent gravel. The grade slopes away from the structures at 0.5 to 1 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to Elevation 97 ft. NGVD. The grade then slopes at approximately 1 percent to a ditch at Elevation 96 ft. NGVD, where stormwater enters Culvert C-1 to Area 5.

Area 3

Area 3 has a drainage area of 0.6 ac., with 31 percent structures, 18.2 percent asphalt, and 50.8 percent gravel. The grade slopes away from the structures at 1 to 10 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.6 percent to Elevation 97 ft. NGVD. The grade then slopes at approximately 1 percent to a ditch at Elevation 96 ft. NGVD, where stormwater enters Culvert C-2 to Area 5.

Area 4

Area 4 has a drainage area of 0.5 ac., with 10.8 percent structures, 25.5 percent asphalt, and 63.7 percent gravel. The grade slopes away from the structures at 5 to 10 percent for the first 0.5 ft. From the farthest point (Elevation 97 ft. NGVD), stormwater flows overland at a slope of 0.55 percent to a ditch at Elevation 96 ft. NGVD, where stormwater enters Culvert C-3 to Area 5.

Area 5

Area 5 has a drainage area of 5.1 ac., with 3.8 percent structures, 6.7 percent asphalt, and 89.5 percent gravel. The grade slopes away from the structures at 5 to 1.5 percent for the first 0.5 ft. From the farthest point, Area 5 receives flow through TD-1, which discharges into a ditch at Elevation 96 ft. NGVD. The ditch slopes at approximately 0.40 percent to Elevation 92.8 ft. NGVD, where stormwater enters Culvert C-4 to Area 6.

Area 6

Area 6 has a drainage area of 3 ac., with 12.5 percent structures, 14.6 percent asphalt, and 85.4 percent gravel. The grade slopes away from the structures at approximately 5 percent for the first 0.5 ft., then slopes to a ditch. From the farthest point, Area 6 receives flow through C-4 into a ditch at Elevation 92.7 ft. NGVD. The ditch slopes at approximately 0.4 percent to Elevation 90 ft. NGVD, where stormwater enters Culvert C-5. The ditch then slopes at 0.5 percent to the Fabriform-lined portion of West Creek.

Area 7

Area 7 has a drainage area of 2.8 ac., with 36.5 percent structures, 7.6 percent asphalt, and 55.9 percent gravel. The grade slopes away from the structures at 1 to 5 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to Elevation 96 ft. NGVD. The grade then slopes at 1.5 percent to a ditch at Elevation 94 ft. NGVD. From the ditch, stormwater enters Culvert C-12 to Area 6.

Area 8

Area 8 has a drainage area of 1.1 ac., with 50.6 percent structures, 18.2 percent asphalt, and 31.2 percent gravel. The grade slopes away from the structures at 1 to 5 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 1 percent to Elevation 97 ft. NGVD. The grade then slopes at approximately 2 percent to a ditch at Elevation 96 ft. NGVD, where stormwater enters Culvert C-7. The ditch then slopes at 0.5 percent to the Fabriform-lined portion of West Creek.

Area 9

Area 9 has a drainage area of 2.2 ac., with 77.2 percent structures, 12.4 percent asphalt, and 10.4 percent gravel. The grade slopes away from the structures at 0.5 to 10 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to a ditch at Elevation 96 ft. NGVD, where it enters Culvert C-8 to Area 8.

Area 10

Area 10 is the substation area. It has a drainage area of 3.2 ac., with 3.7 percent structures, 7.8 percent asphalt, and 88.6 percent gravel. The grade slopes away from the structures at 0.5 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to a ditch at Elevation 95 ft. NGVD, where it enters Culvert C-9. The ditch then slopes at 0.5 percent to the Fabriform-lined portion of West Creek.

Area 11

Area 11 is the substation area. It has a drainage area of 3.2 ac., with 3.7 percent structures, 5.5 percent asphalt, and 90.7 percent gravel. The grade slopes away from the structures at 0.5 percent for the first 0.5 ft. From the farthest point (Elevation 97.5 ft. NGVD), stormwater flows overland at a slope of 0.5 percent to a ditch at Elevation 95 ft. NGVD, where it enters Culvert C-10.

If all of the culverts in the Unit 3 power block area were plugged, stormwater discharge would pass over the perimeter road. The total drainage area in the Unit 3 power block is 25.4 ac. The peak discharge from the power block area can be estimated using the Rational Equation (Reference 2.4.2-208):

$$Q = CIA$$

Where:

Q = The peak runoff rate (cfs).

C = The runoff coefficient (dimensionless).

I = The rainfall intensity (in/hr).

A = Drainage area (acres).

From Table 2.4.3-201, the 5-minute duration PMP for the West Creek watershed, which includes the power block, is 6.2 in. With a conservative C value of 0.9, the peak discharge rate is:

$$Q = (0.9)(6.2 \text{ in./5 minutes})(60 \text{ minutes/hr})(25.4 \text{ ac.}) = 1701 \text{ cfs}$$

The perimeter road around the power block is 3615 ft. long. The depth of flow over the road can be estimated using the Weir equation (Reference 2.4.2-209):

$$Q = CLH^{3/2}$$

Where:

Q = Discharge rate (cfs).

C = Weir coefficient = 2.63 for a broad-crested weir.

L = Weir lengh (ft.).

H = Depth of flow over weir (ft.).

Solving for H results in a flow depth over the perimeter road of 0.3 ft. Thus, even if all of the culverts in the power block area were plugged, stormwater would not jeopardize safety-related equipment.

Precipitation that falls on the roofs of on-site buildings is collected in gutters along the roof edge and discharged via downspouts to the plant yard adjacent to the buildings. Overflow from the roof gutters spills directly onto the plant yard. All building roofs, except for some small areas, are sloped, and no potential exists for significant ponding of rainfall on the roofs. Roof structures are adequately designed to support the maximum potential height of ponded rainwater. Safety-related equipment is not jeopardized by roof drainage during even the most severe postulated rainfall event.

The fetch and depth of any stormwater that may pond in the power block area would not be sufficient to generate waves or significant wave runup. It is clear from a review of plant drainage that runoff from the PMP could not pond above 98 ft. NGVD and jeopardize plant safety-related equipment.

RBS Unit 3 construction would have only a small effect on Unit 1 drainage patterns. A portion of the Unit 1 stormwater discharge is conveyed to the Fabriform-lined portion of West Creek. When the Fabriform-lined portion of West Creek is realigned, the RBS Unit 1 stormwater piping would be extended to the new channel location.

2.4.2.4 References

2.4.2-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report" through Revision 19, July 2006.

2.4.2-202 Odom, L. M., "Atchafalaya Diversion and Its Effects on the Mississippi River," *Transactions ASCE*, Paper No. 2438, 1950.

2.4.2-203 U.S. Congress, "Mississippi River and Tributaries Project," House Document 308, 88th Congress, 2nd Session, Vol. II, U.S. Government Printing Office, Washington, D.C., 1964.

2.4.2-204 Office of the Mississippi River Commission, Vicksburg, Mississippi, 1973.

2.4.2-205 U.S. Army Corps of Engineers, Annual Highest and Lowest Stages of the Mississippi River and Its Outlets and Tributaries to 1953, Mississippi River Commission, New Orleans, Louisiana. (Supplemented by Stage Data, Mississippi River at Bayou Sara, Louisiana, 1956 - 2006.)

2.4.2-206 U.S. Geological Survey National Water Information System: Web Interface, USGS Site Number 0733800, Alexander Ck NR St. Francisville, Louisiana.

2.4.2-207 U.S. Geological Survey National Water Information System: Web Interface, USGS Site Number 0733500, West Fork Thompson Ck NR Wakefield, Louisiana.

2.4.2-208 Viessman, W., G. L. Lewis, and J. W. Knapp, *Introduction to Hydrology*, 3rd Edition, Harper Collins, 1989.

2.4.2-209 Streeter, V. L. and E. B. Wylie, *Fluid Mechanics*, 8th Edition, McGraw-Hill, 1985.

Table 2.4.2-201
Alexander Creek, Louisiana
Maximum Discharges and Gage Heights

Water Year	Date	Gage Height (ft.)	Stream-flow (cfs)	Water Year	Date	Gage Height (ft.)	Stream-flow (cfs)
1953	May 18, 1953	14.18	13,200	1967	Apr. 14, 1967	8.30	2130
1954	Jul. 17, 1954	9.35	3160	1968	Apr. 28, 1968	8.01	1790
1955	Apr. 12, 1955	12.55	8810	1971	Sep. 16, 1971	11.21	5970
1956	Mar. 12, 1956	10.93	5480	1972	Dec. 07, 1971	12.83	9540
1957	1957	8.20	1960[a]	1973	Mar. 24, 1973	12.13	7780
1958	Mar. 24, 1958	9.20	2980	1975	Jul. 09, 1975	10.60	4920
1959	Apr. 19, 1959	9.58	3450	1976	1976	8.59	2320[a]
1960	Dec. 17, 1959	8.41	2150	1977	Apr. 22,1977	11.17	5900
1961	Mar. 17, 1961	12.04	7570	1978	Dec. 01, 1977	11.10	5650
1962	Apr. 06, 1962	11.17	5880	1979	Apr. 22, 1979	11.17	5760
1963	Jan. 19, 1963	7.97	1760	1980	Mar. 27, 1980	10.81	5270
1964	Mar. 02, 1964	10.87	5380	1981	Jul. 03, 1981	12.00	7480
1965	Oct. 04, 1964	13.25	10,700	1982	1982	8.60	2340[a]
1966	Feb. 12, 1966	9.87	3820	1983	Apr. 06, 1983	12.20	7950

a) Discharge less than indicated value, which is the minimum recordable discharge at this site.

Peak Streamflow Qualification Codes.

Table 2.4.2-202
West Fork Thompson Creek, Louisiana
Maximum Discharges and Gage Heights

Water Year	Date	Gage Height (ft.)	Stream-flow (cfs)	Water Year	Date	Gage Height (ft.)	Stream-flow (cfs)
1950	Jan. 06, 1950	14.70	6370	1960	Dec. 17, 1959	14.26	5970
1951	Feb. 06, 1951	12.48	4280	1961	Mar. 17, 1961	19.40	12,500
1952	May 19, 1952	8.78	1920	1962	Nov. 13, 1961	16.97	9000
1953	May 04, 1953	22.65	18,100	1963	Jan. 19, 1963	9.83	2480
1954	Mar. 27, 1954	8.88	1970	1964	Mar. 02, 1964	16.73	8640
1955	Apr. 15, 1955	20.47	14,300	1965	Oct. 04, 1964	20.12	13,600
1956	Dec. 18, 1955	16.60	8520	1966	Feb. 10, 1966	13.20	4900
1957	Dec. 22, 1956	15.36	7140	1967	Apr. 15, 1967	20.00	13,400
1958	May 06, 1958	16.25	8040	1968	Apr. 28, 1968	9.65	2400
1959	Apr. 18, 1959	11.07	3260	1969	Apr. 13, 1969	13.04	4760
				1970	Jun. 02, 1970	15.05	6760

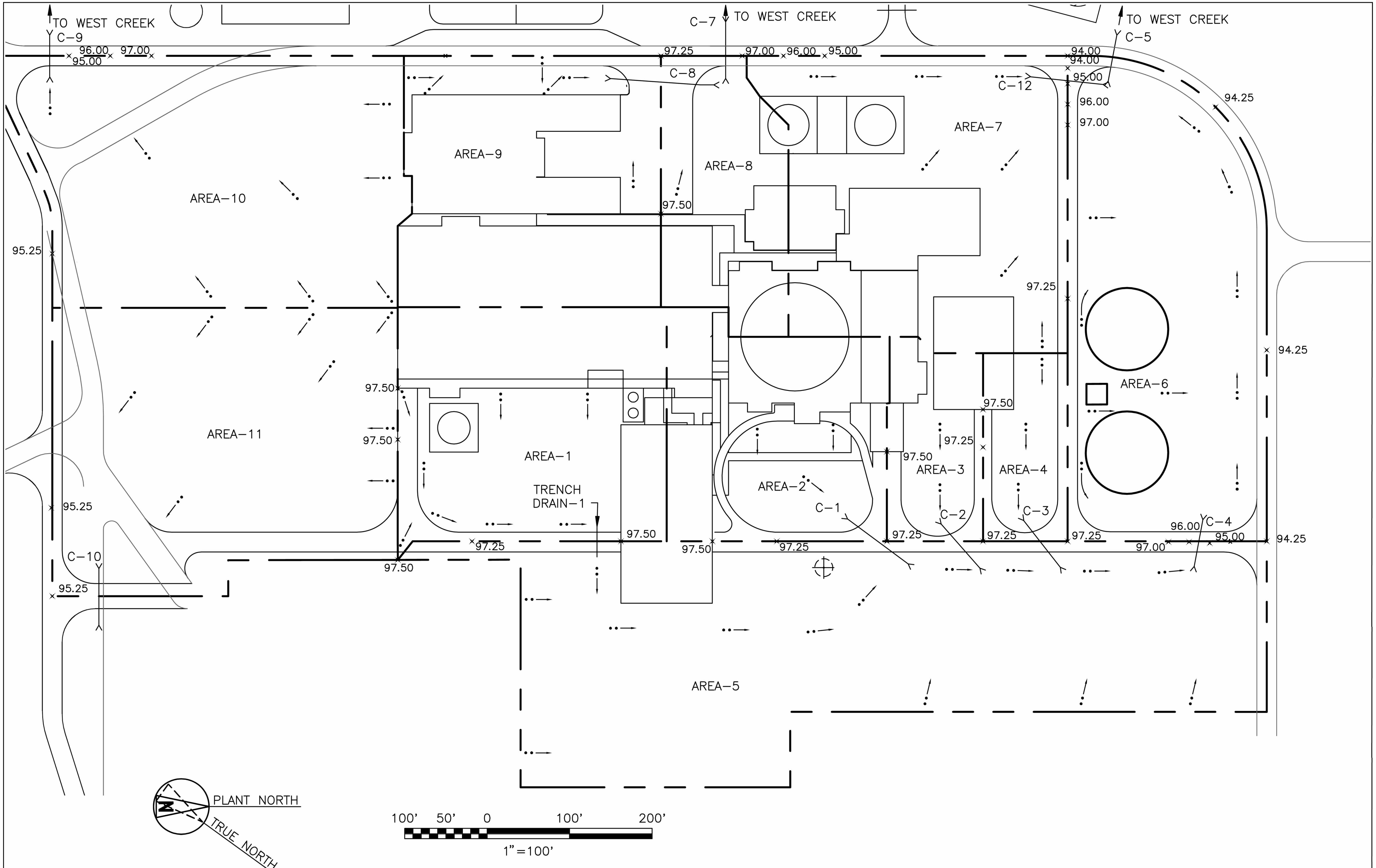


Figure 2.4.2-201. Unit 3 Drainage

2.4.3 PROBABLE MAXIMUM FLOOD ON STREAMS AND RIVERS

2.4.3.1 Probable Maximum Precipitation

RBS COL 2.0-14-A

The PMF analysis for the Mississippi River did not involve a PMP determination (refer to Subsection 2.4.3.4). The following discussion pertains to precipitation in local drainage basins that produces the design basis flooding condition for the RBS.

PMP values for Grants Bayou Basin and sub-basins were based on data contained in Hydrometeorological Reports (HMRs) Nos. 51 and 52, provided by the National Weather Service Hydrometeorological Design Studies Center. Regions covered by generalized PMP studies are presented in Figure 2.4.3-201, which identifies that the United States east of the 105th meridian, including Louisiana, is covered by HMR Nos. 51, 52, and 53 (Reference 2.4.3-201). HMR 51 addresses PMP estimates. HMR No. 52 addresses the application of PMP estimates, and HMR 53 addresses seasonal variation of 10-mi^2 PMP estimates.

The most current definition of PMP is as follows: "Theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of the year" (Reference 2.4.3-201). All-season PMP values for a variety of storm durations and drainage area sizes are based on a nationwide analysis of storm characteristics, such as dew points, land contours, and historical rainfall. PMP values for the local basins are presented in Table 2.4.3-201 (Reference 2.4.3-202).

Based on drainage characteristics of the basins, rainfall durations and storm distributions were selected. Figure 2.4.3-202 shows the basins that were analyzed to determine the effect of extreme local flooding on plant safety. The basins include: Grants Bayou, 15.6 mi^2; Grants Bayou above confluence with West Creek, 8.4 mi^2; and West Creek, 1.0 mi^2. Storm durations were selected such that the shortest time interval in the rainfall distribution corresponded to the unit rainfall duration (the time of runoff-producing rainfall), as calculated for each sub-basin (refer to Subsection 2.4.3.3).

A storm frequency duration of 24 hr. was selected for the entire Grants Bayou basin, while durations of 12 and 6 hr. were applied to Grants Bayou above West Creek and West Creek, respectively.

The storm for each basin was divided into four equal time periods and ordered 1 through 4 in decreasing rainfall magnitude. The storm sequence of these periods was arranged 4, 2, 1, 3. Within the maximum rainfall time period, six additional equal time periods were established and ordered 1 through 6 in decreasing rainfall magnitude. These periods were arranged 6, 4, 2, 1, 3, 5. Rainfall values for each interval were determined from rainfall-duration relationships presented in

Table 2.4.3-201. Storm durations for the local basins are presented in Table 2.4.3-202.

2.4.3.2 Precipitation Losses

The soil in Grants Bayou basin belongs essentially to two soil associations (Reference 2.4.3-212). Approximately 75 percent of the basin is Memphis-Loring Association, and the remaining 25 percent is Vicksburg-Collins-Waverly Association. The component soils of each association were identified by soil group, as shown in Table 2.4.3-203. Approximately 71 percent of the basin is of Type B drainage, and this soil type was used to evaluate runoff characteristics for all sub-basins.

Field inspection showed the RBS site area to be composed mostly of forest, with some gently sloping pasture and meadow. Good pasture and forest drainage conditions exist. This was combined with the assumption of nearly saturated soil conditions resulting from heavy antecedent rainfall at the time of the PMP. Under these conditions, the runoff curve numbers (CNs) from the U.S. Bureau of Reclamation for pasture and forest are 60 and 55, respectively (Reference 2.4.3-211). Additional CNs used in the analysis include: Open Space - CN = 61; Roofs/Paved Areas - CN = 98; Aggregate Surfaced Areas - CN = 85; and Industrial Areas - CN = 88 (Reference 2.4.3-212).

A composite CN of 60 was selected to apply to Grants Bayou above the confluence with West Creek and Grants Bayou below the confluence with West Creek. For RBS Unit 1, a CN of 61.9 was calculated for the West Creek sub-basin. The higher CN accounts for modified drainage conditions in the RBS area. A CN of 65 was conservatively selected for West Creek in the Unit 1 flood analysis.

The RBS Unit 3 power block is located in the West Creek sub-basin. A portion of the Unit 3 construction areas is also located in the West Creek sub-basin. The remaining Unit 3 construction areas drain west to the Alligator Bayou watershed. Infiltration characteristics in the West Creek sub-basin were updated to reflect RBS Unit 3 construction, resulting in a CN of 64.9. Thus, the CN of 65 used in the Unit 1 analysis is still applicable.

Runoff was computed from rainfall using the following formula (Reference 2.4.3-211):

$$Q = \frac{(P - 0.2S)^2}{(P + 0.8S)}$$

Where:

Q = Direct runoff, in.

P = Rainfall, in.

S = Maximum potential difference between P and Q at the beginning of the storm, in.

The value of S for runoff CN 60 is 6.67 in., and the value of S for runoff CN 65 is 5.38 in. (Reference 2.4.3-211).

Minimum soil retention rates were also used to evaluate storm runoff. A rate of 0.2 in/hr was adopted and applied when the above runoff formula predicted a storm runoff rate with less than 0.2 in/hr retained by the soil (Reference 2.4.3-211).

Minimum soil retention rates are dependent on the soil types in the drainage basin. The Soil Conservation Service (SCS) soils map (Reference 2.4.3-212) reveals that the distribution of soil in the Grants Bayou drainage basin is approximately 75 percent Memphis-Loring Association and 25 percent Vicksburg-Collins-Waverly Association. Based on the hydrologic soil group classification (Reference 2.4.3-211), Memphis, Loring, and Vicksburg belong to the Hydrologic Soil Group B. Collins is Soil Group C, and Waverly is Soil Group D. The range of minimum retention rates for Hydrologic Soil Groups B, C, and D is 0.15 to 0.30 in/hr, 0.08 to 0.15 in/hr, and 0.02 to 0.08 in/hr, respectively. The retention rate of 0.2 in/hr was chosen for the Grants Bayou drainage basin. The use of minimum soil retention rates when computing runoff is discussed further in Reference 2.4.3-212.

Initial moisture losses were assumed equal to 0.2S (Reference 2.4.3-212). Table 2.4.3-204 presents the PMP rainfall and runoff values.

2.4.3.3 Runoff and Stream Course Models

Lag time estimates and unit hydrographs for the basins in this analysis were developed for RBS Unit 1 (Reference 2.4.3-202). Construction of the RBS Unit 3 would occur in the West Creek sub-basin, with some construction activities in the Alligator Bayou Basin west of the RBS site. The hydrologic parameters developed for Unit 1 for Grants Bayou and Grants Bayou above the confluence with West Creek are not altered as a result of Unit 3 construction.

For the West Creek sub-basin, infiltration characteristics and lag time are altered as a result of Unit 3 construction. It was shown in Subsection 2.4.3.2 that the SCS CN value of 65 used in the Unit 1 analysis is still applicable for the Unit 3 analysis. The sub-basin lag time developed for Unit 1 is reduced in the Unit 3 analysis as a result of the relocation of the Fabriform-lined portion of West Creek. Nine lag time estimates developed in the Unit 1 analysis for West Creek are presented in Table 2.4.3-206. The range of values was 1.0 to 1.5 hr., and the average of the nine estimates is 1.26 hr. A value of 1.2 hr. was used in the Unit 1 study. For Unit 3, relocation of the Fabriform-lined portion of West Creek reduces the lag time by 0.02 hr. Applied to the Unit 1 average lag time estimate of 1.26 hr., the resulting Unit 3 lag time would be 1.24 hr. Thus, the value of 1.2 hr. used in the Unit 1 study is still applicable in the Unit 3 analysis. Other basin characteristics, such as area and shape, are not altered as a result of Unit 3 construction.

Because the parameters used in the Unit 1 analysis are applicable to the Unit 3 analysis, the lag time estimates and unit hydrographs developed in the Unit 1 study will be used for Unit 3. The development of the lag time estimates and unit hydrographs is presented in this subsection.

Runoff Models

For the purpose of computing flood flow from runoff, runoff models were prepared for each basin. Unit hydrographs were determined by applying drainage area runoff characteristics to three independent methods of unit graph preparation and obtaining an average unit graph for each basin. Table 2.4.3-205 lists basin characteristics used in the study. Basin lag times (the time from the midpoint of unit rainfall duration to the peak of the unit hydrograph) were estimated from local basin data and several independent empirical methods (Reference 2.4.3-202).

Lag Time Estimates

Method 1

Reference 2.4.3-213 presents the Snyder formula:

$$T = C_t (L\ L_{ca})^{0.3}$$

Where:

T = Lag time, hr.

C_t = Basin characteristic.

L = Channel length, mi.

L_{ca} = Channel length to centroid of basin, mi.

Reference 2.4.3-214 also presents a correlation of C versus $S^{1/2}$ for small basins in Texas, where S represents the slope of the basin (ft/ft). For the present study, this was supplemented with data from 16 small Louisiana basins. While Reference 2.4.3-213 showed fairly good correlation for Ct versus $S^{1/2}$, substitution of the Louisiana basin data showed good correlation only in the region of $S^{1/2}$ greater than 0.04. Fortunately, this includes the site basins.

Method 2

This method is a comparison of site basin data with the known lag times and basin characteristics for 16 small Louisiana basins.

Method 3

Reference 2.4.3-214 presents a relationship for basin lag versus $L/S^{1/2}$ for small basins in Texas. Lag times for the site basins were determined by this method. A modification to the relationship was then made by supplementing the database with information from 16 small Louisiana basins, and new estimates of the lag times for the local basins were made. Additional basin lag versus $L/S^{1/2}$ relationships developed from data collected by Ramser and Chow were also used to determine site basin lag times (Reference 2.4.3-202).

Method 4

An empirical formula for the time of concentration is presented in Reference 2.4.3-214:

$$T = 5.33\ L^{0.602}\ S_{10/85}^{\ -0.448}\ S_T^{\ 0.231}$$

Where:

L = Length of stream, mi.

$S_{10/85}$ = Channel slope between 10 and 85 percent of the watercourse, ft/mi.

ST = Percent of basin as swamp, lake, or pond.

An additional relationship without the S factor was also found to be applicable through a check of correlation with data for 16 small Louisiana basins. It is noted that for small basins, the time of concentration is approximately equal to lag time (Reference 2.4.3-202).

Method 5

Reference 2.4.3-210 contains an empirical lag time method:

$$T = \frac{L^{0.8}(S+1)^{0.7}}{1900Y^{0.5}}$$

Where:

L = Length of channel, ft.

Y = Average watershed slope, percent.

$S = (1000/CN) - 10.$

This reference also contains a method for the reduction of computed lag time based on an upgrade of the existing channel due to construction, which is applicable to West Creek.

A summary of Unit 1 lag time values derived for the site basins is provided in Table 2.4.3-206. The selected lag times are 5.0 hr. for the entire Grants Bayou Basin, 2.5 hr. for Grants Bayou upstream of the West Creek confluence, and 1.2 hr. for West Creek. These values are also used for the Unit 3 analysis.

Unit rainfall duration (the time of runoff producing rainfall) for each basin was obtained from the USACE formula:

$T_r = T_p / 5.5$ (Reference 2.4.3-215)

Where:

T_r = Unit rainfall duration, hr.

T_p = Lag time, hr.

These values were rounded to the nearest quarter hour for use in storm distributions and rainfall determination.

Unit Hydrographs

Unit hydrographs were developed by three independent empirical methods. An average unit graph was then computed and adjusted as necessary to ensure the unit hydrograph represented 1-in. runoff volume.

Method 1

Reference 2.4.3-214 presents a method for unit hydrograph construction based on inputs of lag time, storage, runoff, and duration of rainfall excess. A regression formula for lag time previously cited from this source is included in Reference 2.4.3-214.

Method 2

Reference 2.4.3-213 presents dimensionless unit hydrographs for small basins in Texas, which can be converted to unit hydrographs with inputs of lag time, runoff, and duration of rainfall excess.

Method 3

The Snyder Method from Reference 2.4.3-215 identifies the peak unit hydrograph flow as:

$$Q = \frac{A(640C_p)}{T}$$

Where:

Q = Peak flow, cfs.

A = Drainage area, mi^2.

T = Lag time, hr.

$640C_p$ = Basin characteristic.

To determine the value of $640C_p$ for each site area basin, a review was made of computed $640C_p$ values for 13 small Texas basins and 16 small Louisiana basins. It was found that the $640C_p$ values ranged from 194 to 785, with an average value of 472. In an effort to more precisely identify $640C_p$, a Reference 2.4.3-213 correlation of $640C_p$ and $C_t\,(LL_{ca})^{0.3}/A$ was used. This was supplemented with the small Louisiana basins data, and a curve of best fit was established. The values of $640C_p$ for the local basins were then selected. These are 480 for the entire Grants Bayou Basin, 469 for Grants Bayou upstream of the West Creek confluence, and 370 for West Creek.

Reference 2.4.3-215 was then employed to determine the unit hydrograph widths at 50 and 75 percent of peak flow. An excellent correlation of Louisiana and Texas basin known unit hydrograph widths with the Reference 215 values was found. A relationship relating hydrograph width at 10 percent of peak flow was then developed from the Louisiana and Texas data and used to define local basin hydrograph shape for low flow. From Reference 2.4.3-213, the widths at 50 and 75 percent of peak flow are positioned such that one-third of the width is to the left of the peak flow.

Table 2.4.3-207 presents the unit graphs derived from the above three methods, along with the average unit graphs that have been modified as necessary to ensure that 1 in. of runoff volume is represented.

Maximization of Unit Hydrographs

Investigations have shown that peak flow values from major storms in large basins are generally 25 to 50 percent higher than values computed using a unit hydrograph computed from data for minor storms (Reference 2.4.3-215). This is probably due to two separate events:

1. The minor floods analyzed resulted from rainfall of approximately uniform areal distribution. Precipitation during major floods usually covers the entire drainage area, but in most instances, the intensity and accumulated amounts vary over the area. If the volume of runoff during a major storm is proportionately heavier in the lower portion of the basin, or near the principal stream channels, the concentration of runoff would be higher than represented by the unit hydrographs derived from minor floods.

2. During minor floods, the hydraulic gradients in natural streams are usually relatively low because of the series of pools that exist in the channel. As the stage increases during major floods, the pools tend to drown out, and the channel conveyance is usually substantially increased.

Neither of the above conditions is applicable to extreme flooding conditions in the area of the RBS, and no further adjustment to the computed unit hydrographs was made. Areal rainfall distribution is assumed to be uniform throughout the small basins. The discussions regarding increased channel conveyance and drowned pools are not appropriate for the very small site streams.

Unit hydrographs for the local basins are shown in Figures 2.4.3-203 through 2.4.3-205. Local streams flow intermittently, and the base flow for all unit hydrographs was assumed to be zero.

A 1/2 PMF antecedent storm was assumed to occur 1 day prior to the PMF. As determined from the sub-basin unit hydrographs, no overlap would occur from these two storms, and the peak PMF flows would be unaffected. Antecedent Moisture Condition II was used to determine runoff volume, in accordance with Reference 2.4.3-211.

According to the basic theory of unit hydrographs, hydrograph shape is independent of rainfall intensity.

Thus, successive runoff estimations from rainfall of varying intensity may be combined using a unit hydrograph to approximate the actual storm hydrograph. Guidelines for the application of this approach were obtained from Reference 2.4.3-211.

The peak flow values used in the combined events analysis of the 25-year flood + SSE were not determined by the unit graph/runoff method, but were developed through regression analysis, as presented in Subsection 2.4.3.4.

2.4.3.4 Probable Maximum Flood Flow

2.4.3.4.1 Mississippi River

The largest flood flow calculated for the Mississippi River in the site region is the PDF. The flood estimation was performed by the USACE (Reference 2.4.3-203). The PDF has an estimated frequency of occurrence of greater than 100 years, but no more exact frequency determination is available. The occurrence of a greater flood would be very rare and could be estimated only by using very improbable intensities of rainfall, runoff, and storm sequences. The PDF is based on tributary and main stem floods predicted by the U.S. Weather Bureau as "maximum possible" and by the Mississippi River Commission as "maximum probable" (Reference 2.4.3-202).

The USACE defines a Standard Project Flood (SPF) as follows:

> "A Standard Project Flood hydrograph represents critical concentrations of runoff from the most severe combination of precipitation that is considered "reasonably characteristic" of the drainage basin involved. The SPF peak discharge and volume is usually 40 to 60 percent of the PMF estimate for the same drainage basin when the comparison is related to rainfall concentrated in approximately four days or less" (Reference 2.4.3-204).

The PMF in the Mississippi River at the RBS site is determined from the PDF. The PDF is equivalent approximately to the SPF, but is probably somewhat higher. Studies completed to date indicate that the SPF is generally 40 to 60 percent of the PMF. Thus, it would be reasonably conservative to consider the PDF to be 50 to 60 percent of the PMF (Reference 2.4.3-202). In this study, the PDF is considered to be 50 percent of the PMF. The unregulated (not taking into account the existence of upstream reservoir storage) PDF discharge at the latitude of Red River Landing (RM 305) is 3,330,000 cfs, and the estimated PMF discharge at this point is 6,660,000 cfs. The PMF estimation is made for Red River Landing because flood controls exist between this location and the RBS site, and the mitigating effect of these controls is evaluated for computation of the PMF level near the RBS site (refer to Subsection 2.4.3.5).

2.4.3.4.2 Local Streams

The PMP estimates from Subsection 2.4.3.1 were applied to the runoff characteristics of Subsection 2.4.3.2 and the unit hydrographs of Subsection 2.4.3.3, and the PMF runoff hydrographs for the local basins were determined. Table 2.4.3-208 through 2.4.3-210 present the calculated hydrographs and peak flows. Peak flow values are the entire Grants Bayou Basin - 42,690 cfs; Grants Bayou above West Creek confluence - 35,346 cfs; and West Creek - 6,699 cfs.

The 25-year peak flows for the local basins were determined from References 2.4.3-216 and 2.4.3-217. These sources provide regression relationships based on a large amount of Louisiana data. Inputs are drainage area, annual precipitation, and channel slope. Reference 2.4.3-216 applies to basins of 10 mi^2 and smaller, and was used to determine 25-year peak flows of 842 cfs for West Creek and 4,364 cfs for Grants Bayou above the West Creek confluence. Reference 2.4.3-218 applies to basins larger than 10 mi^2 and was used to determine a peak 25-year flow for the entire Grants Bayou Basin of 6760 cfs.

Several small farm ponds are located in the Grants Bayou Basin. The failure of one or more of these ponds concurrently with a design flooding condition would have no significant effect on peak flood flows because of the small volume of storage in the ponds and the relatively large amount of channel storage available during extreme flooding (refer to Subsection 2.4.1.2.3).

2.4.3.5 Water Level Determinations

2.4.3.5.1 Mississippi River

The water surface elevation in the Mississippi River at the RBS site in response to design flood events was determined based on available data and also by an HEC-RAS analysis. HEC-RAS is the USACE's River Analysis System software (Reference 2.4.3-205). This program allows the user to perform steady and unsteady flow river hydraulics calculations. The HEC-RAS software supersedes the HEC-2 river hydraulics program. A verification and validation of the HEC-RAS software package was performed for this analysis.

A portion of the Lower Mississippi River including the river adjacent to the RBS site was recently modeled to support the development of a bridge (Reference 2.4.3-206). This is referred to as the "bridge model" in this discussion. The bridge crosses the river just downstream of the RBS site, at approximately RM 261.9. The RBS site is located at approximately RM 262.5. The bridge model considered the 50-, 100-, and 500-year recurrence interval flood events and neglected the floodplain capacity west of the levee system. The water surface elevations at the RBS site estimated for these events were 54.14 ft. NGVD, 55.68 ft. NGVD, and 58.91 ft. NGVD, respectively.

The bridge study determined that the average backwater caused by the bridge piers for all simulations was 0.03 ft. (Reference 2.4.3-206). The vertical clearance of the bridge above a high water elevation of 56.1 ft. NGVD was set at 65 ft., or Elevation 121.1 ft. NGVD (Reference 2.4.3-207). The Bridge Environmental Assessment also stated that "Adequate cross drains will be designed and installed along the entire length of the roadway within floodplain areas to… maintain existing hydrologic conditions" (Reference 2.4.3-207).

Based on these factors, the new bridge just downstream of the RBS site was not included in the HEC-RAS analysis performed for this COLA. The 0.03 ft. of backwater through the piers is negligible, water surface elevations would not be as high as the low bridge chord elevation, and cross-drains would maintain existing hydrological conditions in the floodplain portion of the roadway.

The objective of the HEC-RAS analysis was to estimate the hydraulic performance of the Mississippi River, including the floodplain west of the river, for large events that overtop the levee west of the river adjacent to the RBS site. The man-made levee constructed on the west side of the river has a crest elevation of approximately 57.5 ft. msl at the RBS site.

Methodology

The RBS site is located at approximately Mississippi RM 262.5. In the bridge model, the channel sections are identified in feet, rather than river miles. The Bridge Hydraulics Report (Reference 2.4.3-206) provides the relationship:

HEC-RAS Station 131,087.4 = Mississippi RM 254.2.

In the bridge model, the HEC-RAS Section nearest the RBS site is 174,347.9. This section is 43,260.5 ft., or 8.2 river miles, upstream of Section 131,087.4, referenced above. Thus, HEC-RAS Section 174,347.9 is at Mississippi RM 262.4. HEC-RAS Section 174,347.9 passes through the RBS site and is perpendicular to the high bluffs located on the east side of the river.

The Mississippi River floodplain at HEC-RAS Section 174,347.9 is approximately 49 mi. wide. At this location, the west limit of the floodplain, located in the upper reaches of the river's deltaic plain, is poorly defined. The peak elevation at the west limit of the floodplain is approximately 66 ft. NVGD. Thus, discharges with elevations in excess of 66 ft. NVGD would not be contained within the Mississippi River floodplain.

To model the river including the floodplain, two additional cross sections from the bridge HEC-RAS model were considered, along with the section passing through the RBS site. HEC-RAS Section 153835.8 is located approximately 3.9 mi. (approximately 4.5 river miles) south of the RBS site. HEC-RAS Section 109087.1 is located approximately 10.4 mi. (approximately 12.9 river miles) south of the RBS site. These sections are also perpendicular to the bluffs on the east side of the river and parallel to the section through the RBS site. Figure 2.4.3-206, from the bridge model, shows the location of the three sections considered in this analysis. The RBS site is at Section 174347.9. Section 109087.1 is the starting downstream section. In this analysis, the sections extend west across the Mississippi River floodplain.

The geometry of the three cross sections developed in the bridge model was extended using USGS 1:100,000 scale quad maps (Reference 2.4.3-208). The floodplain also includes the Atchafalaya River, and the geometry was supplemented with bathymetry obtained from the USACE.

Lower Mississippi River flow is subcritical; thus, the HEC-RAS model began at the downstream section and proceeded upstream. The starting water surface elevation was based on normal depth at the downstream section and the slope of the energy grade line at that section from the bridge model. In the bridge model, the slope of the energy grade line for the 50-, 100-, and 500-year recurrence interval models was 0.000035, 0.000034, and 0.000032, respectively. In this analysis, the 0.000032 value was used to estimate normal depth at the downstream cross section. The 500-year event is similar to the extreme events considered in this analysis, and the slightly flatter slope produced the most conservative results.

The HEC-RAS simulations performed for the Mississippi River at the RBS site included the vast floodplain west of the river. Because the western boundary of the floodplain is low and poorly defined, flow begins to spread beyond the western floodway limits as the water surface elevation increases. For the cross section through the RBS site, the flow would spread beyond the western floodplain boundary for water surface elevations exceeding 66 ft. NGVD. This spreading of flow was considered in the HEC-RAS models.

Upstream of the RBS site, control structures divert a portion of the Mississippi River flow to the Atchafalaya River. At the RBS site, the Atchafalaya River is located approximately 25 mi. west of the Mississippi River, in the Mississippi River floodplain. For the PDF developed by the USACE, approximately 1,530,000 cfs would be diverted into the Atchafalaya River, and approximately 1,500,000 cfs would remain in the Mississippi River. The stage at the RBS site for this event is Elevation 54.5 ft. msl. The anticipated flow distribution to the Mississippi River floodway during a PDF, utilizing an upstream reservoir storage, is shown in Figure 2.4.3-207.

HEC-RAS Model Results

At the RBS site, the top of the levee elevation on the west bank of the Mississippi River is approximately 57.5 ft. msl. In the HEC-RAS output, a discharge of 15,500,000 cfs results in a water surface elevation of 57.54 ft. NGVD, just overtopping the levee. At Elevation 54.5 ft. msl, the combined flow passing the RBS site and the flow diverted to the Atchafalaya River total approximately 3,030,000 cfs. Thus, the capacity of the system jumps from approximately 3,030,000 cfs at a water surface elevation of 54.5, to 15,500,000 cfs at Elevation 57.54, when the levee is overtopped. The cross section at the RBS site for this event (looking downstream) is included as Figure 2.4.3-208. The Mississippi River is located at the left edge of the figure, and the Atchafalaya River is located near the center of the figure. At this water surface elevation, the flow is contained in the Mississippi River floodplain, as illustrated in the figure.

The design plant grade elevation for RBS Unit 3 is 98.0 ft. NGVD. According to DCD Section 3.4.1.2 *Flood Protection from External Sources*, the design plant grade elevation shall be at least 1 ft. (310 mm) above the design flood level. Thus, the flood elevation cannot exceed 97.0 ft. NGVD. In the HEC-RAS output, a discharge of 64,000,000 cfs results in a water surface elevation of 96.83 ft. NGVD. This discharge is more than 20 times greater than the PDF identified by the USACE. The cross section from the HEC-RAS model for this event is included as Figure 2.4.3-209. At this water surface elevation, the discharge is not contained in the Mississippi River floodplain.

The stage-discharge relationship for the Mississippi River, including the floodplain, is included as Figure 2.4.3-210, for water surface elevations exceeding the top-of-levee elevation at the RBS site.

In Subsection 2.4.3.4.1, the PMF flow at the RBS site is estimated at 6,660,000 cfs, neglecting upstream reservoir storage and including flow diverted into the Atchafalaya River. From the HEC-RAS analysis, a flood just overtopping the levee (Elevation 57.54 ft. NGVD) has a capacity of 15,500,000 cfs. Thus, during a PMF, the levee at the RBS site would overtop, but storage and conveyance capacity in the floodplain would prevent the water surface elevation from significantly exceeding the top of the levee elevation. Subsection 2.4.3.6 presents the effects on water level of the combined occurrence of the PMF and the 2-year extreme wind speed.

2.4.3.5.2 Local Streams

Water levels in Grants Bayou and West Creek were computed through the use of the HEC-RAS River Analysis System computer program developed by the USACE (Reference 2.4.3-205). A verification and validation of the HEC-RAS software package was performed for this analysis.

Flood profiles for the design events were computed in Grants Bayou and West Creek for the RBS Station Unit 1. For Unit 1, the profiles were developed using HEC-2, the USACE water surface profiles software package that was superseded by HEC-RAS.

The Unit 1 HEC-2 input files were used as the basis for the Unit 3 analysis. The HEC-2 input files were imported into HEC-RAS and modified to account for Unit 3 construction. Unit 3 construction does not affect the flood profiles in Grants Bayou. Thus, the Grants Bayou portion of the models was not modified. The West Creek portion of the models was modified to account for the relocation and change of cross section of a portion of the Fabriform-lined channel.

Manning's roughness coefficient, n, for the Unit 1 analysis was determined based on observations at the RBS site and experience by a consultant in Louisiana (Reference 2.4.3-202). The roughness coefficients developed for Unit 1 were used in the Unit 3 analysis. The channel and overbank n values for the existing topography and altered topography due to an SSE are presented with the cross-section data in Table 2.4.3-211 and 2.4.3-212. A portion of West Creek in the RBS area has been lined with Fabriform to provide channel stability and to increase conveyance. While the manufacturer's suggested roughness coefficient is 0.012

to 0.015, the roughness coefficient was conservatively assumed to be 0.03, to account for possible debris accumulation.

The River Access Road crosses West Creek near the south end of the Fabriform-lined portion of the channel. It was conservatively assumed that the culverts under River Access Road were 100 percent clogged for the PMF and 25-year + SSE conditions and that flood flow would pass over the road.

Upstream of the River Access Road crossing, the alignment and cross section of the channel were modified for Unit 3 construction. Downstream of the River Access Road crossing, the channel alignment and cross section was not modified. The Fabriform cross sections upstream and downstream of River Access Road are provided in Figure 2.4.3-213.

Another road crossing of West Creek is located upstream of the Fabriform-lined channel. If this crossing is overtopped during the PMF, the floodwaters would be contained in the channel by the high-surrounding topography. This contained water would pass through the drop structure and into the Fabriform-lined channel. This crossing does not affect the downstream analysis.

Flow and water level in Grants Bayou and West Creek are affected by road and railroad bridges, all with bridge piles located adjacent to and in the stream bed. Some moderate debris accumulation has occurred historically at these locations, but there is no record of a debris jam causing higher than anticipated flood levels or bridge washout (Reference 2.4.3-202). However, for the PMF, it was conservatively assumed that each bridge was 50 percent clogged. The cross-section data for the bridges are presented in Tables 2.4.3-211 and 2.4.3-212.

Two flood conditions were analyzed for the local streams. These include the PMF and a 25-year flood SSE. A discussion of the potential effects of an OBE is presented in Subsection 2.4.2.2.

For the SSE, it was assumed that slopes failed to a maximum of 20H:1V. Bridges downstream of the RBS were assumed to remain standing in a fully clogged condition, which would produce higher water levels than a washout condition. Bridges upstream of the RBS were assumed to be unaffected by an earthquake, allowing flood flow to enter the site area unmitigated.

A comparison of PMF and 1/2 PMF flows shows the PMF to be the more severe flood condition. Because stream channel conditions are assumed to be the same for both cases, flood levels from the PMF condition would be greater. The 1/2 PMF + OBE condition was eliminated from further consideration.

The starting elevation for the Grants Bayou backwater profile for both the PMF and 25-year flood + SSE conditions is conservatively assumed to be the Mississippi River PDF level, 54.5 ft. msl. It is highly unlikely that the river PDF would coincide with the PMF on the local basins.

Figure 2.4.3-211 shows cross-section locations for the PMF and 25-year flood + SSE flooding conditions. Cross-section locations in the Fabriform-lined portion of West Creek are shown in Figure 2.4.3-214. The new alignment of the Fabriform-lined channel is 139.47 ft. shorter than the existing alignment. Cross-section data are presented in Tables 2.4.3-211 and 2.4.3-212. Applicable channel and overbank Manning's n values are also presented in these tables. As noted in the tables, vertical walls were assumed to exist at either end of some sections to limit the spread of water and channel conveyance. Conservative water levels would result from this approach.

As discussed previously, bridges were assumed to be partially or fully clogged with debris, and overflow can be treated as for a broad-crested weir. Applicable weir widths and configurations are presented in Figures 2.4.3-212 and 2.4.3-213.

It was shown in the Unit 1 analysis that the peak flooding conditions in Grants Bayou do not impact the RBS site (Reference 2.4.3-202). The computed backwater profiles for West Creek, considering Unit 3 construction, are presented in Table 2.4.3-213. In the Unit 1 analysis, the peak flooding condition in West Creek occurred during the PMF. In the Unit 3 analysis, the peak flooding condition in West Creek occurs during the 25-year + SSE event. This event is more severe in the Unit 3 analysis because the Fabriform-lined channel was shifted west, closer to an area of higher elevation. Thus, the SSE criteria of 20H:1V slopes had a greater effect on the channel cross sections. The Unit 3 HEC-RAS SSE sections are provided in Figures 2.4.3-216 and 2.4.3-217. The SSE HEC-RAS Section 200, as shown in Figure 2.4.3-215, is unchanged from the Unit 1 analysis.

The maximum water surface elevations in West Creek near the plant occur at HEC-RAS Section 190 (refer to Figure 2.4.3-215). For the PMF event, the water surface elevation at this section is 94.61 ft. NGVD. For the 25-year + SSE event, the water surface elevation at this section is 95.39 ft. NGVD. The higher water surface elevations at HEC-RAS Section 200 (Figure 2.4.3-215) are contained by the existing topography and do not affect the site area.

The design plant grade elevation for RBS Unit 3 is 98.0 ft. NGVD. According to DCD Section 3.4.1.2 *Flood Protection from External Sources*, the design plant grade elevation shall be at least 1 ft. (310 mm) above the design flood level. Thus, the flood elevation cannot exceed 97.0 ft. NGVD. Therefore, both the PMF and 25-year + SSE events meet this criteria.

Normal sediment accumulation in the West Creek Fabriform channel will have no significant effect on the conveyance of flood flow past the RBS area. The predicted maximum PMF elevation is approximately 2.4 ft. below the maximum allowable flood level. The analysis used a Manning's roughness coefficient based on sediment accumulation in the channel. The channel capacity is much greater at the higher elevations than at the channel bottom; thus, much more than 2.4 ft. of sediment could accumulate before the maximum flood level is exceeded. Sediment, debris, and vegetation that accumulate during Unit 3 construction would be removed. During Unit 3 operation, annual inspection and maintenance would be performed to remove accumulated vegetation, silt, and debris to maintain the West Creek channel consistent with the assumptions of the analysis.

2.4.3.6 Coincident Wind Wave Activity

2.4.3.6.1 Mississippi River

An estimated PMF level of 57.54 ft. NGVD (refer to Subsection 2.4.3.5.1) was combined with the 2-year extreme wind speed to determine the maximum water level due to river flooding at the RBS site.

Wave height was determined based on a 50-mph wind speed (Reference 2.4.3-202) and a fetch of 50 mi. From Figure 2.4.3-205, with an average bottom elevation of approximately 33 ft. NGVD, the average water depth is approximately 25 ft. For these parameters, using the *Shore Protection Manual* (Reference 2.4.3-210, Figure 3-31), the significant wave height is 5.5 ft. and the wave period is 5.4 seconds. The maximum water surface elevation, including wave runup, would be 65.79 ft. Therefore, the plant, at Elevation 98.0 ft., would not be affected.

Wave height was also determined for the extreme wind condition, as identified in Subsection 2.4.5. The 100-year mean recurrence of maximum 3-second wind speeds from Engineering Weather Data and the USACE is 128 mph. For this case, the significant wave height is 9.5 ft. and the wave period is 7.3 seconds. The maximum water surface elevation, including wave runup, is 71.79 ft. Thus, even for this extreme condition, the RBS would not be affected.

2.4.3.6.2 Local Streams

The design flooding level in the RBS area would not be increased by coincident wind wave activity. No substantial fetch could be generated to affect Grants Bayou flood levels because of the dense vegetation surrounding the stream.

For West Creek, the PMF is contained within the Fabriform channel and would not be substantially affected by high winds. During the postulated 25-year flood + SSE, the water level on West Creek near the RBS (HEC-RAS cross sections 170 to 190) would be only 3 to 4 ft. above the channel bottom and could not generate a significant wave.

2.4.3.7 References

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Table 2.4.3-201
PMP Values at the RBS Site

Duration	West Creek PMP 1.0 mi^2 (in.)	Grants Bayou PMP above West Creek Confluence 8.4 mi^2 (in.)	Grants Bayou PMP 15.6 mi^2 (in.)
5 min	6.2		
15 min	9.7	8.2	--
30 min	14.2	11.9	--
1 hr.	19.4	16.3	14.7
6 hr.	32.0	32.0	31.0
12 hr.	38.7	38.7	37.8
18 hr.	--	43.7	42.6
24 hr.	47.1	47.1	46.3
48 hr.	--	51.8	50.8
72 hr.	--	55.7	--

Source: U.S. Department of Commerce, "Probable Maximum Participation Estimates, United States East of the 105th Meridian," Hydrometerorological Report No. 51, Washington, D.C., 1978.

U.S. Department of Commerce, "Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Hydrometerorological Report No. 52, Washington, D.C., 1982.

Table 2.4.3-202
PMP Storm Distribution

Grants Bayou		Grants Bayou above Confluence with West Creek		West Creek	
Time (hr.)	Incremental Rainfall (in.)	Time (hr.)	Incremental Rainfall (in.)	Time (hr.)	Incremental Rainfall (in.)
0-6	3.7	0-3	2.8	0-1.5	2.8
6-12	6.8	3-6	7.2	1.5-3.0	4.4
12-13	1.7	6-6.5	1.8	3.0-3.25	1.0
13-14	3.3	6.5-7	2.1	3.25-3.5	2.3
14-15	5.4	7-7.5	4.4	3.5-3.75	4.5
15-16	14.7	7.5-8	11.9	3.75-4.0	9.7
16-17	4.0	8-8.5	2.6	4.0-4.25	2.9
17-18	1.9	8.5-9	2.0	4.25-4.5	1.1
18-24	4.8	9-12	3.9	4.5-6.0	3.3
	46.3		38.7		32.0

Source: U.S. Department of Commerce, "Probable Maximum Participation Estimates, United States East of the 105th Meridian," Hydrometerorological Report No. 51, Washington, D.C., 1978.

U.S. Department of Commerce, "Application of Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Hydrometerorological Report No. 52, Washington, D.C., 1982.

Table 2.4.3-203
Local Soils Categorized by Hydrologic Soil Groups

Association	Soil	Percent of Association	Hydrologic Soil Group
Memphis-Loring (75% of Grants Bayou)	Memphis	55	B
	Loring	30	B
	Miscellaneous	15	10 percent C 5 percent D
Vicksburg-Collins-Waverly (25% of Grants Bayou)	Vicksburg	30	B
	Collins	30	C
	Waverly	25	D
	Miscellaneous	15	7.5 percent C 7.5 percent D

Key: B = 71 percent of drainage area
C = 17 percent of drainage area
D = 12 percent of drainage area

Source: References 2.4.3-212 and 2.4.3-213.

Table 2.4.3-204
Rainfall-Runoff Relationships

Basin	Time (hr.)	Incremental Rainfall (in.)	Accumulated Rainfall (in.)	Accumulated Runoff (in.)	Incremental Runoff (in.)	Incremental Loss (in.)
Grants Bayou	0-6	3.7	3.7	0.62	0.62	3.08
	6-12	6.8	10.5	5.30	4.68	2.12
	12-13	1.7	12.2	6.73	1.43	0.27
	13-14	3.3	15.5	9.63	2.40	0.40
	14-15	5.4	20.9	14.59	4.96	0.44
	15-16	14.7	35.6	28.68	14.09	0.61
	16-17	4.0	39.6	32.59	3.80[a]	0.20[a]
	17-18	1.9	41.5	34.44	1.70	0.20
	18-24	4.8	46.3	39.16	3.60	1.20
Grants Bayou above Confluence with West Creek	0-3	2.8	2.8	0.26	0.26	2.54
	3-6	7.2	10.0	4.90	4.64	2.56
	6-6.5	1.8	11.8	6.39	1.49	0.31
	6.5-7	2.1	13.9	8.21	1.82	0.28
	7-7.5	4.4	18.3	12.18	3.97	0.43
	7.5-8	11.9	30.2	23.45	11.27	0.63
	8-8.5	2.6	32.8	25.96	2.50[a]	0.10[a]
	8.5-9	2.0	34.8	27.90	1.90	0.10
	9-12	3.9	38.7	31.71	3.30	0.60
West Creek	0-1.5	2.8	2.8	0.31	0.31	2.49
	1.5-3.0	4.4	7.2	3.26	2.95	1.45
	3.0-3.25	1.0	8.2	4.06	0.80	0.20
	3.25-3.5	2.3	10.5	6.00	1.94	0.36
	3.5-3.75	4.5	15.0	10.04	4.04	0.46
	3.75-4.0	9.7	24.7	19.24	9.20	0.50
	4.0-4.25	2.9	27.6	22.05	2.81	0.09
	4.25-4.5	1.1	28.7	23.12	1.05[a]	0.05[a]
	4.5-6.0	3.3	32.0	26.34	3.00	0.30

a) Minimum retention rate of 0.2 in./hr applies from this point to end of storm.

Table 2.4.3-205 (Sheet 1 of 2)
Hydrologic Characteristics of Small Basins

Texas Basins	$L^{(a)}$ (mi.)	$L_{ca}^{(b)}$ (mi.)	$S^{(c)}$ (ft/mi)	Area (sq mi^2)	Lag Time (hr.)
1	0.96	0.33	62.8	0.48	0.3
2	1.53	0.91	79.2	1.26	1.0
3	2.23	0.87	32.3	1.73	1.4
4	1.84	1.04	58.1	2.14	1.4
5	2.22	1.33	70.2	3.29	0.75
6	2.69	0.90	100.3	3.42	1.25
7	4.79	1.70	63.4	4.32	0.75
8	4.11	1.70	88.2	5.25	1.25
9	3.50	1.70	41.9	7.01	2.25
10	6.78	3.93	19.9	9.16	3.4
11	7.92	3.75	9.1	17.60	5.1
12	19.2	8.50	12.0	70.00	8.5
13	25.0	14.00	6.4	75.50	13.1
Louisiana Basins					
1	5.4	2.7	15.9	12.1	2.5
2	15.1	7.6	11.8	35.3	3.5
3	21.2	11.0	7.1	103.0	12.0
4	16.9	8.6	8.7	89.7	22.5
5	30.9	16.8	6.6	79.5	16.5
6	7.6	4.0	15.3	21.4	4.5
7	3.9	2.1	25.9	5.3	3.5
8	19.2	9.2	8.4	68.3	30.0
9	10.8	5.8	2.2	37.1	9.0
10	11.3	5.9	1.8	19.0	14.0
11	12.3	5.8	2.7	25.7	18.0

Table 2.4.3-205 (Sheet 2 of 2)
Hydrologic Characteristics of Small Basins

Texas Basins	$L^{(a)}$ (mi.)	$L_{ca}^{(b)}$ (mi.)	$S^{(c)}$ (ft/mi)	Area (sq mi^2)	Lag Time (hr.)
12	25.4	12.6	5.4	94.2	27.0
13	23.2	10.2	6.4	82.2	13.5
14	19.2	10.3	7.2	96.5	30.0
15	4.2	2.3	24.4	3.2	3.5
16	8.5	4.9	11.4	13.1	7.5
<u>Local Basins</u>					
GB	7.04	4.81	22.7	15.55	5.0[d]
GBA	4.73	3.64	30.1	8.45	2.5[d]
WC	2.13	1.04	38.8	0.96	1.2[d]

a) Length of longest watercourse from the point of interest to the watershed divide.

b) Length of longest watercourse from the point of interest to the centroid of the basin.

c) Slope of the longest watercourse from the point of interest to the watershed divide. For basins other than Texas Basins, this is $S_{10/85}$, the slope between 10 and 85 percent of the watercourse.

d) Estimated from Table 2.4.3-206.

Key: GB = Grants Bayou
GBA = Grants Bayou above Confluence with West Creek
WC = West Creek

Sources: Reference 2.4.3-213.

U.S. Department of the Interior, U.S. Geological Survey, *Topographic Maps of Louisiana, Elm Park, 1961, Port Hudson, 1963*, Washington, D.C.

U.S. Department of the Interior, U.S. Geological Survey, and Louisiana Department of Transportation, *Unit Hydrographs for Southwestern Louisiana*, Technical Report No. 2D, Baton Rouge, 1969.

U.S. Department of the Interior, U.S. Geological Survey, and Louisiana Department of Transportation, *Unit Hydrographs for Southeastern Louisiana and Southwestern Mississippi*, Technical Report No. 2B, Baton Rouge, 1967.

Table 2.4.3-206
Comparison of Lag Time Estimates

Method	GB	GBA	WC
Snyder[a], $T = C_t (LL_{ca})^{0.3}$	6.1	3.4	1.4
Direct Comparison of Basin Characteristics [a,b,c]	6.0	3.0	1.5
T vs. L/S[a,b]			
Based on Data from Small Texas Basins[a]	4.4	2.3	1.1
Based on Data from Small Texas and Louisiana Basins[a,b,c]	4.8	2.5	1.1
Based on Data from Ramser[d]	4.4	2.3	1.1
Based on Data from Chow[d]	3.5	1.8	1.0
Mitchell[e] $T=5.33L^{.602}S_{10/85}^{-.448}S_t^{.231}$	6.1	3.0	1.4
$T=5.02L^{.65}S_{10/85}^{-.46}$	6.4	2.9	1.5
Soil Conservation Service[f] $T = \frac{L^{0.8}(S+1)^{0.7}}{1900\,Y^{0.5}}$	5.0	3.2	1.2
Average	5.2	2.5	1.2
Range	3.5 - 6.4	1.8 - 3.4	1.0 - 1.5
Values used in Study	5.0	2.5	1.2

Key: GB = Grants Bayou
GBA = Grants Bayou above West Creek confluence
WC = West Creek

Sources: (a) Referernce 2.4.3-213.

(b) U.S. Department of the Interior, U.S. Geological Survey, and Louisiana Department of Transportation, *Unit Hydrographs for Southeastern Louisiana and Southwestern Mississippi*, Technical Report No. 2B, Baton Rouge, 1967.

(c) U.S. Department of the Interior, U.S. Geological Survey, and Louisiana Department of Transportation, *Unit Hydrographs for Southwestern Louisiana*, Technical Report No. 2D, Baton Rouge, 1969.

(d) Chow, V. T., *Hydrologic Determination of the Waterway Areas for the Design of Drainage Structures in Small Drainage Basins*, University of Illinois Bulletin, Vol. 59, No. 65, Urbana, Illinois, 1962.

(e) Mitchell, W. D., *Model Hydrographs*, Geological Survey Water-Supply Paper 2005, Washington, D.C., 1982.

(f) U.S. Department of Agriculture, Soil Conservation Service, *Urban Hydrology for Small Watersheds*, Technical Release No. 55, 1975.

Table 2.4.3-207 (Sheet 1 of 3)
Unit Hydrographs for Local Basins

Method 1		Method 2		Method 3		Final Version	
Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)
Grants Bayou							
0.0	0.0	0.0	0.0	0.0	0	0.0	0.0
0.5	14	1.92	106	1.0	45	1.0	64
1.0	107	2.70	321	2.0	245	2.0	352
1.5	329	3.46	1047	3.0	500	3.0	850
2.0	666	4.24	1401	4.0	900	4.0	1443
2.5	1096	5.00	1536	5.0	1420	5.0	1620
3.0	1572	5.39	1569	6.0	1460	6.0	1415
3.5	1950	6.16	1441	7.0	1270	7.0	1090
4.0	2118	7.32	1047	8.0	1040	8.0	720
4.5	2093	8.86	724	9.0	800	9.0	510
5.0	1913	10.78	445	10.0	600	10.0	380
5.5	1623	13.48	241	11.0	420	11.0	290
6.0	1313	17.32	97	12.0	320	12.0	245
6.5	1051	21.18	33	13.0	265	13.0	205
7.0	842	25.41	0	14.0	200	14.0	180
7.5	674			15.0	180	15.0	160
8.0	540			16.0	120	16.0	140
8.5	432					17.0	115
9.0	346					18.0	90
9.5	277					19.0	70
10.0	222					20.0	45
10.5	178					21.0	40
11.0	142					22.0	30
11.5	114					23.0	20
12.0	91					24.0	10
						25.0	5
						26.0	0

Table 2.4.3-207 (Sheet 2 of 3)
Unit Hydrographs for Local Basins

Method 1		Method 2		Method 3		Final Version	
Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)
Grants Bayou Above West Creek Confluence							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.25	12	0.96	115	0.5	50	0.5	57
0.5	90	1.35	349	1.0	255	1.0	320
0.75	279	1.73	1138	1.5	550	1.5	840
1.0	572	2.12	1523	2.0	905	2.0	1435
1.25	955	2.50	1670	2.5	1450	2.5	1667
1.5	1390	2.70	1705	3.0	1545	3.0	1522
1.75	1755	3.08	1566	3.5	1375	3.5	1175
2.0	1953	3.66	1138	4.0	1090	4.0	855
2.25	1986	4.43	787	4.5	825	4.5	615
2.5	1880	5.39	484	5.0	600	5.0	475
2.75	1669	6.74	262	5.5	425	5.5	360
3.0	1423	8.66	105	6.0	350	6.0	285
3.25	1205	10.59	36	6.5	275	6.5	240
3.5	1020	12.70	0	7.0	200	7.0	200
3.75	863			7.5	160	7.5	150
4.0	731					8.0	130
4.25	618					8.5	115
4.5	524					9.0	90
4.75	443					9.5	70
5.0	375					10.0	60
5.25	318					10.5	50
5.5	269					11.0	40
5.75	228					11.5	30
6.0	193					12.0	20
						12.5	10
						13.0	0

Table 2.4.3-207 (Sheet 3 of 3)
Unit Hydrographs for Local Basins

Method 1		Method 2		Method 3		Final Version	
Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)	Time (hr.)	Flow (cfs)
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12	2	0.46	27	0.25	15	0.25	14
0.24	18	0.65	82	0.5	70	0.5	81
0.36	58	0.83	268	0.75	170	0.75	212
0.48	119	1.02	359	1.0	245	1.0	341
0.60	200	1.20	394	1.25	290	1.25	362
0.72	292	1.30	402	1.5	285	1.5	305
0.84	372	1.48	369	1.75	265	1.75	240
0.96	418	1.76	268	2.0	235	2.0	190
1.08	431	2.13	186	2.25	210	2.25	146
1.20	415	2.60	114	2.5	170	2.5	120
1.32	375	3.25	62	2.75	135	2.75	102
1.44	328	4.17	25	3.0	115	3.0	82
1.56	284	5.10	8			3.25	70
1.68	246	6.12	0			3.5	54
1.80	213					3.75	43
1.92	185					4.0	33
2.04	160					4.25	23
2.16	139					4.5	18
2.28	120					4.75	12
2.40	104					5.0	9
2.52	90					5.25	7
2.64	78					5.5	5
2.76	68					5.75	3
2.88	59					6.0	2
						6.25	1
						6.5	0

Table 2.4.3-208 (Sheet 1 of 2)
PMF Hydrograph for Grants Bayou

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
0	0.0	0	0.0	0
1	1.0	64	0.10	0
2	2.0	352	0.10	6
3	3.0	850	0.10	42
4	4.0	1,443	0.10	127
5	5.0	1,620	0.11	271
6	6.0	1,415	0.11	439
7	7.0	1,090	0.78	579
8	8.0	720	0.78	739
9	9.0	510	0.78	1061
10	10.0	380	0.78	1698
11	11.0	290	0.78	2717
12	12.0	245	0.78	3842
13	13.0	205	1.43	4822
14	14.0	180	2.90	5619
15	15.0	160	4.96	6446
16	16.0	140	14.09	8009
17	17.0	115	3.80	11,777
18	18.0	90	1.70	19,465
19	19.0	70	0.60	29,918
20	20.0	45	0.60	39,808
21	21.0	40	0.60	42,690
22	22.0	30	0.60	38,721
23	23.0	20	0.60	31,701
24	24.0	10	0.60	24,182
25	25.0	5	0.00	19,014
26	26.0	0	0.00	15,625

Table 2.4.3-208 (Sheet 2 of 2)
PMF Hydrograph for Grants Bayou

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
27	27.0			13,242
28	28.0			11,443
29	29.0			9618
30	30.0			7970
31	31.0			6553
32	32.0			5345
33	33.0			4306
34	34.0			3405
35	35.0			2665
36	36.0			2006
37	37.0			1613
38	38.0			1240
39	39.0			900
40	40.0	0.0	0.0	593
41	41.0			376
42	42.0			213
43	43.0			137
44	44.0			90
45	45.0			63
46	46.0			39
47	47.0			21
48	48.0			9
49	49.0			3
50	50.0			0

Table 2.4.3-209 (Sheet 1 of 2)
PMF Hydrograph for Grants Bayou above Confluence with West Creek

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
0	0.0	0	0.0	0
1	0.5	57	0.04	0
2	1.0	320	0.04	2
3	1.5	840	0.04	15
4	2.0	1435	0.04	49
5	2.5	1667	0.05	106
6	3.0	1522	0.05	173
7	3.5	1175	0.77	237
8	4.0	855	0.77	334
9	4.5	615	0.77	613
10	5.0	475	0.77	1259
11	5.5	360	0.78	2326
12	6.0	285	0.78	3553
13	6.5	240	1.49	4672
14	7.0	200	1.82	5583
15	7.5	150	3.97	6472
16	8.0	130	11.27	7765
17	8.5	115	2.50	10,531
18	9.0	90	1.90	16,108
19	9.5	70	0.55	24,334
20	10.0	60	0.55	32,278
21	10.5	50	0.55	35,346
22	11.0	40	0.55	33,202
23	11.5	30	0.55	27,971
24	12.0	20	0.55	22,566
25	12.5	10	0.0	18,208
26	13.0	0		15,243

Table 2.4.3-209 (Sheet 2 of 2)
PMF Hydrograph for Grants Bayou above Confluence with West Creek

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
27	13.5			12,884
28	14.0			10,956
29	14.5			9164
30	15.0			7415
31	15.5			5786
32	16.0			4664
33	16.5			3793
34	17.0			3029
35	17.5			2419
36	18.0			1978
37	18.5			1606
38	19.0			1275
39	19.5	0.0	0.0	969
40	20.0			699
41	20.5			453
42	21.0			250
43	21.5			167
44	22.0			116
45	22.5			83
46	23.0			55
47	23.5			33
48	24.0			17
49	24.5			6
50	25.0			0

Table 2.4.3-210 (Sheet 1 of 2)
PMF Hydrograph for West Creek

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
0	0.0	0	0.0	0
1	0.25	14	0.05	0
2	0.50	81	0.05	1
3	0.75	212	0.05	5
4	1.00	341	0.05	15
5	1.25	362	0.05	32
6	1.50	305	0.06	50
7	1.75	240	0.49	66
8	2.00	190	0.49	85
9	2.25	146	0.49	131
10	2.50	120	0.49	233
11	2.75	102	0.49	389
12	3.00	82	0.50	553
13	3.25	70	0.80	691
14	3.50	54	1.94	804
15	3.75	43	4.04	933
16	4.00	33	9.20	1188
17	4.25	23	2.81	1832
18	4.50	18	1.05	3152
19	4.75	12	0.50	4963
20	5.00	9	0.50	6431
21	5.25	7	0.50	6699
22	5.50	5	0.50	6027
23	5.75	3	0.50	5109
24	6.00	2	0.50	4305
25	6.25	1	0.0	3656
26	6.50	0		3203

Table 2.4.3-210 (Sheet 2 of 2)
PMF Hydrograph for West Creek

Time Interval Number	Time (hr.)	Unit Hydrograph (cfs)	Incremental Runoff (in.)	Total PMF Hydrograph (cfs)
27	6.75			2833
28	7.00			2432
29	7.25			2028
30	7.50			1614
31	7.75			1272
32	8.00			987
33	8.25			749
34	8.50			577
35	8.75			434
36	9.00			330
37	9.25			251
38	9.50			183
39	9.75			128
40	10.00			87
41	10.25			55
42	10.50			32
43	10.75			20
44	11.00			14
45	11.25			9
46	11.50			6
47	11.75			3
48	12.00			2
49	12.25			1
50	12.50			0

Table 2.4.3-211 (Sheet 1 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. 1 (Section 10 in HEC-RAS Model)			
0	56.6	427	36.7
50	56.5	435	43.1
100	56.5	469	43.5
150	56.7	488	49.3
194	56.2	500	51.4
254	56.4	540	56.5
292	56.5	573	56.5
316	52.4	600	56.9
326	49.3	658	57.8
334	43.0	668	58.4
359	40.6	684	59.4
362	36.4	700	59.2
380	36.6	751	60.5
400	36.7	800	60.8
Channel n = 0.04; Overbank n = 0.13.			
Cross Section No. 2 (Section 20 in HEC-RAS Model)			
0	75.0	830	40.0
140	50.0	950	45.0
290	45.0	1000	50.0
730	45.0	1120	75.0
745	40.0		
Channel n = 0.05; Overbank n = 0.13.			

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 2 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. 2a (Section 21 in HEC-RAS Model)			
0	75.0	935	43.0
180	55.0	970	45.0
865	50.0	1430	50.0
900	45.0	1590	75.0
Channel n = 0.05; Overbank n = 0.13.			
Cross Section No. 3 (Section 30 in HEC-RAS Model)			
0	75.0	745	46.0
80	60.0	790	50.0
680	55.0	900	55.0
700	50.0	980	75.0
Channel n = 0.05; Overbank n = 0.13.			
Cross Section No. 4 (Section 40.1 in HEC-RAS Model)			
0	67.3 (RR)	193	56.7
13	63.8	242	55.0
28	58.3	251	59.9
58	56.8	261	65.5
74	54.9	319	70.4
102	55.4	351	70.8
112	49.4	395	71.2
127	47.7	451	71.8
141	49.8	501	72.4
151	46.5	551	73.1
158	48.6	601	73.6
180	48.3	651	74.2

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 3 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
		701	74.8
		751	75.3 (RR)

Bridge assumed clogged at El 61.5 ft. msl.
Channel n = 0.09; Overbank n = 0.13

Bridge piles (12 in. dia) are located at the following distances from the left bank:

14	144
28	157
41	169
54	182
66	195
79	208
92	221
105	234
118	247
131	261

Cross Section No. 4a (Section 41 in HEC-RAS Model)

0	90.0	585	50.0
50	85.0	620	55.0
90	80.0	645	60.0
140	75.0	880	65.0
220	70.0	910	70.0
310	65.0	930	75.0
360	60.0	970	80.0

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 4 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
540	60.0	1060	85.0
550	55.0	1120	90.0

Channel n = 0.06; Overbank n = 0.13.

Cross Section No. 5 (Section 50.1 in HEC-RAS Model)

0	66.2	122	51.1
29	66.4	140	53.3
29	63.2	160	54.6
43	60.5	173	59.2
77	58.0	189	63.0
93	56.6	190	66.1 (RR)
102	52.2	200	65.9
112	50.8		

Bridge assumed clogged at El 61.5 ft. msl.
Channel n = 0.10; Overbank n = 0.13.

Bridge piles (12 in. dia) are located at the following distances from the left bank:

29	119 (Double pile)
43	133
57	147
71	161
86 (Double pile)	176
	189

Cross Section No. 5a (Section 51 in the HEC-RAS Model)

0	90.0	340	55.0
70	85.0	420	55.0

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 5 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
120	80.0	460	60.0
180	75.0	830	65.0
210	70.0	870	70.0
250	65.0	910	75.0
300	60.0	930	80.0
		960	85.0
		990	90.0

Channel n = 0.094; Overbank n = 0.13.

Cross Section No. 6 (Section 60.1 in the HEC-RAS Model)

0	83.0 (RR)	470	66.6
14	78.9	488	61.3
23	77.0	498	54.8
36	74.3	514	55.3
49	73.3	536	55.5
71	69.5	545	58.9
88	66.0	558	66.8
114	64.4	584	67.0
137	63.9	614	67.1
178	63.7	664	67.4
185	57.3	714	68.4
203	64.3	760	69.3
264	64.5	778	70.7
314	65.0	793	71.3
364	65.2	804	75.6
387	65.4	814	80.2

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 6 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
421	64.8	823	84.4 (RR)
436	66.0		

Bridge assumed clogged at El 62.0 ft. msl.
Channel n = 0.094; Overbank n = 0.13.

Bridge piles (12 in. dia) are located at the following distances from the left bank:

469	500	530	561
485	514	545	

Cross Section No. 6a (Section 61 in HED-RAS Model)

0	80.0	460	65.0
120	75.0	590	70.0
250	60.0	650	75.0
285	55.0	690	80.0
320	60.0		

Channel n = 0.094; Overbank n = 0.13.

Cross Section No. 7 (Section 70.1 in HEC-RAS Model)

0	70.6 (RR)	170	56.3
81	67.1	179	56.1
103	62.1	185	59.6
116	57.8	200	62.6
124	56.5	206	65.5
132	55.7	230	64.6
143	56.5	233	69.9

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 7 of 11)
PMF Cross-Section Data[(a)]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
152	56.9	275	69.6 (RR)
160	55.0		

Bridge assumed clogged at El 65.0 ft. msl.
Channel n = 0.09; Overbank n = 0.13.

Bridge piles (12 in. dia) are located at the following distances from the left bank:

82	164
95	177
109	191
122	205
136	219
151	231

<u>Cross Section No. 8 (Section 80 in HEC-RAS Model)</u>

0	100.0	600	65.0
180	75.0	630	70.0
280	70.0	720	75.0
460	65.0	900	100.0
500	60.0		
580	60.0		

Channel n = 0.06; Overbank n = 0.13.

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 8 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. 9 (Section 90 in HEC-RAS Model)			
0	100.0	710	65.0
260	80.0	750	75.0
470	75.0	790	100.0
630	65.0		
Channel n = 0.07; Overbank n = 0.13.			
Cross Section No. 10 (Section 100 in HEC-RAS Model)			
0	100.0	470	75.0
120	90.0	530	80.0
350	80.0	700	90.0
370	75.0	750	100.0
Channel n = 0..07; Overbank n = 0.13.			
Cross Section No. 11 (Section 101 in HEC-RAS Model)			
0	110.0	425	80.0
50	100.0	450	85.0
150	95.0	460	90.0
280	90.0	545	95.0
320	85.0	580	100.0
350	80.0	660	110.0
Channel n = 0.07; Overbank n = 0.13.			

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 9 of 11)
PMF Cross-Section Data[(a)]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
	West Creek		
Cross Section No. W1 (Section 110.1 in HEC-RAS Model)			
0	72.2 (RR)	117	58.9
69	72.6	123	61.9
72	66.9	129	62.5
76	65.3	139	65.0
84	60.0	153	68.5
91	58.3	155	73.2
100	57.6	200	73.8 (RR)
109	58.4		

Bridge assumed clogged at El 67.5 ft. msl.
Channel n = 0.11; Overbank n = 0.12.

Bridge piles (12 in. dia) are located at the following distance from the left bank:

71	98	126	153
84	112	140	

Cross Section No. W1a (Section III in HEC-RAS Model)			
0	90.0	210	70.0
20	85.0	230	75.0
30	80.0	300	80.0
80	75.0	320	85.0
90	70.0	330	90.0
130	65.0		
180	65.0		

Channel n = 0.05; Overbank n = 0.12.

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 10 of 11)
PMF Cross-Section Data[(a)]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. W2 (Section 120.1 in HEC-RAS Model)			
0	86.5 (RR)	124	64.3
78	85.4	139	66.0
79	81.3	146	68.6
92	74.5	156	79.3
104	70.4	158	84.6
109	66.0	250	83.6 (RR)
Bridge assumed clogged at El 77.0 ft. msl Channel n = 0.10; Overbank n = 0.12.			
Bridge piles (12 in. dia) are located at the following distance from the left bank:			
89	105	130	157
102	118	114	
Cross Section No. W3 (Section 130 in HEC-RAS Model)			
0	100.0	250	75.0
40	90.0	265	80.0
90	85.0	360	85.0
120	80.0	400	90.0
150	75.0	440	95.0
200	71.0	470	100.0
Channel n = 0.05; Overbank n = 0.12.			
Cross Section No. W4 (Section 140 in HEC-RAS Model)			
0	100.0	190	80.0
50	95.0	220	85.0
80	90.0	370	90.0

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-211 (Sheet 11 of 11)
PMF Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
110	85.0	400	95.0
155	80.0		

Channel n = 0.05; Overbank n = 0.12.

Cross Section No. W4a (Section 141 in HEC-RAS Model)

0	90.0 (wall)	300	80.0
220	90.0	330	90.0
250	80.0	510	92.0

Channel n = 0.03; Overbank n = 0.12.

Cross Section No. W5 through W9 (Fabriform Channel)

Refer to Figure 2.4.3-214.

Cross Section at River Access Road (Looking Downstream) (HEC-RAS Section 165)

0	96
80	96
135	95
200	94
310	90
470	90
615	96

a) All cross sections looking upstream. Cross-section information as entered into HEC-2. When imported into HEC-RAS, the convention is looking downstream. Thus, the model reverses the sections. For example, in Cross Section No. 1, shown above, Station 0, Elevation 56.6 becomes Station 800, Elevation 56.6, and Station 50, Elevation 56.5 becomes Station 750, Elevation 56.5, all the way to Station 800, Elevation 60.8 becoming Station 0, Elevation 60.8.

Table 2.4.3-212 (Sheet 1 of 4)
SSE Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. W1 (Section 110 in HEC-RAS Model)			
Refer to Figure 2.4.3-212.			
Cross Section No. W1a (Section 111 in HEC-RAS Model)			
0	86.0	500	91.0
200	76.0		
n for entire channel = 0.12			
Cross Section No. W2 (Section 120 in HEC-RAS Model)			
Refer to Figure 2.4.3-213.			
Cross Section No. W3 (Section 136 in HEC-RAS Model)			
0	121.0	980	80.0
320	105.0	1480	100.0
590	105.0	1540	100.0
		1610	105.0
n for entire channel = 0.12			
Cross Section No. W4 (Section 140 in HEC-RAS Model)			
0	99.0	400	87.0
310	83.5	540	94.0
350	85.5	800	105.0
n for entire channel = 0.12			

Table 2.4.3-212 (Sheet 2 of 4)
SSE Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. W4a (Section 141 in HEC-RAS Model)			
0	106.5	590	91.0
310	90.0	660	92.0
340	90.0	680	95.0
430	84.0	790	95.0
		990	105.0
n for entire channel = 0.05			
Cross Section No. W5 (Section 150 in HEC-RAS Model)			
0	106.0	640	92.0
410	83.5	690	95.0
560	91.0	720	95.0
		880	103.0
		940	105.0
n for entire channel = 0.05			
Cross Section No. W6 (Section 160 in HEC-RAS Model)			
0	115.0	990	95.0
610	84.5	1050	95.0
740	91.0	1260	106.0
980	92.0		
n for entire channel = 0.05			

Table 2.4.3-212 (Sheet 3 of 4)
SSE Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. W6.4 (Just D/S of River Access Road) (Section 164 in HEC-RAS Model)			
0	94		
141	92.5	485	95
280.6	85.6	590	95
454.3	94.2	745	100
n for entire channel = 0.05			
Cross Section No. W6.5 (River Access Road) (Section 165 in HEC-RAS Model)			
0	96	310	90
80	96	470	90
135	95	615	96
200	94		
n for entire channel = 0.05			
Cross Section No. W6.6 (Just U/S of River Access Road) (Section 166 in HEC-RAS Model)			
0	95	415.5	83.4
224.3	92.6	1085.3	116.9
n for entire channel = 0.05			
Cross Section No. W7 (Section 170 in HEC-RAS Model)			
0	95 (wall)	798.9	94.3
350	95	835	95
492.7	93.1	985	100
634.2	86.1		
n for entire channel = 0.05			

Table 2.4.3-212 (Sheet 4 of 4)
SSE Cross-Section Data[a]

Distance from Left Bank (ft.)	Elevation (ft. msl)	Distance from Left Bank (ft.)	Elevation (ft. msl)
Cross Section No. W8 (Section 180 in HEC-RAS Model)			
0	95 (wall)	560	92.6
335	95	1199.3	124.6
550.2	93.1		
n for entire channel = 0.05			
Cross Section No. W9 (Section 190 in HEC-RAS Model)			
0	95 (wall)	1184.5	122.6
300	95		
485.6	94.2		
550.7	90.9		
n for entire channel = 0.05			

a) All cross sections looking upstream, except Cross Sections W6.4 through W9, which are looking downstream. Refer to the discussion in Note a, Table 2.4.3-211. Maximum channel side slope after SSE = 20H:1V.

Table 2.4.3-213
Design Flood Profiles

Station (ft.)	Cross Section	HEC-RAS Section	West Creek PMF Flow (cfs)	West Creek PMF Elevation (ft. msl)	West Creek 25-Yr Flood +SSE Flow (cfs)	West Creek 25-Yr Flood +SSE Elevation (ft. msl)
625	No. W1	110	6699	82.11	842	73.5
1325	No. W1a	111	6314	82.94	794	81.41
1925	No. W2	120	5984	87.91	752	85.98
2265	No. W3	130	5598	89.30	703	87.31
3425	No. W4a	141	5158	89.86	648	88.42
3550	No. W5	150	5062	91.36	636	88.54
4070	No. W6	160	4668	91.71	587	88.90
4410.53	River Access Road Crossing	165	4440	92.77	558	90.69
4615.53	No. W7	170	4212	94.23	529	91.05
5135.53	No. W8	180	3818	94.41	480	94.18
5635.53	No. W9	190	3392	94.61	427	95.39

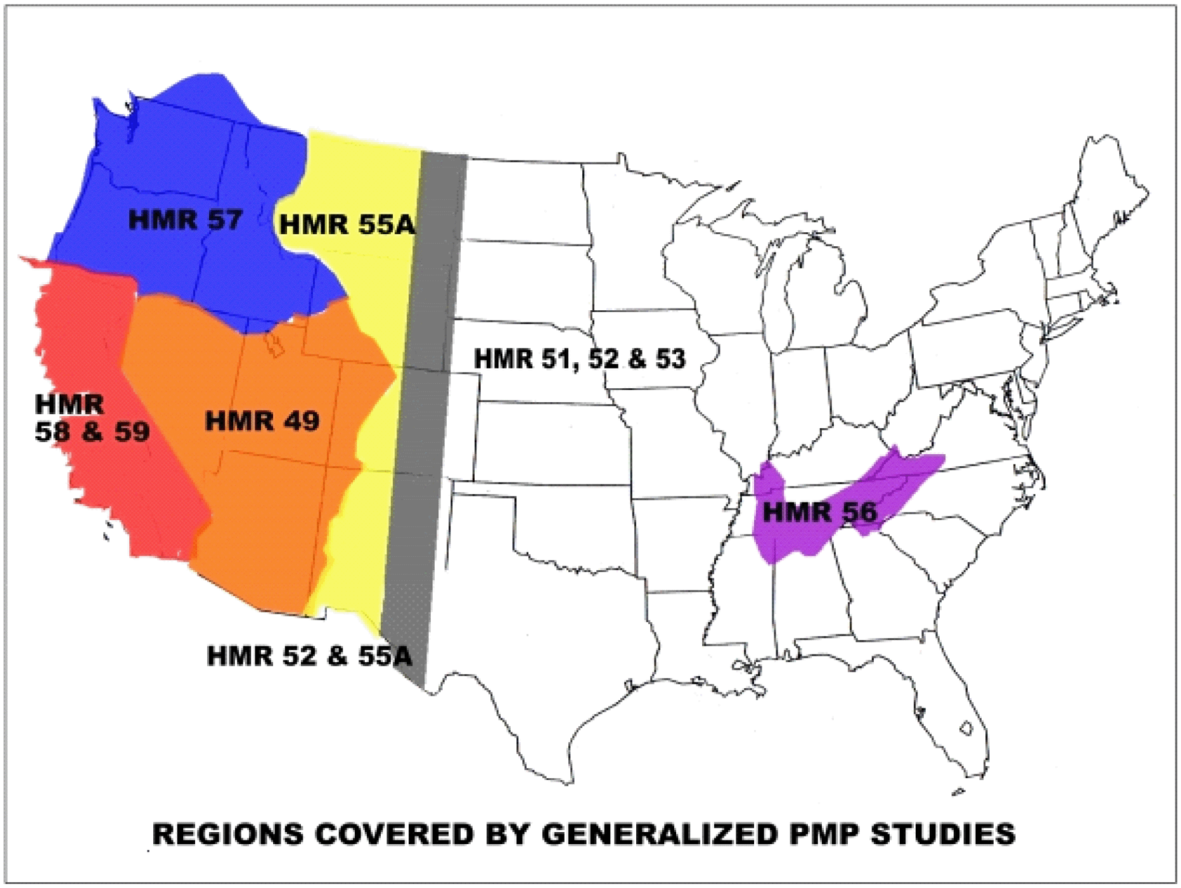


Figure 2.4.3-201. PMP Regions Map

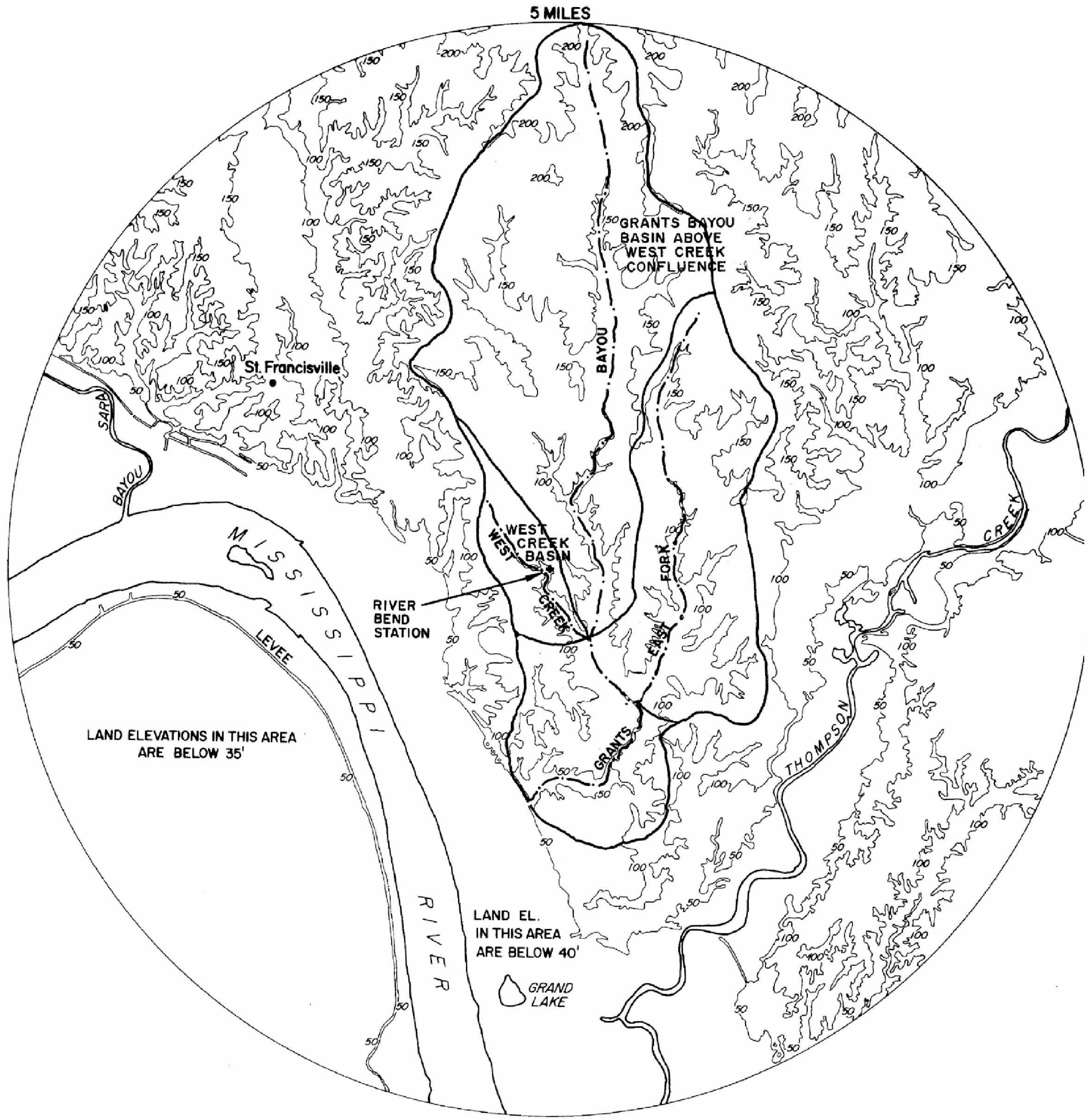


Figure 2.4.3-202. Local Drainage Basins

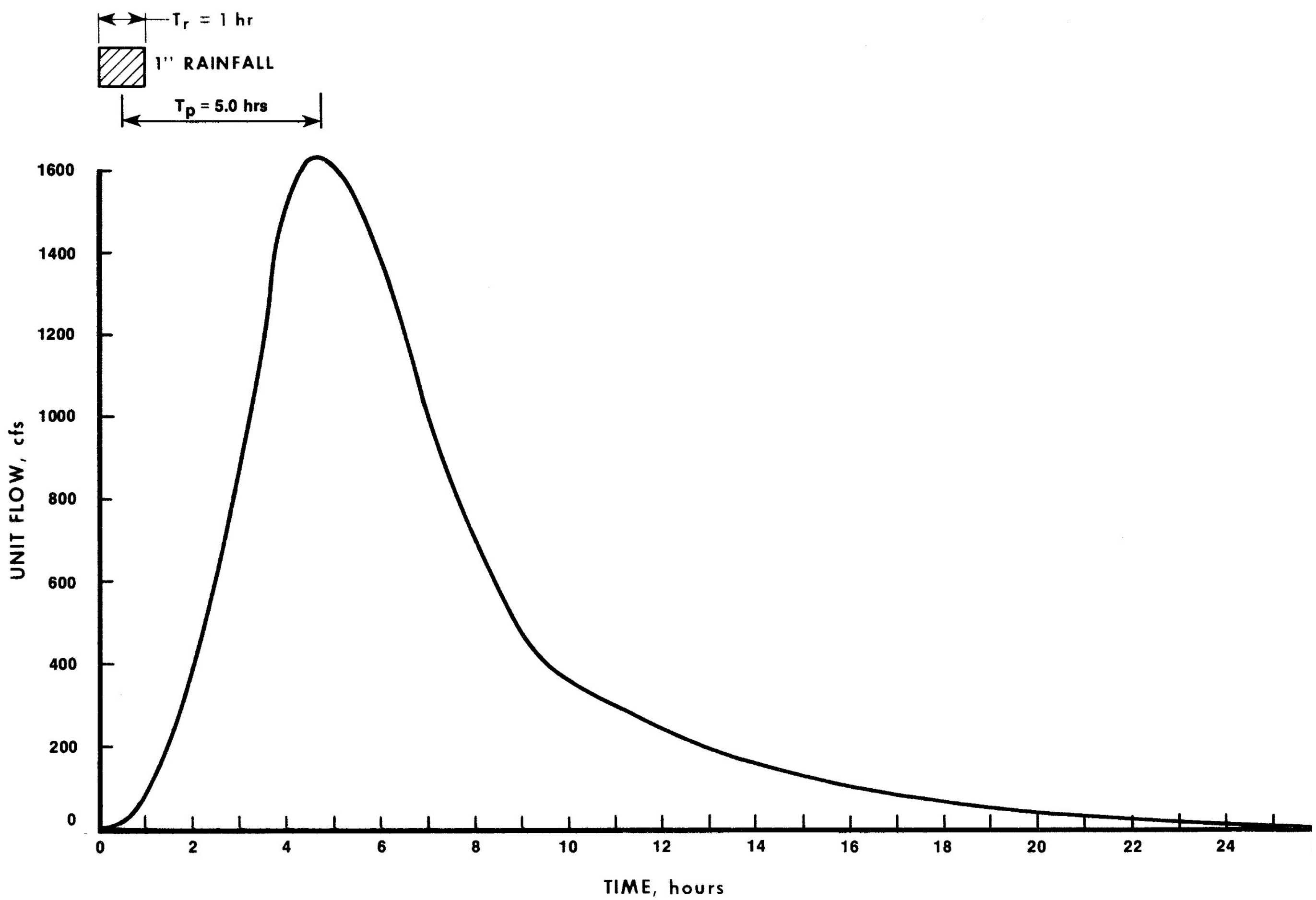


Figure 2.4.3-203. Grants Bayou Unit Hydrograph

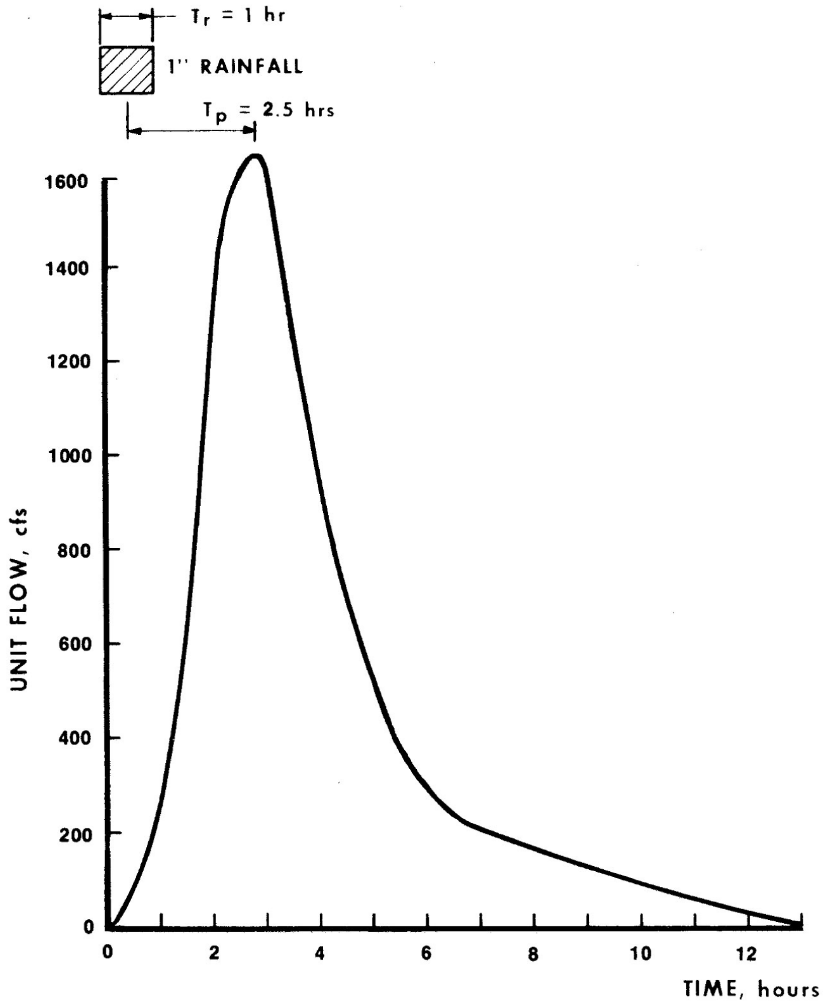


Figure 2.4.3-204. Grants Bayou above Confluence with West Creek Unit Hydrograph

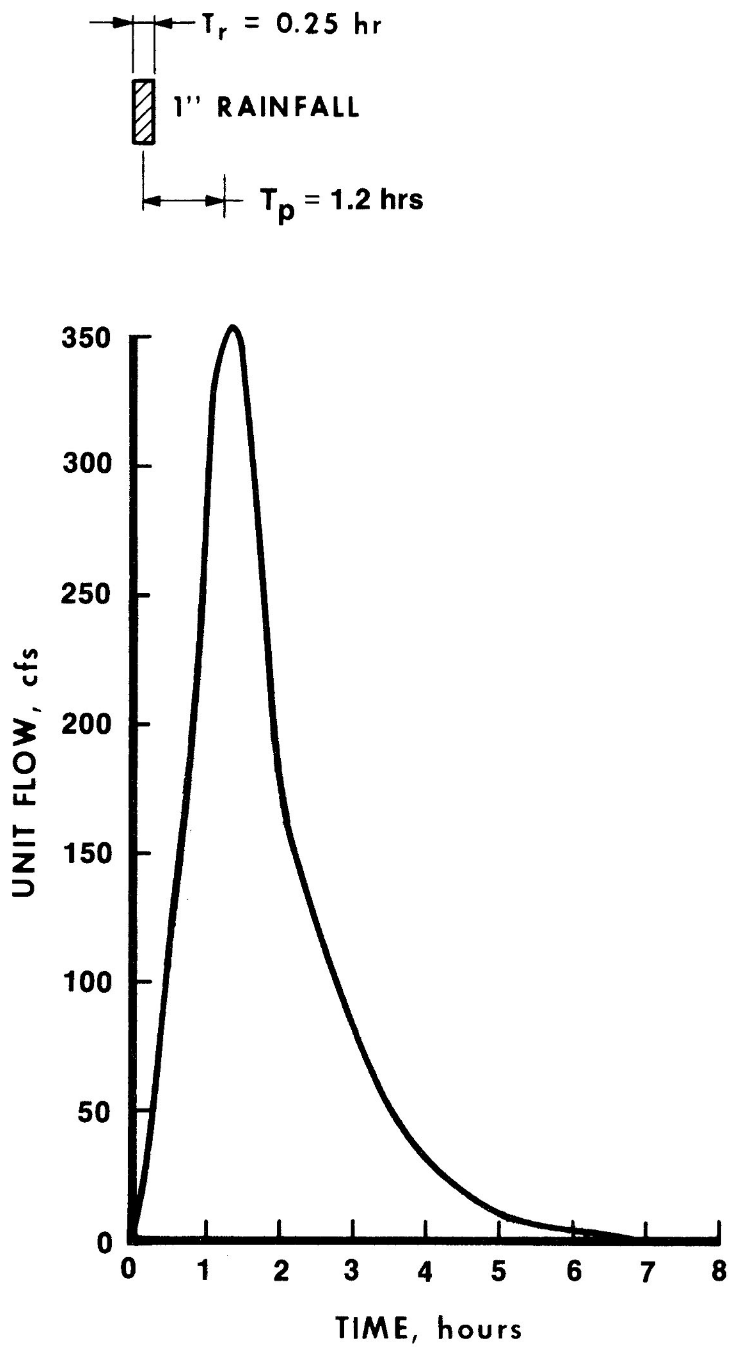
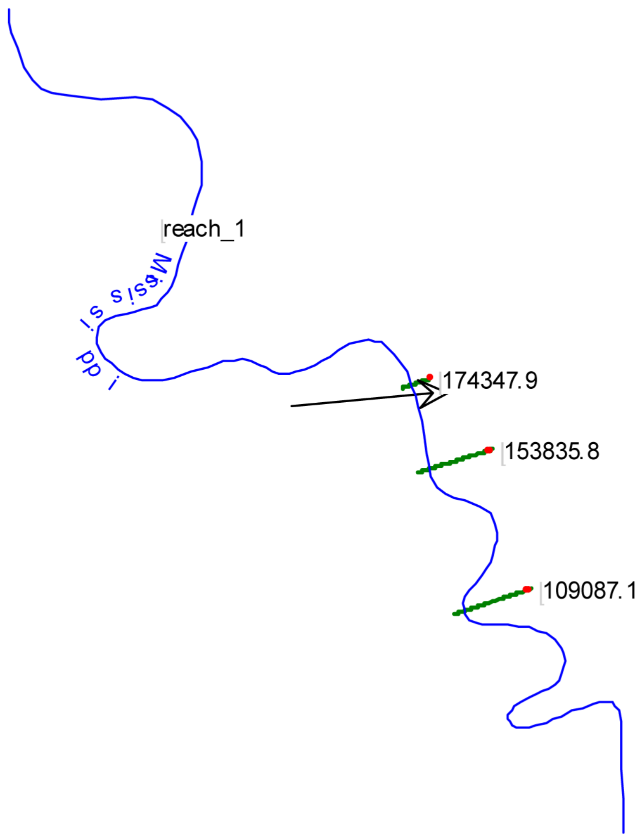


Figure 2.4.3-205. West Creek Unit Hydrograph



Section 174347.9 passes through the RBS site.
Section 109087.1 is the downstream starting section.

Figure 2.4.3-206. Mississippi River HEC-RAS Sections

Source: Ocean Engineering Associates, Inc., Bridge Hydraulics Report, June 2006.

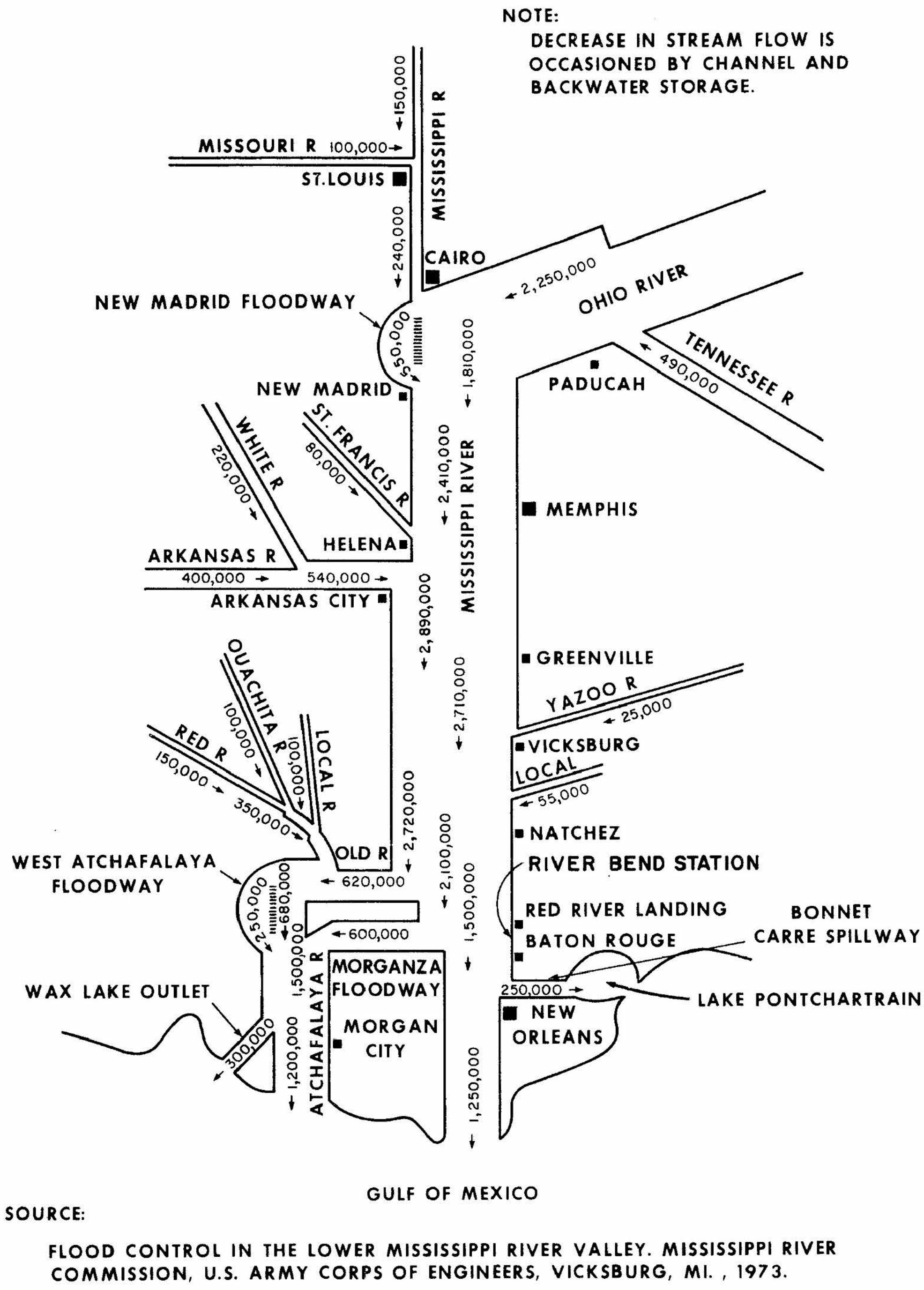


Figure 2.4.3-207. Lower Mississippi River Project Design Flood (PDF)

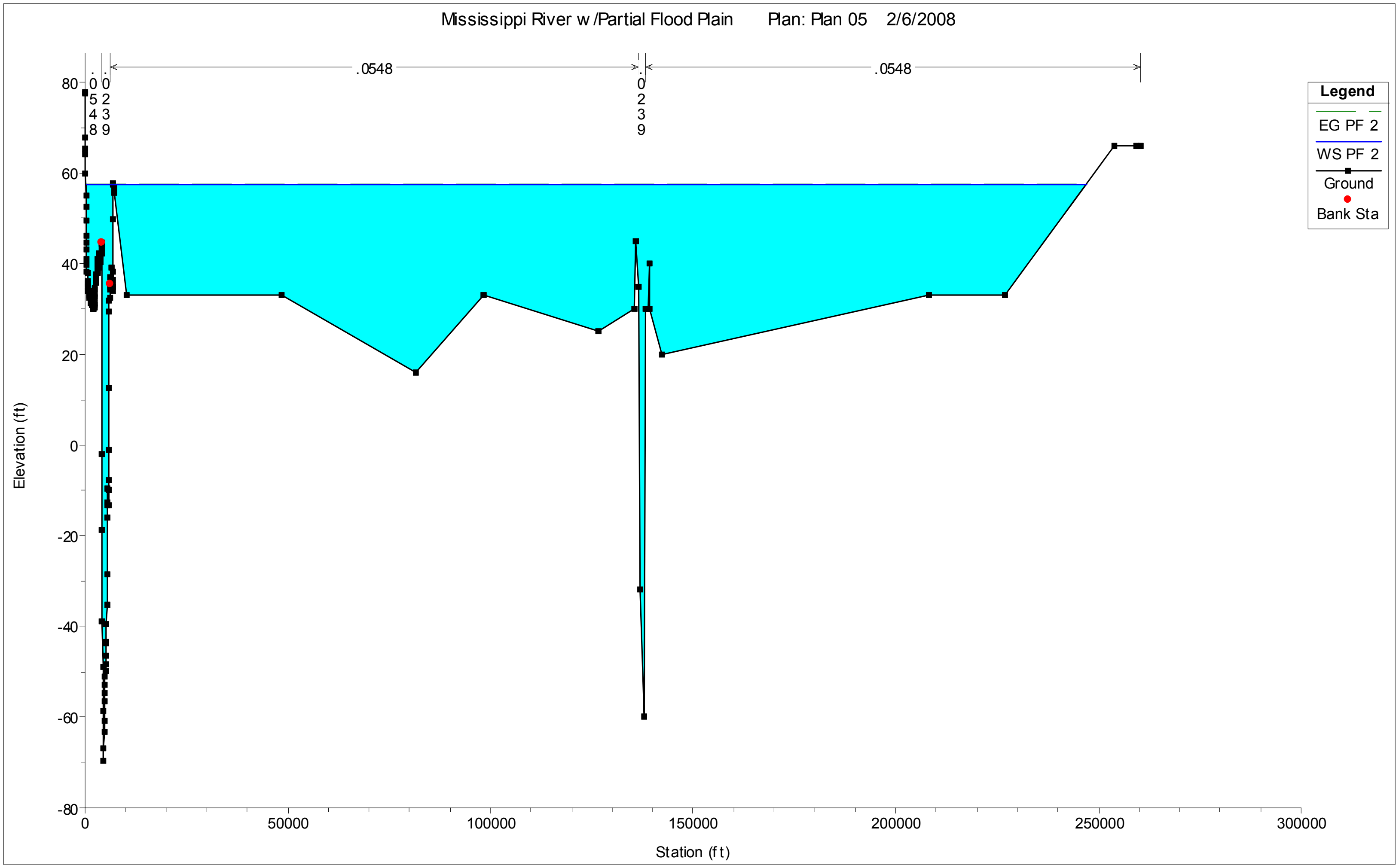


Figure 2.4.3-208. PMF Event Cross Section at the RBS

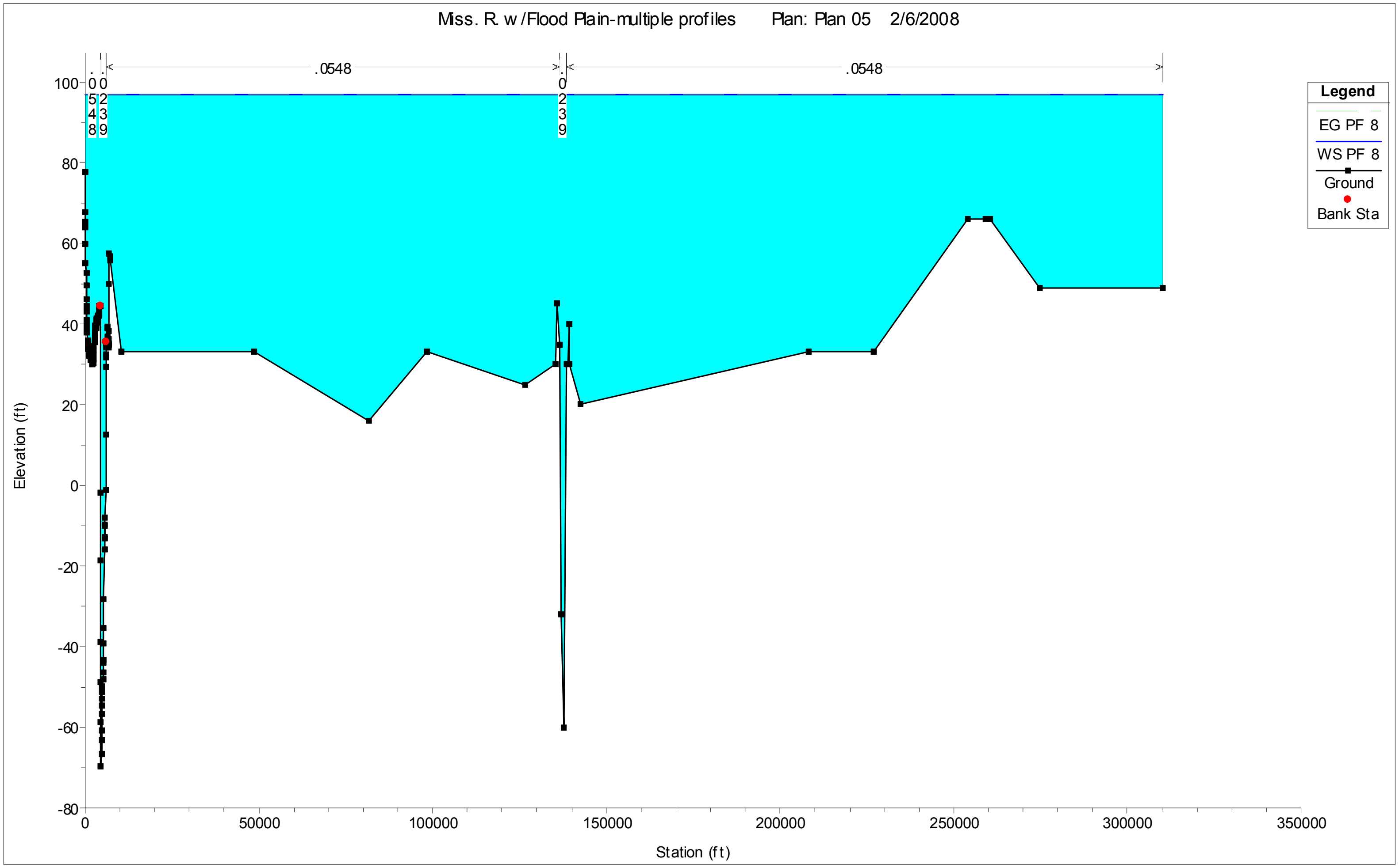


Figure 2.4.3-209. Cross Section with Maximum WSEL below Plant Grade

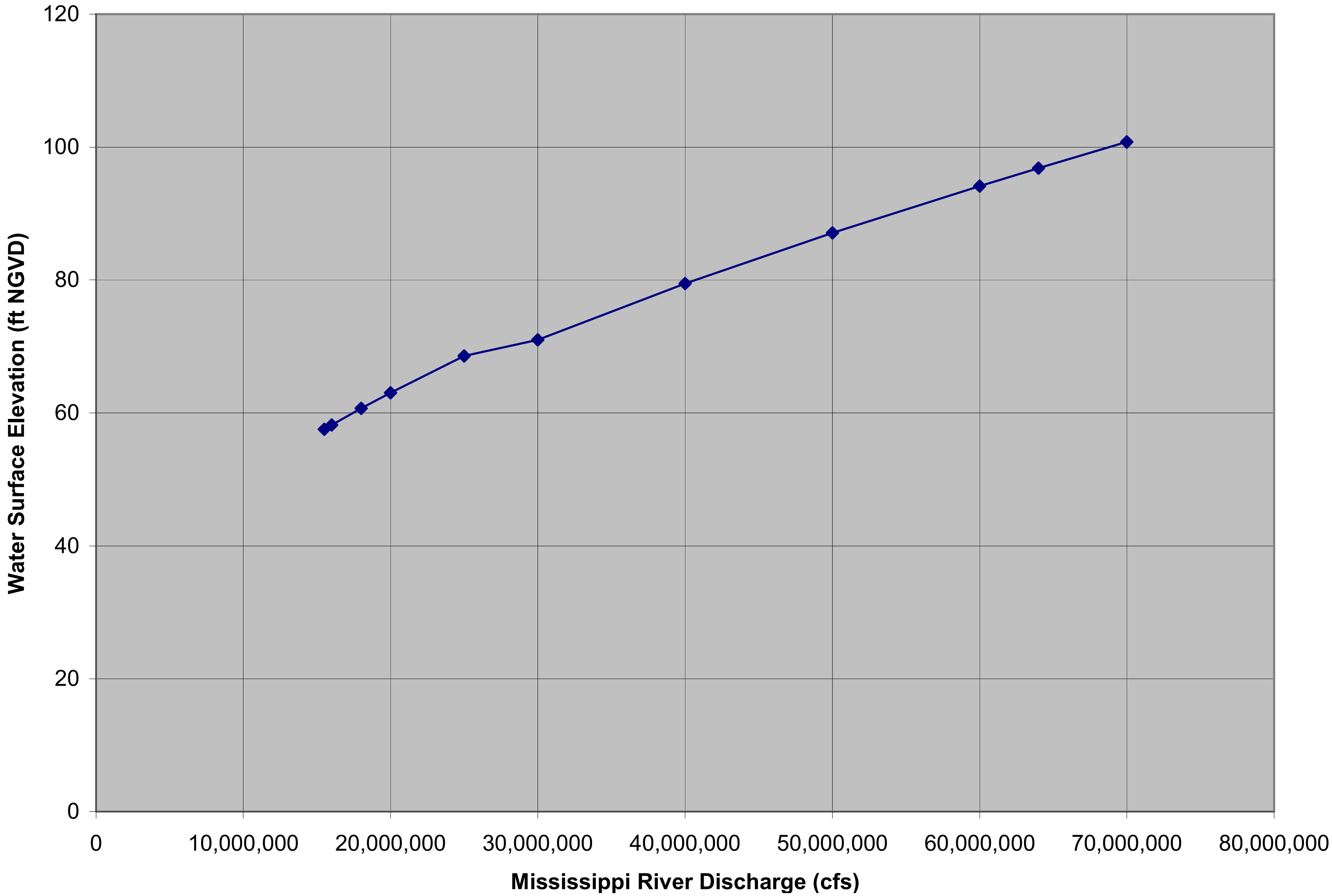


Figure 2.4.3-210. Stage-Discharge Relationship above Levee Elevation

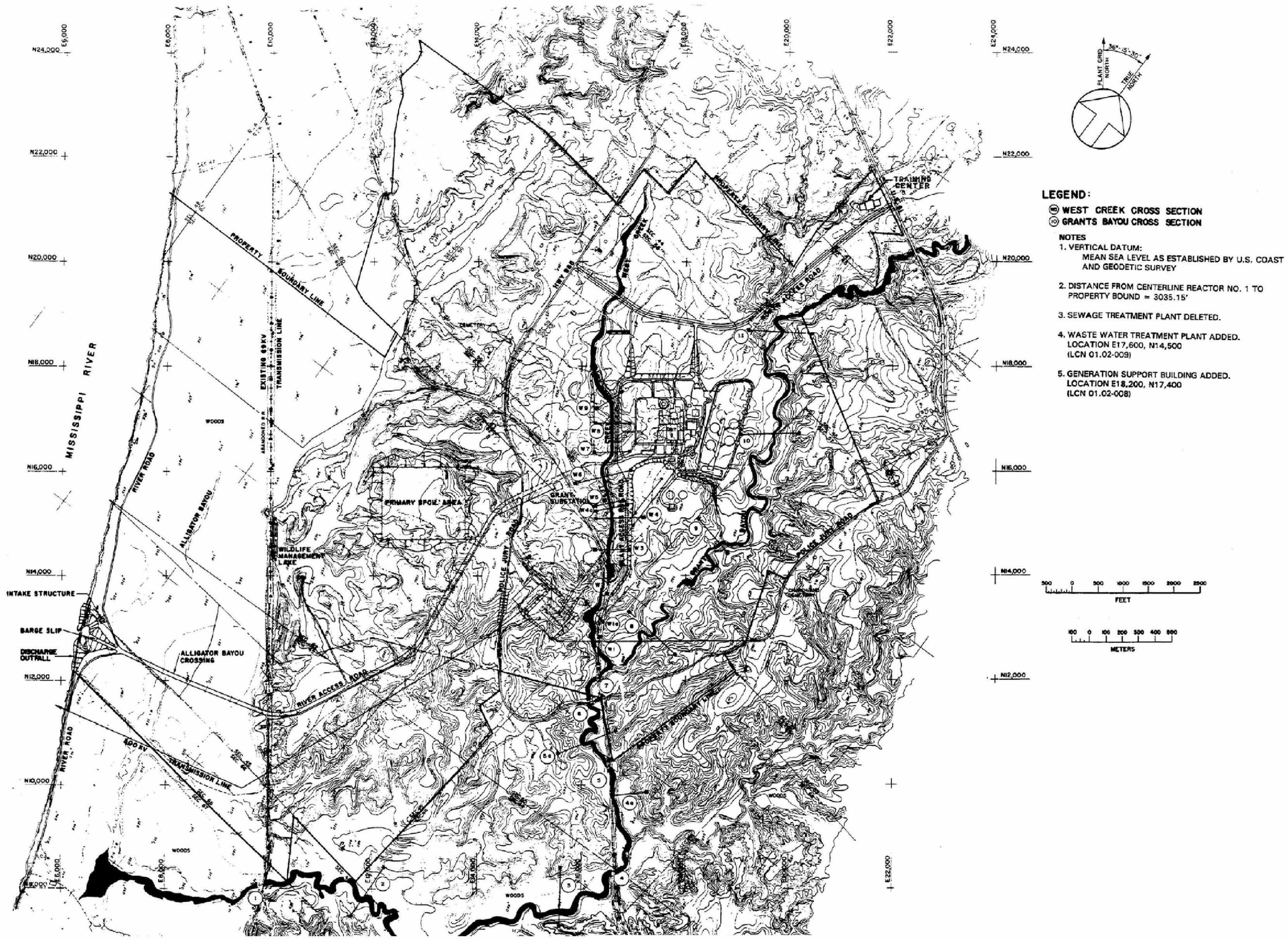
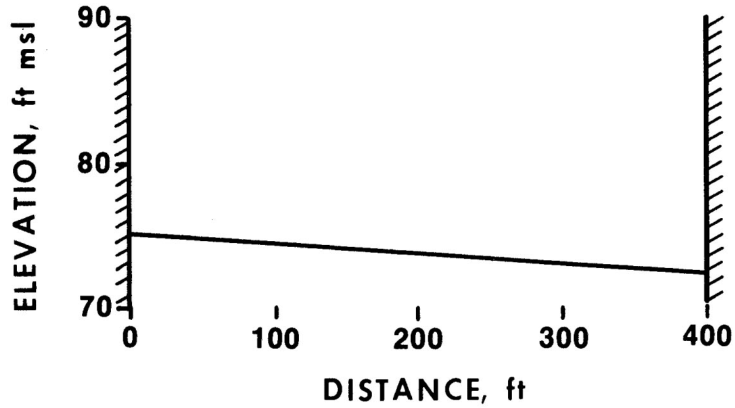
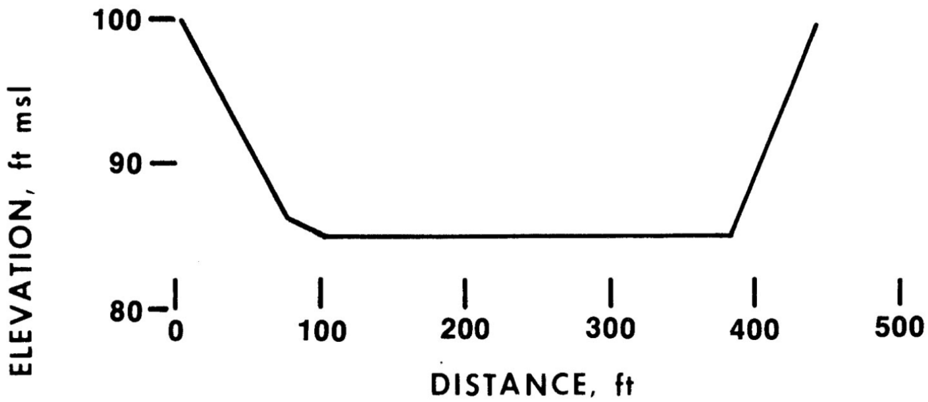


Figure 2.4.3-211. PMF Flows and Stream Cross Sections



NOTES:
LOOKING DOWNSTREAM
REFER TO SECTION LOCATION ON FIGURE 2.4.3-211.

Figure 2.4.3-212. Simulated Weir for Bridge at Cross Section W1 on West Creek, SSE Condition



NOTES:
LOOKING DOWNSTREAM
REFER TO SECTION LOCATION ON FIGURE 2.4.3-211.

Figure 2.4.3-213. Simulated Weir for Bridge at Cross Section W2 on West Creek, SSE Condition

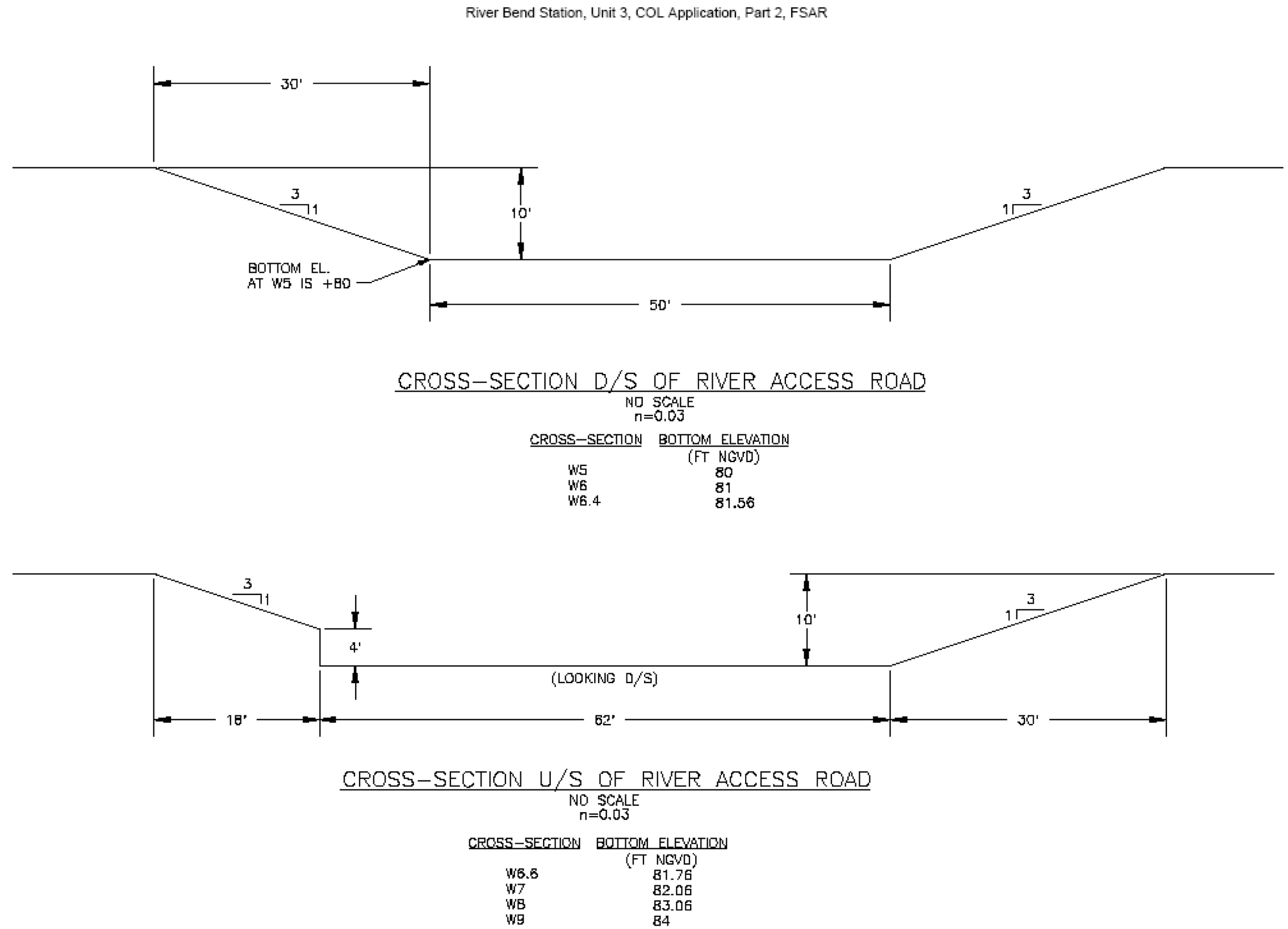


Figure 2.4.3-214. Fabriform Channel Cross Sections

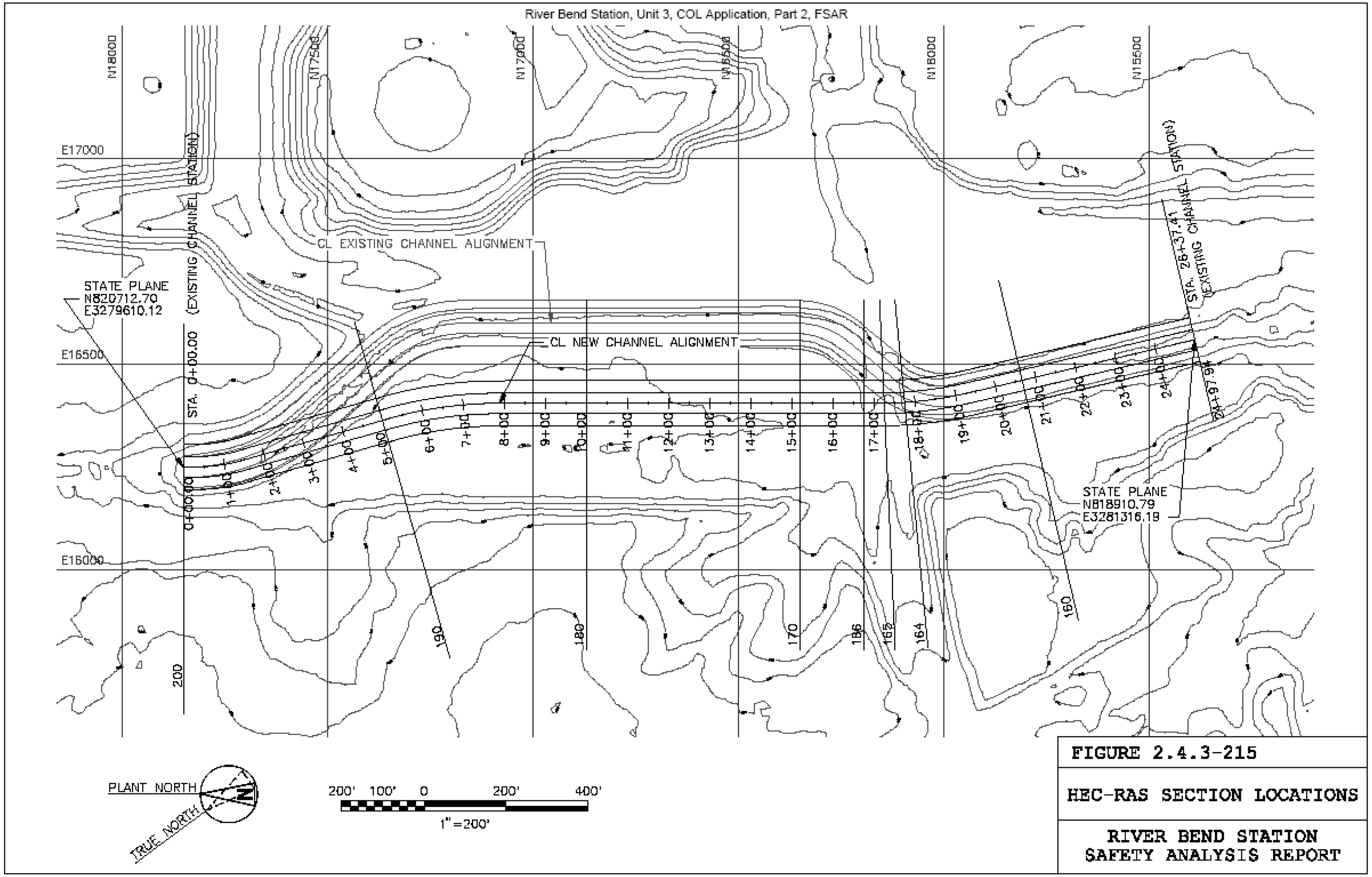


Figure 2.4.3-215. HEC-RAS Section Locations

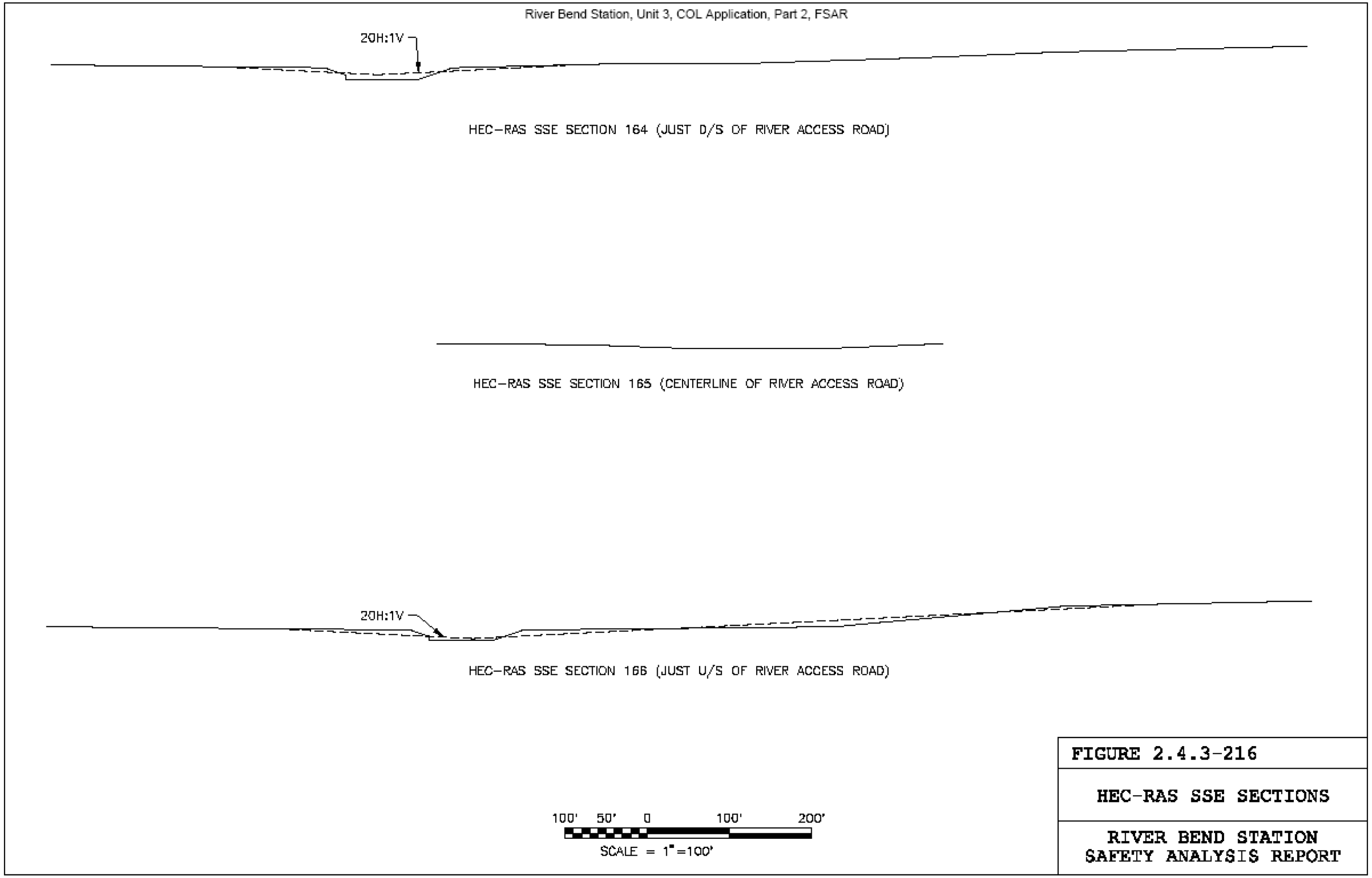


Figure 2.4.3-216. HEC-RAS SSE Sections

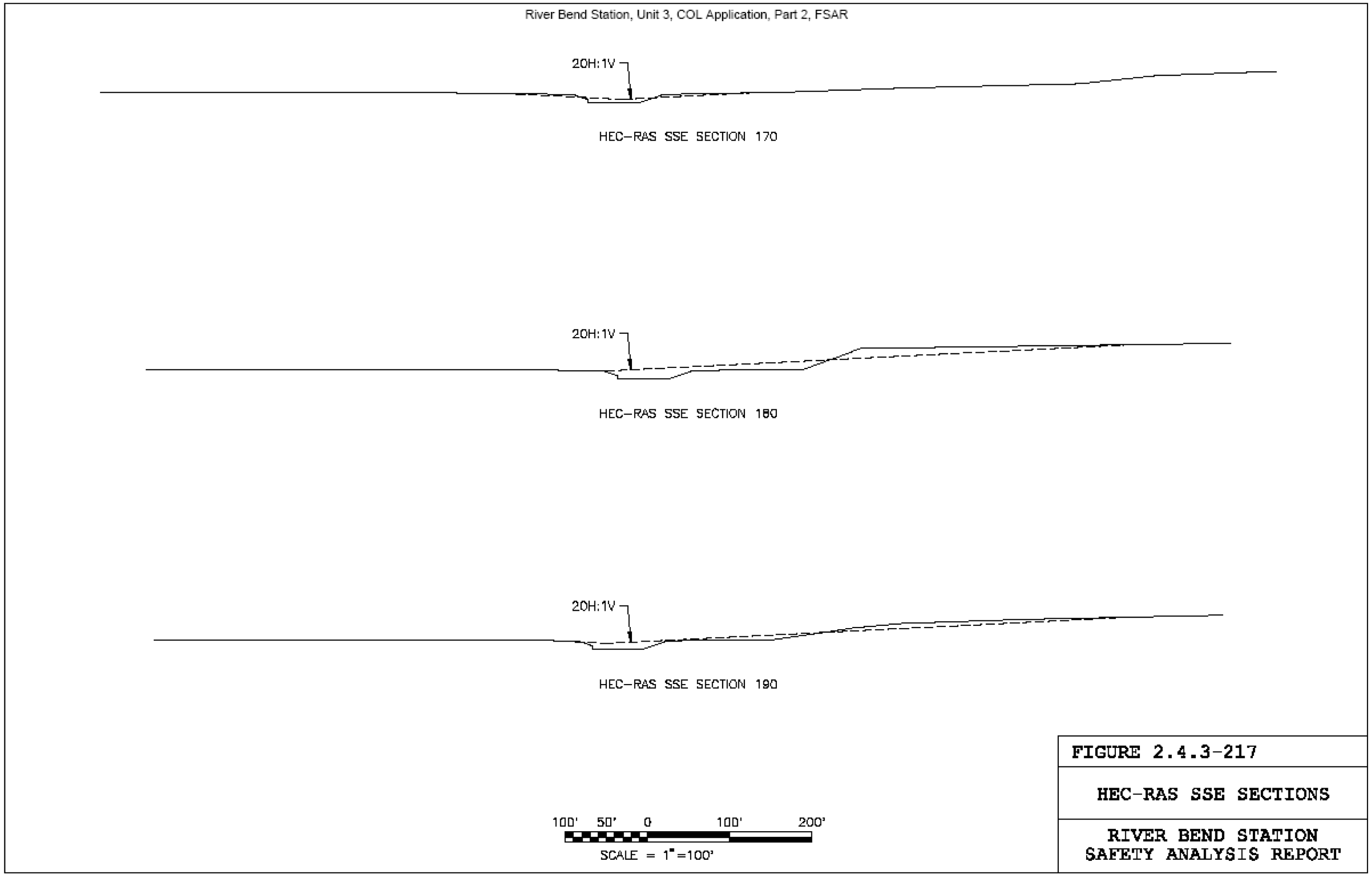


Figure 2.4.3-217. HEC-RAS SSE Sections

2.4.4 POTENTIAL DAM FAILURES, SEISMICALLY INDUCED

RBS COL 2.0-15-A

The effect of dam failures on the water surface elevation of the Mississippi River has been analyzed considering that the Mississippi River is carrying a flood of PDF magnitude with a water surface elevation of 54.5 ft. msl (refer to Subsection 2.4.3.5.1). Although there are no dams on the Mississippi River upstream of the site, in a hypothetical dam failure analysis, the peak discharge from failure of the RBS nearest largest upstream dam on a tributary to the Mississippi River was added to the PDF discharge of the Mississippi River near the RBS site. The details for the analysis are discussed in the following subsections.

Based on the analysis for RBS Unit 3, which follows, there is no potential for impact to a new facility from a potential dam failure coincident with the PDF.

2.4.4.1 Description of Reservoirs

To study the nature of storage in the reservoirs on the different river basins, the Mississippi River Basin was divided into six major drainage areas (refer to Figure 2.4.4-201):

a. Upper Mississippi

b. Missouri

c. Tennessee-Ohio

d. Red-Ouachita

e. Arkansas-White

f. Lower Mississippi

Numerous regulatory structures, including levees, revetments, navigation locks, and major dams, have been built on these rivers. The total number of dams in the basin exceeds 300, of which 61 dams have capacities greater than 1 million ac.-ft.

Figure 2.4.4-202 shows the seismic risk map of the United States (Reference 2.4.4-201). The United States is divided into four zones of seismic risk. Zone 0 represents minimum risk, while Zone 3 represents maximum risk.

The information on dams listed in Table 2.4.4-201 is taken from the report of the International Commission on Large Dams (Reference 2.4.4-202) and is arranged, as follows, on the basis of the major drainage areas in which the dams are located. Table 2.4.4-201 lists dams with reservoir capacities greater than 1 million ac.-ft.

a. Upper Mississippi Basin

The Upper Mississippi Basin has a total estimated storage of 10.0 million ac.-ft. Only three dams have capacities greater than 1 million ac.-ft. All dams in this sub-basin are in Seismic Zone 1.

b. Missouri Basin

The total storage in the dams of this basin is estimated to be 140 million ac.-ft. This includes 21 dams with a capacity of 1 million ac.-ft. or more. The dams of this basin are in Zones 1 and 2.

c. Tennessee-Ohio Basin

The Tennessee-Ohio Basin contains numerous regulatory structures. The total estimated storage is approximately 45 million ac.-ft. There are 14 dams with reservoir capacities greater than 1 million ac.-ft. Nine are in Seismic Zone 2, and the other five are in Zone 3.

d. Red-Ouachita Basin

The Red River feeds into the Atchafalaya River in confluence with Lower Old River near Mississippi RM 304, approximately 42 river miles upstream of the RBS site. Flow from the Red River-Atchafalaya River does not enter the Mississippi River; however, extreme flood flow from this source may affect the floodplain capacity of the Mississippi River near the RBS site, in the event that the levees are overtopped.

e. Arkansas-White Basin

The total estimated storage in this basin is 45 million ac.-ft., with 20 dams having capacities greater than 1 million ac.-ft. The Beaver Reservoir on the White River in Arkansas and Oologah Dam on the Verdigris River in Oklahoma are in Zone 3. There are four dams in Zone 2, and the rest of the dams are in Zone 1.

f. Lower Mississippi Basin

The Lower Mississippi Basin has an extensive river-control system consisting of levees, revetments, cutoffs, and floodways extending from Cairo, Illinois, to the Gulf of Mexico. There are two dams in Zone 2.

Dams in the states of Texas, Mississippi, and Louisiana on tributaries to the river upstream of the RBS site are provided in Table 2.4.4-202. This table lists additional dams with a capacity of less than 1 million ac.-ft.

At the RBS site, the Mississippi River floodplain is approximately 49 mi. wide. A description of the floodplain and the response of the floodplain to design flood events are provided in Subsection 2.4.3.5.1.

The summary of the dams closest to the RBS site in each sub-basin, storage volume, and the approximate distances from the RBS site are as follows (Reference 2.4.4-203):

Sub-Basin	River	Total Storage (million ac.-ft.)	Dam Closest to the RBS	Approx. Distance to the RBS (RM)
Missouri	Missouri	6.300	Fort Randall Reservoir and Dam	1450
Ohio	Tennessee	6.129	Kentucky	600
	Cumberland	2.082	Barkley	600
White	White	1.983	Norfork Reservoir and Dam	500
Arkansas	Arkansas	1.348	Keystone Reservoir and Dam	625
Lower Mississippi	Mississippi	2.722	Grenada Reservoir and Dam	350

Of these, the Kentucky reservoir, because it is the largest of the reservoirs closer to the RBS site, was considered in hypothetical dam failure analysis.

2.4.4.2 Dam-Breaching Effect on the Site

To analyze the effect of potential dam failures on the water levels at the RBS site, the following assumptions were made:

a. The Mississippi River is assumed to be carrying a flood of the PDF magnitude.

a. The Kentucky Reservoir in the Tennessee River Basin is assumed to be at the design flood level, and peak discharge released from the dam failure is superimposed on the Mississippi River PDF discharge near the RBS site.

Breaching of dams would release water and augment the flow in the Mississippi River. High stages due to dam-breaching floods would result in the overtopping of levees and diversion of water into the floodplain beyond the levees.

If the hypothetical complete failure of Kentucky Dam is considered, the initial discharge in this case would be approximately 3.0 million cfs, and the flood stage and velocity would attenuate severely as it travels toward the RBS site approximately 600 mi. downstream. Even considering that this dam-breach discharge is released near the RBS site, the total site discharge, including that of the PDF flow rate of 3,030,000 cfs (refer to Subsection 2.4.3.5.1), would be approximately 6.0 million cfs, which is below the PMF discharge of 6.6 million cfs. If the initial dam breach discharge is added to the PMF flow, the total flow rate of

9,660,000 cfs is still less than the capacity of the Mississippi River, including the floodplain, at Elevation 57.54 ft. NGVD when the levee is overtopped (refer to Figure 2.4.3-210). The flow capacity at this elevation is approximately 15,500,000 cfs (refer to Subsection 2.4.3.5.1).

The above analysis is based on conservative assumptions. In fact, the flood peaks and velocity would be attenuated further because of basin storage, friction, and time required to empty the reservoirs. Therefore, the plant, at Elevation 98.0 ft. NGVD, is not affected.

2.4.4.3 Local Streams

There are no dams or similar water control structures on the local streams. The effect of bridge clogging or stream bank failure on local flooding and floodwater levels is discussed in Subsection 2.4.3. Failure of the Fabriform-lined portion of West Creek, postulated for the SSE condition, is discussed in Subsection 2.4.3. Failure of the drop structure at the upstream end of the lined portion of West Creek could possibly reduce peak flood flow and water level in West Creek. Man-made and natural topography in that area ensures the direction of flood flow along a water course west of the RBS (Reference 2.4.4-204).

2.4.4.4 References

2.4.4-201 Algermissen, S. T., *Seismic Risk Studies in the U.S.*, Proceedings of the Fourth World Conference on Earthquake Engineering, Santiago, Chile, 1969.

2.4.4-202 International Committee on Large Dams, *World Register of Dams*, 1969.

2.4.4-203 U.S. Geological Survey, *National Atlas of the United States of America-Major Dams of the United States*, Website, nationalatlas.gov, 1999.

2.4.4-204 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report" through Revision 19, July 2006.

Table 2.4.4-201 (Sheet 1 of 3)
Major Reserviors in Mississippi River Basin[a]

	Name of Dam	River	State	Capacity, ac.-ft.	Seismic Zone	Height Above Ground Level, ft.
I.	UPPER MISSISSIPPI BASIN					
1	Red Rock	Des Moines	IA	1,890,000	1	110
2	Joanna	Salt	MO	1,428,000	1	106
3	Meramec Park	Meramec	MO	1,000,000	1	165[b]
II.	MISSOURI BASIN					
4	Garrison	Missouri	ND	24,500,000	1	202
5	Oahe	Missouri	SD	23,600,000	1	245
6	Fort Peck	Missouri	MT	19,400,000	2	250
7	Fort Randall	Missouri	SD	6,100,000	1	165
8	Kaysinger	Osage	MO	5,202,000	1	120
9	Table Rock[c]	White	MO	3,462,000	1	252
10	Pattonburg	Grand	MO	1,841,000	1	130[b]
11	Tuttle Creek	Big Blue	KS	2,367,000	2	157
12	Canyon Ferry	Missouri	MT	2,051,000	2	172
13	Kingsley	North Plate	NB	2,000,000	1	170[b]
14	Bagnell	Osage	MO	1,973,000	1	128
15	Big Bend	Missouri	SD	1,900,000	1	95
16	Trenton	Thompson	MO	1,675,000	1	97
17	Stockton	Sac	MO	1,674,000	1	155
18	Blair Creek	Blair Creek	MO	1,449,000	1	213[b]
19	Richland	Gasconade	MO	1,400,000	1	163[b]
20	Yellowtail	Bighorn	MT	1,375,000	2	495
21	Tiber	Marias	MT	1,337,000	2	155
22	Milford	Republican	KS	1,160,000	1	146
23	Moorhead	Powder	MT	1,150,000	1	210[b]
24	Pathfinder	North Platte	WY	1,016,000	1	192
25	Seminoe	North Platte	WY	1,012,000	1	206

Table 2.4.4-201 (Sheet 2 of 3)
Major Reserviors in Mississippi River Basin[a]

	Name of Dam	River	State	Capacity, ac.-ft.	Seismic Zone	Height Above Ground Level, ft.
III.		**TENNESSEE-OHIO BASIN**				
26	Wolf Creek	Cumberland	KY	6,089,000	2	223
27	Kentucky	Tennesse	KY	6,002,600	3	105
28	Mining City	Green	KY	3,795,000	3	132
29	Norris	Clinch	TN	2,567,000	3	240
30	Barkley	Cumberland	KY	2,248,000	3	109
31	Center Hill	Caney Fork	TN	2,092,000	2	226
32	Dale Hollow	Obey	TN	1,706,000	2	178
33	Cherokee	Holston	TN	1,565,400	2	160
34	Douglas	French board	TN	1,514,100	2	145
35	Wheeler	Tennessee	AL	1,150,000	2	65
36	Watts Bar	Tennessee	TN	1,132,000	2	85
37	Pickwick Landing	Tennessee	TN	1,091,400	3	95
38	Guntersville	Tennessee	AL	1,081,700	2	80
39	Falmouth	Licking	WY	1,005,000	2	169
IV.		**RED-OUACHITA BASIN**				
40	Denison	Red	TX-OK	5,530,000	1	165
V.		**ARKANSAS-WHITE BASIN**				
41	Bull Shoals	White	AR	5,408,000	3	258
42	Eufala	Canadian	OK	3,848,000	2	114
43	Greers Ferry	Little Red	AR	2,844,000	1	243
44	Wolf Bayou	White	AR	2,762,000	1	191[b]
45	Norfolk	N. F. White	AR	1,983,000	1	222
46	Beaver	White	AR	1,952,000	3	228
47	Keystone	Arkansas	AR	1,879,000	1	121
48	Water Valley	Eleven Point	AR	1,563,000	1	157
49	Doniphan	Current	MO	1,499,000	3	147[b]
50	Sanford	Canadian	TX	1,408,000	1	200
51	Broken Bow	Moutain Fork	OK	1,368,000	1	225
52	Kaw	Arkansas	OK	1,285,000	1	129

Table 2.4.4-201 (Sheet 3 of 3)
Major Reserviors in Mississippi River Basin[a]

	Name of Dam	River	State	Capacity, ac.-ft.	Seismic Zone	Height Above Ground Level, ft.
53	Fort Gibson	Grand	OK	1,289,000	2	110
54	Union	Canadian	OK	1,270,000	1	107[b]
55	Tenkiller Ferry	Illinois	OK	1,230,000	1	197
56	Gilbert	Buffalo	AR	1,141,100	2	218[b]
57	Boswell	Boswell	OK	1,130,000	1	95
58	Chewey	Illinois	AR	1,083,000	2	160[b]
59	Oologah	Verdigris	OK	1,021,000	3	129
VI.		**LOWER MISSISSIPPI BASIN**				
60	Sardis	Little Tallahatchie	MS	1,570,000	2	117
61	Grenada	Yalobusha	MS	1,337,400	2	102

a) Reference 2.4.4-202.

b) Height above lowest foundation.

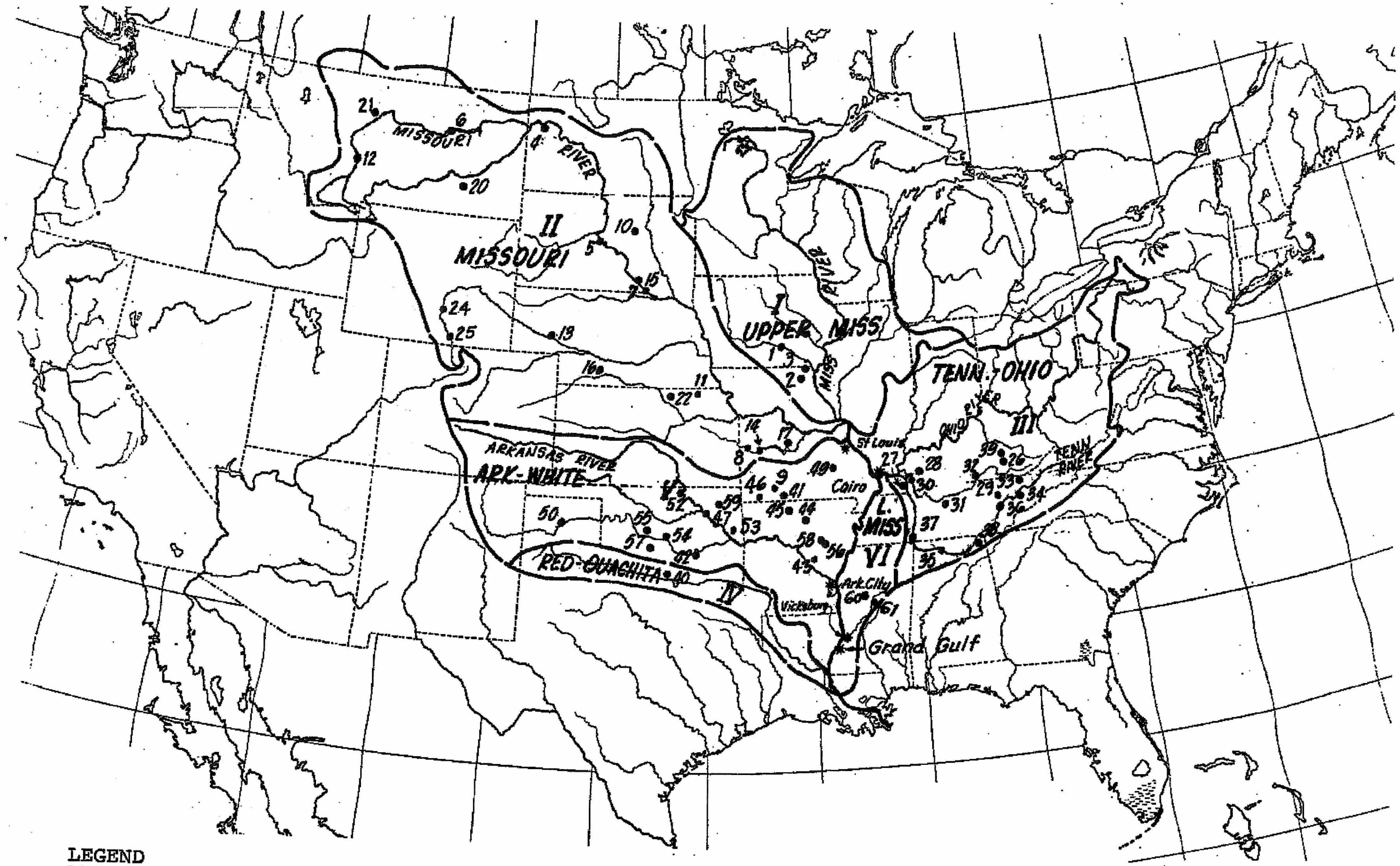
c) Located in Arkansas - White Basin.

Table 2.4.4-202
Maximum Discharge and Gage Heights at Alexander Creek

Year	Flow (cfs)	Gage Height (ft.)
1953	12,700	14.18
1954	3370	9.35
1955	8650	12.55
1956	6600	10.93
1957	1940	8.20
1958	3150	9.20
1959	3750	9.58
1960	2160	8.41
1961	7560	12.04
1962	7200	11.17
1963	1730	7.97
1964	6450	10.87
1965	10,300	13.25
1966	4280	9.87
1967	2120	8.39
1968	1780	8.10
1971	5930	11.21
1972	9300	12.83
1973	7750	12.13
1977	7900	12.20
1978	5730	11.10

Note: Drainage area = 23.9 mi^2.

Source: U.S. Geological Survey Publications, *Surface Water Supply of the U.S. 1961 - 65, Part 7, Lower Mississippi River Basin. Water Supply Paper 1920*, Water Resources Data for Louisiana - 1965 - 1972, 1969.



LEGEND

• 20 NUMBERS REFER TO RESERVOIRS LISTED IN TABLE 2.4–15
(UFSAR TABLE 2.4–14)

Figure 2.4.4-201. Major Reservoirs in the Mississippi Basin

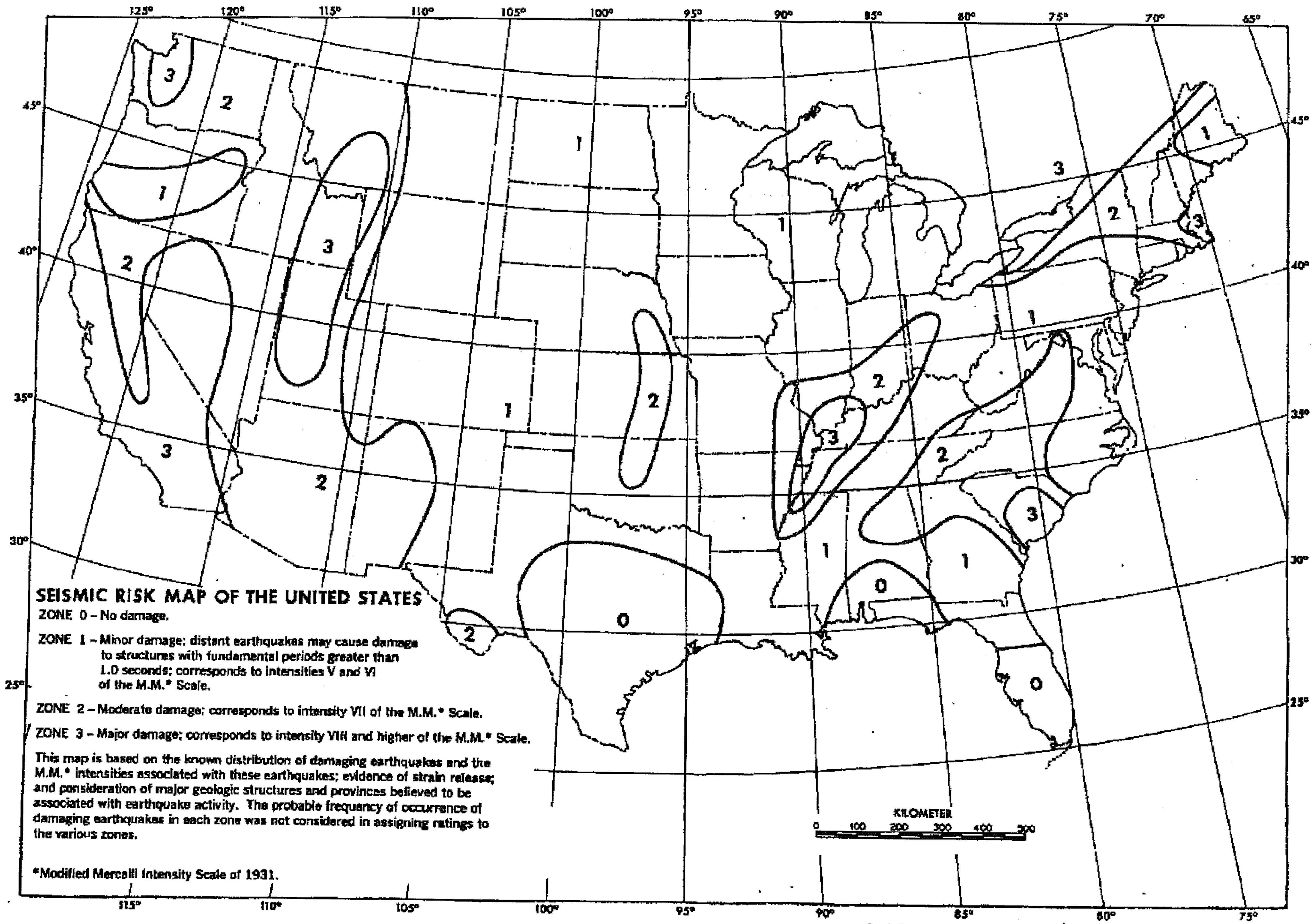


Figure 2.4.4-202. Major Seismic Risk Map for the United States

2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

RBS COL 2.0-16-A

The RBS is not subject to surge or seiche flooding. A discussion of the local parameters affecting surge or seiche formation follows.

Strong Winds

Section 2.3 describes the occurrence of strong winds in the RBS area. Maximum wind speed records were investigated from Ryan Airport from 1971 to 2000 and from the National Climatic Data Center (NCDC) Online Storm Data Database that collects high wind reports from 1950 to the present. The highest instantaneous wind speed on record was 86 mph, occurring in East Baton Rouge Parish on August 1, 1959. Closer to the RBS site in West Feliciana Parish, a 72.5-mph maximum wind speed was recorded on March 5, 1992. In comparison, Ryan Airport recorded a 2-minute maximum speed of 60 mph and a 5-second maximum speed of 78 mph, both occurring in December 2002. The 100-year mean recurrence of maximum 3-second wind speeds from Engineering Weather Data and the USACE is 128 mph. This should be a reasonable indicator of the maximum basic wind speed at the RBS site.

NUREG/CR-4461, Rev. 2, divides the United States into 2-degree latitude/longitude boxes containing the number of tornado events reported from 1950 through August 2003. Figure 5-7 of NUREG/CR-4461, Rev. 2, shows that the RBS is located in the far northern section of the 2-degree box bound between the 90-degree and 92-degree West longitudes and the 29-degree and 31-degree North latitudes. The mean tornado frequency in the RBS region is calculated to be 2.4/year in a 1-degree box surrounding the region. The tornado frequency in a 2-degree and 4-degree box surrounding the RBS site is 7.3/year and 29.4/year, respectively. The probability of a tornado striking the RBS site is calculated to be once in 2630 years.

Wind-generated waves and wave runup have been considered together with extreme flooding conditions and are discussed in Subsection 2.4.3.

Hurricanes

A hurricane undergoes significant weakening by the time it reaches the RBS site, approximately 70 mi. inland. It is extremely unlikely that there could be any coincident flooding due to hurricane surges and flooding due to the Mississippi River PDF or PMF. The USACE, New Orleans District, has stated that the occurrence of a hurricane concurrently with the PDF is highly improbable (Reference 2.4.5-201).

The extent of flooding caused by Hurricane Katrina in August 2005 is shown in Figure 2.4.5-201. For this event, riverine flooding of the Mississippi extended upstream to approximately RM 148 in St. James Parish, Louisiana, located just west of New Orleans. The RBS site is located at approximately RM 262.5; thus, the limit of flooding was approximately 114 river miles downstream of the site.

Seiches

A seiche is an oscillation of the surface of a lake and may be of almost any period and height. Wind and barometric pressure are the two most common seiche-producing forces.

There is no lake near the RBS site that would have a seiche-type oscillation.

Under normal and extreme flooding conditions, the Mississippi River does not permit the formation of a seiche-type oscillation because of its rapid flow velocity.

Low water resulting from seiches is discussed in Subsection 2.4.11.2.

2.4.5.1 References

2.4.5-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report," through Revision 19, July 2006.

River Bend Station, Unit 3, COL Application, Part 2, FSAR

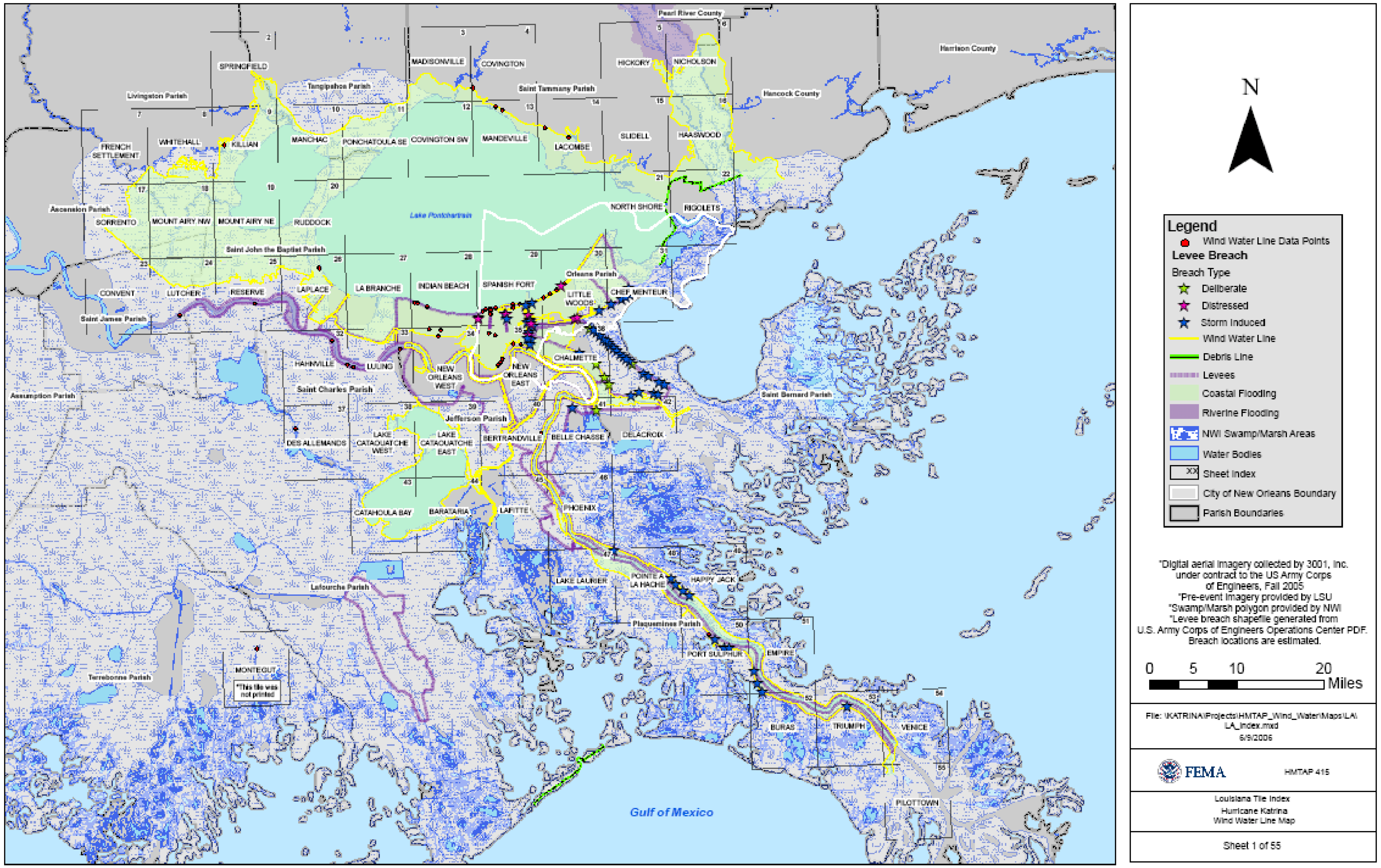


Figure 2.4.5-201 Hurricane Katrina - Wind Water Line Map Revision B

Figure 2.4.5-201. Hurricane Katrina - Wind Water Line Map

2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

RBS COL 2.0-17-A

The NOAA is developing inundation mapping for select U.S. coastal regions, including the Gulf of Mexico. The results of a tsunami inundation study can be used by emergency managers and urban planners primarily to establish evacuation routes and locations of vital infrastructure.

The following discussion on the development of the inundation mapping is based upon information from the NOAA's Website: http://www.ngdc.noaa.gov/mgg/inundation/.

NGDC Tsunami Inundation Gridding Project

The NOAA's National Geophysical Data Center (NGDC) is building high-resolution digital elevation models (DEMs) for select U.S. coastal regions. These combined bathymetric-topographic DEMs are used to support tsunami forecasting and modeling efforts at the NOAA Center for Tsunami Research, Pacific Marine Environmental Laboratory (PMEL). The DEMs are part of the tsunami forecast system SIFT (Short-Term Inundation Forecasting for Tsunamis) currently being developed by PMEL for the NOAA Tsunami Warning Centers and are used in the MOST (Method of Splitting Tsunami) model developed by PMEL to simulate tsunami generation, propagation, and inundation.

Bathymetric, topographic, and shoreline data used in DEM compilation are obtained from various sources, including the NGDC, the U.S. National Ocean Service (NOS), the USGS, the USACE, the Federal Emergency Management Agency (FEMA), and other federal, state, and local government agencies, academic institutions, and private companies. DEMs are referenced to the vertical tidal datum of mean high water (MHW) and horizontal datum of World Geodetic System 1984 (WGS84). Grid spacings for the DEMs range from 1/3 arc-second (approximately 10 m) to 3 arc-seconds (approximately 90 m).

Inundation Modeling

An inundation modeling study attempts to recreate the tsunami generation in deep or coastal waters, wave propagation to the impact zone, and inundation along the study area.

To reproduce the correct wave dynamics during the inundation computations, high resolution bathymetric and topographic grids are used in this type of study. The high quality bathymetric and topographic data sets needed for development of inundation maps require maintenance and upgrades as better data become available and coastal changes occur.

Inundation studies can be conducted taking a probabilistic approach in which multiple tsunami scenarios are considered, and an assessment of the vulnerability of the coast to tsunami hazard is evaluated, or they may focus on the effect of a particular "worst-case scenario" and assess the impact of such a particularly high impact event on the areas under investigation.

Gulf of Mexico Inundation Modeling

Table 2.4.6-201 lists DEMs planned or completed in the Gulf of Mexico Region. Sites along the Gulf Coast were selected based on the availability of good data and the presence of a working tidal gauge. The Biloxi, Mississippi DEM was completed in March 2007 and contains data applicable to the RBS Unit 3 site. The Biloxi, Mississippi DEM is shown in Figures 2.4.6-201 and 2.4.6-202.

Table 2.4.6-201
DEMs Planned or Completed

Completed DEMs					Planned DEMs			
DEM Name	Cell Size	State	Region	Date Completed	DEM Name	State	Region	Year Planned
Panama City	1/3 arc-second	FL	Gulf of Mexico	2007-01-31	Mobile	AL	Gulf of Mexico	TBD
Biloxi	1/3 arc-second	MS	Gulf of Mexico	2007-03-29	Key West	FL	Gulf of Mexico	TBD
Corpus Christi	1/3 arc-second	TX	Gulf of Mexico	2007-05-04	Pensacola	FL	Gulf of Mexico	TBD
Galveston	1/3 arc-second	TX	Gulf of Mexico	2007-05-14	St. Petersburg	FL	Gulf of Mexico	TBD
					Tampa	FL	Gulf of Mexico	TBD
					Freeport	TX	Gulf of Mexico	TBD

Upon completion of the DEMs, the NGDC forwards the model to the NOAA Center for Tsunami Research located in Seattle, Washington. The Center for Tsunami Research then creates the inundation mapping. This mapping for the Gulf Coast has not been completed. According to the NOAA, the Gulf Coast has a low tsunami risk, and the primary Gulf Coast risk is hurricane damage. Therefore, the completion of Gulf Coast tsunami mapping is of lower priority than other coastal areas, particularly the Pacific Coast.

According to the NOAA, an inland site 95 ft. above sea level is well above the likely largest tsunami that could strike the Gulf Coast, and the site would have an extremely low risk of damage resulting from a tsunami. Along the Gulf Coast, a tsunami that is a few feet high is much more likely, which could cause damage to coastal zones (e.g., piers, docks, and moored boats).

Potential tsunami sources in the Gulf of Mexico were analyzed in *The Current State of Knowledge Regarding Potential Tsunami Sources Affecting U.S. Atlantic* *and Gulf Coasts* (Reference 2.4.6-201). A summary of findings related to the Gulf of Mexico is presented below.

Large landslides in the Gulf of Mexico can be found in the submarine canyon and fan provinces extending from present (Mississippi) and former large rivers that emptied into the Gulf. These large landslides were probably active before 7000 years ago. In other areas, landslides continue to be active, probably because of salt movement, but are small and may not pose a tsunami hazard. A more detailed evaluation and sampling are needed to validate these conclusions.

Models of far-field submarine landslide sources, such as the eruption of the Cumbre Vieja volcano in the Canary Islands, show rapid amplitude decay with distance and predict <1 m of flooding in Florida.

Convergent or subduction zones in the southern Caribbean have been reviewed and do not appear to be capable of generating very large earthquakes and, therefore, do not appear to pose a significant tsunami hazard to the Gulf of Mexico coastal zones. Tsunamis generated by earthquakes do not appear to impact the Gulf of Mexico coast.

2.4.6.1 References

2.4.6-201 Atlantic and Gulf of Mexico Tsunami Hazard Assessment Group, *The Current State of Knowledge Regarding Potential Tsunami Sources Affecting U.S. Atlantic and Gulf Coasts*, A Report to the Nuclear Regulatory Commission: U.S. Geological Survey Administrative Report, 2007.

Date Completed: 2007-03-29

Format: ESRI Arc ASCII

Horizontal Datum: WGS84 geographic

Vertical Datum: Mean High Water

Vertical Units: meters

Coverage: Bathy-topo

Registration: Grid-node

Source: NOAA/NGDC/MGG

Project URL:
http://www.ngdc.noaa.gov/mgg/inundation/

Contact: Barry W. Eakins,
Barry.Eakins@noaa.gov, 303-497-6505

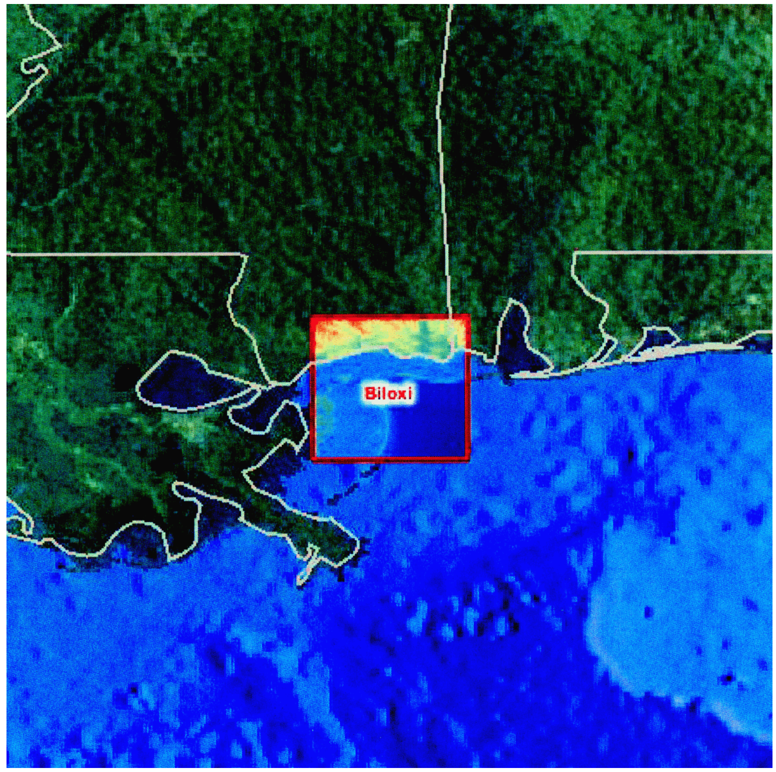


Figure 2.4.6-201. Biloxi, Mississippi Tsunami Inundation DEM

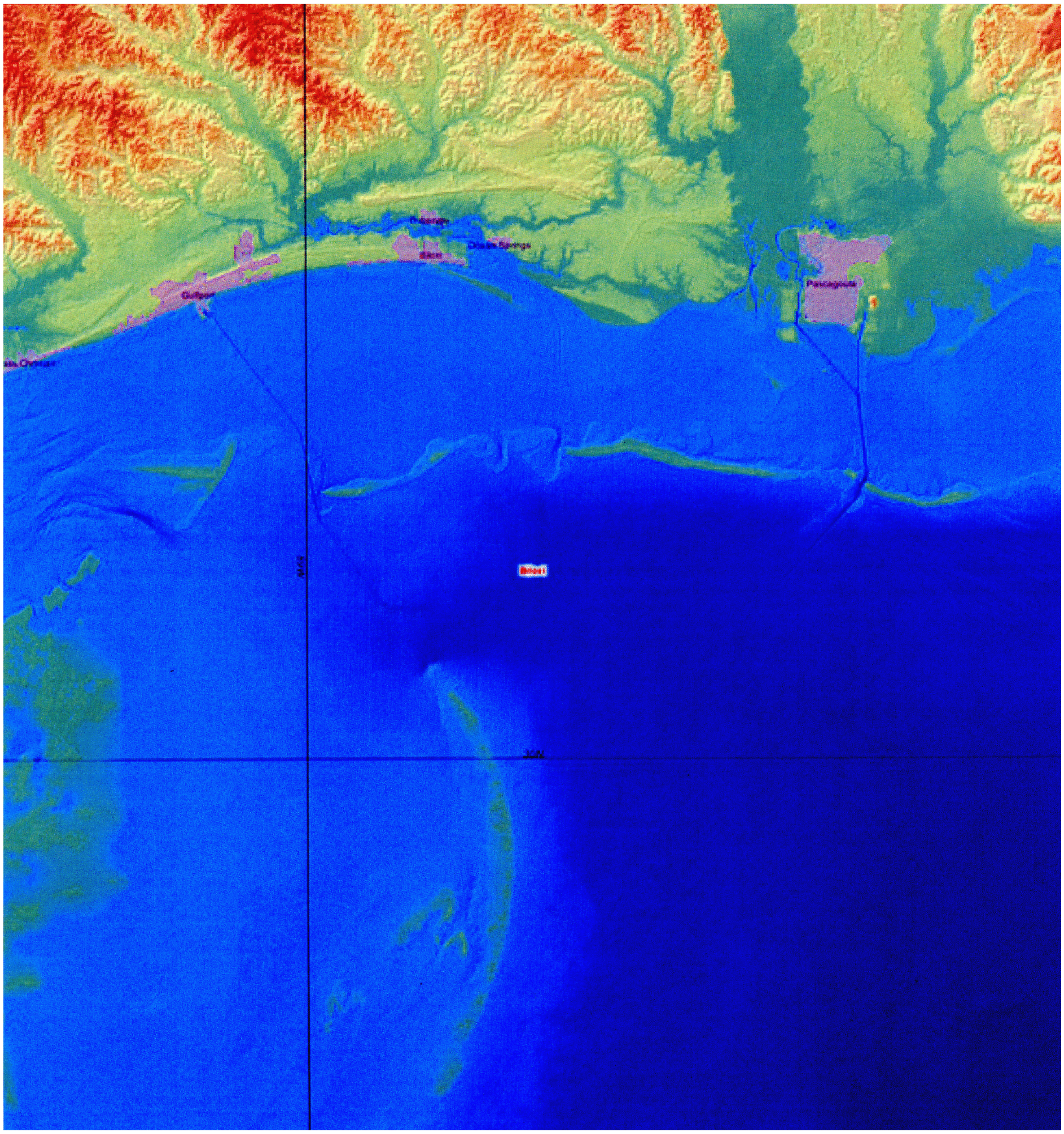


Figure 2.4.6-202. Biloxi, Mississippi DEM - Larger View

2.4.7 ICE EFFECTS

RBS COL 2.0-18-A Water temperatures at the USGS gaging station on the Mississippi River near Saint Francisville, Louisiana, are available for the period of August 1954 to September 1972 and October 1974 to September 2005 (Reference 2.4.7-201). During this period of record, a minimum daily water temperature of 1.0°C occurred on January 29 and 30, 1961 and December 25, 1989. Ice does not form in the river near the RBS site. The St. Francisville, Louisiana gaging station is located approximately 4 mi. upstream from the RBS site.

There is no record of an ice jam causing flooding near the RBS site. The USACE historical database of ice jams on the Mississippi River does not list any ice jams on the Mississippi River in Louisiana (Reference 2.4.7-202). The USACE Ice Jam Map of the United States is included as Figure 2.4.7-201.

The RBS area is approximately 40 ft. above the river levee and is not endangered by the unlikely occurrence of ice jam flooding. As discussed in Subsection 2.4.3, the storage and conveyance capacity of the floodplain west of the Mississippi River is so vast that water surface elevations significantly above the top of levee elevation are not feasible.

The likelihood of low flow in the Mississippi River at the RBS site due to an ice jam is extremely remote. RBS Unit 3 utilizes an ESBWR standard plant design that does not utilize surface water for any safety-related function. As described in DCD Subsection 9.2.5, the ESBWR ultimate heat sink (UHS) is provided by the isolation condenser/passive containment cooling (IC/PCC) pools. The post-accident makeup to the UHS is provided by the Fire Protection System (FPS) through safety-related Fuel and Auxiliary Pool Cooling System (FAPCS) piping.

2.4.7.1 References

2.4.7-201 U.S. Department of Geological Survey Water Data for the St. Francisville, Louisiana Gaging Station, Website, http://la.water.usgs.gov.

2.4.7-202 U.S. Army Corps of Engineers, Ice Engineering Research Group Cold Regions Research and Engineering Laboratory, Website, https://rsgis.crrel.usace.army.mil/icejam/.

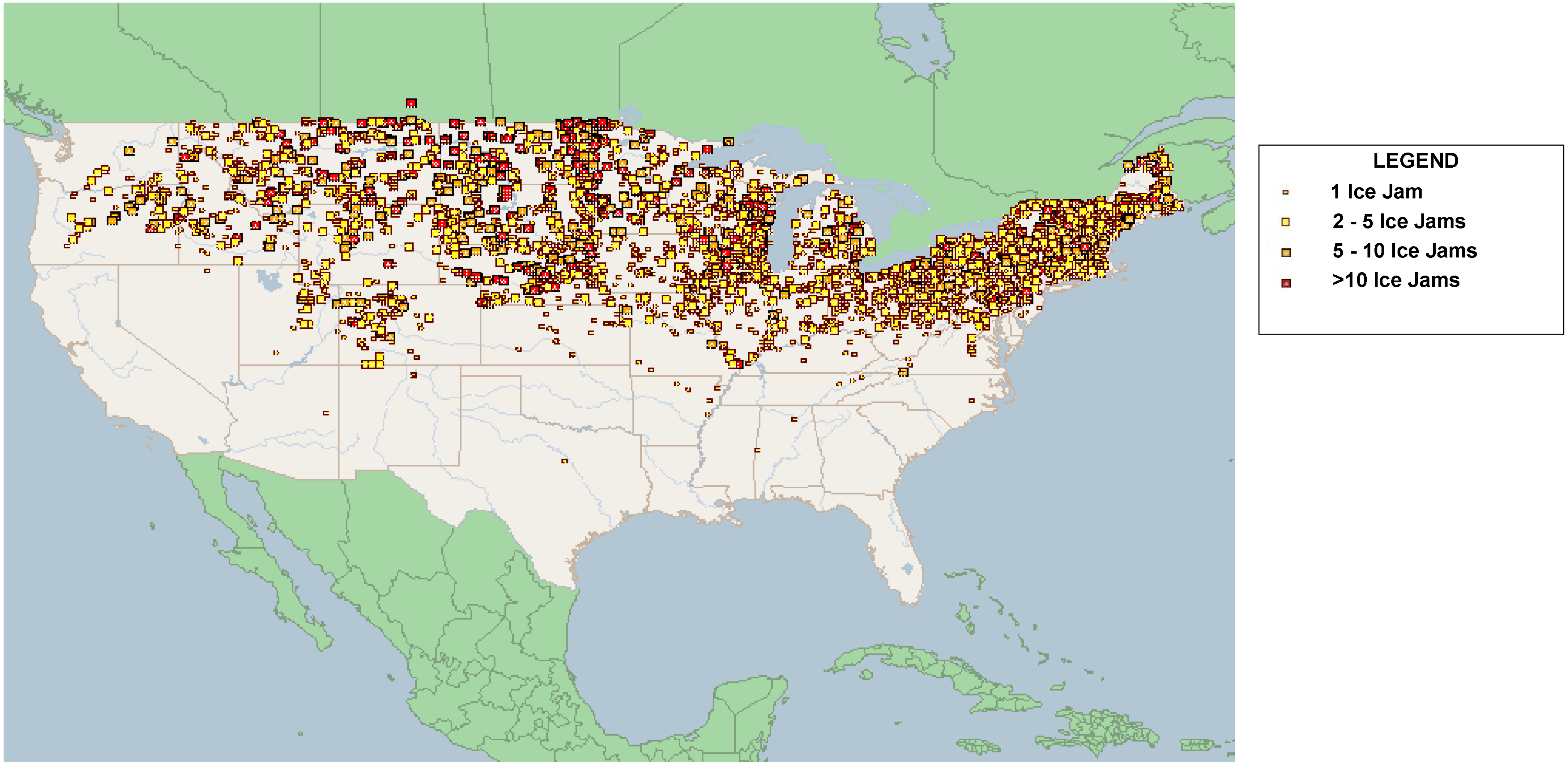


Figure 2.4.7-201. Historic Ice Jams

2.4.8 COOLING WATER CANALS AND RESERVOIRS

RBS COL 2.0-19-A RBS Unit 3 utilizes an ESBWR standard plant design that does not utilize surface water reservoirs or canals for any safety-related function. As described in DCD Subsection 9.2.5, the ESBWR UHS is provided by the IC/PCC pools. The post-accident makeup to the UHS is provided by the FPS through safety-related FAPCS piping.

2.4.9 CHANNEL DIVERSIONS

RBS COL 2.0-20-A

The USACE maintains the Mississippi River in its present channel by means of an extensive program that includes channel stabilization and protection, revetment, dredging, and levee and dike maintenance.

It is considered extremely unlikely for the current course of the Mississippi River to be jeopardized by sudden natural diversion processes. Orderly plant shutdown could occur pending the loss of station makeup water by diversion. RBS Unit 3 utilizes an ESBWR standard plant design that does not utilize surface water for any safety-related function. As described in DCD Subsection 9.2.5, the ESBWR UHS is provided by the IC/PCC pools. The post-accident makeup to the UHS is provided by the FPS through safety-related FAPCS piping.

The river bank in the vicinity of the intake embayment area is protected against bank erosion by riprap. Stone size is 16 to 20 in. and riprap extends to approximately -12 ft. msl, approximately 19 ft. below mean low water. The effectiveness of erosion protection is monitored, and additional control measures are implemented, if required, to protect the embayment area (Reference 2.4.9-201).

Periodic dredging of the embayment is required because of sediment transport in the river. Dredging activities typically occur no more than once per year. The volume of material removed is usually not tracked because it is placed backed into the river; however, the volume of material removed is estimated to be less than 20,000 cubic yards per removal. The most recent maintenance dredging of the embayment was performed on January 9-11, 2008. The estimated volume of material removed was 14,585 cubic yards. According to USACE (General Permit) NOD-23, the removal and deposition of dredged material shall not exceed 125,000 cubic yards (References 2.4.9-202 and 2.4.9-203). Since the construction of the embayment area no maintenance has been required on the slope stabilization.

According to the USACE, "There has been no channel stabilization and protection measures in the area of RM 262 since 1987. The revetment on the left descending bank was installed in 1984. There is no major work or dredging planned in the area at this time."

2.4.9.1 References

2.4.9-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report," through Revision 19, July 2006.

2.4.9-202 U.S. Army Corps of Engineers, New Orleans District, EM-19-980-2001, SE (GENERAL PERMIT) NOD-23, General Permit Silt Removal in the Mississippi River, August 19,1998.

2.4.9-203 U.S. Army Corps of Engineers, New Orleans District, EM-20-020-2486, SE (GENERAL PERMIT) NOD-23, General Permit Silt Removal in the Mississippi River, Permit Time Extension, June 3, 2002.

2.4.10 FLOODING PROTECTION REQUIREMENTS

RBS COL 2.0-21-A As discussed in Subsection 2.4.3.5, the design plant grade elevation for RBS Unit 3 is 98.0 ft. NGVD. According to DCD Section 3.4.1.2 *Flood Protection from External Sources*, the design plant grade elevation shall be at least 310 mm (1 ft.) above the design flood level. Thus, the flood elevation cannot exceed 97.0 ft. NGVD.

For the Mississippi River, an estimated PMF level of 57.54 ft. NGVD (refer to Subsection 2.4.3.5.1) was combined with the 2-year extreme wind speed to determine the maximum water level at the RBS site resulting from river flooding. The maximum water surface elevation, including wave runup, was estimated as 65.79 ft. NGVD (refer to Subsection 2.4.3.6.1). Therefore, the RBS, at Elevation 98.0 ft. NGVD, is not affected.

For local streams, the maximum water surface elevations occurred in West Creek near the RBS site. For the PMF event, the water surface elevation at this location is 94.61 ft. NGVD. For the 25-year + SSE event, the water surface elevation at this section is 95.39 ft. NGVD (refer to Subsection 2.4.3.5.2). Significant wave development is not possible in the local streams because of a short fetch and shallow depths (refer to Subsection 2.4.3.6.2). Therefore, both the PMF and 25-year + SSE events on local streams meet the flood protection criteria.

Dam-breaching effects on the RBS site were considered in Subsection 2.4.4. The estimated initial discharge resulting from a complete failure of the Kentucky Dam is 3,000,000 cfs. This discharge rate would attenuate as it traveled downstream. Even considering the entire 3,000,000 cfs, added to the PDF flow rate of 3,030,000 cfs developed in Subsection 2.4.3.5.1, the total is less than the PMF flow rate of 6,660,000 cfs developed in Subsection 2.4.3.4.1. If the initial dam breach discharge is added to the PMF flow, the total flow rate of 9,660,000 cfs is still less than the capacity of the Mississippi River, including the floodplain, at Elevation 57.54 ft. NGVD when the levee is overtopped (Figure 2.4.3-210).

As discussed in Subsection 2.4.5 through 2.4.9, safety-related systems and components are not at risk as a result of other types of flood conditions. Therefore, the requirements of GDC-2 and 10 CFR 100 are met.

2.4.11 LOW WATER CONSIDERATIONS

2.4.11.1 Low Flow in Streams

Mississippi River

RBS COL 2.0-22-A The occurrence of low flow in the Lower Mississippi River is determined by flows of the major tributaries in the drainage basin, in a manner similar to high flows (refer to Subsection 2.4.2).

The basic difference between the occurrence of high and low flows is that, in the latter case, the interest is centered on the Mississippi River main stem; the Red and Ouachita Rivers do not contribute to the main stem flow because they drain directly to the Gulf of Mexico through the Atchafalaya River. Even at low flows, some flow is diverted from the Mississippi River into the Atchafalaya River via the Old River control structure. This situation existed under natural conditions until the Old River diversion was closed to prevent capture of the Mississippi River main stem flow by the Atchafalaya River. Since 1963, water has been discharged into the Atchafalaya River through a low sill structure to maintain a minimum draft in that river for navigation purposes (Reference 2.4.11-201).

As discussed in Subsections 2.4.11.3 and 2.4.11.4, the probable minimum flow rate of the Mississippi River at the RBS during its operating life is not anticipated to be less than 100,000 cfs. A control structure on the diversion canal was completed in 1963, and minimum flows are now somewhat controlled. Since 1963, the lowest recorded flow at Tarbert Landing (RM 306.3) is 111,000 cfs, which occurred on July 5, 1988 (References 2.4.11-202 and 2.4.11-203).

Annual stage data at Bayou Sara, Louisiana at approximately RM 265 are presented in Table 2.4.11-201 for the period 1889 to 2006 (References 2.4.11-204 and 2.4.11-205). Based on the period 1956 to 2006, the minimum water level at Bayou Sara during a drought event was 2.9 ft. NGVD (2.5 ft. NGVD at the RBS site) and the mean annual low water level is 8.2 ft. NGVD (7.8 ft. NGVD at the RBS site). Since 1965, the minimum water level at Bayou Sara was 4.8 ft. NGVD (4.4 ft. NGVD at the RBS site), which occurred on July 5, 1988. Water levels at the RBS site are approximately 0.4 ft. lower than Bayou Sara levels.

Local Streams

The RBS is located on high ground approximately 2 mi. east of the Mississippi River. The surface drainage of the RBS property is maintained by Alligator Bayou and its tributary, Grants Bayou. Flow from Alligator Bayou enters Thompson Creek and then passes to the Mississippi River. The main plant and construction areas are primarily drained by West Creek, a small tributary of Grants Bayou. Local drainage is depicted in Figure 2.4.1-203.

The flow of streams in the RBS area consists primarily of surface runoff during periods of precipitation and the days immediately following. Generally, the greatest runoff occurs in February and March. June to November is the period of low runoff. Local streams in the area of the RBS site are subject to extended drought periods of zero flow. RBS Unit 3 does not use local streams as a water source (Reference 2.4.11-201).

2.4.11.2 Low Water Resulting from Surges, Seiches, or Tsunamis

Subsections 2.4.5 and 2.4.6 state that the RBS site is not expected to experience sustained strong winds due to hurricanes or to experience seiche or tsunami flooding. Likewise, it is not expected that there would be low water conditions due to surges, seiches, or a tsunami.

Subsection 2.4.7 states that flooding due to ice jams has never occurred at the RBS site, and that, due to water and air temperatures at the site, it is unlikely that an ice jam would ever occur. Therefore, a low flow situation due to or exaggerated by ice formation is not expected.

RBS Unit 3 utilizes an ESBWR standard plant design that does not utilize surface water for any safety-related function. As described in DCD Subsection 9.2.5, the ESBWR UHS is provided by the IC/PCC pools. The post-accident makeup to the UHS is provided by the FPS through safety-related FAPCS piping.

2.4.11.3 Historical Low Water

Low Flow

Flow of the Lower Mississippi River in the RBS site area is affected by diversions into the Atchafalaya River through the Old River diversion channel near Coochie, Louisiana, approximately 53 river mi. upstream of the site (Reference 2.4.11-206). Records collected by the USACE from 1930 to 1963 at Red River Landing, Louisiana, approximately 12 river miles below the diversion (Reference 2.4.11-207), and from 1963 to date at Tarbert Landing, Mississippi, approximately 6 river miles below the diversion (Reference 2.4.11-208), indicate that the minimum daily discharge is 75,000 cfs, which occurred on November 4, 1939. On this same day, the flow into the Old River diversion canal was 13,400 cfs. The minimum daily flow at Vicksburg (RM 436.8) and Natchez (RM 362.5), Mississippi, during this period was 102,000 and 100,000 cfs, respectively. Discharge measurements of 83,200; 89,600; and 91,400 cfs were made at Red River Landing on November 2, 3, and 6, 1939. These measurements, when added to the 13,400 cfs being diverted into the Atchafalaya River, compared favorably with the Vicksburg and Natchez discharges and indicate that the recorded minimum flow of 75,000 cfs for the Lower Mississippi River may be somewhat low. A minimum daily flow of 100,000 cfs occurred at Vicksburg on October 17, 1939, and it is the lowest daily flow of record at that gage. A control structure on the Old River diversion canal was completed in 1963, and minimum flows are now somewhat controlled. As a result, it is doubtful that the daily flow could ever be lower than 100,000 cfs in the Lower Mississippi River. Flow data from 1900 to 2006 are provided in Table 2.4.1-202.

The seasonally varying river flow reaches a peak in April and a low in September (refer to Subsection 2.4.1). Flow records at Tarbert Landing for the period 1963 to 2006 indicate that the minimum flow for this period was 111,000 cfs. This low flow occurred on July 5, 1988.

Low Stage

The USACE stage records from the Bayou Sara gage (References 2.4.11-209 and 2.4.11-210), 3 mi. upstream of the RBS site, show that the minimum low water plane is at Elevation 1.0 ft. msl (recorded November 16, 1895). The corresponding minimum water elevation at the RBS site is approximately 0.6 ft. msl. Based on the period 1956 to 2006, the minimum water level at Bayou Sara was 2.9 ft. msl (2.5 ft. msl at the site) and the mean annual low water level is 8.2 ft. msl (7.8 ft. msl at the RBS site). Since 1965, the minimum water level at Bayou Sara was 4.8 ft. msl (4.4 feet msl at the RBS site), which occurred on July 5, 1988. Stage data at the Bayou Sara gaging station from 1889 to 2006 are provided in Table 2.4.11-201.

Flow records show a discharge of 94,000 cfs at Red River Landing on November 17, 1895. The discharge at the RBS site on the day of the lowest stage would not be significantly different and is estimated to be 94,000 cfs. For the minimum recorded flow of 75,000 cfs at Red River Landing, the stage was approximately 1.7 ft. msl at Bayou Sara (1.3 ft. msl at the site).

Local Streams

Local streams in the RBS site area flow intermittently, as discussed in Subsection 2.4.11.1. The local streams are subject to extended drought periods of zero flow.

2.4.11.4 Future Controls

Continued development of upstream reservoirs for flood control, navigation, irrigation, low-flow augmentation, and hydroelectric power would alter the flow characteristics of the Lower Mississippi. In a study prepared by the Mississippi River Commission, the river flows were projected, with anticipated development in the basin, to the year 2020. This study indicated that the future development in the Mississippi River would tend to increase the low flows and decrease the periods of high flow. This is supported by Table 2.4.1-202. For the period 1956 through 2006, the average annual peak flow has decreased, and the average annual low flow has increased as compared to the period 1900 through 1955.

The proposed surface water intake for a new facility could be affected by future controls on the Mississippi River; however, the USACE has no plans for additional construction in the immediate vicinity of the RBS site, except for occasional maintenance of the existing structures (Reference 2.4.11-212). It is anticipated that the USACE would continue control measures to maintain the river alignment and to allow adequate flow for navigation purposes.

The USACE and the state of Louisiana do not currently restrict the quantity of water that can be withdrawn from the Mississippi River. There is no permit for river water withdrawal for Louisiana and the RBS (Reference 2.4.11-213).

The owner of a new facility would be required to coordinate with the USACE, and obtain permits from the USACE and/or appropriate regulatory agencies, as required, for modification of the intake structure when the final design of the intake structure is defined. The design of the intake structure would be in accordance with USACE guidance, LDEQ and EPA requirements, and good engineering practice.

2.4.11.5 Plant Requirements

The UHS requirements are discussed in Subsection 9.2.5. The following is a discussion of the main cooling system requirements, including a discussion of the plant effluent system and effluent dispersion.

Cooling Tower Makeup System

Makeup water (cooling tower makeup and other raw water needs) for a new facility would be supplied primarily from the Mississippi River. Existing structures and components would be used by the new facility, which would minimize construction impacts.

For RBS Unit 1, an excavated embayment was constructed in the Mississippi River along the east bank at approximately RM 262.5. Intake-discharge area embayment development is shown in Figure 2.4.11-201. A barge slip and the plant makeup water intake screens are located in the embayment, which provides protection from main channel debris and navigation. Access to the embayment area is obtained from the north and south by River Road, which runs parallel to the river along the natural levee and from the east (and the plant area) by River Access Road. Embayment banks are gently sloped and employ riprap protection to -12 ft. msl (about 19 ft. below mean low water level) to reduce the effects of river bank erosion. Riprap stone size is 16 to 20 in. By agreement with the USACE, dredged material from embayment construction was deposited at acceptable bed elevations in the river. Bottom elevation in the embayment is -12 ft. msl.

Periodic dredging of the embayment is required because of sediment transport in the river. Dredging activities typically occur no more than once per year. The volume of material removed is usually not tracked because it is placed backed into the river; however, the volume of material removed is estimated to be less than 20,000 cubic yards per removal.The most recent maintenance dredging of the embayment was performed on January 9-11, 2008. The estimated volume of material removed was 14,585 cubic yards. Since the construction of the embayment area, no maintenance has been performed on the slope stabilization.

The natural bank erosion rate (no slope stabilization) is estimated to be 8 ft/yr. Channel stabilization and improvement is used to mitigate the natural bank erosion. This consists of stabilizing the banks of the Mississippi to a desirable alignment and obtaining efficient stream flow characteristics for flood control and navigation. Dikes made of rock confine the river to a single low-water channel, reduce excessive widths, and develop desired river alignments for the benefit of navigation. Revetment, consisting of large concrete blocks joined together with wires, helps stabilize the Mississippi River channel and protect nearby levees by preventing bank caving. Improvement dredging is used to adjust flow patterns, and maintenance dredging deepens shallow channel crossings that tend to form during low water.

A combined station water system will be used for Units 1 and 3. The existing pumphouse and support systems will be used. The makeup water intake structure profile is shown in Figure 2.4.11-202. The existing intake screens located in the embayment would be replaced to meet the intake velocity requirement (0.5 fps at the screen). For the combined station water system, two pairs of intake screens will be connected to the existing intake pipelines. Removal of the existing intake screens and installation of the new screens would result in a slight increase in turbidity during the construction process.

The intake system is designed for an extreme low water elevation of 1.0 ft., as shown in Figure 2.4.11-202. Based on the discussion of low stage in Subsections 2.4.11.1 and 2.4.11.3, there is sufficient water during periods of low flow for non-safety-related water supplies.

An existing 36-in. diameter pipeline is used to convey makeup water from the pumphouse to the Unit 1 clarifiers. An additional 36-in. diameter pipeline would be installed along the existing pipeline route from the pumphouse to the Unit 3 clarifiers.

Effluent System

The Unit 1 cooling tower blowdown pipeline and the clarifier sludge discharge pipeline exit the plant area adjacent to one another and cross Alligator Bayou along the south side of River Access Road. Both pipes exit to the Mississippi River within the riprapped portion of the river embankment, approximately 400 ft. downstream from the center line of the embayment. The discharge pipelines to the Mississippi River are shown in Figure 2.4.11-203. The pipelines are buried in the roadbed and do not interfere with surface water flow in Alligator Bayou and West Creek. The center line of both outfalls is at -3 ft. msl, approximately 10 ft. below mean low water. There is no impact to river navigation (Reference 2.4.11-201).

Cooling tower blowdown water would be discharged to the Mississippi River through a resized wastewater blowdown line and outfall utilized by RBS Unit 1. The total effluent through the wastewater blowdown line and outfall includes wastewater effluent from RBS Units 1 and 3. The discharge velocity at the pipe exit would be approximately 3 fps.

2.4.11.6 Heat Sink Dependability Requirements

RBS Unit 3 utilizes an ESBWR standard plant design that does not utilize surface water for any safety-related function. As described in DCD Subsection 9.2.5, the ESBWR UHS is provided by the IC/PCC pools. The post-accident makeup to the UHS is provided by the FPS through safety-related FAPCS piping.

The post-accident makeup to the UHS is not reliant on the source of water from the river intake for cooling. Because the emergency cooling water system would be a separate closed-loop system, no warning of impending low flow from the river water makeup system is required.

2.4.11.7 References

2.4.11-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report" through Revision 19, July 2006.

2.4.11-202 U.S. Nuclear Regulatory Commission, "River Bend Environmental Report, Operating License Stage Section 2.3: U.S. Army Corps of Engineers, Red River Landing, Louisiana (RM 300.6) Gaging Station, Flow Data 1900 to 1962," 1984.

2.4.11-203 U.S. Army Corps of Engineers, Tarbert Landing, MS (RM 306.3) Gaging Station, Verified Flow Data 1930 to date.

2.4.11-204 U.S. Army Corps of Engineers, Bayou Sara, Louisiana (RM 265.4) Gaging Station, Verified Stage Data 1946 to date.

2.4.11-205 U.S. Nuclear Regulatory Commission, "River Bend Environmental Report, Operating License Stage Section 2.3: U.S. Army Corps of Engineers, Bayou Sara, Louisiana (RM 265.4) Gaging Station, Stage Data 1988 to 1979," 1984.

2.4.11-206 Mississippi River Commission, "Lower Mississippi Region Comprehensive Study, Appendices A through U," Vicksburg, Mississippi, 1974.

2.4.11-207 National Park Service, U.S. Department of Interior, *The Natural Environment*, Volume 2, "Draft Heritage Study and Environmental Assessment," Website, www.nps.gov/history/delta/volume2/natural.htm.

Table 2.4.11-201 (Sheet 1 of 5)
Annual Stage Data at Bayou Sara, Louisiana - RM 264.7

Year	Max. (ft. NGVD)	Min. (ft. NGVD)	Average (ft. NGVD)
1889	31.8	1.7	
1890	45.0	7.8	
1891	42.6	2.0	
1892	46.0	3.0	
1893	45.3	4.0	
1894	36.9	1.1	
1895	28.5	1.0	
1896	34.5	4.0	
1897	47.5	2.4	
1898	41.3	7.8	
1899	40.5	2.4	
1900	32.9	5.2	
1901	34.2	2.4	
1902	35.5	6.4	
1903	47.1	3.0	
1904	40.5	2.6	
1905	37.2	4.6	
1906	41.2	10.1	
1907	44.1	6.7	
1908	46.4	4.2	
1909	42.9	4.6	
1910	35.4	3.2	
1911	38.8	5.6	
1912	51.2	6.8	
1913	48.3	7.1	
1914	38.7	3.8	
1915	40.1	12.7	

Table 2.4.11-201 (Sheet 2 of 5)
Annual Stage Data at Bayou Sara, Louisiana - RM 264.7

Year	Max. (ft. NGVD)	Min. (ft. NGVD)	Average (ft. NGVD)
1916	49.9	4.5	
1917	44.4	2.6	
1918	32.1	2.0	
1919	40.6	4.2	
1920	48.5	5.5	
1921	41.3	4.8	
1922	53.2	3.8	
1923	45.4	6.8	
1924	39.8	4.5	
1925	29.4	2.7	
1926	35.6	7.5	
1927	55.5	7.9	
1928	43.0	8.0	
1929	50.5	5.1	
1930	39.4	2.1	
1931	31.7	3.4	
1932	49.7	4.4	
1933	44.8	3.1	
1934	33.9	3.1	
1935	45.2	3.6	
1936	39.8	2.4	
1937	52.6	3.6	
1938	43.4	4.0	
1939	45.0	1.7	
1940	36.8	1.9	
1941	28.4	3.4	
1942	38.4	8.2	
1943	45.5	4.4	

Table 2.4.11-201 (Sheet 3 of 5)
Annual Stage Data at Bayou Sara, Louisiana - RM 264.7

Year	Max. (ft. NGVD)	Min. (ft. NGVD)	Average (ft. NGVD)
1944	48.2	4.7	
1945	53.7	6.3	
1946	42.9	4.6	
1947	40.1	4.2	
1948	41.8	4.1	
1949	44.6	6.3	
1950	50.7	7.2	
1951	39.4	8.7	
1952	39.9	3.2	
1953	36.8	2.6	
1954	25.0	3.6	
1955	39.2	4.3	
1956	34.6	2.9	
1957	40.4	7.8	
1958	39.2	6.3	
1959	31.7	4.7	
1960	33.8	5.7	
1961	43.1	7.3	
1962	41.2	6.5	
1963	35.5	4.6	
1964	40.8	3.6	
1965	37.6	7.2	
1966	39.4	6.7	
1967	34.1	8.0	
1968	36.3	7.0	
1969	39.1	8.4	
1970	39.3	8.2	
1971	36.9	8.1	

Table 2.4.11-201 (Sheet 4 of 5)
Annual Stage Data at Bayou Sara, Louisiana - RM 264.7

Year	Max. (ft. NGVD)	Min. (ft. NGVD)	Average (ft. NGVD)
1972	37.2	10.5	
1973	50.7	12.5	
1974	46.3	10.3	
1975	49.5	12.0	
1976	34.6	7.0	
1977	37.4	7.1	
1978	40.7	9.0	
1979	52.5	9.0	
1980	45.3	11.3	24.6
1981	36.8	6.2	17.3
1982	39.6	9.1	23.9
1983	53.9	9.7	30.1
1984	49.3	8.6	28.0
1985	46.3	9.6	27.4
1986	43.3	11.0	25.0
1987	41.1	9.4	25.8
1988	40.9	4.8	17.8
1989	44.2	6.0	26.1
1990	46.4	8.1	27.7
1991	48.9	9.0	30.7
1992	39.1	8.0	22.9
1993	45.3	9.2	33.2
1994	48.6	9.5	30.4
1995	48.9	9.9	27.4
1996	44.3	10.8	24.0
1997	53.5	10.7	31.0
1998	44.4	10.7	27.8
1999	45.4	7.2	28.3

Table 2.4.11-201 (Sheet 5 of 5)
Annual Stage Data at Bayou Sara, Louisiana - RM 264.7

Year	Max. (ft. NGVD)	Min. (ft. NGVD)	Average (ft. NGVD)
2000	31.5	6.7	16.7
2001	43.8	7.1	21.5
2002	46.5	8.6	26.8
2003	43.1	11.9	24.6
2004	38.9	10.4	25.9
Ave =	**41.7**	**6.1**	**25.4**
Ave. Low Stage 1889 - 1955 =			**4.6**
Ave. Low Stage 1956 - 2006 =			**8.2**
Ave. Peak Stage 1889 - 1955 =			**41.5**
Ave. Peak Stage 1956 - 2006 =			**42.0**

Source: U.S. Army Corps of Engineers.

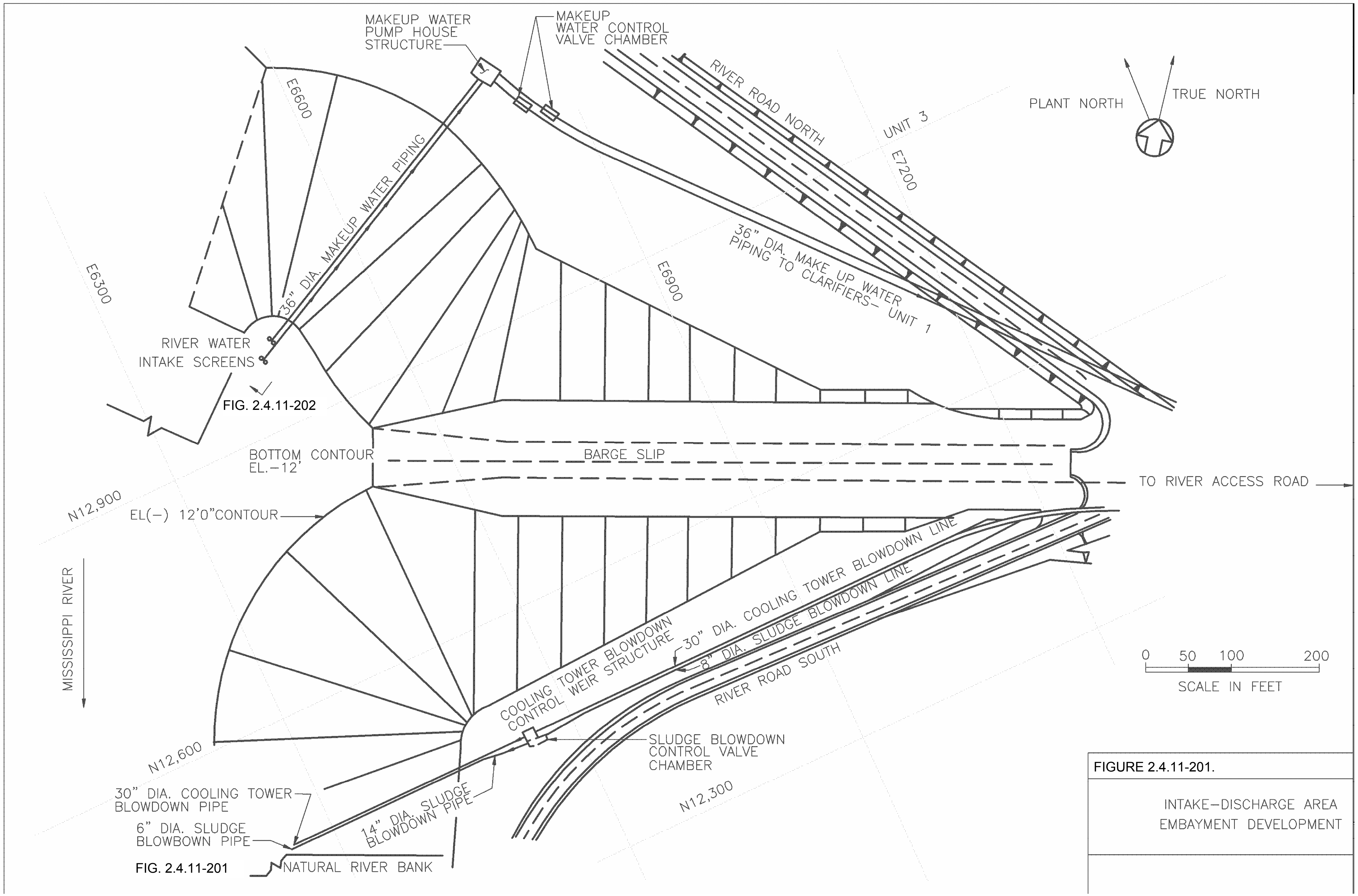


Figure 2.4.11-201. Intake-Discharge Area Embayment Development

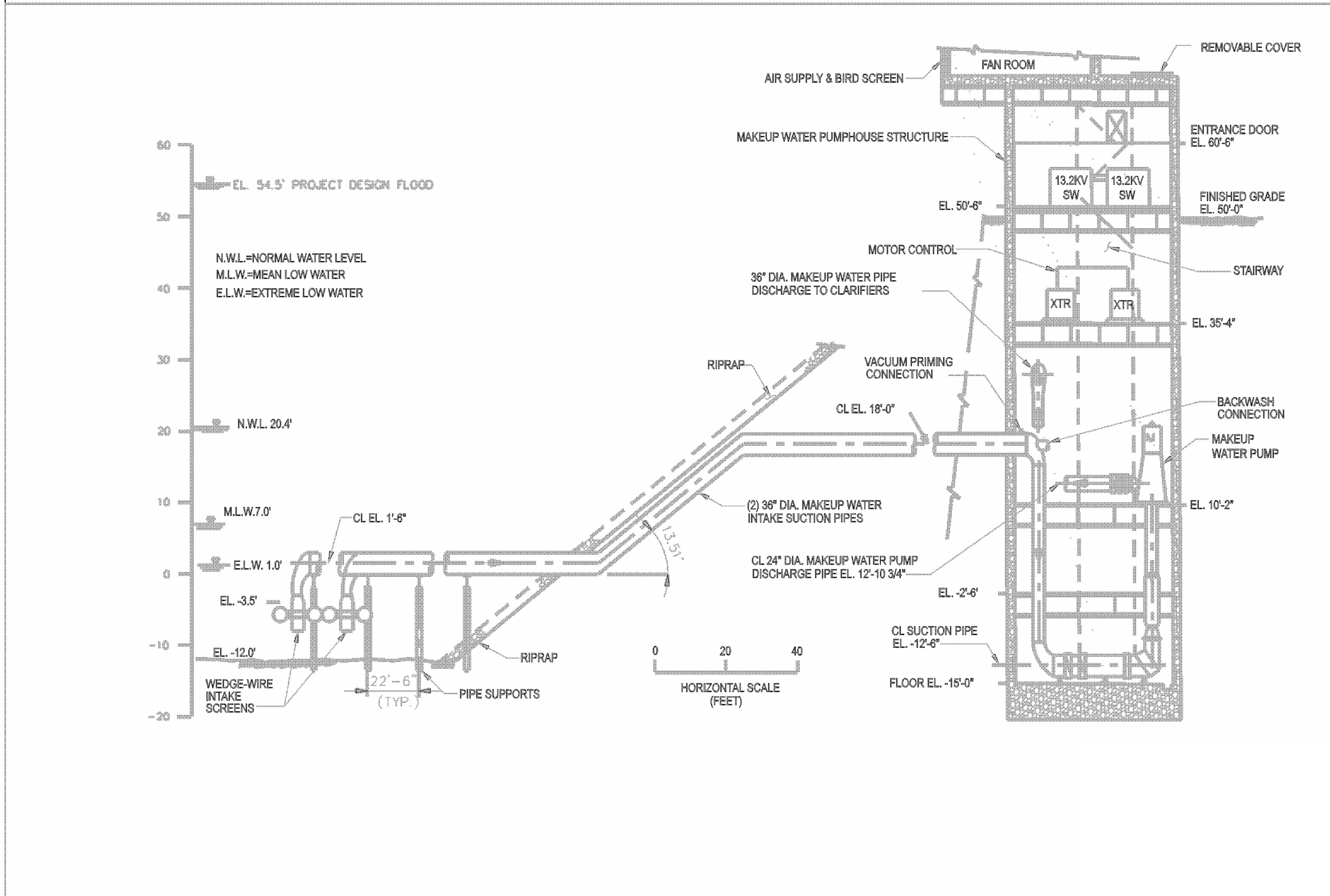


Figure 2.4.11-202. Makeup Water Intake Structure Profile

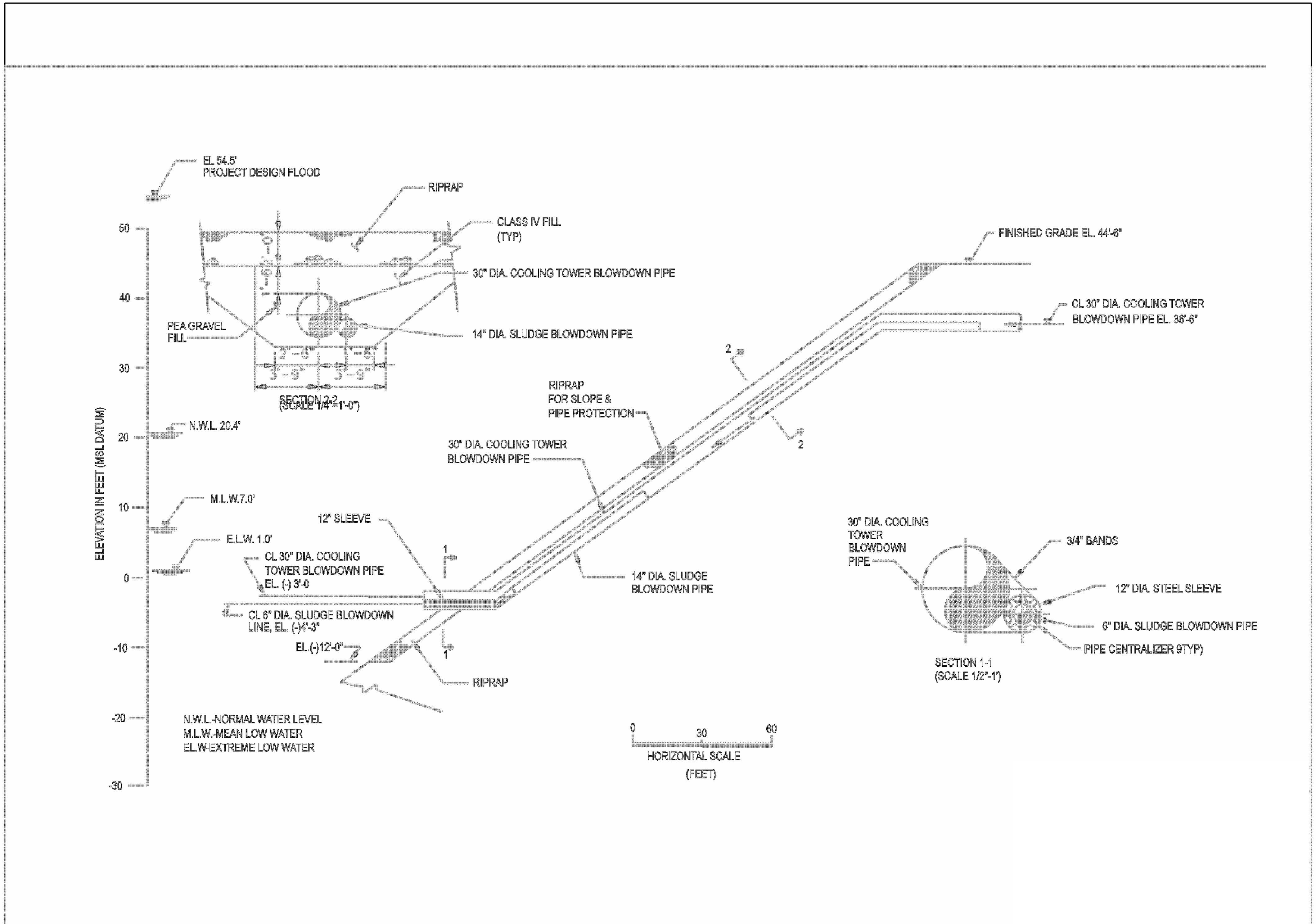


Figure 2.4.11-203. Discharge Pipelines to Mississippi River

RBS COL 2.0-23-A

2.4.12 GROUNDWATER

This subsection describes the characteristics and usage of the regional and local groundwater resources to allow an evaluation of potential hydrogeologic impacts to plant foundations and the reliability of safety-related water supply and dewatering systems. Note that the word "groundwater" is consistently used throughout this subsection, as opposed to other acceptable variations of that term, including "ground water" and "ground-water." Also note that although geology and surface water are discussed in context in this subsection, these topics are described in depth in Subsections 2.4.2 and 2.5.1, respectively.

2.4.12.1 Description and On-Site Use

2.4.12.1.1 Regional Hydrogeologic Setting

The RBS site covers an area of approximately 3300 ac. and is located on the coastal plain of southeastern Louisiana, along the eastern portion of the Mississippi River. The site lies approximately 3 mi. southeast of St. Francisville, which has a population of approximately 8000, and is located 24 mi. northwest of the city of Baton Rouge (refer to Figure 2.4.12-201).

The majority of the site (approximately two-thirds) is located on upland areas east of the Mississippi River (refer to Figure 2.1-202) where the maximum elevation is approximately 120 ft. above mean sea level (msl) (refer to Figure 2.5.1-226). The upland areas of the site are heavily dissected by dry swales and intermittent streams. The remaining one-third of the site stretches approximately north to south across 3000 to 4000 ft. of floodplains of the Mississippi River, where the elevation of the land surface is approximately 30 to 40 ft. msl. Major drainage features include the Alligator Bayou to the west and Grants Bayou to the south and east of the site. The western boundary of the RBS site runs along the Mississippi River (refer to Figure 2.4.12-202).

The RBS site lies within the Gulf Coastal Plain Physiographic Province, which extends from central Arkansas to the Gulf of Mexico, encompassing all of Louisiana and most of Mississippi (refer to Figure 2.4.12-203). It is situated on two sub-provinces of the Coastal Plain Physiographic Province: the Southern Hills and the Mississippi Alluvial Valley. The Southern Hills subprovince is characterized as a coastal plain of low hills, low cuesta ridges, and gentle lowlands and ranges in elevation from sea level along the coast to approximately 300 ft. msl in the northern parts of the Feliciana Parishes (References 2.4.12-201 and 2.4.12-202). Fine-grained strata underlie the low-lying areas, whereas coarse sand and gravel underlie low ridges and hills (Reference 2.4.12-201).

The Mississippi Alluvial Valley is approximately 43 mi. wide near the RBS site and consists of a low floodplain and delta system that were formed by the Mississippi River (Reference 2.4.12-201). The elevation of land surface in backswamp areas within the valley in adjacent Pointe Coupee Parish ranges from 50 ft. msl in the northern part of the parish to 15 ft. msl in the southern part of the parish

(Reference 2.4.12-203). Elevations are greater at the tops of levees and along the bluffs at the boundary of the Mississippi Alluvial Valley and the Southern Hills subprovinces (Reference 2.4.12-201). The elevation of the bottom of the Mississippi River is approximately 85 ft. below msl in Pointe Coupee Parish (Reference 2.4.12-203).

The RBS site is underlain by a thick stratigraphic sequence of Coastal Plain sediments of Mesozoic and Cenozoic age that were deposited in the Mississippi Embayment and the Gulf Coast geosynclinal basin (Figures 2.4.12-204 and 2.4.12-205). The Mississippi Embayment is a large valley that forms a southward-plunging syncline and is closely aligned with the present-day location of the Mississippi River. Except where covered by Holocene alluvial deposits of the Mississippi River, Coastal Plain sedimentary rocks of Cretaceous to early Tertiary age generally crop out in bands that parallel the embayment and thicken toward the axis of the embayment (References 2.4.12-201 and 2.4.12-231). Late Eocene to Pliocene age sediments crop out in bands paralleling the coastline and dip gently southward into the Gulf Coast geosynclinal basin. From their landward extent, the Coastal Plain sediments thicken greatly toward the axes of the Mississippi Embayment and the Gulf Coast Geosyncline. At the RBS site, the Coastal Plain sedimentary strata are more than 20,000 ft. thick.

Sediments of early Tertiary age and younger were deposited during progradational cycles of alluvial and deltaic infilling within the Gulf Coast Basin. Local Tertiary and Pleistocene age sediments include fluvial deposits from both glacial and non-glacial sources (References 2.4.12-204 and 2.4.12-205). A diverse depositional sequence of the Mississippi River, its tributaries, and coastal plain streams was deposited during a considerable part of the late Pleistocene age. This depositional sequence includes terrace (horizontal layers of gravel sand and deposited river materials from former river floodplains), fluvial (meander belt and braided stream), colluvial, estuarine, deltaic, and marine sedimentary units. Late Pleistocene loess (an eolian silt veneer) was deposited over earlier Pleistocene and older deposits. Thickness of the loess ranges from 1 to 90 ft. and is greater than 10 ft. within 2 mi. east of the Mississippi River (Reference 2.4.12-205). Later Quaternary alluvial and deltaic deposits of the Mississippi River and its tributaries form a wide alluvial plain that extends southward from the northern part of the Mississippi Embayment and into the Gulf of Mexico. Locally, alluvial deposits of the Mississippi Alluvial Valley average 200 ft. in thickness (Reference 2.4.12-206).

The Coastal Plain strata are interrupted by uplifts, domes, anticlines, basins, synclines, and growth faults of regional size. Growth fault systems comprise a series of east-to-west trending normal faults, along which the southern block has moved downward relative to the northern block (refer to Figures 2.4.12-205 and 2.4.12-206). These faults dip toward the Gulf of Mexico and generally show increasing displacement with depth. The displacement at the Baton Rouge fault ranges from approximately 20 ft. near ground surface to approximately 300 to 380 ft. at depths of 1300 to 3200 ft. below msl (Reference 2.4.12-207).

Major aquifers in the area are highly variable in composition, consolidation, and hydraulic character and consist of unconsolidated to poorly consolidated Coastal Plain strata of gravel, sand, clay, and minor limestone of Cretaceous to Holocene age (Reference 2.4.12-201). Two or more aquifers that are hydraulically connected may function together as an aquifer system. Aquifers comprising an aquifer system may be separated in places by confining units. However, on a regional scale, there is hydraulic continuity between the aquifers, and a change in conditions in one aquifer affects the other aquifer (Reference 2.4.12-201). Similarly, confining units may function together as a confining system that retards the vertical flow of groundwater, even though local aquifers may be contained within some of the confining units (Reference 2.4.12-201).

The U.S. Geological Survey (USGS) Regional Aquifer-System Analysis (RASA) program has identified two regional aquifer systems underlying the RBS site: (1) the shallower coastal lowlands aquifer system (CLAS) consisting of late Oligocene to Holocene age strata and (2) the deeper Mississippi Embayment aquifer system (MEAS) consisting of Late Cretaceous to Middle Eocene age strata (Reference 2.4.12-201, Figure 2.4.12-207). The CLAS extends southward from the Vicksburg-Jackson area in Mississippi to the Gulf of Mexico and includes the RBS site and most of Louisiana (Figure 2.4.12-207). In accordance with the USGS program, the CLAS includes the Mississippi River alluvial aquifer (MRAA), because the aquifer is lithologically similar and in hydrologic connection with the underlying and adjacent coastal lowlands aquifer sediments.

A thick, effective confining unit, the Vicksburg-Jackson formation comprises the base of the CLAS. At the RBS site, the base of the CLAS is greater than 6000 ft. below msl (refer to Figure 2.4.12-205). The MEAS lies below this confining unit. The MEAS consists of the gulfward-dipping Mississippi Embayment sedimentary sequence. Beneath the site, the aquifer system lies at a depth of more than 6000 ft. and is confined on the top by the Vicksburg-Jackson confining unit and on the bottom by the Midway Group (refer to Figure 2.4.12-205). Recharge to the aquifer system occurs north of the RBS site where the aquifer units are exposed (refer to Figures 2.4.12-204 and 2.4.12-222).

2.4.12.1.2 Regional Hydrogeologic Description

Although the CLAS extends from the Vicksburg-Jackson area in Mississippi to the Gulf of Mexico, this RBS study is limited to a smaller geographic region consisting of the following parishes: West and East Feliciana Parishes, Pointe Coupee Parish, and West and East Baton Rouge Parishes. There are several aquifers containing freshwater in this region of the coastal lowlands aquifer system. These are part of the Southern Hills Regional Aquifer System and include portions of the MRAA and several aquifers within the wedge of Miocene to Quaternary age Coastal Plain sediments (Figure 2.4.12-208; Reference 2.4.12-238). The lower boundary of the aquifers within the region is the base of freshwater, which ranges from 500 to 3500 ft. below msl (Reference 2.4.12-207; Figure 2.4.12-209). In the vicinity of the RBS site, the base of fresh groundwater (groundwater containing less than 250 ppm chloride) is approximately 1800 ft. below msl (References

2.4.12-203 and 2.4.12-206). The Baton Rouge fault represents the approximate downgradient extent of the regional aquifers, because saltwater is found at much shallower depths south of the fault (refer to Figure 2.4.12-209).

The Miocene to Quaternary age sediments within the region were deposited in fluvial, deltaic, and marginal marine environments. Together, the sediments form a heterogeneous, unconsolidated to poorly consolidated sequence of complexly interbedded strata (Reference 2.4.12-201). Aquifers in the region are composed of very fine sand to coarse sand and can contain gravel and cobbles (Reference 2.4.12-207). Rapid, numerous, and complex facies changes have produced sand and gravel aquifers of irregular thickness and extent, interfingered with leaky confining beds of clay and silt (References 2.4.12-201 and 2.4.12-202). Thick beds of sand or clay of wide areal extent are not common (Reference 2.4.12-201).

Correlating aquifers and confining layers over distances greater than a few parishes are extremely difficult because of the complex depositional environments (Reference 2.4.12-201). Lateral and vertical boundaries of aquifers and confining layers are gradational and poorly constrained (Reference 2.4.12-201). Aquifers may merge with vertically adjacent aquifers or may terminate abruptly (Reference 2.4.12-207). Widespread marker horizons or continuous clay beds are absent (Reference 2.4.12-201). In some areas, numerous growth faults may displace the hydrogeologic units (References 2.4.12-201 and 2.4.12-207). Because of the difficulty in correlating units on a regional scale, many of the water-producing zones are identified by local names that vary across the region.

Two systems of nomenclature are used in this study (refer to Table 2.4.12-201). Water-producing zones were delineated in 1961 in the Baton Rouge area (20 mi. southeast of the RBS site) based on the depth at which the zones are usually encountered in that area (Reference 2.4.12-207). North of Baton Rouge, in the Feliciana Parishes, three distinct groups of Tertiary freshwater-bearing sands were identified on the basis of characteristics of the water-bearing zones in the vicinity of the town of Clinton, East Feliciana Parish (17 mi. east-northeast of the RBS site) and divided into three hydraulic zones, according to the characteristic water levels (which decreased with depth) and concentrations of sodium bicarbonate (which increased with depth) (Reference 2.4.12-207).

General correlations of the water-bearing zones in the Feliciana Parishes with the water-bearing zones of the Baton Rouge area are presented in Table 2.4.12-202. A hydrogeologic cross section was constructed that passes through the RBS site and Baton Rouge and shows the Baton Rouge sand units extending beneath the RBS site (Reference 2.4.12-207). Figure 2.4.12-210 shows a trace of the cross section B-B', and the cross section is depicted in Figure 2.4.12-211. Well WF-246 is shown on the cross section; this is a production well that was installed at the RBS site in 1976. At the RBS site, the well is referred to as Well P-1B and is located approximately 600 ft. southeast of the proposed RBS Unit 3 facility.

The aquifers identified at the RBS site include two Quaternary age aquifers (the Upland Terrace Aquifer [UTA] and the MRAA) and the Tertiary age freshwater aquifers referred to as the Tertiary aquifers (Zones 1, 2, and 3). These aquifers are described in detail in the following subsections.

2.4.12.1.2.1 Upland Terrace Aquifer

The UTA is the uppermost aquifer within the upland areas and consists primarily of the Quaternary age Citronelle Formation and secondarily of the remnants of later terrace sediments that were deposited on the Citronelle Formation. The RBS site is located within the outcrop area of the Citronelle Formation, which extends from approximately 70 mi. north of the Louisiana-Mississippi state line to approximately 5 mi. south of the RBS site (refer to Figure 2.4.12-212). The Port Hickey Terrace is the only terrace deposit that has been identified in the site area (Reference 2.4.12-232). Although it is younger than the Citronelle Formation, the Port Hickey Terrace may occur topographically lower than the upper surface of the Citronelle Formation, because it was deposited on the dissected surface of the Citronelle Formation. Together, the Citronelle Formation and the terrace deposits behave as a single hydrogeologic unit that correlates with the 400-ft. and 600-ft. sands of the Baton Rouge area (Tables 2.4.12-201 and 2.4.12-202; Figure 2.4.12-211). The total thickness of the UTA increases to the south, ranging from approximately 75 ft. in East and West Feliciana Parishes to about 400 ft. at Baton Rouge where the aquifer exists at depth as the two separate 400-ft. and 600-ft. aquifers (Reference 2.4.12-207). In the Feliciana Parishes, the base of the UTA ranges from approximately 200 ft. msl to 100 ft. below msl. At the RBS site, the base of the UTA ranges from approximately 50 to 150 ft. below msl. The sedimentary deposits of the UTA unconformably overlie the Miocene age Pascagoula Formation in the RBS site vicinity. The Pascagoula Formation consists of approximately 200 ft. of clay that separates the UTA from the Tertiary aquifers below (Figure 2.4.12-213).

The UTA is a broad, somewhat discontinuous, near-surface aquifer (Reference 2.4.12-207). Sediments range from clay and fine sand to gravel, with the coarse sediments dominant in the northern portion of the aquifer (Reference 2.4.12-202). Most of the eastern portion of the UTA is blanketed by a layer of loess (eolian silt) that extends 30 to 40 mi. east of the Mississippi River (Reference 2.4.12-204). The loess is thicker near the river and is approximately 6 to 8 ft. thick at the RBS site (refer to Figure 2.4.12-214, Reference 2.4.12-219). The loess is absent along streams where it has been eroded.

The UTA exists primarily as a water-table aquifer (Reference 2.4.12-206). However, the lower portions of the aquifer may exhibit confined conditions due to abundant, but discontinuous, fine-grained beds of local extent. Average values of hydraulic conductivity of equivalent units in the Baton Rouge area are 55 ft./day for the 400-ft. sand and 90 ft/day for the 600-ft. sand (Reference 2.4.12-207).

A map of water level elevations from 1960 to 1961 within the UTA shows a hydraulic gradient generally toward the south from the outcrop area (refer to Figure 2.4.12-215). Average water level elevation at the RBS site is approximately 56 ft. msl.

The primary withdrawals from the UTA within the Feliciana Parishes are from domestic wells (Reference 2.4.12-206). Three-quarters of all rural pumpage within the Feliciana Parishes are from the UTA. In the 1960s, there were three industrial wells and two public water supply wells reported in the Feliciana Parishes (Reference 2.4.12-206). Total withdrawals from the UTA at that time were approximately 0.3 million gallons daily (Mgd) and 75 percent of the withdrawal from the UTA was from private domestic wells (Reference 2.4.12-206).

2.4.12.1.2.2 Mississippi River Alluvial Aquifer

The Quaternary alluvium that occurs in the Mississippi Alluvial Valley is referred to as the MRAA (Figure 2.4.12-208). The MRAA is a largely uninterrupted aquifer (Reference 2.4.12-207) that typically grades upward from coarse sand and gravels at the base to fine sand, silt, and clay at the top (Reference 2.4.12-206). The most productive portion of the aquifer is the basal zone that consists of sand and gravel deposited during late Pleistocene time by melt water from retreating glaciers (Reference 2.4.12-206). The upper part of the aquifer consists of point-bar deposits, natural levee deposits, backswamp deposits, and clay plugs of oxbow lakes (Reference 2.4.12-206). Locally, the MRAA terminates east of the Mississippi River against the natural levee wall of the Mississippi River valley and lies unconformably above older Quaternary and Tertiary deposits (refer to Figure 2.4.12-213). The average thickness of the MRAA is reported to be approximately 200 ft. in West Feliciana Parish (Reference 2.4.12-203). The land surface elevation in the Mississippi Alluvial Valley at the RBS site ranges from approximately 30 to 40 ft. msl.

The elevation of the bottom of the Mississippi River near the site is approximately 85 ft. below msl (refer to Figure 2.4.12-213). Generally, the MRAA is hydraulically connected with the Mississippi River (Reference 2.4.12-206). However, the MRAA may be confined or semi-confined at the top by clayey backswamp deposits (Reference 2.4.12-202). In some places, clay (up to 50 ft. thick) may separate the MRAA from other aquifers and the Mississippi River (Reference 2.4.12-202). Similarly, the MRAA may or may not be in direct hydraulic connection with laterally or vertically adjacent Quaternary and Tertiary aquifers (Reference 2.4.12-206). Water levels within the MRAA are affected primarily by the stages of the Mississippi River (Reference 2.4.12-203). From 1963 to 1965, water levels at Well PC-49, located in Pointe Coupee Parish, ranged from 7 to 32 ft. msl (Reference 2.4.12-203). During the same time period, the Mississippi River stage near St. Francisville ranged from 5 to 40 ft. msl (Reference 2.4.12-203). Under normal conditions in the 1960s, water levels were higher in the MRAA than they were in the Mississippi River (Reference 2.4.12-206). An equipotential map of water levels within the MRAA (refer to Figure 2.4.12-216; Reference 2.4.12-208) shows a hydraulic gradient directed southward. The map shows that the equipotential surface within the MRAA at the RBS site is approximately 10 ft. msl.

Reported values of hydraulic conductivity and storage coefficient for the MRAA are 200 ft/day and 1.0 x 10-2 to 9.0 x 10-4, respectively (Reference 2.4.12-206).

Withdrawals from the MRAA within the Feliciana Parishes were negligible (<0.01 Mgd) in the 1960s and consisted primarily of pumpage from one industrial well and a few domestic wells (Reference 2.4.12-206). The reported yield of the 145-ft. deep industrial well was 225 gpm (Reference 2.4.12-206). In 1964, approximately 2.5 Mgd were pumped from the MRAA in Pointe Coupee Parish (Reference 2.4.12-203). Practically all of this water was used for processing sugar cane and for irrigation, and less than 1 percent was used for domestic water supply (Reference 2.4.12-203). Well yields of up to 4250 gpm are reported for Pointe Coupee Parish (Reference 2.4.12-203).

2.4.12.1.2.3 Tertiary Aquifers

Tertiary age aquifers containing freshwater in the area include fine- to coarse-grained sand deposits of the Pascagoula and Hattiesburg Formations that crop out approximately 16 mi. north of the RBS site (refer to Figure 2.4.12-212). The Tertiary aquifers have been divided into three separate zones (Reference 2.4.12-206). Generally, each of these zones represents a confined flow system comprised of multiple sand units. However, in many areas, the confining clay layers may contain silt and sand and may be leaky, thin, or absent (Reference 2.4.12-209). The sand units of the Tertiary aquifers may be unconfined in the outcrop areas or in areas where they are overlain by sands of the UTA (Reference 2.4.12-206). Correlations of the three zones with laterally equivalent aquifers in Baton Rouge are presented in Tables 2.4.12-201 and 2.4.12-202, and in Figure 2.4.12-211. Well WF-246, shown in the Figure 2.4.12-211 cross section, is a production well in the Tertiary aquifers that was installed at the RBS site in 1976. The depths and thicknesses of the Tertiary sands at the RBS site are shown in Table 2.4.12-203.

Zone 1

At the RBS site, Zone 1 consists of the first series of sand units underlying the Quaternary upland deposits, including the UTA and is overlain by more than 200 ft. of clay belonging to the Pascagoula Formation (Figure 2.4.12-211). Zone 1 includes four sand units ranging in depth from 380 ft. to 870 ft. below ground surface (bgs). The total thickness of the Zone 1 sands is 270 ft. The Zone 1 sands beneath the RBS site have been correlated with the 1000-ft. sand, the 1200-ft. sand, and the 1500-ft. sand in the Baton Rouge area, and parts of the Fort Adams and Homochitto Members of the Pascagoula Formation in southern Mississippi (refer to Table 2.4.12-201 and Figure 2.4.12-211). In St. Francisville, the sand units of Zone 1 are principally fine- to medium-grained (Reference 2.4.12-206). The southern limit of freshwater in the 1500-ft. sand is generally considered to be at or near the Baton Rouge fault (Reference 2.4.12-210). The following hydrologic parameters were calculated for the Zone 1 sands on the basis of pumping tests conducted on two wells (Wells 34 and 76) located 22 mi. east-northeast of the RBS site: transmissivity (4000 ft^2/day and 2800 ft^2/day, respectively), aquifer thickness (35 ft. and 72 ft., respectively), and hydraulic conductivity (114 ft/day and 39 ft/day, respectively) (Reference 2.4.12-206). Values of the hydraulic conductivity and storage coefficient of Zone 1 sands in the Baton Rouge area range from 70 to 168 ft/day and from 2.0 x 10^{-4} to 8.0 x 10^{-4}, respectively (Reference 2.4.12-207).

Equipotential maps for the year 2001 for both the 1200-ft. sand and the 1500-ft. sand in the Baton Rouge area are presented in Figures 2.4.12-217 and 2.4.12-218, respectively (References 2.4.12-211 and 2.4.12-210). The figures show that hydraulic gradients are directed generally from north to south, but have been altered by large cones of depression centered in Baton Rouge and by smaller, more local pumping centers in neighboring Pointe Coupee and East Baton Rouge Parishes. In addition, the figures indicate that equipotential surfaces at the RBS site for the 1200-ft. and 1500-ft. sands are approximately 20 ft. msl and at sea level (0 ft. msl), respectively. Water levels in the Zone 1 sands in northern St. Francisville fluctuate in response to the stages of the Mississippi River (Reference 2.4.12-206). Zone 1 sands are hydraulically connected with the MRAA in the vicinity of the RBS site or in areas north of the RBS site (Reference 2.4.12-203).

The average water withdrawal rate from Zone 1 sands in the Feliciana Parishes in 1961 was approximately 0.6 Mgd (Reference 2.4.12-206). Most of the withdrawals were for industrial use and public water supply. Yields of large diameter wells ranged from 70 to 400 gpm and averaged 200 gpm (Reference 2.4.12-206). Yields of small diameter domestic wells ranged from 3 to 55 gpm and averaged 15 gpm (Reference 2.4.12-206).

Zone 2

At the RBS site, the Zone 1 and Zone 2 sands are separated by approximately 300 ft. of clay. Zone 2 sands include two sand units that extend from 1170 to 1290 ft. bgs. The total thickness of the two sands is approximately 90 ft. Zone 2 contains sand units of Pliocene and/or Miocene age that are believed to be equivalent to the 2000-ft. sand in the Baton Rouge area and to the Homochitto Member of the Pascagoula Formation in southern Mississippi. The 1700-ft. sand, which also correlates with Zone 2 sands, is absent in the St. Francisville area as it pinches out south of the RBS site (refer to Figure 2.4.12-211). In St. Francisville, the upper sand units of Zone 2 consist of very fine to fine sand, and the lower unit grades down from fine sand at the top to medium sand at the bottom (Reference 2.4.12-206). The following hydrologic parameters were calculated for the Zone 2 sands on the basis of pumping tests conducted on two wells (Wells 50 and 63) located 3 mi. south of the RBS site: transmissivity (5200 ft^2/day and 6800 ft^2/day), aquifer thickness (120 ft. and 80 ft., respectively), and hydraulic conductivity (43 ft/day and 86 ft/day, respectively) (Reference 2.4.12-206).

A map of the 2002 equipotential surface of the 2000-ft. sand was published in 2004 (Reference 2.4.12-212). Several published maps purport to represent the actual or modeled equipotential surface of groups of aquifers that include Zone 2 sand units (References 2.4.12-209, 2.4.12-213, 2.4.12-214, and 2.4.12-215). All of these maps show a hydraulic gradient directed to the south or southwest, with a large cone of depression centered in Baton Rouge. The elevation of the equipotential surface of these groups of aquifers at the RBS site ranges from 15 ft. below msl (Reference 2.4.12-209) to 50 ft. msl (Reference 2.4.12-214). Zone 2 sands are in hydraulic connection with the MRAA at Angola, approximately 20 mi. northwest of the RBS site (Reference 2.4.12-206). Water levels within Zone 2 sands at Angola fluctuate in response to the stages of the Mississippi River (Reference 2.4.12-206).

The largest withdrawals of groundwater within the Feliciana Parishes in 1961 were from the Zone 2 sands, and total withdrawals of groundwater from Zone 2 sands in the Feliciana Parishes in 1961, were approximately 4.3 Mgd (Reference 2.4.12-206). In 1961, major public water supply wells and industrial wells were located in or near St. Francisville.

Most of the withdrawals were for industrial use and public water supply, but there was some rural and domestic use of the Zone 2 aquifer. Yields of large diameter wells ranged from 410 to 1160 gpm and averaged 750 gpm (Reference 2.4.12-206). Yields of smaller diameter industrial and public water supply wells ranged from 30 to 250 gpm (Reference 2.4.12-206).

Zone 3

Zone 3 consists of the deepest sand units containing freshwater (less than 250 milligrams per liter [mg/L] chloride) in the region. Zone 3 is separated from the overlying Zone 2 sands by 270 ft. of clay. These Zone 3 Miocene deposits are believed to be equivalent to the 2400-ft. sand and the 2800-ft. sand in the Baton Rouge area and to the Hattiesburg Formation and part of the Catahoula Sandstone in southern Mississippi (Reference 2.4.12-206 and Table 2.4.12-201). Near the RBS site, the base of fresh groundwater associated with this zone is approximately 1900 ft. below msl (Reference 2.4.12-206). Zone 3 consists of two sand units at the RBS site. The combined thickness of the two sand units, which extend from 1560 to 1880 ft. bgs, is 210 ft. (Figure 2.4.12-229). The following hydrologic parameters were calculated for the Zone 3 sands on the basis of one pumping test conducted at Well 215, located 3 mi. south of the RBS site: transmissivity (16,000 ft^2/day), aquifer thickness (80 ft.), and hydraulic conductivity (200 ft/day) (Reference 2.4.12-206).

Equipotential maps of the combined 2000-ft. Zone 2 sand unit and the 2400-ft. Zone 3 sand unit are shown in Figure 2.4.12-219. These zones are lumped together as the Upper Jasper in that figure. The correlation of the two zones to the Upper Jasper is included in Table 1 of the source maps of this figure (Reference 2.4.12-215). The figure shows a gradient directed to the southwest and a large cone of depression centered in Baton Rouge (References 2.4.12-214 and 2.4.12-215). The recent elevation of the equipotential surface of the Zone 3 aquifer at the RBS site ranges from 5 to 10 ft. below msl (References 2.4.12-214 and 2.4.12-215). An equipotential map for the year 1984 prepared for the 2800-ft. sand (refer to Figure 2.4.12-220) shows a large cone of depression extending from Baton Rouge to St. Francisville (Reference 2.4.12-215).

In 1961, the withdrawal of groundwater from Zone 3 sands within the Feliciana Parishes was approximately 2.5 Mgd (Reference 2.4.12-206). Most of this water (2.3 Mgd) was pumped from two industrial wells located 3 mi. south of the RBS site. Other users of groundwater derived from Zone 3 include public water supplies, including St. Francisville and rural and domestic users (Reference 2.4.12-206).

Yields of large diameter wells ranged from 560 to 1140 gpm (Reference 2.4.12-206). Yields of smaller diameter industrial and public water supply wells ranged from 15 to 75 gpm (Reference 2.4.12-206).

2.4.12.1.2.4 Groundwater Sources and Sinks

The primary source of recharge to the aquifer system is precipitation falling on interstream areas in southwestern Mississippi and southeastern Louisiana where the aquifers crop out (References 2.4.12-201, 2.4.12-205, 2.4.12-207, and 2.4.12-216; Figures 2.4.12-208, 2.4.12-221, and 2.4.12-222). The average annual precipitation is approximately 60 in. (Reference 2.4.12-217). The amount of precipitation recharging the groundwater system is partially dependent on shallow soil types and topography. In areas of greater topographic relief, much of the precipitation drains to local streams as runoff. The UTA may be overlain by clayey Quaternary deposits and loess that may inhibit recharge from precipitation. Recharge is greater where the erosion of clayey surficial deposits has exposed the underlying sands. The greatest recharge potential is in areas of deep, well-drained sands and gravels with low runoff potential (refer to Figure 2.4.12-221).

Much of the recharge to the surficial aquifers discharges to nearby streams and major rivers. However, because aquifers in the region are interconnected, some infiltrated precipitation percolates downward through the surficial aquifers to the deeper aquifers (References 2.4.12-202, 2.4.12-206, and 2.4.12-207; Figures 2.4.12-209 and 2.4.12-223). It is estimated that less than 1 in. per year of recharge in the outcrop area goes into the regional flow system, although local variations may range from 0.04 to 4 in. per year (Reference 2.4.12-202). The RBS site is located in an area that overlaps both a groundwater recharge area and a groundwater discharge area (refer to Figure 2.4.12-222).

Recharge may also occur in the form of leakage from adjacent aquifers of greater hydraulic head, especially from alluvium in contact with major rivers (Reference 2.4.12-209). The UTA and the Tertiary aquifers are in hydraulic connection with the MRAA, and recharge to underlying aquifers may occur depending on relative water levels within the aquifers and the stage of the Mississippi River. Flow reversals may occur in local areas, depending on the stage of the river (Reference 2.4.12-206). During high river stages, usually from March through May, flow is from the river and into the MRAA (Reference 2.4.12-202). During low stages, usually July through October, flow is out of the MRAA and into the river (Reference 2.4.12-202). However, computer simulations indicate that, prior to development, there was a net discharge from deeper aquifers to the MRAA (Reference 2.4.12-202).

Prior to development, groundwater within the Tertiary and deeper aquifer systems generally flowed in a south to southwest direction from the upland terrace areas of southwestern Mississippi and southeastern Louisiana toward the Gulf Coast and major river valleys (Reference 2.4.12-218). Natural areas of discharge include the Mississippi River and its tributaries (refer to Figure 2.4.12-222). Groundwater elevations decreased with depth in the recharge areas and increased with depth in the discharge areas (Reference 2.4.12-218). Historically, groundwater discharged in an area near the Baton Rouge fault (References 2.4.12-206, 2.4.12-210, and 2.4.12-211). In these downgradient areas, north of the Baton Rouge fault, groundwater in deeper aquifers had higher hydraulic head than groundwater in shallower aquifers (Reference 2.4.12-206). Under these conditions, groundwater would slowly seep upward toward the ground surface (Reference 2.4.12-206).

Currently, groundwater withdrawal from wells in the Baton Rouge area is resulting in a major groundwater sink (Reference 2.4.12-218). Effects of groundwater withdrawal on the flow system are discussed in Subsection 2.4.12.2.5.

2.4.12.1.3 Local and Site-Specific Hydrogeology and Sources

The majority of the RBS site is located on upland areas east of the Mississippi River. The upland areas of the site are heavily dissected by dry swales and intermittent streams. A smaller portion of the site stretches across 3000 to 4000 ft. of the Mississippi River floodplain. Major drainage features include numerous bayous and creeks that eventually discharge into the Mississippi River (refer to Figure 2.4.12-202).

The developed portions of the RBS site area are graded to allow runoff to drain to East and West Creeks, which then drain into Grants Bayou (refer to Figures 2.5.1-225 and 2.5.1-226). Within the developed portion of the RBS site is a large pit at the previously planned, RBS Unit 2 power block area that allows surface water to infiltrate directly to the UTA. The pit was excavated to a depth of 20 ft. msl in anticipation of building a foundation for the RBS Unit 2 facility. The RBS Unit 2 facility was never built, and the pit was backfilled to an elevation of approximately +65 ft. msl with fill. Refer to Subsection 2.5.4 for additional details regarding the RBS Unit 2 excavation area.

The Phase 3 subsurface investigation of RBS Unit 3 included geotechnical and hydrogeological investigations of the site to a maximum depth of 550 ft. bgs (Boring RB-31B). The geotechnical investigation included soil borings, cone penetrometer tests (CPTs), and geophysical surveys. Figure 2.4.12-224 depicts the soil borings. Subsection 2.5.4 describes the results of the geotechnical investigation.

The hydrogeologic investigation, performed during 2006 and 2007, included the installation of 21 groundwater monitoring wells and 3 piezometers to depths ranging from 57 to 116 ft. bgs (refer to Figure 2.4.12-225; Table 2.4.12-204, and Appendix 2AA). Reference 2.4.12-233 contains Monitoring Well logs MW-1 through MW-21, and Reference 2.4.12-234 contains Piezometer Logs PZ-01, 02, and 03. Groundwater levels within the wells were measured monthly (refer to Table 2.4.12-205), and slug tests were performed on eight of the wells to estimate hydraulic conductivity (Table 2.4.12-207). Groundwater samples were collected and analyzed for water quality (refer to Table 2.4.12-206).

Numerous subsurface investigations have been conducted previously at the RBS site for design and permitting purposes and for the evaluation of on-site groundwater resources. Locations of previous soil borings and groundwater monitoring wells are shown in Figures 2.4.12-226 and 2.4.12-227. Data from these prior investigations were used to supplement the recent investigations. Two hydrogeologic cross sections that pass through the RBS Unit 3 site were constructed. The locations of the cross sections are presented in Figure 2.4.12-228. Figures 2.4.12-213 and 2.4.12-229 show the cross sections of the site prepared using data from both the recent investigations and from prior investigations.

2.4.12.1.3.1 Geohydrology

UTA

The UTA is the uppermost aquifer within the upland areas of the RBS site; it consists of coarse deposits of the Port Hickey and Citronelle Formations. The Port Hickey Formation lies unconformably over the Citronelle Formation. The UTA is largely unconfined, except beneath discontinuous clay layers at depth or beneath thick surficial deposits of silt and clay close to the boundary with the MRAA (refer to Figure 2.4.12-213). Perched groundwater was not observed above discontinuous clay layers that occur above the local water table. The average depth to the water table is approximately 70 ft. bgs (ranging from approximately 30 to 90 ft. bgs). However, depth to groundwater varies according to the elevation of the highly dissected land surface (refer to Figure 2.4.12-213). The saturated thickness of the UTA increases from 100 ft. at the location of the RBS Unit 3 to at least 200 ft. near the contact with the MRAA (refer to Figure 2.4.12-213). The base of the aquifer (the top of clay deposits of the Pascagoula Formation) slopes in that direction, ranging in elevation from approximately 50 ft. below msl at the RBS site to 150 ft. or more below msl near the contact with the MRAA (refer to Figure 2.4.12-213). The elevation of the top of the clay underlying the UTA may be quite variable in any given location. At the RBS site, the elevation of the top of the Tertiary deposits (i.e., the clay of Pascagoula Formation) ranges from 10 to 50 ft. below msl (refer to Figure 2.4.12-230).

Over most of the site, the UTA is overlain by up to 60 ft. of Pleistocene age loess and fine-grained deposits of both the Port Hickey and Citronelle Formations. Hydraulic conductivity estimates from slug test data at monitoring wells completed in the upper zones of the UTA during the Unit 3 investigation in 2007 show the lower hydraulic conductivity of the upper zone of the UTA (refer to Table 2.4.12-207). The mantle of silt and clay above the saturated zone of the UTA limits infiltration over most of the site. At lower elevations within the uplands areas of the site, the silt and clay have been eroded away, and groundwater recharge is more likely to occur. The pit, previously dug for the construction of the RBS Unit 2 facility, penetrates the mantle of silt and clay and provides a direct conduit of infiltration to the UTA.

Locally, the Port Hickey Formation consists of yellowish-brown silty sand with thin lenses of reddish yellow clay. Previous investigations divide the UTA into two units: an upper clayey and silty sand unit (top stratum) and a lower well to poorly-graded sand to gravelly sand unit. Hydrogeologic properties of the terrace deposits at the site vary greatly because of the lenticular nature of the deposits. Thick deposits of relatively clean sand and gravel were encountered during the RBS Unit 3 geotechnical investigation. These deposits were located in the vicinity of T-10, T-06, P-1, and T-07 (Figure 2.4.12-227) and represent the most productive zone within the terrace deposits at the site. East of the proposed RBS Unit 3, at Well MW7, thick deposits of clay occupy the horizon that is normally occupied by sands of the UTA (refer to Figure 2.4.12-229).

MRAA

The MRAA is the uppermost aquifer within the floodplain portion of the site. The land surface elevation within the floodplain ranges from 30 to 40 ft. msl (refer to Figure 2.4.12-213). As part of an evaluation of the MRAA as a potential groundwater resource, several borings and test wells were drilled to 250 ft. bgs into the floodplain at the site in 1977. Data collected at the borings showed that the floodplain sediments could be divided roughly into three zones. The upper zone is approximately 85 ft. thick and is composed of interbedded clay, silt, and sand, with clay being the dominant sediment type (refer to Figure 2.4.12-213). This heterogeneous upper clayey unit acts as a confining to semi-confining layer above the middle zone, which is approximately 65 ft. thick and is composed of fine sand, coarse sand, and gravel. Underlying this aquifer zone is a lower confining layer that is composed predominantly of clay (Reference 2.4.12-219). As shown in Figure 2.4.12-213, the MRAA lies unconformably against the east wall of the Mississippi River Valley.

Tertiary Confining Layer

The base of the Quaternary UTA is defined as the top clay unit of the Tertiary age Pascagoula Formation. Beneath the RBS Unit 3, the top clay unit is approximately 200 ft. thick (refer to Figure 2.4.12-213). The top of the clay surface slopes toward the Mississippi River, and the clay may thin or pinch out in that direction (refer to Figure 2.4.12-213). The upper portion of the clay layer contains sand lenses (refer to Figures 2.4.12-213 and 2.4.12-229).

Tertiary Aquifers and Intervening Confining Layers

The Tertiary aquifers and intervening confining layers at the site were identified from limited soil sampling performed to a depth of 550 ft. bgs at Boring RB-31B and from geophysical logs of on-site production wells. Depths of the Tertiary aquifers are presented in Figures 2.4.12-211 and 2.4.12-229, summarized in Table 2.4.12-203, and described in Subsection 2.4.12.1.2.4. Well WF-246, shown in the Figure 2.4.12-211 cross section, is a production well that was installed at the RBS site in 1976 and is referred to as P-1B at the RBS site. Zone 1 includes four sand units that extend from 380 to 870 ft. bgs. The total thickness of the Zone 1 sands is 270 ft. The uppermost, Zone 1 sand extends from 380 to 500 ft. bgs and consists of fine sand with occasional lenses of silty clay and clayey silt. A 300-ft. thick confining layer separates Zones 1 and 2. Zone 2 extends from 1170 to 1290 ft. bgs and includes two sand units with a total thickness of 90 ft. A 270-ft. thick confining layer separates Zones 2 and 3. The Zone 3 sands extend from 1560 to 1880 ft. bgs and include two sand units with a total thickness of 210 ft.

2.4.12.1.3.2 New Unit Groundwater Use Projections

Operational Use

Makeup (cooling tower makeup and other raw water needs) for a new facility would be supplied from the Mississippi River via an intake located on the east bank of the river and on the north side of the existing barge slip (refer to Figure 2.4.12-231). Groundwater or public water may be utilized for other general plant purposes, including potable and sanitary needs. The expected maximum consumption of groundwater/public water for these uses (for a new facility and the existing facility) is approximately 315 gpm. No additional groundwater wells are scheduled to be installed for the new RBS Unit 3 other than for construction dewatering purposes.

Construction Use

Construction activities for the RBS Unit 3 would require about 165,000 gallons per day (gpd), or 114 gpm, of water for concrete batch plant operation, dust suppression, and sanitary needs. Public water use is planned. The recommended planning number for tap water consumption for workers in hot climates is 3 gpd for each worker. Based on a maximum estimated construction worker population of 3150 people, the tap water consumption is estimated at 9450 gpd.

Because the average annual groundwater use is much less than 100 gpm, an assessment of the effects of the proposed groundwater use on nearby groundwater users is not required (Supplement 1 to Regulatory Guide 4.2, Section 4.5, 2000).

Dewatering would be needed for the construction of RBS Unit 3, and activities associated with construction dewatering are expected to produce groundwater flow reversals. Dewatering was conducted from approximately 1976 to 1981 to install RBS Unit 1. The dewatering activities for the RBS Unit 1 are described in detail in Subsection 2.4.12.3.1.1. Unit 3 dewatering is discussed in Subsection 2.5.4.

Details on the effects of the groundwater reversal on the existing structures, and any monitoring and mitigation programs are presented in Subsection 2.5.4.

There are no known or suspected discharges of water or wastewater.

2.4.12.1.3.3 Chemical Quality of Water

Groundwater and surface water samples were collected for chemical analysis to evaluate the chemical character of local water resources. In addition, several non-chemical groundwater parameters were measured. The samples were obtained from monitoring wells and RBS Unit 1 pumping wells, and a surface water sample was collected from the Mississippi River. Table 2.4.12-206 summarizes the results of these samples and provides a complete list of parameters measured and analyses performed

Results of groundwater samples collected at the RBS site showed that wells screened within the MRAA (MW-20 and P-1D) have concentrations of dissolved minerals and hardness similar to that of the Mississippi River. The groundwater from Well MW-20 shows elevated concentrations of minerals and dissolved solids, and groundwater samples from Well P-1D contain elevated levels of microorganisms. In general, the groundwater samples from wells screened in the UTA, Zone 1 Aquifer at the Pascagoula Formation, and Zone 3 Aquifer indicate relatively consistent concentrations across the site. Lead and zinc were the only metals detected in groundwater at the site. Analytical reports for all water quality samples collected during this investigation are presented in Reference 2.4.12-235.

Water quality sampling and testing was conducted at the Mississippi River in 2004 and 2005, as summarized in Table 2.4.12-208 (Reference 2.4.12-221). Additional historic surface water quality data for the Mississippi River were obtained from the USGS sampling point near St. Francisville dating from 1965 to 2004 (Reference 2.4.12-222), as shown in Table 2.4.12-209. The results of these analyses are generally consistent with current concentrations for total hardness and suspended sediment in the river.

2.4.12.2 Sources

Groundwater is a very important resource in the region because it is used extensively as a raw water supply for various purposes, including public water supply, industry, power generation, agriculture, and rural domestic use. This subsection describes the groundwater use in the region and in the vicinity of the site. The expected future demand for groundwater in the area and the effects of the construction and operation of the facility on the groundwater resources are also presented.

2.4.12.2.1 Sole Source Aquifers

The RBS site lies within the western portion of the Southern Hills Aquifer System (refer to Figure 2.4.12-208), a sole source aquifer designated by the Environmental Protection Agency (EPA) in 1999. The aquifer system is located in portions of southwestern Mississippi and southeastern Louisiana (refer to Figure 2.4.12-232). It includes all of the regional aquifers that are Oligocene and later in age and includes all of the aquifers discussed herein (refer to Table 2.4.12-202). A sole source aquifer is an aquifer that is the sole source of at least 50 percent of the drinking water consumed in the area overlying the aquifer. The aquifers in southeast Louisiana that comprise the Southern Hills Regional Aquifer System include the MRAA, UTA, and the Tertiary aquifers (Zones 1, 2, and 3 sands). At the RBS Unit 3 site location, the UTA is not in direct contact with the Tertiary aquifers and is separated from the Zone 1 and Zone 3 sands by 200 ft. of the Pascagoula clay (refer to Figure 2.4.12-213). These aquifers are described further in Subsection 2.4.12.2.5.

Withdrawals from the Southern Hills Aquifer System totaled approximately 290 million gpd in 2000 (refer to Figure 2.4.12-233). Approximately 49 percent of the water was used for public supply, and 39 percent was used for industry. The largest of the pumping centers is located in the East Baton Rouge Parish, which produced approximately 131 million gpd in 1995, compared to that of the West Feliciana Parish pumping center, which produced approximately 3 million gpd (refer to Figure 2.4.12-234). These groundwater withdrawals created a decline in the water level from 1990 to 2000 of approximately 0.5 ft. per yr. in the West Feliciana parish to 2 ft. per yr. in the East Baton Rouge Parish (refer to Figure 2.4.12-235).

Groundwater use from the Southern Hills Aquifer System, as it relates to the site vicinity and the five-parish region (West and East Feliciana Parishes, Pointe Coupee Parish, West and East Baton Rouge Parishes), is discussed in the following subsections.

2.4.12.2.2 Regional Groundwater Use

Total groundwater use in the five-parish region (West and East Feliciana Parishes, Pointe Coupee Parish, West and East Baton Rouge Parishes) in 2000 was 181 Mgd (Table 2.4.12-210; Reference 2.4.12-223). Groundwater withdrawals in West Feliciana Parish represented only 3.4 percent of the total withdrawals within the region. Most of the withdrawals were in the Baton Rouge area. The primary aquifers in the region are the Tertiary sands (Zones 1 through 3), accounting for more than 80 percent of the total withdrawals. In West Feliciana Parish, more than 99 percent of the groundwater withdrawals were from the Tertiary aquifers. Large withdrawals of groundwater from the MRAA occur in neighboring Pointe Coupee and West Baton Rouge Parishes. A significant amount of water is extracted from the UTA in Pointe Coupee Parish (Reference 2.4.12-223).

The total withdrawal of 9.63 Mgd of groundwater from the Feliciana Parishes in 2000 represents a 28 percent increase over the total withdrawal of 7.3 Mgd from the two parishes reported for 1959 through 1961 (Reference 2.4.12-206). More than 95 percent of the withdrawals during both periods were from wells screened in Tertiary aquifers (Zones 1 through 3; References 2.4.12-206 and 2.4.12-223).

Groundwater use in Pointe Coupee Parish has increased more than 500 percent from the estimated groundwater use in 1964 (Reference 2.4.12-203). In 1964, the estimated withdrawals in Pointe Coupee Parish from the MRAA and the Tertiary sands were 2.50 Mgd and 1.12 Mgd, respectively, for a total groundwater withdrawal from Pointe Coupee Parish of 3.62 Mgd (Reference 2.4.12-203).

The primary uses of groundwater within the entire five-parish region are public supply and industrial. However, industrial and agricultural use may exceed public supply use in some parishes. In Pointe Coupee Parish, industrial and agricultural uses of groundwater are more than three times greater than public supply uses of groundwater. In West Baton Rouge Parish, industrial use of groundwater exceeds public supply uses of groundwater by approximately 70 percent (refer to Table 2.4.12-211).

2.4.12.2.3 Vicinity Groundwater Use

A database of local water supply wells was obtained from the Louisiana Department of Transportation and Development, Louisiana Well Registry (Reference 2.4.12-224). The Mississippi River is considered to be a groundwater divide for the shallow aquifer systems, and therefore, wells to the west of the river can be eliminated from further review. Locations of water supply wells in use east of the Mississippi River and within a 25-mi. radius of the RBS site are presented in Figure 2.4.12-236. Information regarding ownership, well use, and construction characteristics was available for some of the wells shown in Figure 2.4.12-236 and is included in Table 2.4.12-212 (Reference 2.4.12-224). Figure 2.4.12-237 and Table 2.4.12-213 provide locations and information on water supply wells located east of the Mississippi River and within a 5-mi. radius of the RBS site (Reference 2.4.12-224). Figure 2.4.12-238 and Table 2.4.12-215 show the locations and information on the water supply wells within 2 mi. of the site.

The Safe Drinking Water Information System (SDWIS), maintained by the EPA, provides information on public water supply systems within the United States (Reference 2.4.12-225). The nearest water supply systems are identified in Table 2.4.12-214.

There are six public water supply systems that utilize groundwater listed in West Feliciana Parish. Major, local public water suppliers utilizing groundwater in West Feliciana Parish include the St. Francisville water system (0.75 Mgd), West Feliciana Water District 2 (0.73 Mgd), and West Feliciana Water District 13 (1.26 Mgd) (Reference 2.4.12-223). The RBS system listed in Table 2.4.12-214 is the RBS site that is discussed in this subsection.

The closest area of concentrated groundwater withdrawal is the West Feliciana District 13 water system, located approximately 5 mi. southeast of the site. Pumpage for this system is provided by six wells with withdrawals producing approximately 3600 gpd (refer to Table 2.4.12-212).

Aside from RBS Unit 1, the primary use of groundwater in West Feliciana Parish is for public supply purposes, with a small percentage used for household, irrigation, and industrial purposes. Within a 2-mi. radius of the plant site, essentially all groundwater is used for domestic and industrial purposes (refer to Table 2.4.12-215).

2.4.12.2.4 Facility Use

Surface water from the Mississippi River is used for cooling tower makeup and other raw water needs and is extracted from the river at a point approximately 2 mi. southeast of the plant at Alligator Bayou (refer to Figure 2.4.12-231).

There are four water supply wells at the existing RBS facility that are listed as industrial use. Two of the wells (Wells P-1A and P-1B) are 390 ft. apart and are screened within the Zone 3 sands at a total depth of approximately 1800 ft. bgs (Figure 2.4.12-239 and Reference 2.4.12-219). These two wells are used to supply water for general site purposes, including plant makeup water. Groundwater is pumped from these wells at a rate of 150 gpm each to maintain the level in the 100,000-gallon (gal.) well water storage tank in order to supply plant domestic water and to maintain level in the standby cooling tower water storage basins (Reference 2.4.12-219).

A third well (Well BP-1) is screened in Zone 1 and is 500 ft. deep. Groundwater from this well is used for sanitary supply, air-conditioning, and landscape maintenance. The fourth well (Well P-5) is screened within the UTA at depths of 84 to 124 ft. bgs. This well is capable of pumping 800 gpm to two 300,000-gal. water storage tanks. Water from this well is used for normal fire protection (Reference 2.4.12-219).

The average annual volume of groundwater pumped from the four wells was 7.85 million gal. (0.021 Mgd) from 2000 to 2006. Based on the most recent information (2005), annual withdrawals from Wells P1-A and P-1B were 2.33 million gal. and 4.29 million gal., respectively. Annual withdrawals from Wells BP-1 and P-5 were 0.18 million gal. and 0.19 million gal., respectively.

2.4.12.2.5 Regional Groundwater Demands

Although there were relatively few water supply wells installed in the vicinity of the RBS site from 1990 to 2000 (refer to Figure 2.4.12-240), the RBS site is located in an area where aquifer water levels are declining 1 ft. or more per year (refer to Figure 2.4.12-241). Within the five-parish region, withdrawals of large quantities of groundwater from the Coastal Plain aquifer systems during the last 90 years have lowered water levels, decreased the saturated thickness of several aquifers, caused the encroachment of saltwater, altered patterns of regional groundwater flow, induced recharge to the aquifers in upland areas, and caused some land subsidence (References 2.4.12-201, 2.4.12-202, and 2.4.12-209). Extensive groundwater development in the region has significantly reduced the amount of groundwater that was regionally discharged to surface water and has induced groundwater recharge from most of the major river valleys to the underlying aquifers (References 2.4.12-201 and 2.4.12-218). Computer simulations indicate that there is now a net recharge from the MRAA to deeper aquifers, whereas prior to development, there was a net discharge from deeper aquifers to the MRAA (Reference 2.4.12-201). Groundwater recharge areas are much more extensive now than they were prior to development (Figures 2.4.12-222 and 2.4.12-242). The effects of groundwater development on the various aquifers in the vicinity of the RBS site are discussed in the following subsections.

2.4.12.2.5.1 Upland Terrace Aquifer

Pumpage from the 400-ft. and 600-ft. aquifers in Baton Rouge by industrial users ranged from 22 to 36 Mgd from 1940 to 1960 and caused water level declines of as much as 190 ft. in the industrial district of Baton Rouge (Reference 2.4.12-202). These water level declines resulted in more than 1 ft. of subsidence in the industrial district of Baton Rouge between 1935 and 1965 (Reference 2.4.12-202). In 1986, water levels in the industrial district rebounded to only a 100-ft. decline as a result of water conservation measures, less industrial use of groundwater, and the decentralization of public water supply withdrawals (Reference 2.4.12-202).

A map of water level elevations within the UTA in 1960 and 1961 shows a hydraulic gradient directed generally toward the south from the outcrop area in the north (refer to Figure 2.4.12-215). A map of water level elevations measured within the UTA in 1980 shows the same general trends (Figure 2.4.12-243; Reference 2.4.12-226). The water surface elevation within the aquifer ranges from more than 280 ft. msl in the northern recharge areas to 100 ft. below msl at the cones of depression located at Baton Rouge. At the RBS site in 1961, the hydraulic gradient was 0.002 ft/ft and was directed toward the southwest (Figure 2.4.12-215; Reference 2.4.12-206). The water level elevation at the site was approximately 50 ft. msl in 1961 (Reference 2.4.12-206; Figure 2.4.12-215). In 1980, the water level elevation at the site was approximately 40 ft. msl (Reference 2.4.12-226). This apparent decline of water levels within the UTA at the site is deemed insignificant. Water levels measured in monitoring wells located at the RBS site exceed this range of water levels. There were no significant declines of water levels in Quaternary aquifers in the Feliciana Parishes from 1958 to 1962 (Reference 2.4.12-206). Modeling results of the UTA indicate that heavy pumping of the equivalent aquifers in Baton Rouge (i.e., the 400-ft. and 600-ft. sands) does not affect water levels at the RBS site (Reference 2.4.12-201). Even under heavy pumping conditions in the Baton Rouge and Port Hudson areas, the hydraulic gradient within the UTA at the RBS site remains to the southwest toward the Mississippi River (Reference 2.4.12-201). In addition, the UTA recovers quickly from the effects of pumpage because of the proximity of the outcrop area and the Mississippi River (Reference 2.4.12-201).

The USGS has been measuring quarterly water levels in Well WF-158, screened in the UTA aquifer at a location that is 4 mi. north of the RBS site (Figure 2.4.12-244; Reference 2.4.12-227). Water levels in 2005 were approximately 19 ft. lower than they were in 1958, but were 3 ft. higher than they were in 1991. From 2001 to 2005, water levels remained fairly stable and fluctuated less than 2 ft.

In 2000, less than 0.01 Mgd was pumped from the UTA in all of West Feliciana Parish (Reference 2.4.12-223).

2.4.12.2.5.2 Mississippi River Alluvial Aquifer

Water levels in the MRAA are heavily influenced by the stage of the Mississippi River (Reference 2.4.12-206). Computer simulations indicate that there is now a net recharge from the MRAA to deeper aquifers, whereas prior to development, there was a net discharge from deeper aquifers to the MRAA (Reference 2.4.12-202). In 2000, there was no recorded usage of the MRAA in West Feliciana Parish (Reference 2.4.12-223). Only one of the wells east of the Mississippi River, within 4 mi. of the site, reports using the MRAA as a water supply (Table 2.4.12-213, Reference 2.4.12-224). This well is located 4 mi. west-northwest of the RBS site. A recent USGS report did not include monitoring results of any wells screened in the MRAA within West Feliciana Parish (Reference 2.4.12-227).

2.4.12.2.5.3 Tertiary Aquifers

Zone 1 - 1200-Ft. Sand

From 1920 to 1953, pumpage from the 1200-ft. sand in the Baton Rouge area was less than 3 Mgd (Reference 2.4.12-202). Development of the aquifer increased substantially after 1953 (References 2.4.12-207 and 2.4.12-210). In 2001, the 1200-ft. sand was the fourth most heavily pumped aquifer in the five-parish Baton Rouge area (Reference 2.4.12-211). Of the 20.8 Mgd withdrawn from the aquifer in 2001 within the Baton Rouge area, 18.5 Mgd were withdrawn from East Baton Rouge Parish (Reference 2.4.12-211). From 1990 to 2001, withdrawals from the aquifer increased by approximately 26 percent (Reference 2.4.12-211).

Near pumping centers southeast of the Baton Rouge industrial district, approximately 20 mi. southeast of the RBS site, water levels in the 1200-ft. sand declined approximately 120 ft. from 1943 to 1961 (Reference 2.4.12-211). From 1961 to 2001, water levels have fluctuated in the Baton Rouge metropolitan area and were only 28 ft. lower than they were in 1961 (Reference 2.4.12-211). From 1990 to 2001, water levels declined approximately 20 ft. in the Baton Rouge metropolitan area.

In East Feliciana Parish, at Well EF-27, located 8 mi. east-northeast of the RBS site, water levels declined from 130 ft. to 110 ft. msl in Zone 1 sands from 1945 to 1962, in response to pumping at Baton Rouge (Reference 2.4.12-206). In 2001, the water level in the 1200-ft. sand at this location was 90 ft. msl (Reference 2.4.12-211), suggesting a total drawdown of 40 ft. from 1945 to 2001 at this location.

In West Feliciana Parish, at Well WF-57, located 3.5 mi. northwest of the RBS site, water levels within Zone 1 sands fluctuated between 50 and 58 ft. msl in response to the stage of the Mississippi River from 1958 to 1961 (Reference 2.4.12-206). There was no apparent decline of water levels at the well over the 4-yr. time period, and therefore, the average water level can be considered to be 54 ft. msl over that period. In 2001, the water level in the 1200-ft. sand in the vicinity of Well WF-57 was approximately 45 ft. msl (Reference 2.4.12-211), suggesting a cumulative drawdown of approximately 9 ft. from 1958 to 2001 at this location.

Prior to development, groundwater in the 1200-ft. sand flowed in a south-to-southwest direction toward the discharge area near the Baton Rouge fault, where groundwater would flow upward from the 1500-ft. and 1200-ft. sands to the 1000-ft. sand (Reference 2.4.12-211). As a result of pumping, this natural discharge has diminished, and saltwater encroachment from south of the fault has occurred (Reference 2.4.12-210).

In 2001, the highest water level in the 1200-ft. sand in the Baton Rouge area was approximately 154 ft. and was located in northeastern West Feliciana Parish (refer to Figure 2.4.12-217). The lowest water level was 90 ft. below msl in monitoring wells located in the Baton Rouge industrial district. Water levels were more than 50 ft. below msl in most of the Baton Rouge metropolitan area, where a large cone of depression was associated with the heavy pumping there. A cone of depression of approximately 5 ft. msl was located in eastern Pointe Coupee Parish, approximately 2 mi. southwest of the RBS site. In 2001, the water level at the RBS site was approximately 20 ft. msl. Groundwater flow was generally to the southwest from recharge areas to the Mississippi River and to the pumping centers. Based on Figure 2.4.12-217, the horizontal hydraulic gradient from the RBS site to the cone of depression located in eastern Pointe Coupee Parish was approximately 0.0017 ft/ft.

A recent USGS report did not include the monitoring results of any wells screened in the 1200-ft. sand within West Feliciana Parish (Reference 2.4.12-227).

Zone 1 - 1500-Ft. Sand

Development of the aquifer began after 1927 (Reference 2.4.12-210). By 1950, pumpage from the aquifer within the Baton Rouge area was 5 Mgd (Reference 2.4.12-202). In 2001, the 1500-ft. aquifer was the fifth most heavily pumped aquifer in the five-parish Baton Rouge area (Reference 2.4.12-210). In 2001, of the 17.8 Mgd withdrawn from the aquifer within the Baton Rouge area, 14.5 Mgd was withdrawn from East Baton Rouge Parish (Reference 2.4.12-210). From 1990 to 2001, withdrawals from the aquifer decreased by 9 percent (Reference 2.4.12-210).

Near pumping centers southeast of the Baton Rouge industrial district, approximately 20 mi. southeast of the RBS site, water levels in the 1500-ft. sand declined approximately 160 ft. from 1940 to 2001. From 1990 to 2001, water levels declined 10 to 20 ft. in the Baton Rouge metropolitan area (Reference 2.4.12-210).

In Pointe Coupee Parish, at Well PC-39, located 22 mi. west-northwest of the RBS site, water levels declined from 0 to 20 ft. below msl in the 1500-ft. sand from 1951 to 2001 (Reference 2.4.12-210). Well PC-39 is located in northern Pointe Coupee Parish in an area that is closer to the recharge area for the aquifer and where little groundwater withdrawal occurs (Reference 2.4.12-210).

Prior to development, groundwater flowed in a south-to-southwest direction toward the discharge area near the Baton Rouge fault, where groundwater would flow upward from the 1700-ft. and 1500-ft. sands to the 1200-ft. sand (Reference 2.4.12-210). As a result of pumping, this natural discharge has diminished and saltwater encroachment from south of the fault has occurred (Reference 2.4.12-210). In 1998, connector wells were installed between municipal wells and the saltwater front in Baton Rouge to recharge the 1500-ft. sand with groundwater from shallower aquifers in an effort to mitigate saltwater encroachment (Reference 2.4.12-210).

In 2001, the highest water level in the 1500-ft. sand in the Baton Rouge area was approximately 123 ft. and was located near the Mississippi state line near the boundary between the Feliciana Parishes (Figure 2.4.12-218). The lowest water level was 135 ft. below msl in a monitoring well located in Baton Rouge. Water levels were more than 70 ft. below msl in most of the Baton Rouge metropolitan area, where a large cone of depression is associated with the heavy pumping there. A cone of depression of approximately 60 ft. below msl was located in northwestern East Baton Rouge Parish, approximately 7 mi. southeast of the RBS site. In 2001, the water level at the RBS site was approximately at msl (0 ft. msl) (Figure 2.4.12-218). Groundwater flow is generally to the southwest from recharge areas to the Mississippi River and to pumping centers. Based on Figure 2.4.12-218, the horizontal hydraulic gradient from the RBS site to the cone of depression located in northwestern East Baton Rouge Parish is approximately 0.0011 ft/ft.

A recent USGS report did not include monitoring results of any wells screened in the 1200-ft. sand within West Feliciana Parish (Reference 2.4.12-227).

Zone 2

At the RBS site, the 1700-ft. sand is absent (Reference 2.4.12-207), and Zone 2 includes only the 2000-ft. sand. In the Baton Rouge area, pumpage from the

2000-ft. sand was less than 3 Mgd prior to 1938 (Reference 2.4.12-202). After 1938, pumpage of the aquifer increased sharply, and by the early 1960s, pumpage from the aquifer exceeded 25 Mgd within the region. Pumpage of the aquifer peaked in the early 1980s at approximately 40 Mgd and dropped down to 30 Mgd in the mid-1980s. Current estimates of the regional use of the aquifer are difficult to obtain because some researchers lump the aquifer with other aquifers (Table 2.4.12-210; Reference 2.4.12-223).

Declining water levels in the Feliciana Parishes are partially due to pumping in the Feliciana Parishes, but are primarily due to the heavy pumping in the Baton Rouge metropolitan area (Reference 2.4.12-206). In East Feliciana Parish at Well EF-207, located 7 mi. east-southeast of the RBS site, water levels in Zone 2 dropped from approximately 146 to 65 ft. msl from 1918 to 1962 (Reference 2.4.12-206).

A map of the 2002 equipotential surface of the 2000-ft. sand was published in 2004 (Reference 2.4.12-212) and is included as Figure 2.4.12-245.

In St. Francisville, from 1962 to 1975, water levels in Zone 2 declined from 80 to 40 ft. msl (Figure 2.4.12-246).

Zone 3

Water levels declined from 145 to 65 ft. msl in Zone 3 from 1918 to 1962 in the Feliciana Parishes (Reference 2.4.12-206). Zone 3 water levels at St. Francisville declined 38 ft. during the period from 1941 to 1961 (Reference 2.4.12-206). The annual rate of decline in the Feliciana Parishes was 5 ft. from 1958 to 1961 (Figure 2.4.12-247; Reference 2.4.12-206).

2.4.12.2.5.4 Projected Future Groundwater Use

The area within 25 mi. of the RBS is expected to contain approximately 837,657 people by the year 2030 (Reference 2.4.12-219), representing a population density of an average of 427 people per square mile.

As indicated in Table 2.4.12-212, a significant majority of wells in the 25 mile radius of the RBS are limited to domestic (household) use. Therefore, aside from plant use, future groundwater demands in the vicinity of the site may be estimated on the basis of projected population growth.

According to population projections provided in Subsection 2.1.3, the population within a 2-mi. radius of the plant for the year 2067 is predicted to be 993 people (excluding RBS plant personnel). Assuming an average per capita groundwater use of 60 gal. per person per day (Reference 2.4.12-220, Page 17), the estimated groundwater withdrawal within a 2-mi. radius of the plant by the year 2070 would be 59,580 gpd.

2.4.12.3 Subsurface Pathways

2.4.12.3.1 Observation Well Data

The hydrogeologic investigation of the RBS Unit 3 facility, performed in 2006 and 2007, included the installation of 21 groundwater monitoring wells and 3 piezometers to depths ranging from 57 to 116 ft. bgs (Figure 2.4.12-225; Tables 2.4.12-204 and 2.4.12-201; References 2.4.12-233 and 2.4.12-234). One of the wells, Well MW20 was installed in the MRAA, 2200 ft. from the Mississippi River. The remaining wells were installed in the upper portions of the UTA in an area extending from the proposed RBS Unit 3 site to a distance of 7700 ft. south of the proposed RBS Unit 3 site. The elevations of the bottoms of the wells range from 45 ft. msl to 14 ft. below msl, whereas the bottom of the UTA ranges from approximately 50 ft. to 150 ft. below msl. Groundwater levels within the wells were measured monthly, and slug tests were performed on eight of the wells to estimate hydraulic conductivity (Table 2.4.12-207).

Numerous subsurface evaluations have been conducted previously at the site for design and permitting purposes of the existing facilities and for the evaluation of groundwater resources on-site. Figure 2.4.12-227 shows the locations of previously installed monitoring wells and piezometers. Data from these prior investigations were used to supplement the recent investigations.

As recommended in the RBS Unit 1 Updated Safety Analysis Report (Reference 2.4.12-219), water levels have been periodically measured at the site throughout the operational phase of the plant. Since 1985, water levels have been measured intermittently in wells emplaced in the MRAA, UTA, Zone 1 Aquifer, and Zone 3 Aquifer.

2.4.12.3.1.1 Upland Terrace Aquifer

Recent and historical hydrographs of water levels within the UTA show the influence of the Mississippi River stage, precipitation, pumping tests, and construction dewatering performed at the site. The effect of the Mississippi River stage on water levels is more pronounced in wells screened closer to the Mississippi River than in wells screened farther from the Mississippi River.

Hydrographs

Hydrographs of water level data collected from the UTA wells that were installed in 2006 and 2007 are presented in Figure 2.4.12-248 through 2.4.12-251. Monthly water levels are plotted against time and extend from December 2006 through November 2007. Water levels range from approximately 36 to 61 ft. msl and decrease from the northeast to the southwest.

Water level fluctuations within the UTA wells over the 12-month span range from approximately 3 ft. near the contact of the UTA and MRAA to approximately 1.5 ft. at the RBS Unit 3 site. The general trend, which is similar to the trend of the stage of the Mississippi River, is an increase in water level elevation from December through May, followed by a decrease in water level elevation from May to August (refer to Figure 2.4.12-252). Mississippi River stages measured at Red River Landing, approximately 2 mi. north of the site area, are presented in Figure 2.4.12-253 (Reference 2.4.12-209). The Mississippi River stage does not cause significant water level fluctuation in the UTA at the RBS Unit 3 site area because of the distance of the plant site from the Mississippi River (Reference 2.4.12-228). Based on water level fluctuations measured at monitoring wells north of the site, up to 1 ft. of the fluctuation at the RBS Unit 3 site can be attributed to the seasonal change in precipitation recharge of the water table. Therefore, the effect of the Mississippi River water level change at the site groundwater level is minimal.

Hydrographs of water level data collected intermittently from 1985 to 2005 from three UTA wells (Wells P1, P7, and P10) are presented in Figure 2.4.12-254. Normal groundwater elevations at these wells range from 56 ft. to 61 ft. msl. Short-lived, anomalously high water levels (65 ft. to 70 ft. msl) occur at Wells P1 and P7 and short-lived anomalously low water levels (23 ft. to 54 ft. msl) occur at wells P1 and P10. The cause of these anomalous water levels is unknown.

Hydrographs of water level data collected from 1972 to 1979 from six UTA wells (Wells B69, B72, T2, P4, P5, and P10) are presented in Figure 2.4.12-255. Normal groundwater elevations at these wells range from 33 to 61 ft. msl. The depression of water levels in late 1974 was caused by a 60-day pumping test performed in the UTA at the site in November and December of 1974. After the pumping test, water levels in most of the piezometers and observation wells did not fully recover to background levels until August and September 1975 (refer to Figure 2.4.12-255). The effects of the Unit 1 construction dewatering system, which was used between May 11, 1976 to May 23, 1977, and from May 31, 1979 to some time in 1981, are clearly depicted in Figure 2.4.12-255. Water levels at Well B69 may vary seasonally by as much as 10 ft. and may vary according to the stage of the Mississippi River. The highest water levels at Well B69 occurred in May and June, the same time of the year when the stage of the Mississippi River is highest (refer to Figure 2.4.12-252).

Piezometric Surface Map(s)

A map of the piezometric surface of the UTA was prepared, based on hydrograph information for the month of July 2007, as shown in Figure 2.4.12-256. At the RBS, the July water levels are the highest water levels measured in the UTA during the one year. The groundwater table at the site slopes to the south-southwest toward the Mississippi River. The horizontal hydraulic gradient in Figure 2.4.12-256 within 4000 ft. downgradient of the proposed RBS Unit 3 facility was 0.0029 ft/ft. Farther downgradient, the gradient was lower, approximately 0.0009 ft/ft.

1974 Pumping Test

A 60-day pumping test was performed in the UTA at the site in November and December 1974. The pumping well, T1, was installed in the UTA and is labeled on Figure 2.4.12-257 and Table 2.4.12-204. Twelve observation wells were drilled into the UTA to monitor the groundwater level fluctuations before, during, and after the UTA pumping test performed at the site. These observation wells are labeled Wells T2 through T12, and T15 in Figure 2.4.12-227 and Table 2.4.12-204 (Reference 2.4.12-228). The pump test stressed the UTA over a wide area causing drawdown to a distance of 2875 ft. (Reference 2.4.12-219). Consequently, the pump test analysis results represent average aquifer parameters of the aquifer over the RBS area.

Construction Dewatering in 1976 and 1977

The information presented in this subsection is based on information gathered during and after the construction dewatering at the RBS Unit 1 site, as presented in the RBS Unit 1 USAR (Reference 2.4.12-219). Construction dewatering in 1976 and 1977 was accomplished with forty-four 12 in. diameter wells that were emplaced to an elevation of 35 ft. to -45 ft. below msl in the UTA. The wells were drilled in a rectangular pattern around the periphery of the excavation, and each was equipped with a 700 gpm vertical turbine pump and a 30-ft. section of well screen. Inside the rectangular area, a series of 12-in. diameter sand drains were used to transmit perched water down to the UTA.

The average discharge rate of the dewatering system during the first phase of dewatering was approximately 7700 gpm, and the maximum discharge rate was approximately 21,700 gpm. The measured drawdown due to the dewatering system at a distance of 2000 ft. from the excavation, was 43 ft. in a northerly direction and 38 ft. in a southerly direction. At a distance of 1 mi. from the excavation, the actual measured drawdown was 18 ft. in a northerly direction and 8 ft. in a southerly direction.

Figures 2.4.12-257 through 2.4.12-260 show the changes in the configuration of the piezometric surface of the UTA caused by the operation of the dewatering system. These figures were constructed from the hydraulic head data and water level data measured in the piezometers and observation wells in the UTA. The piezometric surface maps were constructed for the same time of year, late March to early April, in order to eliminate seasonal variation in water levels. Figure 2.4.12-257 shows the background configuration of the piezometric surface in March 1975, prior to dewatering. The hydraulic gradient, as shown in this figure, slopes toward the Mississippi River at a rate of approximately 14 ft./mi.

The configuration of the piezometric surface in March 1977 (the approximate time of maximum drawdown) is shown in Figure 2.4.12-258. A localized reversal of the hydraulic gradient is evident due to the formation of a cone of depression around the excavation created by the dewatering system. Water level elevations in the immediate vicinity of the excavation were obtained from a series of observation wells.

Figure 2.4.12-259 shows the configuration of the piezometric surface in early April 1978, after the dewatering system had been shut off for approximately 10 months. Figure 2.4.12-259 shows the partial recovery of the piezometric surface to its background level. No cone of depression is present, and the hydraulic gradient has recovered to its normal direction, toward the Mississippi River, and its normal rate of 14 ft/mi. This configuration of the piezometric surface is very similar to that of March 1975 (refer to Figure 2.4.12-257), except that the elevation of the surface is slightly lower, indicating that complete recovery to background level had not yet occurred. Twenty-two months after the dewatering system had been shut off, the piezometric surface had almost recovered to its original background level prior to the dewatering, as shown in Figure 2.4.12-260. The hydraulic gradient, as shown in Figure 2.4.12-260, is equal to 14 ft./mi., which is equivalent to the background gradient determined from Figure 2.4.12-257.

Figure 2.4.12-261 shows cross sections of the piezometric surface of the UTA taken from Figures 2.4.12-257 and 2.4.12-260 along line Z-Z'. These cross sections show the normal hydraulic gradient, the configuration of the cone of depression, the recovery of the piezometric surface, and the reestablishment of the normal hydraulic gradient.

Construction Dewatering in 1979 and 1981

From May 1979 to some time in 1981 when construction was completed below local water level, the dewatering system was operated at the plant site. At this time, the number of operable wells was reduced from 44 to 30 primarily because the piezometric surface in the UTA did not need to be drawn down to as low an elevation. The cone of depression developed during this second phase of dewatering was shallower and smaller in areal extent than the cone of depression developed during the first phase of dewatering.

2.4.12.3.1.2 Mississippi River Alluvial Aquifer

Hydrographs of Wells MW20, P-1D, and P-1S are shown in Figure 2.4.12-263. Monthly water levels are plotted against time and extend from December 2006 through November 2007. Water levels range from approximately 10 to 34 ft. msl. The range in water levels of 24 ft. is much greater than the range in water levels of 3 ft. or less observed in the UTA wells over the same time period. The data in the hydrographs illustrate that the MRAA groundwater level fluctuates with the Mississippi River stage. The maximum fluctuation during the 12-month recording was noted at Wells P-1D and P-1S (24.3 ft. and 22.4 ft., respectively), which are adjacent to the river bank. The fluctuation in the MRAA dissipates with distance from the river. At Well MW-20, which is approximately 2200 ft. from the river, the fluctuation during the 12-month period was 10.31 ft.

Hydrographs of water level data collected intermittently from 1985 to 2005 from Wells P-1D and P-1S are presented in Figure 2.4.12-262. Water levels at the two wells range from 8 to 41 ft. msl and vary seasonally. Similar seasonal variations observed in the stage of the Mississippi River measured at Red River Landing, approximately 2 mi. north of the site area (Figure 2.4.12-253; Reference 2.4.12-228) indicate that the MRAA is in direct hydraulic connection with the Mississippi River.

Hydrographs of water level data collected from 1978 to 1979 from two MRAA wells (Wells B449 and B450) are presented in Figure 2.4.12-264. These wells are 94 ft. and 64 ft. deep (bottom elevations of 51.5 ft. and 20 ft. below msl), respectively. Water levels in these wells also vary greatly seasonally in response to changes in the stage of the Mississippi River.

A meaningful map of hydraulic head within the MRAA could not be constructed because of insufficient data.

2.4.12.3.1.3 Tertiary Aquifers

Hydrographs of Well T14 that was installed in Zone 1 and Wells P-1A and P-1B that were installed in the 2800-ft. sand of Zone 3 are shown in Figure 2.4.12-265. Monthly water levels are plotted against time and extend from December 2006 through November 2007. The water level in Zone 1 is approximately 28 ft. msl, whereas the water level in Zone 3 is approximately 5 ft. below msl. Water levels are generally stable in Zone 1, but decrease approximately 1 to 2 ft. in Zone 3 over the monitoring period. Water levels in wells P-1A and P-1B are nearly equal due to similar well construction and proximity (390 ft. apart).

Hydrographs of water level data collected intermittently from 1985 to 2005 from the three Tertiary wells (T-14, P-1A, and P-1B) are presented in Figures 2.4.12-266 and 2.4.12-267. Water levels at Well T-14, screened in Zone 1, appear to fluctuate seasonally, ranging from 8 to 41 ft. msl, possibly in response to the changing stages of the Mississippi River. Zone 1 is likely in connection with the MRAA either on-site or in areas north of the RBS site (Reference 2.4.12-206). Water levels in Zone 1 apparently have declined approximately 5 ft. over the 20-year period. Water levels at Wells P-1A and P-1B have fallen from 25 ft. msl to 5 ft. below msl, declining approximately 30 ft. over the 20-year period, most likely in response to regional pumping of the aquifer. Variations in water levels may be due to either fluctuation in recharge north of the RBS site (where the aquifer may be in connection with the MRAA) or to intermittent pumping on- and off-site.

Hydrographs of water level data collected from 1973 to 1979 from two Zone 1 wells (Wells P9 and T13) and one Zone 3 well (Well T14) are presented in Figure 2.4.12-264. Water levels in the Zone 1 wells range from 32 to 69 ft. msl and appear to fluctuate seasonally in response to the stage of the Mississippi River. Aside from the seasonal fluctuations, water levels have remained fairly constant, decreasing approximately 2 ft. in Well T13 over a 5-year period and increasing approximately 6 ft. in Well P-9 over a 7-year period. Water levels in Zone 3 range from 18 to 34 ft. msl from 1975 to 1979, with a decline in water levels beginning in 1978. From 1975 to 1978, water levels at Well T14 in Zone 3 and water levels at Well T13 in Zone 1 follow a similar pattern, fluctuating seasonally with the stage of the Mississippi River. Beginning in 1978, water levels at Well T14 screened in Zone 3 begin to decline, whereas the water levels at Well T13 screened in Zone 1 do not. A comparison of water levels at Well T14 from 1978 to water levels at Wells P-1A and P-1B in 2007 show a 38-ft. decline of water level over the 29-year period.

Vertical Hydraulic Gradients

All of the water level data presented above support a consistent downward vertical gradient between Zone 1 and Zone 3 that varies in magnitude with location and time. The gradient has increased over time as water levels in Zone 3 have declined, possibly in response to the regional pumping of Zone 3. The lowest vertical gradient between Zones 1 and 3 was observed in December 1977, when water levels at Wells T13 and T14 were essentially equal. The current downward vertical gradient from Zone 1 to Zone 3 at the proposed RBS Unit 3 facility is approximately 0.028 ft/ft. In the summer of 1979, the downward hydraulic gradient between Zones 1 and 3 anomalously increased to 0.037 ft/ft when water levels spiked 12 ft. higher than normal at Well P9. Based in part on the consistent gradient, reversals of flow are expected.

Map of Hydraulic Head

A meaningful map of hydraulic head within the Tertiary aquifers could not be constructed because of insufficient data.

2.4.12.3.2 Hydrogeologic Properties

As part of the investigation of RBS Unit 3, site hydrogeologic properties were estimated by slug tests and grain-size analyses of sediment samples. Previous hydrogeologic evaluations of the site are also summarized in this subsection.

2.4.12.3.2.1 Upland Terrace Aquifer

Hydraulic conductivities were determined by slug tests and empirically based on the Hazen equation, which correlates hydraulic conductivity with effective particle size (Reference 2.4.12-229). The effective particle size represents the particle size at which 10 percent of the soil is comprised of smaller particles. Field-measured hydraulic properties of the aquifers encountered at the site are presented in Table 2.4.12-207. The locations of tested monitoring wells are presented in Figure 2.4.12-225.

Results of slug tests, hydraulic conductivity values determined by the Hazen equation, and hydraulic conductivity determined by the pump test at Well T1 are presented in Table 2.4.12-207 and Figure 2.4.12-268. The slug test results represent the silty sand zones of the UTA with a high percentage of fine grains.

The hydraulic conductivity values ranged from 0.008 to 15 ft/day 2.8x10^{-6} to 5.3x10^{-3} cm/sec). Calculated hydraulic conductivity values based on the Hazen equation (Reference 2.4.12-229) ranged between 0.6 to 91.8 ft/day (2.3x10^{-4} to 6.4x10^{-1} cm/sec).

As shown in Figure 2.4.12-268, field-measured hydraulic conductivity values tend to increase with depth. Lower hydraulic conductivities were measured at the upper part of the Citronelle sands because of their higher fines content. Values obtained for hydraulic conductivity based on slug tests may not be representative of the UTA as a whole. The tests were performed in wells that were constructed in the upper zone of the aquifer primarily for the purpose of obtaining groundwater level measurements. Therefore, the slug tests were performed in the uppermost portion of the UTA and are only representative of a small portion of a non-uniform aquifer. This uppermost layer of the aquifer consists of fine sediments and produces lower hydraulic conductivity values than deeper portions of the formations.

In November and December 1974, a 60-day pumping test was performed at the site to determine the hydraulic characteristics of the UTA in the area of the excavation for the power plant. For the purpose of this test, 13 observation wells, labeled T2 through T12, T14, and T15 (refer to Figure 2.4.12-227), and one 150-ft. pumping well, labeled T1 (12-in. diameter), were drilled into the UTA. A total of 16 observation wells were used to collect water level measurements. During the test, the pumping well discharged at an average rate of 1950 gpm, and time-drawdown data were obtained from all of the observation wells. A water level decline during November and December 1974 is recorded in the hydrographs of some of the nearby piezometers and observation wells, particularly in Piezometers P10 and B72 and Observation Well T2 (refer to Figure 2.4.12-255). Water levels began to rise in late December 1974 and early 1975 in response to the cessation of pumping. Water levels in most piezometers and observation wells did not fully recover to background levels until August and September 1975.

Results of the analysis show that the average coefficient of transmissivity, as determined from five sets of time-drawdown data, is 184,400 gpd/ft. The mean effective storage coefficient, as determined from the same five sets of time-drawdown data, is 0.08, with a standard deviation of 0.044. A check on the mean coefficient of transmissivity was done using the distance-drawdown method outlined in Cooper and Jacob. The calculation yielded a coefficient of transmissivity of 194,000 gpd/ft, which compares favorably with the mean value calculated from the time-drawdown data. Porosity data were developed for the Citronelle Formation, a major stratum of the UTA. Porosity was calculated based on specific gravity and dry unit weight of the Citronelle samples (Reference 2.4.12-219). The calculated porosity is 0.36. Assuming an approximate average thickness of 98 ft. for the UTA at the RBS, the hydraulic conductivity of the aquifer from the pump test result is 251 ft/day (0.1 cm/sec). The pump test result is a more reliable value for average hydraulic conductivity of the UTA at the RBS. This is because the pump test interrogates a vastly larger portion of the aquifer than any slug test can evaluate.

2.4.12.3.2.2 Mississippi River Alluvial Aquifer

In September 1977, a 72-hour, constant rate pumping test was performed at the site in the MRAA for the purpose of evaluating the possible use of this aquifer for cooling tower makeup water. Prior to the pumping test, six test holes were drilled 250 ft. deep and 500 ft. apart along the east floodplain of the Mississippi River within the site boundary. The test holes were logged for lithology, resistivity, and spontaneous potential. These data showed that the floodplain sediments could be divided into three zones. The upper zone is approximately 85 ft. thick and is composed predominantly of clay. It acts as a confining layer above the middle zone, which is approximately 65 ft. thick and is composed of fine sand, coarse sand, and gravel. Underlying this aquifer zone is a lower confining layer, which is composed predominantly of clay (Reference 2.4.12-219).

The pumping test was performed in a 190-ft. deep, 16-in. diameter test well constructed at the site. The test well was equipped with 60 ft. of wire-wrapped screen, which was surrounded by a gravel pack. Eight observation wells were installed to measure drawdown during the test (Reference 2.4.12-219).

Analysis of the time-drawdown data showed that the Mississippi River acts as a source of recharge. Water level measurements in this observation well and Mississippi River stage measurements prior to the pumping test showed that the MRAA responded to changes in river stage. The coefficient of transmissivity was calculated to be 139,000 gpd/ft, and the coefficient of storage was calculated to be 0.001 (Reference 2.4.12-219).

2.4.12.3.2.3 Tertiary Aquifers

Zone 3

The hydraulic characteristics of the Zone 3 Aquifer were determined by performing a pumping test in a 1890-ft. deep test Well T13 (refer to Figure 2.4.12-227) drilled at the site. After development, the test well was pumped continuously at a rate of 40 gpm for 3 days, after which the pumping rate was increased to 60 gpm (3.8 l/s) for 4 days. During the test, time-drawdown data were continuously recorded in the pumped well. The water level drawdown at 40 gpm stabilized at 8.1 ft. and at 60 gpm at 14.3 ft. The coefficient of transmissivity of the screened area of the Zone 3 Aquifer was determined to be 35,000 gpd/ft, based on the specific capacity data and an assumed (average value for confined aquifers) coefficient of storage of 0.0001 ft. (Reference 2.4.12-219).

The values for the coefficients of transmissivity and storage were checked by using the Theis equation and solving for the coefficient of storage using the corrected drawdown data, actual pumping rates, a coefficient of transmissivity of 35,000 gpd/ft, and a well radius of 0.25 ft. This resulted in a coefficient of storage of 0.000093 at a discharge rate of 40 gpm and 0.000088 at a discharge rate of 60 gpm. These values compare favorably with the assumed value of 0.0001. Sieve analyses of sediment samples from the exposed interval had a d10 value of

0.125 mm, which yields an effective porosity of 12 percent (Reference 2.4.12-219).

2.4.12.3.3 Groundwater Flow and Transport

This subsection presents an evaluation of subsurface pathways for off-site exposure resulting from a liquid effluent release at RBS Unit 3. This subsection focuses on advective groundwater flow. Discussion of sorption and radioactive decay on off-site exposure is presented in Subsection 2.4.13.

2.4.12.3.3.1 Potential Contaminant Pathways

As discussed in Subsection 2.4.12.1, the majority of the site is situated on upland areas east of the Mississippi River. The remaining one-third of the site is on the Mississippi River floodplain. Earth materials at the site include surface and near-surface clays over approximately two-thirds of the land area, with sands and gravels over the remaining third. The materials are mostly natural, with artificial fill in some areas. Beneath the surficial materials is an extensive sequence of generally coarser materials (e.g., sand and gravel) interbedded with thick clays. The coarse materials make up the UTA and MRAA aquifer systems described in greater detail in Subsection 2.4.12.1. A thick clay sequence, the upper Pascagoula Formation separates the upper aquifer system (UTA and MRAA) from the lower Tertiary aquifers. Consequently, the upper aquifers and the Mississippi River are the most likely potential contaminant pathways and are discussed in this subsection.

Many RBS plant processes would occur at the ground surface. Moreover, some building foundations would be deep and in direct contact with the UTA. Therefore, direct leaks into shallow saturated zones are possible. The groundwater gradient throughout the area is to the south, toward the Mississippi River (The groundwater gradient is southwest with respect to the local plant grid coordinate system.). When the river is at or near flood stage, the groundwater gradient may hypothetically be reversed from the river to the MRAA in areas close to the river. The gradient in upland portions of the site ranges between 0.0035 and 0.005 to the south and, in lower portions, approximately 0.0012 to the south, as estimated from data collected July 2007 (refer to Figure 2.4.12-256).

The approximate average groundwater water level beneath the site is 58 ft. msl, which is approximately 58.6 ft. NGVD. The estimated probable maximum flood (PMF) level of the Mississippi River, west of that location, is approximately 57.5 ft. NGVD, which is approximately 56.9 ft. msl. The estimated 500-yr. flood level at that location is approximately 59 ft. NGVD, which is approximately 58.4 ft. msl (refer to Subsection 2.4.3.5.1). Under the 500-yr. flood level condition, it is theoretically possible that the flow direction under the site could reverse. However, even if that were to happen, there would be no practical effect for several reasons. Among the reasons, this high water level at the river would only produce an infinitesimal reversal in gradient (approximately 0.0001) at the site. In addition, the small reversal would not be maintained for long because the flood would shortly recede. Therefore, for all practical purposes, the groundwater gradient at the RBS site is not affected by the river stage.

The prevailing groundwater flow direction in the UTA during 2007 was consistently to the south. This is inferred because water level fluctuations at all relevant wells (the wells used to develop the contour plot in Figure 2.4.12-256) were minimal throughout the year (refer to Table 2.4.12-205). The nearest water wells lie within 2.5 mi. of RBS Unit 3 structures and are treated as the most likely groundwater exposure points. The distance from the Radwaste Building at RBS Unit 3 to Well 2 (Table 2.4.12-215), the closest exposure point, is approximately 5292 ft. (refer to Figure 2.4.12-238). The scenario of groundwater transport to the nearest well is calculated below.

Surface water bodies in the general direction of the hydraulic gradient include Grants Bayou (5522 ft. from the site), and the Mississippi River (12,403 ft. from the site). Parts of Grants Bayou lie to the east and south of the site. The point along Grants Bayou that lies hydrologically downgradient from the water table under the RBS Unit 3 site is approximately 5522 ft. away. The advective transport calculation detailed in the following subsection addresses transport to Well 2, Grants Bayou, and the Mississippi River.

2.4.12.3.3.2 Advective Transport

Advective transport assumes that an accidental liquid effluent release travels at the same velocity as groundwater flow. The groundwater flow velocity or seepage velocity is calculated from the following standard equation:

$$V = K*i/n_e$$

Where V = Average linear velocity (ft/day).

K = Hydraulic Conductivity (ft/day).

i = Hydraulic gradient (ft/ft).

n_e = Effective porosity (dimensionless).

The travel time from the effluent source to the receptor is calculated by:

$$T = D/V$$

Where T = Travel time (days).

D = Distance from source to receptor (ft).

V = Average linear groundwater velocity (ft/day).

Travel time calculations discussed in this subsection assume the most conservative input parameters.

The highest hydraulic conductivity measurement was adapted from Table 2.4.12-207. The hydraulic conductivity value of 250 ft/day is characteristic of coarse sand or fine gravel. Calculated porosity, based on field and laboratory measurements of the UTA (Citronelle cohesionless) properties, was assigned a value of 0.36. This value was used in the analysis, along with the gradient ranges already described.

Based on the exposure points described in the previous subsection, this subsection addresses three possible groundwater release transport cases:

1. Transport from the RBS Unit 3 Radwaste Building, through the UTA to the nearest well.

2. Transport from the RBS Unit 3 Radwaste Building, through the UTA to the nearest surface water body (approximately downgradient).

3. Transport from the RBS Unit 3 Radwaste Building, through the UTA to the Mississippi River (downgradient).

All cases were evaluated based on a groundwater seepage velocity of 3.47 ft/day. That value was determined from a porosity of 0.36, a hydraulic conductivity of 250 ft/day, and the maximum groundwater gradient calculated for the site vicinity of 0.005. These scenarios assume instantaneous delivery to the saturated zone (i.e., no time to travel through the unsaturated zone from the surface). Refer to the following:

- For Case 1, given the distance to Well 2 of 5292 ft., the travel time was calculated to be 1525 days (approximately 4.2 years).

- For Case 2, given the distance to Grants Bayou of 5522 ft., the travel time was calculated to be 1591 days (approximately 4.4 years).

- For Case 3, given the distance to the Mississippi River of 12,403 ft., the travel time was calculated to be 3574 days (approximately 9.8 years).

2.4.12.4 Monitoring or Safeguard Requirements

RBS Unit 1 currently has an ongoing Radiological Environmental Monitoring Program and submits an Annual Radiological Event Environmental Operating Report to the NRC. Preconstruction groundwater monitoring would be conducted prior to initial construction in order to reaffirm baseline groundwater level data, as discussed in this section.

The construction monitoring program will include periodic collection of groundwater level data measurements and assessment of potential impacts during construction and associated dewatering activities. Current well locations will be evaluated to determine which wells are to be closed due to construction and if any new wells will be required to establish an adequate monitoring network for the evaluation of impacts on site groundwater levels during plant construction. There are currently 21 groundwater monitoring wells, three piezometers, and eight older wells that have been measured to support RBS Unit 3. Groundwater monitoring will continue for approximately 2 years following construction.

2.4.12.5 Site Characteristics for Subsurface Hydrostatic Loading and Dewatering

2.4.12.5.1 Groundwater and Site Construction Grade Elevations

Groundwater level data have been obtained at the site since 1972. The highest groundwater level within the UTA that was measured in the vicinity of the proposed RBS Unit 3 plant was 70 ft. msl (Subsection 2.4.12.3.1; Figure 2.4.12-254). This level was considered anomalously high; however, levels of 60 to 70 ft. msl have been recorded within this aquifer (within the site boundaries). The highest groundwater level within the UTA, measured during the 2007 investigation for RBS Unit 3 at the power block, was 57.57 ft. msl. This maximum groundwater level was based on measurements collected from Piezometers PZ-01 through PZ-03, which are installed in the RBS Unit 3 area. Based on the water level measurement, a conservative groundwater level elevation of 60 ft. msl is assumed for the hydrostatic loading assessment.

The plant grade is set at 97.5 ft. msl, which is approximately 98 ft. NGVD (refer to Figure 2.5.5-202). Therefore, the UTA water table at the site lies at least 27 ft. below the plant grade. Table 2.0-1 of the DCD establishes that the maximum water table elevation must be at least 2 ft. below plant grade. The maximum water table elevations recorded indicate that this requirement is satisfied.

The minimal land surface elevation resulting from planned excavation activities at the site would be 20 ft. msl (refer to Figure 2.5.4-236). Therefore, the goal of construction dewatering is to lower the water table below that elevation in the excavation area.

2.4.12.5.2 Groundwater Modeling of Excavation Dewatering.

The proprietary software package Groundwater Modeling System (GMS) Version 6.0 (Reference 2.4.12-236) was used to develop the dewatering simulation. The MODFLOW groundwater simulation code (Reference 2.4.12-237) is embedded within GMS to perform the actual simulation.

The model domain covers a rectangular area that is approximately 80,000 ft. by 13,000 ft. in area. Figure 2.4.12-269 shows the model domain (purple line). The model has been rotated -40 degrees azimuth, to more easily align with the Mississippi River and related water features, which facilitates a constant head boundary condition there. The plant boundary and the local site area are also indicated in the figure.

This model was run to simulate dewatering activities through a set of 18 wells surrounding the site, as shown in Figure 2.4.12-270. The active wells are represented by the yellow dots in the figure. Each well pumps at an average rate of 450 gpm. The figure indicates the contours (in ft. msl), of the new potentiometric surface resulting from this pumping regime. That surface falls under the target level of 20 ft. throughout the excavation domain.

The long-term extent of the cone of depression resulting from dewatering activities is also indicated in Figure 2.4.12-269. The figure includes the 1-ft. drawdown contour, which extends roughly 2 mi. from the construction locality in most directions except the Mississippi River. There is no dewatering drawdown at the Mississippi River boundary because the river boundary provides an unlimited source of water to the aquifer.

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Table 2.4.12-201
Correlation of Quaternary and Tertiary Deposits in the RBS Site Area to Other Areas

		Other Areas			Local Area	RBS Area
System	Series	Camp Van Dorn, Miss (Brown & Guyton, 1943)		Baton Rouge Area (Morgan, 1961)	East and West Feliciana Parishes (Morgan, 1963)	2006 and 2007 Investigation Data
Quaternary	Holocene and Pleistocene	Citronelle Formation		Alluvial Deposits	Undifferentiated Quaternary Alluvium	Mississippi River Alluvial Aquifer
				Shallow Pleistocene 400-ft. sand 600-ft. sand	Undifferentiated Quaternary Upland Deposits	Upland Terrace Aquifer
Tertiary	Pliocene	Pascagoula Formation	Fort Adams Member Homochitto Member	800-ft. sand		
	Miocene			1000-ft. sand 1200-ft. sand	Zone 1	Zone 1
				1700-ft. sand 2000-ft. sand	Zone 2	Zone 2
		Hattiesburg Formation Catahoula Sandstone		2400-ft. sand 2800-ft. sand	Zone 3	Zone 3

Source: Modified from Reference 2.4.12-219.

Table 2.4.12-202
Correlation of Hydrogeologic Units in Southeastern Louisiana

System	Series	Stratigraphic Unit		Hydrogeologic Units: Aquifer System or Confining Unit	Aquifer or Confining Unit: Baton Rouge Area North	Baton Rouge Area South	East Florida Parishes North	East Florida Parishes South	New Orleans Area
Quaternary	Holocene	Mississippi River and other alluvial deposits		Near-surface aquifers or confining unit	Mississippi River Alluvial Aquifer		No regionally extensive hydrogeologic units		New Orleans Aquifer System: Shallow Aquifers
									New Orleans Aquifer System: Mississippi River Alluvial Aquifer
Quaternary	Pleistocene	Unnamed Pleistocene Deposits		Southern Hills Regional Aquifer System: Chicot equivalent aquifer system or surficial confining unit	No regionally extensive hydrogeologic units		No regionally extensive hydrogeologic units		New Orleans Aquifer System: Gramercy Aquifer
									New Orleans Aquifer System: Norco Aquifer
					Shallow sands				New Orleans Aquifer System: Gonzalez-New Orleans Aquifer
					Upland Terrace Aquifer	400-ft. sand	Upland Terrace Aquifer	Upper Ponchatoula Aquifer	New Orleans Aquifer System: 1200-ft. sand
						600-ft. sand			
Tertiary	Pliocene / Miocene	Fleming Formation	Blounts Creek Member	Southern Hills Regional Aquifer System: Evangeline equivalent aquifer system or surficial confining unit	800-ft. sand		Lower Ponchatoula Aquifer		Generally, no fresh groundwater occurs in deeper units
					1000-ft. sand				
					1200-ft. sand		Big Branch Aquifer		
					1500-ft. sand		Kentwood Aquifer	Abita Aquifer	
					1700-ft. sand			Covington Aquifer	
							Slidell Aquifer		
	Miocene	Fleming Formation	Castor Creek Member	Unnamed confining unit					
			Williamson Creek Member	Southern Hills Regional Aquifer System: Jasper equivalent aquifer system	2000-ft. sand		Tchefuncte Aquifer		
			Dough Hills Member		2400-ft. sand		Hammond Aquifer		
			Carnahan Bayou Member		2800-ft. sand		Amite Aquifer		
							Ramsay Aquifer		
			Lena Member	Unnamed confining unit					
	Oligocene	Catahoula Formation		Southern Hills Regional Aquifer System: Catahoula equivalent aquifer system	Catahoula Aquifer		Franklinton Aquifer		

Source: Modified from Reference 2.4.12-207.

Table 2.4.12-203
Correlation and Depths of Freshwater-Bearing Tertiary Sands at the RBS Site

Zone (Morgan, 1963)	Baton Rouge Area (Morgan, 1961)	Top of Sand (Depth below ground surface of 110 ft. msl at RBS site)	Bottom of Sand (Depth below ground surface of 110 ft. msl at RBS site)	Thickness (ft.)
1	1000-ft. sand & 1200-ft. sand	380	500	120
1	1500-ft. sand	560	600	40
1	1500-ft. sand	680	700	20
1	1500-ft. sand	780	870	90
2	2000-ft. sand	1170	1240	70
2	2000-ft. sand	1270	1290	20
3	2400-ft. sand	1560	1620	60
3	2800-ft. sand	1730	1880	150

Note: Data developed from Borehole P-1B at the RBS site.

Table 2.4.12-204 (Sheet 1 of 3)
Monitoring Wells, Pumping Wells, and Piezometers at the RBS Site

Piezometer/ Well Number	Well Depth (ft.)	Elevation Top of Casing (ft. msl)	Ground Surface Elevation (ft. msl)	Tip Elevation (ft. msl)	Aquifer	Year Installed	Casing Diameter (in.)
MW-1	104.0	129.3	126.3	22.3	UT	2007	2
MW-2	85.4	99.6	96.2	10.8	UT	2007	2
MW-3	116.0	139.0	135.9	19.9	UT	2007	2
MW-4	88.7	96.9	93.6	4.9	UT	2007	2
MW-5	99.0	133.8	130.7	31.7	UT	2007	2
MW-6	88.0	96.3	93	5	UT	2007	2
MW-7	97.0	92.0	88.8	-8.2	UT	2007	2
MW-8	116.0	142.4	138.8	22.8	UT	2007	2
MW-9	57.2	105.1	102.1	44.9	UT	2007	2
MW-10	110.0	110.7	107.4	-2.6	UT	2007	2
MW-11	114.5	139.3	135.7	21.2	UT	2007	2
MW-12	107.0	128.4	124.9	17.9	UT	2007	2
MW-13	116.5	106.3	103	-13.5	UT	2007	2
MW-14	109.5	139.1	136.1	26.6	UT	2007	2
MW-15	105.0	138.0	134.7	29.7	UT	2007	2
MW-16	91.0	3.6	99.4	8.4	UT	2007	2
MW-17	107.0	127.5	124	17	UT	2007	2
MW-18	92.0	116.4	113.2	21.2	UT	2007	2
MW-19	90.0	115.3	112.2	22.2	UT	2007	2
MW-20	71.2	49.5	46.5	-24.7	MRAA	2007	2
MW-21	101.0	108.1	104.9	3.9	UT	2007	2
PZ-01	65	99.6	94.4	29.4	UT	2007	2
PZ-02	77.8	99.3	94.7	16.9	UT	2007	2
PZ-03	66.8	70.2	64.4	-2.4	UT	2007	2
B1	200	114.2	111.3	-88.7	UT	1970	2
B2	200	112.2	108.7	-91.3	UT	1970	2

**Table 2.4.12-204 (Sheet 2 of 3)
Monitoring Wells, Pumping Wells, and Piezometers at the RBS Site**

Piezometer/ Well Number	Well Depth (ft.)	Elevation Top of Casing (ft. msl)	Ground Surface Elevation (ft. msl)	Tip Elevation (ft. msl)	Aquifer	Year Installed	Casing Diameter (in.)
B3	200	112.2	109.7	-90.3	UT	1970	2
B4	200	108.8	105.3	-94.7	UT	1970	2
B15	135	101	98.1	-36.9	UT	1971	2
B20	149.4	109.5	107.1	-42.3	UT	1971	2
B61	150	61	59	-91	UT	1971	2
B69	148.9	55.9	54.6	-94.3	UT	1971	2
B72	150	146.3	144	-6	UT	1972	2
B449	94	45.6	42.5	-51.5	MRAA	1978	2
B450	64	44.4	44	-20	MRAA	1978	2
WW	NA	110.1	108.4	NA	ND	ND	ND
P1	217.8	112.4	119.8	-98	UT	1972	2
P1-A	1800	95.68	94.0	-1706.0	Z3	1976	2
P1-B	1800	95.68	94.0	-1706.0	Z3	1976	2
P2	114	123.1	120.5	6.5	UT	ND	2
P3	235	142.8	139.6	-95.4	UT	1972	2
P4	140	142	138.7	-1.3	UT	ND	2
P5	187.5	107.3	105.3	-82.2	UT	1972	2
P6	57.5	106.2	104.3	46.8	UT	1972	2
P7	192	124.9	123.5	-68.5	UT	1972	2
P8	82	125	123.5	41.5	UT	1972	2
P9	410	128.5	126.8	-283.2	Z1	1972	2
P10	130	128.7	126.9	-3.1	UT	1972	2
P11	205.5	105.1	103.9	-101.6	UT	1972	2
P12	106	105.2	104	-2	UT	1973	2
P13	200	109.5	107.7	-92.3	UT	1973	2
T1	ND	107.1	105.3	-44.7	UT	1972	ND
T2	ND	107.1	105.3	0.3	UT	1972	ND

Table 2.4.12-204 (Sheet 3 of 3)
Monitoring Wells, Pumping Wells, and Piezometers at the RBS Site

Piezometer/ Well Number	Well Depth (ft.)	Elevation Top of Casing (ft. msl)	Ground Surface Elevation (ft. msl)	Tip Elevation (ft. msl)	Aquifer	Year Installed	Casing Diameter (in.)
T3	ND	106.7	104.8	-0.2	UT	1972	ND
T4	ND	106	104.2	-0.8	UT	1972	ND
T5	ND	105.1	103	3	UT	1972	ND
T6	ND	101.5	98.8	-1.2	UT	1972	ND
T7	ND	108.5	105.2	0.2	UT	1972	ND
T8	ND	107.5	106	10	UT	1972	ND
T9	ND	111.8	110.3	4.3	UT	1972	ND
T10	ND	119.2	117.3	0.3	UT	1972	ND
T11	ND	105.2	103.8	-46.2	UT	1972	ND
T12	ND	100	103.9	-25	UT	1972	ND
T13	ND	97.9	96	-1780	Z3	1972	ND
T14	ND	115	113.2	-3926	Z1	1972	ND
T15	ND	109	107.4	-4.2	UT	1972	ND

Notes:

ft. = feet
ft. msl = feet relative to mean sea level
in. = inches
ND = no data
UT = Upland Terrace
Z1 = Zone 1
Z3 = Zone 3

Table 2.4.12-205 (Sheet 1 of 2)
Groundwater Levels Measured at the RBS Site

Piezometer/ Well ID	Aquifer	Plant Coordinate System		Piezometeric Water Level in Ft. (relative to msl)											
		North	East	12/17/2006	1/16/2007	2/14/2007	3/16/2007	4/17/2007	5/11/2007	6/25/2007	7/19/2007	8/15/2007	9/14/2007	10/14/2007	11/7/2007
MW - 1	UT	18278.92	14625.00	51.94	52.03	52.40	52.65	52.94	52.92	52.84	52.93	52.87	52.48	52.25	52.10
MW - 2	UT	17667.95	16194.00	54.72	54.81	55.16	55.21	55.49	55.47	55.46	55.52	55.56	55.22	55.06	54.87
MW - 3	UT	15879.00	12901.00	44.00	44.11	44.76	45.01	45.31	45.46	45.34	45.36	45.38	44.94	44.63	44.31
MW - 4	UT	16333.00	16402.00	51.32	52.42	52.77	52.87	53.09	53.16	53.16	53.19	53.22	52.93	52.74	52.57
MW - 5	UT	16205.00	14545.00	48.17	48.19	48.57	48.84	49.16	49.25	49.23	49.27	49.32	48.97	48.72	48.50
MW - 6	UT	16037.00	17991.00	57.73	57.94	58.17	58.16	58.27	58.34	58.27	58.27	58.37	58.09	57.98	57.77
MW - 7	UT	15711.00	18421.00	61.00	61.28	61.60	61.56	61.30	61.85	61.45	61.46	61.42	61.25	61.04	60.80
MW - 8	UT	15211.00	14937.00	47.20	47.06	47.48	47.76	48.14	48.24	48.24	48.24	48.27	47.46	47.70	47.40
MW - 9	UT	14738.00	17805.00	58.61	58.78	59.37	59.75	60.04	59.94	59.69	59.59	59.50	59.23	59.01	58.90
MW - 10	UT	14868.00	17039.00	45.95	50.23	50.44	50.62	50.69	50.80	50.91	50.98	51.01	50.93	50.73	50.58
MW - 11	UT	13650.00	13154.00	41.68	41.53	42.27	42.43	42.88	43.07	42.85	42.86	42.79	42.31	41.81	42.24
MW - 12	UT	13959.00	14531.00	42.40	42.32	42.74	43.17	43.61	43.76	43.91	43.92	43.98	40.72	43.45	43.08
MW - 13	UT	13785.00	17241.00	50.91	51.47	51.91	52.13	52.19	52.29	52.32	52.34	52.29	52.24	52.05	51.88
MW - 14	UT	14426.00	15286.00	46.02	45.92	46.28	46.63	46.89	47.07	47.17	47.16	47.22	47.01	46.76	46.45
MW - 15	UT	12760.00	14300.00	41.21	41.29	41.85	42.20	42.76	42.92	42.96	42.96	42.95	42.52	42.14	41.83
MW - 16	UT	13126.00	10921.00	38.01	38.89	39.98	39.94	40.39	40.60	39.78	39.98	39.36	38.57	37.63	37.55
MW - 17	UT	12518.00	12945.00	40.16	40.46	41.22	41.49	41.96	42.15	42.00	41.98	41.89	41.28	40.78	40.44
MW - 18	UT	11832.00	14395.00	41.32	41.42	41.85	42.25	42.75	42.92	43.08	43.10	43.08	42.74	42.39	42.10
MW - 19	UT	11495.00	11168.00	36.81	37.53	39.03	38.96	39.49	39.73	39.07	38.98	38.68	37.70	36.80	36.45
MW - 20	MRAA	11979.80	8383.70	na	na	na	na	31.70	32.89	30.11	29.81	29.51	26.08	23.97	23.71
MW - 21	UT	10956.00	12206.00	38.47	38.82	39.84	40.15	40.56	40.79	40.67	40.54	40.42	39.87	39.21	38.80
PZ-01	UT	16696.87	16925.30	na	na	na	na	56.62	56.64	56.57	56.64	56.68	56.38	56.20	56.03

Table 2.4.12-205 (Sheet 2 of 2) Groundwater Levels Measured at the RBS Site

Piezometer/ Well ID	Aquifer	Plant Coordinate System		Piezometeric Water Level in Ft. (relative to msl)											
		North	East	12/17/2006	1/16/2007	2/14/2007	3/16/2007	4/17/2007	5/11/2007	6/25/2007	7/19/2007	8/15/2007	9/14/2007	10/14/2007	11/7/2007
PZ-02	UT	17161.07	16785.44	na	na	na	na	57.27	56.27	56.51	56.30	56.31	56.01	55.85	55.69
PZ-03	UT	16952.68	17324.45	na	na	na	na	57.48	57.53	57.47	57.37	57.57	57.28	57.13	56.97
P-1	UT	19023.33	15931.44	55.55	na	56.25	57.70	56.14	56.34	56.30	56.24	56.23	55.98	55.75	55.42
P-1A	Z3	16380.00	17916.54	-5.02	-5.17	-5.24	-5.97	-6.36	-5.87	-7.00	-5.89	-6.60	-6.17	-5.43	-5.22
P1-B	Z3	16380.00	17625.05	-4.92	-4.97	-5.17	-4.85	-6.22	-5.77	-6.90	-5.79	-6.49	-6.04	-5.30	-5.14
P-1D	MRAA	13586.97	6471.78	21.89	33.66	27.87	32.41	31.63	30.83	21.36	28.47	14.83	14.89	9.45	15.71
P-1S	MRAA	13586.97	6471.78	21.98	32.63	28.63	31.91	31.50	31.01	21.95	28.12	16.18	17.72	10.24	15.86
P-10	UT	18750.49	18112.83	59.59	59.56	59.90	59.91	60.14	60.14	60.08	60.14	60.22	60.03	59.79	59.60
T-14	Z1	11828.66	14460.59	27.45	27.64	27.74	28.01	27.73	27.60	26.66	27.19	26.99	25.89	24.63	24.78

Notes:

UT = Upland Terrace.
MRAA = Mississippi River Alluvial Aquifer.
Z1 = Zone 1.

Table 2.4.12-206 (Sheet 1 of 3)
Groundwater Chemical Analyses at the RBS Site

	A	B	C	D	E	F	G	H	I	J	K
Temperature (°C)	20.1	24.3	18.2	23.5	20.3	22.1	21.1	21.8	27.8	23.8	17.4
Specific Conductance (μmhos/cm)	262.9	268.8	153	376	132.3	370.2	2329	160	294.1	230.8	438.3
Total Alkalinity (mg/L $CaCO_3$)	36	160	30	170	48	128	462	66	130	20	130
Ammonia (mg/L)	0.252	0.242	0.086	0.993	0.054	3.17	2.54	ND	ND	ND	ND
Bicarbonate as $CaCO_3$ (mg/L)	36	140	30	170	48	12	462	66	118	20	130
Biochemical Oxygen Demand (mg/L)	ND	ND	ND	ND	ND	9	53	ND	ND	ND	ND
Carbon Dioxide (mg/L)[(a)]	26	NT	26	14	22	0	26	14	NT	NT	NT
Chemical Oxygen Demand (mg/L)	22.3	ND	ND	5.4	5.77	50.1	234	ND	ND	ND	14.3
Chloride, Total (mg/L)	16	ND	12.4	12.4	14.2	8.86	30.1	ND	ND	17.7	26.6
Chromium, Hexavalent (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Apparent Color (PtCo Units)	47	38	50	127	29	23	488	16	7	7	421
True Color (PtCo Units)	21	3	28	10	6	10	273	2	4	3	42
Hardness (mg/L CO_3)	82	10	26	150	36	ND	284	52	6	56	180
Mercury (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Antimony (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Beryllium (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 2.4.12-206 (Sheet 2 of 3)
Groundwater Chemical Analyses at the RBS Site

	A	B	C	D	E	F	G	H	I	J	K
Chromium (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead (mg/L)	ND	ND	ND	0.073	0.016	0.123	ND	ND	ND	ND	ND
Nickel (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Selenium (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thallium (mg/L)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc (mg/L)	ND	ND	ND	0.0288	2.58	31.7	0.0678	ND	ND	ND	ND
Nitrate Nitrogen (mg/L)	0.549	ND	0.653	0.017	0.523	ND	NT	ND	NT	NT	1.81
Nitrogen Nitrite (mg/L)	ND	ND	ND	ND	ND	ND	NT	ND	NT	NT	0.011
Nitrate-Nitrite (as N) (mg/L)	NT	NT	NT	NT	NT	NT	0.011	NT	ND	0.052	NT
Odor, Threshold	ND	ND	ND	ND	ND	2	4	ND	ND	ND	ND
Orthophosphate (mg/L)	ND	0.184	0.062	0.397	0.397	ND	1.02	0.099	0.159	ND	0.166
pH	6.03	8.73	5.99	7.23	6.28	10.8	6.79	6.81	8.89	5.92	7.9
Phosphorus, (mg/L)	0.102	0.164	ND	0.507	0.072	0.189	1.55	0.161	0.145	ND	0.202
Silica, Dissolved (as SIO_2) (mg/L)	21.3	22.1	27	31.2	22.5	ND	38.7	44.1	21.3	19.2	7.11
Sulfate (mg/L)	44.7	ND	7.25	ND	ND	ND	426	ND	ND	31.7	38.4
Total Dissolved Solids (mg/L)	177	214	124	206	80	189	1,710	157	194	163	318
Total Dissolved Solids (mg/L)	177	214	124	206	80	189	1,710	157	194	163	318
Total Suspended Solids (mg/L)	37	14	11	14	17	408	157	ND	ND	ND	165
Turbidity (ntu)	26.6	1.69	11.1	49.3	12.4	9.68	164	5.44	0.53	1.35	73.5

Table 2.4.12-206 (Sheet 3 of 3)
Groundwater Chemical Analyses at the RBS Site

	A	B	C	D	E	F	G	H	I	J	K
Total Nitrogen (mg/L)	2.03	0.49	0.56	0.91	0.7	NT	NT	NT	NT	NT	NT
Fecal Coliform (col/100 ml)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fecal Streptococcus (col/ 100 ml)	ND	ND	ND	ND	ND	10	ND	0	ND	ND	1060
Silica (mg/L)	3.56	2.37	2.84	4.21	4.16	0.09	2.72	2.51	2.23	2.24	2.22
Total Coliform (col/100 ml)	6400	ND	8700	167,000	1500	ND	1800	ND	ND	400	12,000

a) Carbon dioxide was measured in the field on January 8, 2008.

Notes:

A - MW-4, 02/09/2007
B - P-1A, 02/14/2007
C - MW-18, 02/14/2007
D - P-1D, 02/13/2007
E - P-10, 02/13/2007
F - T-14, 03/22/2007
G - MW-20, 05/01/2007
H - BP-1, 04/30/2007
I - P-1B, 05/01/2007
J - P-5, 05/01/2007
K - Mississippi River (MR), 04/30/2007

mmhos/cm = micromhos per centimeter.
mg/L = milligrams per liter.
col/100 ml = colony per 100 milliliters.
ntu = nephelometric turbidity units.
PtCo = platinum-cobalt standard units.
ND = not detected at or above the laboratory detection limit.
NT = not tested.

Table 2.4.12-207
Field Measured and Estimated Aquifer Hydraulic Properties at the RBS Site

Well No.	Aquifer	Approximate Screen Elevation (ft. msl)	Field Hydraulic Conductivity (ft/sec)	Type of Test	Hydraulic Conductivity (ft/day)[a]	Coefficient of Transmissivity (gpd/ft)	Storage Coefficient
T1	UT	50 to -30	2.93E+02	Pump	251	184,400	0.08
T-13	Z-3	-1690	5.85E+01	Pump	N/A	35,000	0.0001
MW-1	UT	20	4.61E-06	Slug	0.040		
MW-2	UT	10	4.40E-05	Slug	3.810		
MW-4	UT	3	1.74E-04	Slug	15.034		
MW-7	UT	-2	1.55E-05	Slug	1.340		
MW-18	UT	13	4.26E-06	Slug	0.377		
MW-5	UT	31	(b)	Slug	(b)		
MW-11	UT	18	1.96E-07	Slug	0.016		
MW-14	UT	33	8.73E-08	Slug	0.008		
N/A	MRAA	N/A	N/A	Pump	N/A	139,000	0.001

a) Empirical hydraulic conductivity values based on the Hazen Equation or from pump test hydraulic conductivity estimates from transmissivity assuming uniform aquifer thickness.

b) Slug test results were questionable or considered not representative of zone tested.

Notes:

ft. msl = feet relative to mean sea level.
ft/sec = feet per second.
ft/day = feet per day.
gpd/ft = gallons per day per foot.
UT = Upland Terrace.
MRAA = Mississippi River Alluvial Aquifer.
N/A - Information not available.

Source: References 2.4.12-230 and 2.4.12-229.

Table 2.4.12-208 (Sheet 1 of 2)
Mississippi River Water Quality, West Feliciana 2004 to 2005

Sample Date	Temp (°F)	pH pH Units	Specific Conductance μS/cm	Suspended Sediments mg/L	Total Alkalinity (as $CaCO_3$) mg/L	Sulfate (SO_4) mg/L	Chloride (as Cl) mg/L	Total Hardness mg/L	Total Iron (as Fe) μg/L
10/26/2004	68.9	8.4	NT	70	121	41	17.6	55.8	7
11/16/2004	59.9	NT	291	201	96	33.7	17	14.3	7
12/21/2004	47.3	NT	262	172	87	26.9	13.1	11.26	18
2/2/2005	41.7	7.6	269	119	81	28.7	14.1	11.3	17
3/22/2005	48.7	7.7	369	100	115	38.8	22.2	15.7	14
4/13/2005	57.9	7.7	346	222	96	39.6	26	10	35
4/27/2005	65.5	7.7	321	147	103	34.8	18	13.8	14
5/10/2005	64	7.5	367	203	108	43.8	20	16.6	ND
5/24/2005	74.3	7.9	386	71	126	43.4	18.2	18.3	ND
6/14/2005	80.4	7.6	NT	68	138	46.2	24.4	19.7	ND
6/28/2005	NT	7.8	NT	217	118	51.3	31.7	17.8	E6
7/12/2005	84.7	8	470	77	139	51.4	30	19.4	47
8/10/2005	86.4	8.2	436	38	135	52.1	23.5	18.3	11
9/7/2005	82.4	8	414	116	107	49.4	34.2	17	9

Table 2.4.12-208 (Sheet 2 of 2)
Mississippi River Water Quality, West Feliciana 2004 to 2005

Notes:

mg/L = milligrams per liter.
µg/L = micrograms per liter.
µS/cm = microsiemens per centimeter.
°F = degrees Fahrenheit.
E = estimated.
NT = not tested.
ND = not detected .
Total hardness calculated as the total of calcium and magnesium concentrations.

Source: Reference 2.4.12-221.

Table 2.4.12-209 (Sheet 1 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/1/1965	ND	337	ND	7.3	120	ND	NT	NT	NT	NT
4/11/1965	ND	281	ND	7.4	110	ND	NT	NT	NT	NT
7/11/1965	ND	351	ND	7.8	130	ND	NT	NT	NT	NT
10/11/1965	ND	376	ND	7.4	150	ND	NT	NT	NT	NT
1/12/1966	ND	376	ND	7.1	140	ND	NT	NT	NT	NT
4/11/1966	ND	407	ND	7.5	170	ND	NT	NT	NT	NT
7/11/1966	ND	438	ND	7.6	180	ND	NT	NT	NT	NT
10/11/1966	ND	501	ND	7.5	170	ND	NT	NT	NT	NT
1/11/1967	ND	333	ND	7.4	140	ND	NT	NT	NT	NT
4/10/1967	ND	361	ND	7	150	ND	NT	NT	NT	NT
7/11/1967	ND	370	ND	7.5	140	ND	NT	NT	NT	NT
10/5/1967	ND	460	ND	7.2	150	ND	NT	NT	NT	NT
1/22/1968	ND	254	ND	7.9	100	ND	NT	NT	NT	NT
4/4/1968	68	287	ND	7.2	110	ND	NT	NT	NT	NT
7/15/1968	ND	388	ND	7.2	150	ND	NT	NT	NT	NT
10/8/1968	77	473	ND	7.6	170	ND	NT	NT	NT	NT
1/20/1969	41	343	ND	7.4	130	ND	NT	NT	NT	NT
4/29/1969	64.4	322	ND	7	130	ND	NT	NT	NT	NT
7/1/1969	80.6	456	ND	7.9	170	ND	NT	NT	NT	NT
10/22/1969	68.9	578	ND	7.5	190	ND	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 2 of 9) Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/15/1970	40.1	283	12	7.5	110	ND	NT	NT	NT	NT
4/27/1970	68	377	7.6	7.4	140	ND	NT	NT	NT	NT
7/8/1970	ND	392	ND	7.3	150	ND	NT	NT	NT	NT
10/13/1970	69.8	312	ND	7	120	ND	NT	NT	NT	NT
1/21/1971	46.4	304	12	7.4	120	ND	NT	NT	NT	NT
4/6/1971	50.9	365	ND	8	150	ND	NT	NT	NT	NT
6/1/1971	73.4	332	6.8	8.1	130	ND	NT	NT	NT	NT
11/9/1971	62.6	469	ND	7.3	160	ND	NT	NT	NT	NT
1/21/1972	44.6	305	ND	7.3	120	ND	NT	NT	NT	NT
2/18/1972	44.6	325	ND	7	140	ND	NT	NT	NT	NT
3/7/1972	48.2	314	10.8	7.3	120	ND	NT	NT	NT	NT
5/12/1972	65.3	330	ND	7.5	130	ND	NT	NT	NT	NT
1/16/1973	40.1	297	11	7.2	120	ND	NT	NT	NT	NT
4/17/1973	57.2	296	9.5	7	120	ND	NT	NT	NT	NT
7/18/1973	84.2	403	6.4	7.7	160	ND	NT	NT	NT	NT
10/18/1973	71.6	366	8	ND	160	ND	NT	NT	NT	NT
1/16/1974	41	270	9.7	7.5	110	ND	NT	NT	NT	NT
4/17/1974	61.7	315	9	7.5	130	ND	NT	NT	NT	NT
7/3/1974	77.9	ND	6.2	ND	ND	ND	NT	NT	NT	NT
10/11/1974	68	411	8.6	8	160	ND	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 3 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/9/1975	47.3	302	10.8	7.5	120	ND	NT	NT	NT	NT
4/4/1975	58.1	263	8.8	7.4	98	ND	NT	NT	NT	NT
7/16/1975	84.2	391	6.4	7.7	170	ND	NT	NT	NT	NT
10/2/1975	69.8	448	7.8	8.1	160	ND	NT	NT	NT	NT
1/22/1976	41.9	291	10.4	7.8	120	ND	NT	NT	NT	NT
4/13/1976	61.7	300	7.8	7.7	120	ND	NT	NT	NT	NT
7/15/1976	83.3	427	6.4	8.1	130	ND	NT	NT	NT	NT
10/27/1976	59.9	457	9.4	7.6	160	ND	NT	NT	NT	NT
1/10/1977	40.1	ND	12.6	7.6	140	ND	NT	NT	NT	NT
4/4/1977	61.7	275	8.8	7.7	100	ND	NT	NT	NT	NT
7/13/1977	84.2	352	6.9	7.7	140	ND	NT	NT	NT	NT
10/18/1977	64.4	385	8.2	7.9	140	ND	NT	NT	NT	NT
1/13/1978	38.3	377	12.7	7.8	160	ND	NT	NT	NT	NT
4/25/1978	62.6	357	8.6	7.9	150	ND	NT	NT	NT	NT
7/12/1978	87.8	448	6.9	7.5	160	359	NT	NT	NT	NT
10/23/1978	64.4	477	8.5	7.6	210	196	NT	NT	NT	NT
1/8/1979	46.4	295	11.7	7.7	110	300	NT	NT	NT	NT
4/2/1979	55.4	293	10.2	7.2	110	ND	NT	NT	NT	NT
7/20/1979	82.4	380	7.3	7.2	140	ND	NT	NT	NT	NT
10/1/1979	75.2	323	7.1	7.2	130	265	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 4 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/7/1980	44.6	321	9.7	7.4	130	247	NT	NT	NT	NT
4/10/1980	57.2	295	9.1	7.6	120	283	NT	NT	NT	NT
7/7/1980	86	394	6.1	7.1	160	391	NT	NT	NT	NT
10/17/1980	69.8	425	8.3	7.1	170	154	NT	NT	NT	NT
1/12/1981	41	512	12.2	7.5	200	139	NT	NT	NT	NT
4/20/1981	69.8	388	8.5	7.4	140	111	NT	NT	NT	NT
7/8/1981	80.6	326	6.5	7.2	130	ND	NT	NT	NT	NT
10/9/1981	71.6	522	8.2	7.9	200	128	NT	NT	NT	NT
1/11/1982	41	384	11.6	7.2	140	ND	NT	NT	NT	NT
4/9/1982	55.4	330	8.9	7.3	140	334	NT	NT	NT	NT
7/12/1982	80.6	460	6.7	7.2	160	273	NT	NT	NT	NT
10/7/1982	73.4	400	8.9	7.6	160	265	NT	NT	NT	NT
1/25/1983	40.1	315	12.7	7.3	130	302	NT	NT	NT	NT
4/26/1983	55.4	344	8.2	6.9	130	ND	NT	NT	NT	NT
7/19/1983	85.1	431	6.2	7.2	170	281	NT	NT	NT	NT
10/3/1983	75.2	506	8.1	7.6	ND	81	NT	NT	NT	NT
1/9/1984	34.7	305	12.6	ND	ND	166	NT	NT	NT	NT
4/16/1984	56.3	348	9	7.8	ND	204	NT	NT	NT	NT
7/19/1984	82.4	404	6.7	7.9	170	253	NT	NT	NT	NT
10/15/1984	71.6	493	7.5	8	160	153	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 5 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/7/1985	48.2	315	11	7.7	110	304	NT	NT	NT	NT
4/11/1985	58.1	324	8.9	7.8	120	196	NT	NT	NT	NT
7/22/1985	85.1	419	6.9	7.8	170	120	NT	NT	NT	NT
10/1/1985	69.8	457	7.5	7.9	ND	111	NT	NT	NT	NT
1/28/1986	41.9	453	11	7.5	ND	119	NT	NT	NT	NT
4/15/1986	64.4	425	8.2	7.8	160	168	NT	NT	NT	NT
7/21/1986	85.1	468	6.8	7.9	ND	394	NT	NT	NT	NT
10/6/1986	78.8	450	6.9	8	ND	ND	NT	NT	NT	NT
1/27/1987		441	12.2	7.6	170	200	NT	NT	NT	NT
4/7/1987	54.5	390	9.6	7.8	ND	295	NT	NT	NT	NT
7/13/1987	86	472	6.9	7.8	180	236	NT	NT	NT	NT
10/20/1987	65.48	517	9.3	7.9	ND	81	NT	NT	NT	NT
1/5/1988	42.8	276	10.7	7.6	100	548	NT	NT	NT	NT
4/5/1988	62.6	391	9.1	7.3	ND	252	NT	NT	NT	NT
7/5/1988	86.9	550	8.7	8.1	210	30	NT	NT	NT	NT
10/12/1988	69.8	460	8.3	7.6	ND	111	NT	NT	NT	NT
1/17/1989	45.5	284	10.5	7.2	110	351	NT	NT	NT	NT
3/30/1989	57.2	302	9.8	7.8	ND	202	NT	NT	NT	NT
7/11/1989	81.5	289	6	7.6	ND	169	NT	NT	NT	NT
10/6/1989	70.34	375	7.8	7.8	ND	183	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 6 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/8/1990	41.9	318	13	7.7	ND	403	NT	NT	NT	NT
4/17/1990	59	355	8.5	7.8	ND	170	NT	NT	NT	NT
7/17/1990	82.4	376	6.4	7.4	ND	262	NT	NT	NT	NT
10/30/1990	62.6	408	9.2	7.2	ND	138	NT	NT	NT	NT
1/15/1991	42.8	232	11.2	7.3	ND	263	NT	NT	NT	NT
4/2/1991	71.6	322	9.4	7.6	ND	238	NT	NT	NT	NT
7/23/1991	86	425	6.8	8.1	ND	118	NT	NT	NT	NT
11/5/1991	60.8	560	8.4	7.4	ND	360	NT	NT	NT	NT
							NT	NT	NT	NT
1/28/1992	41	348	14.2	7.5	ND	187	NT	NT	NT	NT
5/14/1992	65.3	410	8.2	7.8	ND	228	NT	NT	NT	NT
7/15/1992	82.4	396	6.9	8.1	ND	162	NT	NT	NT	NT
10/14/1992	69.8	384	8.3	7.3	ND	157	NT	NT	NT	NT
1/26/1993	41.9	334	12.8	7.7	ND	223	NT	NT	NT	NT
4/20/1993	49.1	319	9.6	8.1	ND	184	NT	NT	NT	NT
7/28/1993	85.1	348	5.3	7.8	ND	260	NT	NT	NT	NT
11/8/1993	54.5	469	10.2	7.8	ND	116	NT	NT	NT	NT
1/24/1994	37.4	346	13.2	7	ND	196	NT	NT	NT	NT
3/14/1994	46.4	305	10.4	7.5	ND	129	NT	NT	NT	NT
6/28/1994	84.2	412	6.7	7.9	ND	133	NT	NT	NT	NT
10/20/1994	68	408	7.9	7.9	ND	82	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 7 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/23/1995	46.4	356	11	7.6	ND	267	NT	NT	NT	NT
4/24/1995	64.4	380	7.5	7.9	ND	832	NT	NT	NT	NT
8/7/1995	82.4	477	6.8	8	ND	113	NT	NT	NT	NT
10/17/1995	69.8	496	8	8	ND	239	NT	NT	NT	NT
2/7/1996	35.6	323	12.3	7.8	ND	437	NT	NT	NT	NT
5/1/1996	63.32	408	8.5	7.7	ND	334	NT	NT	NT	NT
7/23/1996		482	6.9	8.2	ND	191	NT	NT	NT	NT
11/25/1996	52.7	345	9.6	7.6	ND	308	NT	NT	NT	NT
1/15/1997	49.1	328	10.3	8	ND	183	NT	NT	NT	NT
4/24/1997	59	345	9.8	7.8	ND	173	NT	NT	NT	NT
7/9/1997	83.3	379	6.6	8	ND	191	NT	NT	NT	NT
11/17/1997	75.2	465	10.4	7.6	ND	76	NT	NT	NT	NT
1/28/1998	44.6	310	11.3	7.8	ND	160	NT	NT	NT	NT
4/2/1998	56.3	349	8.9	7.9	ND	214	NT	NT	NT	NT
7/9/1998	78.8	354	6.1	8	ND	227	NT	NT	NT	NT
9/28/1998	81.5	471	7.4	8.3	ND	183	NT	NT	NT	NT
1/12/1999	40.1	375	12.4	8	ND	225	NT	NT	NT	NT
4/19/1999	63.32	375	8.2	8	ND	177	NT	NT	NT	NT
7/21/1999	84.92	396	6.8	7.8	ND	197	NT	NT	NT	NT
11/11/1999	62.6	550	9	7.8	ND	49	NT	NT	NT	NT

Table 2.4.12-209 (Sheet 8 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
1/27/2000	44.6	425	10.1	8	ND	74	NT	NT	NT	NT
4/12/2000	60.98	416	8.7	7.4	ND	147	NT	NT	NT	NT
7/18/2000	86.9	440	8	7.9	ND	188	NT	NT	NT	NT
11/28/2000	51.08	453	11.5	7.7	ND	159	NT	NT	NT	NT
1/24/2001	40.1	375	9.8	7	ND	482	NT	NT	NT	NT
4/16/2001	62.78	403	8.5	7.4	ND	156	NT	NT	NT	NT
7/18/2001	84.92	434	6.7	7.8	ND	115	NT	NT	NT	NT
10/30/2001	63.86	383	7.7	8	ND	120	NT	NT	NT	NT
1/22/2002	44.42	346	11	7.2	ND	138	NT	NT	NT	NT
4/10/2002	56.3	264	8.7	7.3	ND	145	NT	NT	NT	NT
8/5/2002	86.54	430	8.1	7.9	ND	75	NT	NT	NT	NT
11/12/2002	59	362	10	7.2	ND	164	NT	NT	NT	NT
1/28/2003	41.9	345	9.3	ND	ND	74	NT	NT	NT	NT
4/15/2003	59.9	366	9.2	7.8	ND	205	NT	NT	NT	NT
7/14/2003	83.66	371	7	7.9	ND	87	NT	NT	NT	NT
10/27/2003	67.64	402	7.7	7.4	ND	55	NT	NT	NT	NT
1/13/2004	43.88	367	11.3	7.7	ND	122	NT	NT	NT	NT
3/30/2004	56.66	350	8.2	7.3	ND	162	NT	NT	NT	NT
7/20/2004	84.74	399	7.2	7.3	ND	128	NT	NT	NT	NT
10/26/2004	68.9	383	9.5	8.4	55.8	70	121	41	17.6	7

Table 2.4.12-209 (Sheet 9 of 9)
Mississippi River Historic Water Quality near St. Francisville, Louisiana

Sample Date	Water Temp (°F)	Specific Conductance (μS/cm at 25°C)	Dissolved Oxygen (mg/L)	pH	Hardness Total (mg/L as $CaCO_3$)	Suspended Sediment (mg/L)	Alkalinity Total (mg/L as $CaCO_3$)	Sulfate mg/L (SO_4)	Chloride mg/L (Cl)	Iron mg/L (as Fe)
11/16/2004	59.9	291	NT	NT	14.3	201	96	33.7	17	7
12/21/2004	47.3	262	NT	NT	11.26	172	87	26.9	13.1	18
2/2/2005	41.72	274	11.3	7.6	11.3	119	81	28.7	14.1	17
3/22/2005	48.7	369	NT	7.7	15.7	100	115	38.8	22.2	14
4/13/2005	57.92	358*	9.2	7.7	10	222	96	39.6	26	35
4/27/2005	65.5	321	NT	7.7	13.8	147	103	34.8	18	14
5/10/2005	64	367	NT	7.5	16.6	203	108	43.8	20	ND
5/24/2005	74.3	386	NT	7.9	18.3	71	126	43.4	18.2	ND
6/14/2005	80.4	NT	NT	7.6	19.7	68	138	46.2	24.4	ND
6/28/2005	NT	462	6.5	7.8	17.8	217	118	51.3	31.7	E6
7/12/2005	84.7	470	NT	8	19.4	77	139	51.4	30	47
8/10/2005	86.4	436	NT	8.2	18.3	38	135	52.1	23.5	11
9/7/2005	82.4	425*	ND	8	17	116	107	49.4	34.2	9

a) Average of two values on same date.

Sources: References 2.4.12-221 and 2.4.12-222.

Notes:

°F = degrees Fahrenheit.
mg/L = milligrams per liter.
μS/cm = microsiemens per centimeter.
ND = not detected.
NT = not tested.
E = estimated.

Table 2.4.12-210
Groundwater Withdrawal Rates in the Five-Parish Region for the Year 2000

Parish	Mississippi River Alluvial Aquifer	Uplands Terrace Aquifer	Zone 1 Sands and 1700-Ft. Sand of Zone 2	2,000-Ft. Sand of Zone 2 and Zone 3 Sands	Total
West Feliciana		0.01	3.56	2.59	6.16
East Feliciana		0.27	1.16	2.04	3.47
Pointe Coupee	7.92	1.63	3.76	5.86	19.17
West Baton Rouge	10.21	0.01	6.1		16.32
East Baton Rouge	0.09	15.57	42.51	77.48	135.65
Total	18.22	17.49	57.09	87.97	180.77

Note:

Groundwater rates shown are in million gallons per day.

Source: Reference 2.4.12-223.

Table 2.4.12-211
Groundwater Usage for the Year 2000

Parish	Public Supply	Industrial	Power Generation	Rural Domestic	Agriculture[a]	Total
West Feliciana	4.52	1.59	0.02	0.04		6.17
East Feliciana	2.97	0.03		0.27	0.19	3.46
Pointe Coupee	3.56	7.35	2.94	0.23	5.08	19.16
West Baton Rouge	6.07	10.19		0.04	0.02	16.32
East Baton Rouge	64.14	63.37	7.44	0.25	0.46	135.66
Total	81.26	82.53	10.4	0.83	5.75	180.77

a) Includes groundwater used for livestock, irrigation, and aquaculture.

Note:

Groundwater usage shown is in million gallons per day.

Source: Reference 2.4.12-223, Table 2.

Table 2.4.12-212 (Sheet 1 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
2	- 82	30.7672	-91.321	W. Feliciana	Domestic	510	Zone 1	1.06
4	- 84	30.7699	-91.342	W. Feliciana	Domestic	180	UTA	1.06
10	-5053Z	30.7416	-91.328	W. Feliciana	Domestic	410	Zone 1	1.07
5	- 241	30.7702	-91.343	W. Feliciana	Domestic	161	UTA	1.09
12	- 83	30.7405	-91.330	W. Feliciana	Domestic	115	UTA	1.12
6	- 65	30.7716	-91.340	W. Feliciana	Domestic	169	UTA	1.12
3	- 87	30.7705	-91.324	W. Feliciana	Industrial	497	Zone 1	1.13
8	- 64	30.7719	-91.340	W. Feliciana	Domestic	1647	Zone 3	1.13
13	-5276Z	30.7402	-91.329	W. Feliciana	Irrigation/ Agriculture	115	UTA	1.14
7	- 68	30.7638	-91.316	W. Feliciana	Domestic	483	Zone 1	1.18
14	- 88	30.7394	-91.329	W. Feliciana	Stock	520	Zone 1	1.20
9	- 94	30.7730	-91.326	W. Feliciana	Domestic	525	Zone 1	1.22
11	- 91	30.7688	-91.318	W. Feliciana	Domestic	485	Zone 1	1.25
16	- 72	30.7716	-91.346	W. Feliciana	Domestic	114	UTA	1.29
19	-5284Z	30.7380	-91.328	W. Feliciana	Domestic	120	UTA	1.31
15	- 86	30.7755	-91.328	W. Feliciana	Domestic	480	Zone 1	1.36
17	-5292Z	30.7763	-91.334	W. Feliciana	Domestic	120	--	1.37
18	- 17	30.7688	-91.314	W. Feliciana	Domestic	502	Zone 1	1.44
20	- 92	30.7608	-91.306	W. Feliciana	Domestic	520	Zone 1	1.66
21	- 56	30.7799	-91.340	W. Feliciana	Domestic	1486	Zone 3	1.66
24	- 245	30.7769	-91.357	W. Feliciana	Public-Commercial	120	UTA	2.00
25	- 244	30.7772	-91.357	W. Feliciana	Public-Commercial	120	UTA	2.01
22	- 73	30.7855	-91.338	W. Feliciana	Domestic	180	UTA	2.02
23	-5289Z	30.7802	-91.312	W. Feliciana	Domestic	150	UTA	2.08
26	-5335Z	30.7538	-91.299	W. Feliciana	Irrigation/ Agriculture	140	--	2.08
27	- 294	30.7874	-91.331	W. Feliciana	Public-Rural	285	Zone 1	2.14
28	- 283	30.7877	-91.331	W. Feliciana	Public-Rural	280	Zone 1	2.16

Table 2.4.12-212 (Sheet 2 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
29	- 251	30.7677	-91.297	W. Feliciana	Domestic	138	UTA	2.32
30	- 250	30.7469	-91.294	W. Feliciana	Domestic	110	UTA	2.46
31	-5283Z	30.7341	-91.299	W. Feliciana	Domestic	230	Zone 1	2.58
32	- 290	30.7894	-91.306	W. Feliciana	Public-Rural	1752	Zone 3	2.80
33	- 240	30.7974	-91.319	W. Feliciana	Stock	636	Zone 1	2.95
34	- 60	30.7977	-91.319	W. Feliciana	Stock	176	UTA	2.97
35	- 222	30.7833	-91.377	W. Feliciana	Public-Municipal	1526	Zone 3	3.17
36	- 270	30.7738	-91.384	W. Feliciana	Public-Municipal	1750	Zone 3	3.26
37	- 63	30.7088	-91.322	W. Feliciana	Industrial	1372	Zone 2	3.35
39	- 215	30.7083	-91.325	W. Feliciana	Industrial	2068	Zone 3	3.36
38	- 50	30.7088	-91.321	W. Feliciana	Industrial	1569	Zone 3	3.36
40	- 48	30.7086	-91.322	W. Feliciana	Industrial	2083	Zone 3	3.37
41	- 221	30.7669	-91.389	W. Feliciana	Industrial	145	MRAA	3.40
42	- 213	30.7963	-91.370	W. Feliciana	Domestic	1670	Zone 3	3.51
43	-5061Z	30.8030	-91.303	W. Feliciana	Irrigation/ Agriculture	210	Zone 1	3.68
44	- 81	30.7661	-91.395	W. Feliciana	Domestic	152	UTA	3.70
45	-5280Z	30.8075	-91.361	W. Feliciana	Domestic	190	UTA	3.88
46	-5240Z	30.8080	-91.361	W. Feliciana	Public-Commercial	140	UTA	3.90
47	-5286Z	30.8055	-91.368	W. Feliciana	Domestic	140	UTA	3.95
49	- 6	30.7097	-91.293	E. Feliciana	Domestic	190	UTA	4.04
48	- 64	30.7447	-91.266	E. Feliciana	Industrial	480	Zone 1	4.09
50	-5304Z	30.7769	-91.268	W. Feliciana	Domestic	120	MRAA	4.17
51	- 281	30.7444	-91.265	E. Feliciana	Industrial	1427	Zone 3	4.19
52	- 296	30.6949	-91.341	W. Feliciana	Public-Commercial	183	MRAA	4.26
53	-5306Z	30.8127	-91.295	W. Feliciana	Irrigation/ Agriculture	160	--	4.50
55	- 235	30.8047	-91.385	W. Feliciana	Public-Municipal	1675	Zone 3	4.52
56	- 36	30.8069	-91.383	W. Feliciana	Industrial	412	Zone 1	4.54
54	- 167	30.7966	-91.272	W. Feliciana	Domestic	100	UTA	4.58

Table 2.4.12-212 (Sheet 3 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
57	- 197	30.7711	-91.256	E. Feliciana	Domestic	38	UTA	4.71
58	-5305Z	30.7886	-91.262	W. Feliciana	Domestic	110	UTA	4.79
59	- 154	30.8266	-91.334	W. Feliciana	Domestic	718	Zone 2	4.84
63	- 286	30.7075	-91.275	E. Feliciana	Public-Commercial	210	UTA	4.86
61	- 153	30.8274	-91.333	W. Feliciana	Domestic	218	Zone 1	4.89
60	- 166	30.8069	-91.276	W. Feliciana	Domestic	380	Zone 1	4.89
64	-5288Z	30.8111	-91.386	W. Feliciana	Domestic	135	UTA	4.90
62	- 165	30.8116	-91.281	W. Feliciana	Domestic	126	UTA	4.93
66	- 79	30.7972	-91.403	W. Feliciana	Domestic	137	UTA	4.99
65	- 312	30.8113	-91.279	W. Feliciana	Irrigation/ Agriculture	50	--	5.00
67	- 137	30.8136	-91.388	W. Feliciana	Domestic	589	Zone 1	5.09
68	-5290Z	30.8150	-91.386	W. Feliciana	Domestic	135	UTA	5.12
74	-5239Z	30.7986	-91.408	W. Feliciana	Domestic	175	UTA	5.30
69	- 274	30.8327	-91.321	W. Feliciana	Public-Rural	1630	Zone 3	5.31
73	-5307Z	30.6988	-91.274	E. Feliciana	Irrigation/ Agriculture	170	UTA	5.31
70	-5278Z	30.8333	-91.327	W. Feliciana	Domestic	200	UTA	5.31
72	-5329Z	30.8330	-91.351	W. Feliciana	Irrigation/ Agriculture	135	--	5.38
75	- 81	30.7161	-91.256	E. Feliciana	Domestic	34	UTA	5.39
71	-5065Z	30.8327	-91.312	W. Feliciana	Domestic	120	UTA	5.41
76	-5220Z	30.8338	-91.352	W. Feliciana	Irrigation/ Agriculture	387	Zone 1	5.44
77	- 254	30.8258	-91.378	W. Feliciana	Public-Institution	793	Zone 2	5.46
78	- 255	30.8258	-91.378	W. Feliciana	Public-Institution	674	Zone 2	5.46
79	-5115Z	30.8369	-91.327	W. Feliciana	Domestic	150	UTA	5.56
80	-5063Z	30.7933	-91.417	W. Feliciana	Domestic	210	--	5.56
84	- 79	30.7022	-91.261	E. Feliciana	Domestic	150	UTA	5.69
81	- 160	30.8377	-91.316	W. Feliciana	Domestic	275	Zone 1	5.69
82	- 29	30.8361	-91.305	W. Feliciana	Stock	426	Zone 1	5.75

Table 2.4.12-212 (Sheet 4 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
83	- 30	30.8361	-91.305	W. Feliciana	Stock	407	Zone 1	5.75
85	- 80	30.7019	-91.259	E. Feliciana	Domestic	117	UTA	5.80
87	-5330Z	30.7936	-91.422	W. Feliciana	Domestic	155	--	5.84
88	- 78	30.6811	-91.286	E. Feliciana	Domestic	78	UTA	5.92
86	-5013Z	30.8213	-91.268	W. Feliciana	Irrigation/ Agriculture	140	UTA	5.95
92	- 77	30.7941	-91.424	W. Feliciana	Irrigation- Agriculture	175	UTA	6.00
89	- 155	30.8372	-91.372	W. Feliciana	Public-Institution	650	Zone 2	6.01
91	-7296Z	30.6969	-91.260	E. Baton Rouge	Domestic	280	UTA	6.02
93	- 86	30.7108	-91.246	E. Feliciana	Stock	168	UTA	6.08
90	-5307Z	30.8033	-91.247	W. Feliciana	Irrigation/ Agriculture	140	--	6.09
94	- 288	30.8380	-91.374	W. Feliciana	Industrial	618	Zone 3	6.12
98	- 78	30.7969	-91.426	W. Feliciana	Stock	154	UTA	6.17
97	- 111	30.8322	-91.389	W. Feliciana	Domestic	650	Zone 2	6.19
95	-5309Z	30.8438	-91.308	W. Feliciana	Domestic	150	UTA	6.21
96	-5331Z	30.8461	-91.344	W. Feliciana	Domestic	145	--	6.21
99	-5275Z	30.8497	-91.346	W. Feliciana	Irrigation/ Agriculture	130	UTA	6.47
100	- 179	30.8469	-91.301	W. Feliciana	Domestic	387	Zone 1	6.52
102	- 123	30.8172	-91.419	W. Feliciana	Domestic	120	UTA	6.61
101	- 260B	30.7363	-91.225	E. Feliciana	Public-Rural	2008	Zone 3	6.62
103	- 80	30.8011	-91.432	W. Feliciana	Stock	67	UTA	6.63
104	- 115	30.8141	-91.424	W. Feliciana	Domestic	210	Zone 1	6.71
106	- 83	30.7219	-91.227	E. Feliciana	Stock	150	UTA	6.77
107	- 116	30.8216	-91.419	W. Feliciana	Domestic	89	UTA	6.78
105	-5222Z	30.8430	-91.278	W. Feliciana	Domestic	210	Zone 1	6.83
108	-5454Z	30.7666	-91.218	E. Feliciana	Domestic	120	UTA	6.90
109	- 186	30.8511	-91.375	W. Feliciana	Domestic	333	Zone 1	6.97
111	- 124	30.8541	-91.365	W. Feliciana	Domestic	322	Zone 1	6.98
110	- 253	30.7633	-91.216	E. Feliciana	Industrial	168	UTA	7.00

Table 2.4.12-212 (Sheet 5 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
115	- 285	30.6622	-91.289	E. Baton Rouge	Domestic	200	UTA	7.01
113	- 139	30.8500	-91.380	W. Feliciana	Domestic	330	Zone 1	7.02
112	- 82	30.7338	-91.218	E. Feliciana	Domestic	165	UTA	7.03
116	- 185	30.8538	-91.373	W. Feliciana	Domestic	343	Zone 1	7.11
117	- 84	30.7261	-91.219	E. Feliciana	Domestic	180	UTA	7.11
119	- 16	30.8488	-91.388	W. Feliciana	Domestic	1224	Zone 3	7.15
118	-5291Z	30.8594	-91.349	W. Feliciana	Irrigation/ Agriculture	340	--	7.15
114	- 152	30.8399	-91.262	W. Feliciana	Domestic	1529	Zone 3	7.15
122	- 571	30.6802	-91.252	E. Baton Rouge	Domestic	1239	Zone 2	7.16
121	- 102	30.8427	-91.401	W. Feliciana	Public-Institution	100	UTA	7.19
127	-8768Z	30.6619	-91.280	E. Baton Rouge	Public-Commercial	204	--	7.25
120	- 198	30.7866	-91.217	E. Feliciana	Domestic	200	Zone 1	7.25
124	-8597Z	30.6913	-91.238	E. Baton Rouge	Irrigation/ Agriculture	195	UTA	7.26
128	-1322	30.6616	-91.280	E. Baton Rouge	Industrial	204	--	7.27
123	- 101	30.8452	-91.400	W. Feliciana	Stock	260	Zone 1	7.27
126	- 114	30.8274	-91.424	W. Feliciana	Public-Institution	230	Zone 1	7.28
125	-5241Z	30.8561	-91.375	W. Feliciana	Irrigation/ Agriculture	300	Zone 1	7.30
132	- 838	30.6600	-91.280	E. Baton Rouge	Industrial	1282	Zone 2	7.37
129	-5561Z	30.7927	-91.216	E. Feliciana	Domestic	400	--	7.42
130	-5557Z	30.7941	-91.216	E. Feliciana	Domestic	140	--	7.45
136	-1173	30.6600	-91.277	E. Baton Rouge	Industrial	2436	Zone 3	7.45
137	-1256	30.6600	-91.277	E. Baton Rouge	Industrial	392	UTA	7.45
138	- 875	30.6602	-91.275	E. Baton Rouge	Public-Institution	1277	Zone 2	7.49
134	- 109	30.8452	-91.406	W. Feliciana	Stock	245	Zone 1	7.49
131	-5347Z	30.7933	-91.215	E. Feliciana	Domestic	270	Zone 1	7.49
133	-5338Z	30.7927	-91.214	E. Feliciana	Domestic	190	UTA	7.52
135	-5450Z	30.8030	-91.218	E. Feliciana	Domestic	160	UTA	7.58
140	- 85	30.7144	-91.215	E. Feliciana	Domestic	1090	Zone 1	7.65

Table 2.4.12-212 (Sheet 6 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
139	- 208	30.7502	-91.205	E. Feliciana	Domestic	250	UTA	7.66
141	- 837	30.6575	-91.274	E. Baton Rouge	Industrial	1300	Zone 2	7.67
142	- 846	30.6572	-91.275	E. Baton Rouge	Industrial	2475	Zone 3	7.68
143	- 194	30.6855	-91.233	E. Baton Rouge	Domestic	1900	Zone 3	7.73
146	-1241	30.6527	-91.279	E. Baton Rouge	Industrial	2376	Zone 3	7.86
147	-1257	30.6527	-91.279	E. Baton Rouge	Industrial	397	UTA	7.86
148	-1294	30.6530	-91.277	E. Baton Rouge	Industrial	770	Zone 1	7.87
145	- 77	30.7072	-91.214	E. Feliciana	Domestic	1122	Zone 1	7.88
149	-1277	30.6530	-91.277	E. Baton Rouge	Industrial	1287	Zone 2	7.89
150	- 845	30.6527	-91.277	E. Baton Rouge	Industrial	2485	Zone 3	7.89
144	-5479Z	30.8044	-91.212	E. Feliciana	Domestic	270	UTA	7.94
153	- 840	30.6508	-91.280	E. Baton Rouge	Industrial	785	Zone 1	7.95
152	- 943	30.6611	-91.258	E. Baton Rouge	Domestic	200	UTA	7.95
151	-1326	30.6819	-91.231	E. Baton Rouge	Irrigation/ Agriculture	195	--	7.95
154	-1174	30.6541	-91.271	E. Baton Rouge	Industrial	2460	Zone 3	7.98
156	- 947	30.6544	-91.268	E. Baton Rouge	Industrial	265	UTA	8.03
158	-1247	30.6480	-91.283	E. Baton Rouge	Industrial	2362	Zone 3	8.06
159	-1248	30.6480	-91.282	E. Baton Rouge	Industrial	1302	Zone 2	8.07
160	- 105	30.8550	-91.409	W. Feliciana	Industrial	180	Zone 1	8.14
162	- 844B	30.6486	-91.277	E. Baton Rouge	Industrial	2478	Zone 3	8.16
155	-5274Z	30.8383	-91.234	W. Feliciana	Irrigation/ Agriculture	240	Zone 1	8.17
163	- 835	30.6483	-91.277	E. Baton Rouge	Industrial	1328	Zone 2	8.17
157	- 216	30.8411	-91.237	W. Feliciana	Irrigation- Agriculture	152	Zone 1	8.20
161	-5444Z	30.7563	-91.196	E. Feliciana	Domestic	235	UTA	8.20
165	-1243	30.6477	-91.276	E. Baton Rouge	Industrial	390	UTA	8.24
164	-5416Z	30.7844	-91.198	E. Feliciana	Domestic	130	UTA	8.30
167	- 689	30.6419	-91.290	E. Baton Rouge	Domestic	1193	Zone 2	8.30
166	- 973	30.6536	-91.260	E. Baton Rouge	Industrial	390	UTA	8.32

Table 2.4.12-212 (Sheet 7 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
168	- 433	30.6924	-91.213	E. Baton Rouge	Domestic	1907	Zone 3	8.40
173	- 963	30.6474	-91.270	E. Baton Rouge	Industrial	1054	Zone 1	8.42
174	-1231	30.6469	-91.270	E. Baton Rouge	Industrial	280	UTA	8.44
170	-1204	30.7033	-91.206	E. Baton Rouge	Irrigation/ Agriculture	190	UTA	8.44
169	-5362Z	30.7097	-91.202	E. Feliciana	Domestic	93	UTA	8.45
172	- 135	30.8763	-91.367	W. Feliciana	Domestic	335	Zone 1	8.50
175	- 103	30.8605	-91.411	W. Feliciana	Domestic	167	UTA	8.51
171	- 282	30.8158	-91.208	E. Feliciana	Public-Institution	1525	Zone 3	8.54
176	- 258	30.8802	-91.358	W. Feliciana	Industrial	866	Zone 2	8.65
177	- 177	30.8502	-91.234	W. Feliciana	Domestic	450	Zone 1	8.75
178	-5096Z	30.6477	-91.256	E. Baton Rouge	Domestic	200	UTA	8.78
179	- 508	30.6897	-91.206	E. Baton Rouge	Domestic	1135	Zone 2	8.88
181	-1190	30.6358	-91.277	E. Baton Rouge	Public-Commercial	200	UTA	8.97
180	- 228B	30.8297	-91.207	E. Feliciana	Public-Institution	1276	Zone 3	9.06
182	- 125	30.8880	-91.350	W. Feliciana	Domestic	837	Zone 2	9.12
183	- 213	30.7311	-91.179	E. Feliciana	Stock	230	UTA	9.35
184	- 281	30.8930	-91.339	W. Feliciana	Irrigation/ Agriculture	185	UTA	9.41
185	- 128	30.8930	-91.339	W. Feliciana	Domestic	787	Zone 2	9.42
186	- 136	30.8938	-91.326	W. Feliciana	Domestic	320	Zone 1	9.48
187	-5474Z	30.8372	-91.204	E. Feliciana	Irrigation/ Agriculture	265	Zone 1	9.51
188	-5559Z	30.8061	-91.184	E. Feliciana	Domestic	120	--	9.53
189	- 48	30.8372	-91.203	E. Feliciana	Industrial	365	Zone 1	9.55
190	- 62	30.8955	-91.346	W. Feliciana	Domestic	576	Zone 1	9.61
191	-5453Z	30.8444	-91.207	E. Feliciana	Domestic	135	UTA	9.66
193	- 262	30.8369	-91.200	E. Feliciana	Public-Municipal	1292	Zone 3	9.67
192	- 258	30.8463	-91.209	E. Feliciana	Public-Municipal	1256	Zone 2	9.67
194	- 301	30.8388	-91.201	E. Feliciana	Public-Municipal	1270	Zone 3	9.72
195	- 211	30.7563	-91.170	E. Feliciana	Domestic	38	UTA	9.74

Table 2.4.12-212 (Sheet 8 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
197	-5174Z	30.7500	-91.168	E. Feliciana	Domestic	195	UTA	9.84
196	-5313Z	30.8111	-91.180	E. Feliciana	Domestic	140	UTA	9.86
198	-5215Z	30.8091	-91.179	E. Feliciana	Domestic	240	Zone 1	9.90
199	- 104	30.8811	-91.416	W. Feliciana	Domestic	72	UTA	9.90
200	- 180	30.8888	-91.265	W. Feliciana	Domestic	340	Zone 1	9.98
201	- 288	30.7658	-91.165	E. Feliciana	Irrigation/ Agriculture	185	UTA	10.03
202	- 171	30.9011	-91.312	W. Feliciana	Industrial	540	Zone 1	10.05
203	- 173	30.8788	-91.241	W. Feliciana	Stock	234	Zone 1	10.07
204	- 291	30.8955	-91.281	W. Feliciana	Public-Rural	1072	Zone 3	10.08
206	-5397Z	30.7533	-91.163	E. Feliciana	Domestic	210	UTA	10.14
205	- 146	30.8961	-91.279	W. Feliciana	Public-Institution	466	Zone 1	10.15
209	-1225	30.6383	-91.231	E. Baton Rouge	Irrigation/ Agriculture	320	UTA	10.17
207	- 126	30.9041	-91.342	W. Feliciana	Domestic	175	UTA	10.19
211	-1316	30.6383	-91.230	E. Baton Rouge	Irrigation/ Agriculture	200	UTA	10.21
208	- 196	30.8355	-91.188	E. Feliciana	Domestic	296	Zone 1	10.22
215	-8722Z	30.6283	-91.244	E. Baton Rouge	Industrial	240	--	10.31
210	-5577Z	30.8322	-91.184	E. Feliciana	Irrigation/ Agriculture	120	--	10.32
212	- 273	30.8286	-91.181	E. Feliciana	Public-Institution	1325	Zone 3	10.34
213	- 272	30.8286	-91.181	E. Feliciana	Public-Institution	1325	Zone 3	10.35
214	-5388Z	30.7527	-91.160	E. Feliciana	Domestic	197	UTA	10.36
216	- 919	30.6630	-91.196	E. Baton Rouge	Domestic	385	UTA	10.39
217	-5236Z	30.8736	-91.444	W. Feliciana	Domestic	145	Zone 1	10.41
219	- 112	30.8847	-91.429	W. Feliciana	Domestic	465	Zone 2	10.52
218	-5364Z	30.7608	-91.156	E. Feliciana	Domestic	170	UTA	10.54
220	-1186	30.6641	-91.192	E. Baton Rouge	Public-Municipal	2096	Zone 3	10.54
222	- 263	30.8216	-91.494	W. Feliciana	Irrigation/ Agriculture	216	MRAA	10.57
221	-5377Z	30.7836	-91.157	E. Feliciana	Domestic	185	UTA	10.66

Table 2.4.12-212 (Sheet 9 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
223	- 195	30.8283	-91.172	E. Feliciana	Domestic	364	Zone 1	10.80
224	- 19	30.8841	-91.228	W. Feliciana	Stock	157	UTA	10.81
227	-1302	30.6538	-91.195	E. Baton Rouge	Public-Municipal	2120	Zone 3	10.85
225	-5595Z	30.7583	-91.151	E. Feliciana	Domestic	230	--	10.85
230	-8085Z	30.6355	-91.216	E. Baton Rouge	Domestic	230	UTA	10.87
228	- 588	30.7038	-91.161	E. Baton Rouge	Public-Municipal	2201	Zone 3	10.90
231	-1315	30.6661	-91.183	E. Baton Rouge	Irrigation/ Agriculture	330	UTA	10.90
232	-8086Z	30.6977	-91.163	E. Baton Rouge	Irrigation/ Agriculture	200	UTA	10.93
226	- 94	30.8538	-91.188	E. Feliciana	Domestic	113	UTA	10.93
229	- 100	30.8688	-91.203	E. Feliciana	Domestic	680	Zone 1	10.98
233	- 854	30.6650	-91.182	E. Baton Rouge	Public-Municipal	2090	Zone 3	11.00
236	- 200	30.8102	-91.509	W. Feliciana	Stock	408	Zone 1	11.05
234	-5452Z	30.7094	-91.156	E. Feliciana	Domestic	155	UTA	11.07
235	-8240Z	30.6897	-91.164	E. Baton Rouge	Domestic	70	UTA	11.07
238	-8464Z	30.6055	-91.262	E. Baton Rouge	Public-Institution	315	UTA	11.24
237	- 542	30.6547	-91.186	E. Baton Rouge	Domestic	1405	Zone 2	11.25
240	-5322Z	30.7199	-91.146	E. Feliciana	Domestic	160	UTA	11.41
242	-8193Z	30.7016	-91.152	E. Baton Rouge	Domestic	168	UTA	11.43
239	- 170	30.9197	-91.298	W. Feliciana	Domestic	220	Zone 1	11.44
241	- 98	30.8713	-91.194	E. Feliciana	Domestic	136	UTA	11.48
244	- 190	30.6411	-91.193	E. Baton Rouge	Domestic	1876	Zone 3	11.54
243	- 254	30.8702	-91.190	E. Feliciana	Public-Rural	1728	Zone 3	11.57
248	- 970	30.6127	-91.232	E. Baton Rouge	Industrial	1132	Zone 1	11.61
247	- 643	30.6341	-91.199	E. Baton Rouge	Stock	2250	Zone 3	11.62
250	- 969	30.6125	-91.231	E. Baton Rouge	Industrial	1130	Zone 1	11.65
245	- 168	30.9194	-91.281	W. Feliciana	Domestic	220	Zone 1	11.65
249	- 223	30.7191	-91.142	E. Feliciana	Public-Municipal	2000	Zone 3	11.70
246	- 185	30.8330	-91.158	E. Feliciana	Public-Institution	1514	Zone 3	11.71
252	- 539	30.6247	-91.209	E. Baton Rouge	Domestic	2590	Zone 3	11.72

Table 2.4.12-212 (Sheet 10 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
251	-5282Z	30.8788	-91.471	W. Feliciana	Irrigation/ Agriculture	270	Zone 1	11.74
256	- 915	30.6125	-91.225	E. Baton Rouge	Domestic	265	UTA	11.82
253	- 259	30.9280	-91.338	W. Feliciana	Public-Rural	1005	Zone 3	11.82
260	-1314	30.5977	-91.257	E. Baton Rouge	Public-Institution	2003	Zone 3	11.84
254	- 50	30.8347	-91.156	E. Feliciana	Public-Institution	1503	Zone 2	11.87
257	-5054Z	30.9055	-91.434	W. Feliciana	Domestic	130	Zone 1	11.89
255	- 289	30.9255	-91.292	W. Feliciana	Irrigation/ Agriculture	185	Zone 1	11.91
262	-5221Z	30.8405	-91.509	W. Feliciana	Irrigation/ Agriculture	120	MRAA	11.92
261	- 287	30.6838	-91.152	E. Baton Rouge	Domestic	240	UTA	11.92
263	- 293	30.8502	-91.502	W. Feliciana	Irrigation/ Agriculture	134	MRAA	11.93
259	- 286	30.9297	-91.339	W. Feliciana	Public-Rural	982	Zone 3	11.94
258	-5414Z	30.8761	-91.188	E. Feliciana	Domestic	250	Zone 1	11.97
266	-8237Z	30.6924	-91.145	E. Baton Rouge	Domestic	160	UTA	12.05
267	- 321	30.6202	-91.206	E. Baton Rouge	Domestic	1460	Zone 2	12.05
264	- 176	30.9086	-91.233	W. Feliciana	Domestic	260	Zone 1	12.08
265	- 205	30.7711	-91.131	E. Feliciana	Domestic	151	UTA	12.08
269	- 113	30.8502	-91.506	W. Feliciana	Irrigation- Agriculture	420	Zone 2	12.11
268	- 122	30.7847	-91.132	E. Feliciana	Domestic	100	UTA	12.16
270	-8260Z	30.7069	-91.137	E. Baton Rouge	Domestic	110	UTA	12.19
271	-1310	30.6394	-91.180	E. Baton Rouge	Irrigation/ Agriculture	280	UTA	12.20
273	- 136	30.6844	-91.145	E. Baton Rouge	Domestic	1300	Zone 3	12.25
272	-5560Z	30.8727	-91.176	E. Feliciana	Domestic	120	Zone 3	12.32
274	- 169	30.9299	-91.282	W. Feliciana	Domestic	225	Zone 1	12.33
275	-5539Z	30.8586	-91.163	E. Feliciana	Domestic	120	--	12.37
276	- 95	30.8969	-91.467	W. Feliciana	Domestic	142	UTA	12.51
277	- 100	30.9027	-91.458	W. Feliciana	Domestic	1209	Zone 3	12.51
280	- 106	30.8805	-91.488	W. Feliciana	Stock	225	Zone 1	12.55

Table 2.4.12-212 (Sheet 11 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
281	- 310	30.8786	-91.491	W. Feliciana	Irrigation/ Agriculture	164	--	12.57
279	-6402Z	30.7072	-91.130	E. Baton Rouge	Domestic	90	UTA	12.58
278	- 127	30.9386	-91.349	W. Feliciana	Domestic	40	UTA	12.59
282	-5305Z	30.7374	-91.122	E. Feliciana	Domestic	205	UTA	12.66
283	- 129	30.7238	-91.124	E. Feliciana	Domestic	186	UTA	12.69
284	- 173	30.6783	-91.140	E. Baton Rouge	Domestic	1035	Zone 2	12.70
286	-5567Z	30.7394	-91.120	E. Feliciana	Domestic	210	--	12.77
285	- 18	30.9363	-91.281	W. Feliciana	Domestic	218	Zone 1	12.79
287	-5217Z	30.7297	-91.121	E. Feliciana	Domestic	245	UTA	12.79
289	-5487Z	30.5974	-91.223	E. Baton Rouge	Domestic	230	UTA	12.79
288	- 128	30.7519	-91.117	E. Feliciana	Domestic	225	UTA	12.87
292	- 97	30.9141	-91.451	W. Feliciana	Domestic	111	UTA	12.91
293	- 234	30.9141	-91.451	W. Feliciana	Domestic	558	Zone 2	12.91
295	- 98	30.8994	-91.474	W. Feliciana	Domestic	125	UTA	12.92
297	-1260	30.5841	-91.247	E. Baton Rouge	Industrial	1252	Zone 1	12.95
290	- 175	30.9138	-91.214	W. Feliciana	Domestic	90	Zone 1	12.96
291	-5054Z	30.8749	-91.164	E. Feliciana	Domestic	140	Zone 1	12.96
298	- 748	30.5852	-91.242	E. Baton Rouge	Industrial	1277	Zone 1	12.99
294	- 97	30.8927	-91.182	E. Feliciana	Domestic	225	Zone 1	13.00
296	-5067Z	30.8736	-91.161	E. Feliciana	Domestic	120	UTA	13.06
302	-1020	30.5838	-91.242	E. Baton Rouge	Industrial	2441	Zone 3	13.07
304	-1155	30.5838	-91.239	E. Baton Rouge	Industrial	1296	Zone 1	13.14
299	-5224Z	30.8766	-91.162	E. Feliciana	Domestic	280	Zone 1	13.15
300	- 71	30.9252	-91.230	W. Feliciana	Domestic	593	Zone 3	13.16
301	-5268Z	30.8761	-91.160	E. Feliciana	Domestic	65	UTA	13.21
312	-1048	30.5822	-91.241	E. Baton Rouge	Industrial	1288	Zone 1	13.21
308	-8242Z	30.6230	-91.174	E. Baton Rouge	Domestic	260	UTA	13.22
313	- 384	30.6016	-91.202	E. Baton Rouge	Domestic	1916	Zone 3	13.24
303	- 149	30.9394	-91.265	W. Feliciana	Domestic	240	Zone 1	13.25

Table 2.4.12-212 (Sheet 12 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
310	- 96	30.9172	-91.456	W. Feliciana	Domestic	293	Zone 1	13.26
317	-6473Z	30.5922	-91.217	E. Baton Rouge	Domestic	270	UTA	13.27
311	- 243	30.9247	-91.442	W. Feliciana	Domestic	90	UTA	13.27
320	-1034	30.5836	-91.234	E. Baton Rouge	Industrial	2608	Zone 3	13.29
316	- 31	30.9202	-91.452	W. Feliciana	Domestic	242	Zone 1	13.30
324	- 645	30.5833	-91.234	E. Baton Rouge	Industrial	2579	Zone 3	13.31
305	-5253Z	30.8755	-91.157	E. Feliciana	Domestic	86	UTA	13.31
306	-5540Z	30.8755	-91.157	E. Feliciana	Domestic	140	UTA	13.31
325	-1152	30.5819	-91.238	E. Baton Rouge	Industrial	1231	Zone 1	13.31
314	-8721Z	30.7080	-91.117	E. Baton Rouge	Domestic	270	--	13.31
307	-5325Z	30.8763	-91.158	E. Feliciana	Domestic	87	UTA	13.32
309	-5257Z	30.8772	-91.158	E. Feliciana	Domestic	90	UTA	13.33
315	-5505Z	30.8744	-91.155	E. Feliciana	Domestic	160	UTA	13.37
318	-5544Z	30.7655	-91.109	E. Feliciana	Domestic	120	--	13.38
319	-5371Z	30.8763	-91.156	E. Feliciana	Domestic	93	UTA	13.41
333	- 380	30.5977	-91.203	E. Baton Rouge	Domestic	1122	Zone 1	13.43
321	-5534Z	30.8747	-91.154	E. Feliciana	Domestic	102	UTA	13.43
322	-5055Z	30.8772	-91.156	E. Feliciana	Domestic	90	UTA	13.43
323	-5293Z	30.8774	-91.156	E. Feliciana	Domestic	83	UTA	13.44
327	-8761Z	30.7083	-91.115	E. Baton Rouge	Domestic	252	--	13.45
326	-5363Z	30.8805	-91.159	E. Feliciana	Domestic	68	UTA	13.46
330	- 286	30.6899	-91.121	E. Baton Rouge	Domestic	265	UTA	13.47
336	-5480Z	30.5891	-91.216	E. Baton Rouge	Domestic	250	UTA	13.49
328	-5275Z	30.8786	-91.156	E. Feliciana	Domestic	63	UTA	13.52
329	-5309Z	30.9077	-91.189	E. Feliciana	Domestic	230	Zone 1	13.52
334	-5096Z	30.9486	-91.381	W. Feliciana	Domestic	258	Zone 1	13.53
331	-5310Z	30.8744	-91.151	E. Feliciana	Domestic	290	Zone 1	13.54
332	-5433Z	30.8388	-91.127	E. Feliciana	Domestic	90	UTA	13.54
335	-5476Z	30.7597	-91.106	E. Feliciana	Irrigation/ Agriculture	150	UTA	13.55

Table 2.4.12-212 (Sheet 13 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
341	-8739Z	30.5794	-91.234	E. Baton Rouge	Public-Commercial	300	--	13.56
339	-8238Z	30.7072	-91.112	E. Baton Rouge	Domestic	240	UTA	13.60
343	-6853Z	30.5941	-91.203	E. Baton Rouge	Domestic	280	UTA	13.62
337	-5068Z	30.8749	-91.150	E. Feliciana	Domestic	185	UTA	13.63
338	-5513Z	30.8844	-91.159	E. Feliciana	Domestic	265	Zone 1	13.63
342	- 770	30.6469	-91.142	E. Baton Rouge	Public-Municipal	2080	Zone 3	13.66
340	-5225Z	30.8855	-91.159	E. Feliciana	Domestic	155	UTA	13.68
347	- 99	30.9216	-91.463	W. Feliciana	Domestic	294	Zone 1	13.72
354	- 346	30.5941	-91.199	E. Baton Rouge	Domestic	1604	Zone 2	13.75
355	- 457	30.5883	-91.209	E. Baton Rouge	Domestic	913	Zone 1	13.75
344	-5194Z	30.8874	-91.159	E. Feliciana	Domestic	95	UTA	13.75
345	-5280Z	30.8772	-91.149	E. Feliciana	Domestic	150	UTA	13.76
346	-5350Z	30.8744	-91.146	E. Feliciana	Domestic	110	UTA	13.79
348	-5477Z	30.8430	-91.124	E. Feliciana	Domestic	115	Zone 1	13.80
352	-5379Z	30.8272	-91.116	E. Feliciana	Irrigation/Agriculture	115	UTA	13.82
349	-5369Z	30.8783	-91.149	E. Feliciana	Domestic	80	UTA	13.82
350	-5150Z	30.8686	-91.141	E. Feliciana	Domestic	210	Zone 1	13.82
351	-5503Z	30.8761	-91.147	E. Feliciana	Domestic	70	UTA	13.82
353	-5389Z	30.8791	-91.149	E. Feliciana	Domestic	140	UTA	13.87
356	-5447Z	30.8558	-91.130	E. Feliciana	Domestic	120	Zone 1	13.92
367	- 428	30.5822	-91.215	E. Baton Rouge	Public-Commercial	190	UTA	13.93
357	-5346Z	30.7219	-91.103	E. Feliciana	Domestic	120	UTA	13.95
361	-7297Z	30.6674	-91.123	E. Baton Rouge	Domestic	210	UTA	13.96
358	-5176Z	30.8677	-91.136	E. Feliciana	Domestic	100	Zone 1	14.00
370	-1184	30.5808	-91.214	E. Baton Rouge	Industrial	195	UTA	14.03
359	- 92	30.8694	-91.137	E. Feliciana	Domestic	162	UTA	14.03
360	- 93	30.8694	-91.137	E. Feliciana	Domestic	140	UTA	14.03
362	-5267Z	30.8761	-91.143	E. Feliciana	Public-Commercial	120	UTA	14.03

Table 2.4.12-212 (Sheet 14 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
363	- 290	30.8697	-91.137	E. Feliciana	Irrigation/ Agriculture	125	UTA	14.04
364	-5223Z	30.8699	-91.137	E. Feliciana	Public- Commercial	100	Zone 1	14.05
366	- 172	30.9455	-91.245	W. Feliciana	Domestic	143	Zone 1	14.05
365	-5378Z	30.8788	-91.144	E. Feliciana	Domestic	160	UTA	14.05
368	- 32	30.9500	-91.409	W. Feliciana	Domestic	387	Zone 1	14.08
369	- 227	30.9613	-91.325	W. Feliciana	Domestic	443	Zone 1	14.12
379	- 432	30.5849	-91.203	E. Baton Rouge	Public-Institution	1942	Zone 3	14.13
372	-8725Z	30.6869	-91.110	E. Baton Rouge	Domestic	225	--	14.14
373	-5673Z	30.6938	-91.107	E. Baton Rouge	Domestic	215	UTA	14.14
374	- 289	30.7136	-91.101	E. Feliciana	Irrigation/ Agriculture	120	UTA	14.17
371	-5376Z	30.9105	-91.175	E. Feliciana	Domestic	110	UTA	14.18
376	- 124	30.7877	-91.098	E. Feliciana	Public-Institution	78	UTA	14.20
381	-6288Z	30.6919	-91.107	E. Baton Rouge	Domestic	200	UTA	14.21
380	- 229	30.7141	-91.100	E. Feliciana	Domestic	186	UTA	14.21
389	-1001	30.5813	-91.207	E. Baton Rouge	Public-Institution	1926	Zone 3	14.22
382	-8018Z	30.6922	-91.106	E. Baton Rouge	Domestic	200	UTA	14.22
375	- 91	30.8691	-91.133	E. Feliciana	Stock	130	UTA	14.22
378	- 132	30.9608	-91.367	W. Feliciana	Stock	145	Zone 1	14.22
384	-8087Z	30.6899	-91.107	E. Baton Rouge	Domestic	220	UTA	14.23
383	-8914Z	30.7077	-91.101	E. Baton Rouge	Domestic	160	--	14.23
377	-5515Z	30.8930	-91.154	E. Feliciana	Domestic	265	Zone 1	14.23
386	-5251Z	30.9322	-91.460	W. Feliciana	Irrigation/ Agriculture	190	Zone 1	14.26
387	-8130Z	30.6888	-91.107	E. Baton Rouge	Domestic	200	UTA	14.28
388	-8129Z	30.6886	-91.107	E. Baton Rouge	Domestic	200	UTA	14.28
391	-5510Z	30.6858	-91.108	E. Baton Rouge	Domestic	200	UTA	14.29
385	-5106Z	30.8705	-91.133	E. Feliciana	Domestic	120	Zone 1	14.29
390	-8025Z	30.7077	-91.100	E. Baton Rouge	Domestic	120	UTA	14.29
394	-8076Z	30.6869	-91.107	E. Baton Rouge	Domestic	220	UTA	14.32

Table 2.4.12-212 (Sheet 15 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
395	-8031Z	30.6849	-91.107	E. Baton Rouge	Domestic	210	UTA	14.35
392	- 150	30.9466	-91.235	W. Feliciana	Domestic	230	Zone 1	14.36
397	-7662Z	30.6844	-91.107	E. Baton Rouge	Domestic	260	UTA	14.36
396	-8206Z	30.6858	-91.106	E. Baton Rouge	Domestic	195	UTA	14.36
393	-5244Z	30.8944	-91.152	E. Feliciana	Domestic	320	Zone 1	14.38
398	-5421Z	30.7408	-91.092	E. Feliciana	Domestic	135	UTA	14.40
399	-8726Z	30.6874	-91.105	E. Baton Rouge	Domestic	225	--	14.42
400	- 25	30.7372	-91.092	E. Feliciana	Domestic	189	UTA	14.45
404	-7668Z	30.6824	-91.106	E. Baton Rouge	Domestic	200	UTA	14.48
403	-5296Z	30.7324	-91.092	E. Feliciana	Domestic	178	UTA	14.48
405	-8485Z	30.6872	-91.104	E. Baton Rouge	Domestic	200	UTA	14.49
406	-7669Z	30.6824	-91.106	E. Baton Rouge	Domestic	200	UTA	14.49
402	-5218Z	30.9613	-91.277	W. Feliciana	Domestic	130	Zone 1	14.51
401	-5240Z	30.9091	-91.165	E. Feliciana	Domestic	310	Zone 1	14.51
412	-6366Z	30.7041	-91.097	E. Baton Rouge	Domestic	200	UTA	14.53
408	- 121	30.7927	-91.093	E. Feliciana	Domestic	114	UTA	14.55
410	- 248	30.7830	-91.091	E. Feliciana	Public-Rural	2197	Zone 3	14.55
407	-5226Z	30.9086	-91.163	E. Feliciana	Domestic	300	Zone 1	14.57
409	-5565Z	30.8986	-91.152	E. Feliciana	Domestic	100	--	14.57
413	-5216Z	30.9644	-91.288	W. Feliciana	Irrigation/ Agriculture	195	Zone 1	14.58
411	-5554Z	30.8969	-91.150	E. Feliciana	Irrigation/ Agriculture	122	--	14.58
414	- 237	30.7830	-91.090	E. Feliciana	Domestic	140	UTA	14.60
415	-5014Z	30.9033	-91.511	W. Feliciana	Domestic	200	Zone 1	14.60
422	-1027	30.5733	-91.208	E. Baton Rouge	Public-Municipal	1926	Zone 3	14.68
416	-5177Z	30.9111	-91.163	E. Feliciana	Domestic	300	Zone 1	14.72
425	-1153	30.5716	-91.210	E. Baton Rouge	Industrial	977	Zone 1	14.72
417	-5522Z	30.8977	-91.148	E. Feliciana	Irrigation/ Agriculture	170	UTA	14.72
418	-5523Z	30.8980	-91.148	E. Feliciana	Domestic	170	UTA	14.72

Table 2.4.12-212 (Sheet 16 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
419	-5010Z	30.9130	-91.165	E. Feliciana	Domestic	310	Zone 1	14.73
421	- 123	30.7588	-91.086	E. Feliciana	Domestic	108	UTA	14.74
420	- 273	30.9347	-91.196	W. Feliciana	Public-Institution	160	Zone 1	14.75
424	-6661Z	30.7030	-91.093	E. Baton Rouge	Domestic	210	UTA	14.77
423	- 131	30.9705	-91.350	W. Feliciana	Domestic	360	Zone 1	14.78
427	-6257Z	30.6883	-91.097	E. Baton Rouge	Domestic	210	UTA	14.83
426	-5143Z	30.8994	-91.146	E. Feliciana	Domestic	300	Zone 1	14.87
428	-5187Z	30.7344	-91.084	E. Feliciana	Domestic	240	UTA	14.91
435	- 886	30.5677	-91.211	E. Baton Rouge	Industrial	384	UTA	14.92
430	-8232Z	30.6883	-91.095	E. Baton Rouge	Domestic	250	UTA	14.93
429	-5185Z	30.9186	-91.166	E. Feliciana	Domestic	275	Zone 1	14.96
432	-5308Z	30.9736	-91.348	W. Feliciana	Domestic	100	UTA	14.99
433	-5310Z	30.9736	-91.348	W. Feliciana	Domestic	100	UTA	14.99
434	-5366Z	30.7197	-91.085	E. Feliciana	Domestic	310	Zone 1	15.00
431	-5464Z	30.9055	-91.150	E. Feliciana	Domestic	260	--	15.00
436	-5279Z	30.9669	-91.399	W. Feliciana	Domestic	240	Zone 1	15.02
438	- 129	30.9727	-91.368	W. Feliciana	Stock	162	Zone 1	15.04
437	- 145	30.9747	-91.340	W. Feliciana	Domestic	480	Zone 2	15.04
439	- 230	30.9749	-91.336	W. Feliciana	Stock	562	Zone 2	15.05
440	-5480Z	30.9011	-91.143	E. Feliciana	Domestic	105	UTA	15.08
445	- 698	30.5922	-91.166	E. Baton Rouge	Public-Municipal	2395	Zone 3	15.10
441	- 283	30.8955	-91.137	E. Feliciana	Stock	172	UTA	15.12
443	-5287Z	30.9763	-91.341	W. Feliciana	Domestic	130	Zone 1	15.16
448	-5277Z	30.9416	-91.472	W. Feliciana	Irrigation/ Agriculture	250	Zone 1	15.17
442	-5345Z	30.9199	-91.162	E. Feliciana	Public-Commercial	250	Zone 1	15.18
447	- 829	30.6861	-91.092	E. Baton Rouge	Public-Municipal	1972	Zone 3	15.18
444	-5085Z	30.8163	-91.088	E. Feliciana	Domestic	120	UTA	15.18
451	- 107	30.9477	-91.461	W. Feliciana	Domestic	30	UTA	15.20
454	- 754	30.5994	-91.154	E. Baton Rouge	Public-Municipal	2368	Zone 3	15.21

Table 2.4.12-212 (Sheet 17 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
449	- 130	30.9769	-91.352	W. Feliciana	Domestic	169	Zone 1	15.23
446	-5569Z	30.9102	-91.149	E. Feliciana	Domestic	260	--	15.24
452	-5498Z	30.7569	-91.077	E. Feliciana	Irrigation/ Agriculture	92	UTA	15.25
458	- 290	30.6363	-91.118	E. Baton Rouge	Domestic	366	UTA	15.25
453	-5514Z	30.7633	-91.077	E. Feliciana	Domestic	75	UTA	15.26
450	- 241	30.8477	-91.100	E. Feliciana	Domestic	96	UTA	15.27
457	- 417	30.6872	-91.090	E. Baton Rouge	Domestic	210	UTA	15.27
465	- 655	30.5588	-91.217	E. Baton Rouge	Public-Commercial	1341	Zone 1	15.29
456	-5384Z	30.7605	-91.076	E. Feliciana	Domestic	90	UTA	15.30
455	-5094Z	30.8974	-91.134	E. Feliciana	Domestic	200	Zone 1	15.32
459	- 294	30.8838	-91.122	E. Feliciana	Irrigation/ Agriculture	307	Zone 1	15.34
467	- 142	30.6525	-91.105	E. Baton Rouge	Domestic	1170	Zone 1	15.35
460	-5314Z	30.9349	-91.178	E. Feliciana	Domestic	220	Zone 1	15.38
461	-5158Z	30.9036	-91.139	E. Feliciana	Domestic	125	UTA	15.38
469	-5593Z	30.6916	-91.086	E. Baton Rouge	Domestic	228	UTA	15.39
479	- 629	30.5619	-91.206	E. Baton Rouge	Industrial	1025	Zone 1	15.39
462	-5329Z	30.9133	-91.149	E. Feliciana	Domestic	97	UTA	15.39
464	-5214Z	30.9774	-91.294	W. Feliciana	Irrigation/ Agriculture	65	UTA	15.41
463	-5197Z	30.9036	-91.138	E. Feliciana	Domestic	253	Zone 1	15.42
484	- 978	30.5613	-91.206	E. Baton Rouge	Industrial	2540	Zone 3	15.43
486	-1268	30.5597	-91.210	E. Baton Rouge	Industrial	2504	Zone 3	15.43
466	-5034Z	30.9186	-91.155	E. Feliciana	Domestic	220	Zone 1	15.43
470	-5215Z	30.9780	-91.296	W. Feliciana	Irrigation/ Agriculture	198	Zone 1	15.43
472	-5302Z	30.9802	-91.346	W. Feliciana	Domestic	100	UTA	15.43
487	- 659	30.5688	-91.192	E. Baton Rouge	Public-Municipal	1295	Zone 1	15.44
481	-5016Z	30.9072	-91.526	W. Feliciana	Domestic	170	Zone 1	15.44
468	-5033Z	30.9177	-91.153	E. Feliciana	Domestic	220	Zone 1	15.44

Table 2.4.12-212 (Sheet 18 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
471	-5288Z	30.9188	-91.154	E. Feliciana	Domestic	85	UTA	15.46
482	-5328Z	30.9458	-91.473	W. Feliciana	Domestic	180	--	15.47
483	-5273Z	30.9452	-91.474	W. Feliciana	Irrigation/ Agriculture	290	Zone 1	15.47
473	-5250Z	30.8994	-91.133	E. Feliciana	Domestic	161	UTA	15.47
474	-5258Z	30.9102	-91.144	E. Feliciana	Domestic	310	Zone 1	15.48
475	-5118Z	30.9047	-91.138	E. Feliciana	Domestic	120	UTA	15.50
489	- 341	30.6602	-91.098	E. Baton Rouge	Domestic	1670	Zone 3	15.50
485	-5189Z	30.6911	-91.084	E. Baton Rouge	Domestic	230	UTA	15.50
476	-5087Z	30.9050	-91.138	E. Feliciana	Domestic	115	UTA	15.51
477	-5286Z	30.9152	-91.148	E. Feliciana	Domestic	270	Zone 1	15.52
478	-5290Z	30.9133	-91.146	E. Feliciana	Domestic	318	Zone 1	15.52
480	-5424Z	30.9361	-91.176	E. Feliciana	Domestic	260	Zone 1	15.53
497	- 977	30.5597	-91.206	E. Baton Rouge	Industrial	1340	Zone 1	15.54
494	-5594Z	30.6919	-91.083	E. Baton Rouge	Domestic	222	UTA	15.57
488	-5532Z	30.9113	-91.143	E. Feliciana	Domestic	280	Zone 1	15.57
490	-5149Z	30.9072	-91.138	E. Feliciana	Domestic	180	UTA	15.58
491	-5287Z	30.9111	-91.142	E. Feliciana	Domestic	260	Zone 1	15.58
492	-5431Z	30.9122	-91.143	E. Feliciana	Domestic	110	UTA	15.61
493	-5546Z	30.9166	-91.148	E. Feliciana	Domestic	260	--	15.62
496	- 126	30.7224	-91.074	E. Feliciana	Domestic	240	UTA	15.62
499	-5252Z	30.9474	-91.476	W. Feliciana	Domestic	330	Zone 1	15.64
495	-5551Z	30.9063	-91.136	E. Feliciana	Domestic	120	--	15.64
503	-8983Z	30.6597	-91.095	E. Baton Rouge	Domestic	240	--	15.68
498	-5411Z	30.9169	-91.146	E. Feliciana	Domestic	114	UTA	15.70
507	- 148	30.5594	-91.200	E. Baton Rouge	Domestic	1349	Zone 1	15.72
500	-5301Z	30.8722	-91.106	E. Feliciana	Domestic	320	Zone 1	15.72
501	-5032Z	30.9144	-91.142	E. Feliciana	Domestic	280	Zone 1	15.74
502	-5548Z	30.8988	-91.126	E. Feliciana	Domestic	290	--	15.74
504	-5270Z	30.9122	-91.139	E. Feliciana	Domestic	100	UTA	15.79

Table 2.4.12-212 (Sheet 19 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
505	- 214	30.7724	-91.069	E. Feliciana	Domestic	830	Zone 1	15.80
506	- 134	30.9858	-91.346	W. Feliciana	Public-Commercial	150	Zone 1	15.82
509	- 226	30.9849	-91.363	W. Feliciana	Irrigation/ Agriculture	480	Zone 2	15.84
508	-5536Z	30.8697	-91.101	E. Feliciana	Domestic	140	UTA	15.85
510	-5448Z	30.8686	-91.100	E. Feliciana	Domestic	140	Zone 1	15.89
518	- 965	30.5561	-91.200	E. Baton Rouge	Industrial	2547	Zone 3	15.92
521	-1002	30.5530	-91.206	E. Baton Rouge	Industrial	2570	Zone 3	15.93
511	-5281Z	30.8730	-91.102	E. Feliciana	Domestic	150	Zone 1	15.94
514	-5179Z	30.7888	-91.068	E. Feliciana	Domestic	80	UTA	15.94
512	-5050Z	30.9183	-91.142	E. Feliciana	Domestic	365	Zone 1	15.95
523	-1171	30.5575	-91.196	E. Baton Rouge	Industrial	445	UTA	15.96
513	-5006Z	30.9252	-91.150	E. Feliciana	Domestic	220	Zone 1	15.96
515	-5352Z	30.8699	-91.099	E. Feliciana	Domestic	140	Zone 1	15.98
524	- 984	30.5572	-91.196	E. Baton Rouge	Industrial	1365	Zone 1	15.98
526	-1292	30.5575	-91.195	E. Baton Rouge	Industrial	2420	Zone 3	15.98
516	-5427Z	30.8688	-91.098	E. Feliciana	Domestic	130	Zone 1	16.01
527	- 551	30.5888	-91.147	E. Baton Rouge	Public-Municipal	2300	Zone 3	16.01
531	- 561	30.5530	-91.203	E. Baton Rouge	Industrial	1361	Zone 1	16.02
517	-5005Z	30.8752	-91.102	E. Feliciana	Domestic	158	Zone 1	16.03
525	-5301Z	30.9525	-91.479	W. Feliciana	Domestic	185	UTA	16.04
519	- 174	30.9611	-91.205	W. Feliciana	Domestic	590	Zone 2	16.05
529	- 121	30.9586	-91.468	W. Feliciana	Domestic	175	UTA	16.05
520	-5506Z	30.8730	-91.100	E. Feliciana	Domestic	120	Zone 1	16.07
537	- 723	30.5536	-91.200	E. Baton Rouge	Industrial	2512	Zone 3	16.07
539	- 572	30.5527	-91.201	E. Baton Rouge	Industrial	2511	Zone 3	16.09
522	-5358Z	30.8697	-91.097	E. Feliciana	Domestic	135	Zone 1	16.09
528	-5374Z	30.8741	-91.099	E. Feliciana	Domestic	125	Zone 1	16.12
530	-5331Z	30.8638	-91.093	E. Feliciana	Domestic	130	Zone 1	16.13
543	-1023	30.5655	-91.175	E. Baton Rouge	Industrial	170	UTA	16.18

Table 2.4.12-212 (Sheet 20 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
533	-5415Z	30.8238	-91.073	E. Feliciana	Irrigation/ Agriculture	120	UTA	16.18
532	-5570Z	30.8647	-91.092	E. Feliciana	Domestic	120	--	16.19
534	- 141	30.9855	-91.273	W. Feliciana	Domestic	110	Zone 1	16.19
535	-5210Z	30.9469	-91.174	E. Feliciana	Domestic	135	Zone 1	16.20
536	-5264Z	30.8736	-91.097	E. Feliciana	Domestic	120	Zone 1	16.20
538	-5125Z	30.8763	-91.099	E. Feliciana	Public-Institution	110	Zone 1	16.21
540	- 66	30.9916	-91.347	W. Feliciana	Domestic	104	UTA	16.22
548	- 264	30.9663	-91.459	W. Feliciana	Public-Rural	960	Zone 3	16.26
541	-5573Z	30.8719	-91.095	E. Feliciana	Domestic	135	--	16.26
551	- 340	30.6472	-91.091	E. Baton Rouge	Domestic	1380	Zone 2	16.27
542	-5136Z	30.8747	-91.096	E. Feliciana	Domestic	115	Zone 1	16.28
544	- 140	30.9866	-91.271	W. Feliciana	Domestic	402	Zone 1	16.29
545	-5354Z	30.8772	-91.098	E. Feliciana	Domestic	130	UTA	16.31
546	-5405Z	30.8930	-91.109	E. Feliciana	Public-Commercial	100	Zone 1	16.32
549	-5494Z	30.8333	-91.074	E. Feliciana	Domestic	100	Zone 1	16.32
547	-5420Z	30.8733	-91.095	E. Feliciana	Domestic	130	Zone 1	16.32
550	-5470Z	30.8769	-91.097	E. Feliciana	Domestic	120	Zone 1	16.33
552	-5276Z	30.8763	-91.095	E. Feliciana	Domestic	135	Zone 1	16.39
553	- 127	30.7469	-91.058	E. Feliciana	Domestic	31	UTA	16.40
554	-5306Z	30.9202	-91.132	E. Feliciana	Domestic	147	Zone 1	16.45
555	-5086Z	30.8394	-91.074	E. Feliciana	Domestic	84	UTA	16.46
560	-5057Z	30.9774	-91.440	W. Feliciana	Domestic	343	Zone 1	16.48
556	-5164Z	30.9241	-91.136	E. Feliciana	Domestic	160	Zone 1	16.49
557	-5060Z	30.9291	-91.141	E. Feliciana	Domestic	100	UTA	16.51
558	-5360Z	30.9197	-91.130	E. Feliciana	Domestic	140	Zone 1	16.52
559	-5463Z	30.9288	-91.140	E. Feliciana	Domestic	95	UTA	16.53
563	-5238Z	30.9738	-91.451	W. Feliciana	Domestic	178	UTA	16.53
569	-1324	30.5627	-91.169	E. Baton Rouge	Irrigation/ Agriculture	265	--	16.55

Table 2.4.12-212 (Sheet 21 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
567	-5237Z	30.9733	-91.454	W. Feliciana	Domestic	173	UTA	16.56
561	-5303Z	30.9713	-91.208	W. Feliciana	Domestic	140	MRAA	16.57
564	- 143	30.9969	-91.347	W. Feliciana	Stock	150	Zone 1	16.59
565	- 144	30.9969	-91.347	W. Feliciana	Stock	150	Zone 1	16.59
562	-5220Z	30.9244	-91.134	E. Feliciana	Domestic	170	Zone 1	16.59
566	- 234	30.7938	-91.058	E. Feliciana	Domestic	636	Zone 1	16.60
568	- 148	30.9947	-91.289	W. Feliciana	Domestic	140	UTA	16.63
570	-5271Z	30.7466	-91.054	E. Feliciana	Domestic	78	UTA	16.65
571	- 142	30.9980	-91.347	W. Feliciana	Domestic	150	Zone 1	16.66
573	-8620Z	30.6355	-91.091	E. Baton Rouge	Domestic	380	UTA	16.68
572	- 178	30.9716	-91.203	W. Feliciana	Domestic	199	Zone 1	16.73
580	- 860	30.5530	-91.180	E. Baton Rouge	Industrial	2435	Zone 3	16.73
574	-5367Z	30.8530	-91.075	E. Feliciana	Domestic	107	Zone 1	16.75
583	- 859	30.5530	-91.179	E. Baton Rouge	Industrial	2440	Zone 3	16.75
575	-5236Z	30.8050	-91.058	E. Feliciana	Domestic	80	UTA	16.75
584	-1213	30.5452	-91.194	E. Baton Rouge	Public-Commercial	220	UTA	16.76
579	- 120	30.9655	-91.478	W. Feliciana	Domestic	85	UTA	16.76
576	- 103	30.8558	-91.076	E. Feliciana	Domestic	126	UTA	16.78
577	-5285Z	30.9824	-91.226	W. Feliciana	Domestic	215	Zone 1	16.82
578	- 104	30.8591	-91.077	E. Feliciana	Domestic	80	UTA	16.83
581	-5395Z	30.8791	-91.088	E. Feliciana	Domestic	130	UTA	16.86
582	-5417Z	30.9552	-91.168	E. Feliciana	Domestic	415	Zone 1	16.88
585	-5530Z	30.9655	-91.185	E. Feliciana	Domestic	120	UTA	16.89
586	-5303Z	30.9674	-91.189	E. Feliciana	Domestic	325	Zone 1	16.89
595	-8958Z	30.6086	-91.106	E. Baton Rouge	Domestic	180	--	16.94
587	-5156Z	30.8836	-91.089	E. Feliciana	Domestic	100	UTA	16.95
594	-8033Z	30.6466	-91.079	E. Baton Rouge	Domestic	290	UTA	16.95
588	- 87	30.9563	-91.167	E. Feliciana	Domestic	425	Zone 1	16.96
589	- 99	30.9199	-91.120	E. Feliciana	Domestic	125	UTA	16.97

Table 2.4.12-212 (Sheet 22 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
592	- 277B	30.8147	-91.056	E. Feliciana	Public-Rural	2101	Zone 3	16.98
590	- 102	30.9166	-91.116	E. Feliciana	Domestic	250	Zone 1	16.98
591	- 101	30.9186	-91.118	E. Feliciana	Domestic	30	UTA	16.99
593	-5216Z	30.9563	-91.166	E. Feliciana	Domestic	435	Zone 1	17.00
596	- 221	30.9208	-91.119	E. Feliciana	Public-Rural	506	Zone 1	17.04
598	-5471Z	30.8105	-91.054	E. Feliciana	Irrigation/ Agriculture	175	UTA	17.04
597	-5302Z	30.9711	-91.191	E. Feliciana	Domestic	450	Zone 1	17.05
608	- 491	30.5466	-91.181	E. Baton Rouge	Industrial	1320	Zone 1	17.07
599	-5399Z	30.9386	-91.139	E. Feliciana	Domestic	88	UTA	17.07
600	- 296	30.9166	-91.114	E. Feliciana	Public-Municipal	585	Zone 1	17.09
601	-5167Z	30.9633	-91.174	E. Feliciana	Domestic	135	Zone 1	17.10
609	- 339	30.5991	-91.111	E. Baton Rouge	Domestic	1206	Zone 1	17.11
603	-5490Z	30.8077	-91.052	E. Feliciana	Irrigation/ Agriculture	440	Zone 1	17.11
602	- 295	30.9727	-91.192	W. Feliciana	Public-Commercial	130	Zone 1	17.12
605	- 26	30.8080	-91.052	E. Feliciana	Domestic	427	Zone 1	17.13
604	-5114Z	30.9205	-91.117	E. Feliciana	Domestic	100	UTA	17.13
611	- 892A	30.5755	-91.135	E. Baton Rouge	Public-Municipal	2446	Zone 3	17.16
606	-5092Z	30.9486	-91.150	E. Feliciana	Domestic	230	Zone 1	17.17
607	-5201Z	30.9655	-91.176	E. Feliciana	Domestic	140	Zone 1	17.18
610	-5524Z	30.7991	-91.049	E. Feliciana	Domestic	320	Zone 1	17.20
613	- 38	30.9333	-91.538	W. Feliciana	Domestic	549	Zone 2	17.22
612	-5482Z	30.8002	-91.047	E. Feliciana	Domestic	150	UTA	17.29
617	- 119	30.9722	-91.483	W. Feliciana	Domestic	14	UTA	17.30
618	- 225	30.9722	-91.483	W. Feliciana	Domestic	204	Zone 1	17.30
621	- 265	30.9355	-91.538	W. Feliciana	Public-Rural	822	Zone 3	17.33
614	-5278Z	30.9430	-91.138	E. Feliciana	Domestic	455	Zone 1	17.34
615	-5191Z	30.9430	-91.138	E. Feliciana	Domestic	110	UTA	17.35
616	-5407Z	30.9036	-91.096	E. Feliciana	Domestic	80	UTA	17.36

Table 2.4.12-212 (Sheet 23 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
619	-5549Z	30.9683	-91.175	E. Feliciana	Domestic	120	--	17.38
620	-5083Z	30.8680	-91.071	E. Feliciana	Domestic	80	UTA	17.39
626	- 214	30.9316	-91.544	W. Feliciana	Public-Commercial	679	Zone 2	17.39
627	-1187	30.5538	-91.159	E. Baton Rouge	Public-Municipal	2405	Zone 3	17.39
622	-5461Z	30.7977	-91.045	E. Feliciana	Domestic	120	UTA	17.41
629	- 3	30.9274	-91.550	W. Feliciana	Domestic	800	Zone 3	17.45
623	-5289Z	30.9597	-91.158	E. Feliciana	Domestic	410	Zone 1	17.46
624	- 95	30.9038	-91.094	E. Feliciana	Domestic	123	UTA	17.47
625	- 210	30.9691	-91.173	E. Feliciana	Domestic	505	Zone 1	17.48
630	- 108	30.9330	-91.546	W. Feliciana	Domestic	650	Zone 2	17.52
628	-5348Z	30.9688	-91.171	E. Feliciana	Domestic	140	Zone 1	17.54
631	- 74	30.9274	-91.553	W. Feliciana	Domestic	346	Zone 2	17.57
632	-5460Z	30.7455	-91.036	E. Feliciana	Domestic	80	UTA	17.73
638	- 750	30.5280	-91.196	E. Baton Rouge	Public-Municipal	2643	Zone 3	17.74
635	- 75	30.9299	-91.554	W. Feliciana	Domestic	624	Zone 2	17.75
636	- 830	30.6372	-91.069	E. Baton Rouge	Public-Municipal	2190	Zone 3	17.78
633	-5485Z	30.8608	-91.060	E. Feliciana	Domestic	120	Zone 1	17.80
634	- 117	30.7638	-91.034	E. Feliciana	Domestic	39	UTA	17.81
640	-1162	30.6919	-91.043	E. Baton Rouge	Industrial	140	UTA	17.83
637	- 96	30.9247	-91.105	E. Feliciana	Domestic	283	Zone 1	17.86
642	- 14	30.9505	-91.533	W. Feliciana	Domestic	705	Zone 2	17.86
639	-5063Z	30.9491	-91.132	E. Feliciana	Domestic	165	Zone 1	17.88
643	-8718Z	30.6597	-91.055	E. Baton Rouge	Domestic	107	--	17.89
641	-5269Z	30.7419	-91.033	E. Feliciana	Domestic	108	UTA	17.92
644	- 119	30.7519	-91.032	E. Feliciana	Domestic	504	Zone 1	17.93
645	- 186	30.8588	-91.056	E. Feliciana	Public-Rural	1500	Zone 3	17.96
646	- 252	30.8588	-91.056	E. Feliciana	Public-Rural	550	Zone 1	17.96
648	-5553Z	30.8611	-91.057	E. Feliciana	Domestic	140	--	17.97
647	-5499Z	30.9000	-91.081	E. Feliciana	Public-Institution	120	UTA	17.97

Table 2.4.12-212 (Sheet 24 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
649	-5227Z	30.7391	-91.032	E. Feliciana	Domestic	220	UTA	17.98
652	- 292	30.9583	-91.527	W. Feliciana	Public-Rural	802	Zone 2	18.04
650	-5277Z	30.8724	-91.061	E. Feliciana	Domestic	180	UTA	18.08
653	- 141	30.6005	-91.089	E. Baton Rouge	Domestic	165	UTA	18.08
654	- 118	30.9602	-91.526	W. Feliciana	Public-Institution	600	Zone 2	18.10
651	-5111Z	30.9644	-91.148	E. Feliciana	Domestic	235	Zone 1	18.10
658	- 568	30.5588	-91.132	E. Baton Rouge	Public-Municipal	2457	Zone 3	18.14
659	-1242	30.5311	-91.175	E. Baton Rouge	Irrigation/ Agriculture	280	UTA	18.18
657	-5356Z	30.7397	-91.028	E. Feliciana	Domestic	100	UTA	18.21
655	-5468Z	30.8724	-91.058	E. Feliciana	Domestic	115	Zone 1	18.22
656	- 90	30.9627	-91.141	E. Feliciana	Domestic	428	Zone 1	18.24
661	-8836Z	30.6219	-91.069	E. Baton Rouge	Stock	70	--	18.29
662	- 13	30.9647	-91.524	W. Feliciana	Domestic	314	Zone 1	18.29
660	-5282Z	30.8583	-91.049	E. Feliciana	Domestic	120	UTA	18.34
667	- 110	30.9352	-91.562	W. Feliciana	Domestic	250	Zone 1	18.34
663	- 125	30.7758	-91.026	E. Feliciana	Domestic	150	UTA	18.36
665	- 11	30.7769	-91.026	E. Feliciana	Domestic	220	Zone 1	18.37
666	-5012Z	30.7883	-91.027	E. Feliciana	Domestic	140	UTA	18.38
664	-5144Z	30.8911	-91.066	E. Feliciana	Domestic	105	UTA	18.39
670	- 831	30.6858	-91.034	E. Baton Rouge	Public-Municipal	1920	Zone 3	18.48
673	- 798	30.5258	-91.175	E. Baton Rouge	Public-Municipal	2647	Zone 3	18.49
675	- 773	30.5255	-91.175	E. Baton Rouge	Public-Municipal	1395	Zone 1	18.50
668	-5095Z	30.9824	-91.165	E. Feliciana	Domestic	75	UTA	18.50
669	-5526Z	30.9127	-91.080	E. Feliciana	Public- Commercial	250	Zone 1	18.51
674	- 730	30.5513	-91.133	E. Baton Rouge	Public-Municipal	2461	Zone 3	18.51
678	- 828	30.5252	-91.174	E. Baton Rouge	Public-Municipal	1934	Zone 2	18.55
677	-1238	30.5869	-91.091	E. Baton Rouge	Irrigation/ Agriculture	178	UTA	18.57
671	-5248Z	30.9133	-91.079	E. Feliciana	Domestic	260	Zone 1	18.58

Table 2.4.12-212 (Sheet 25 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
672	-5119Z	30.9677	-91.139	E. Feliciana	Domestic	415	Zone 1	18.59
679	-1272	30.6344	-91.054	E. Baton Rouge	Irrigation/ Agriculture	197	UTA	18.63
676	-5138Z	30.8719	-91.050	E. Feliciana	Domestic	90	UTA	18.64
681	- 996	30.5302	-91.159	E. Baton Rouge	Public-Institution	1374	Zone 1	18.74
680	-5311Z	30.9016	-91.066	E. Feliciana	Irrigation/ Agriculture	87	UTA	18.80
683	- 137	30.5588	-91.116	E. Baton Rouge	Domestic	997	Zone 1	18.80
682	- 140	30.5966	-91.078	E. Baton Rouge	Domestic	175	UTA	18.80
686	- 636	30.6036	-91.069	E. Baton Rouge	Domestic	2490	Zone 3	18.95
685	-8902Z	30.6283	-91.052	E. Baton Rouge	Domestic	140	--	18.96
684	-1311	30.7069	-91.020	E. Baton Rouge	Public-Rural	1870	Zone 3	18.98
688	- 338	30.5983	-91.072	E. Baton Rouge	Public-Commercial	1251	Zone 1	18.99
687	- 105	30.9538	-91.109	E. Feliciana	Domestic	105	UTA	19.04
689	- 40	30.9424	-91.571	W. Feliciana	Public-Institution	632	Zone 2	19.05
690	- 228	30.9444	-91.569	W. Feliciana	Public-Institution	649	Zone 2	19.07
694	- 546	30.5108	-91.184	E. Baton Rouge	Industrial	585	UTA	19.11
692	- 21	30.9455	-91.569	W. Feliciana	Public-Institution	595	Zone 2	19.13
691	-8407Z	30.7077	-91.017	E. Baton Rouge	Domestic	100	UTA	19.15
697	- 454	30.5102	-91.184	E. Baton Rouge	Industrial	2301	Zone 3	19.15
699	- 537	30.5083	-91.188	E. Baton Rouge	Industrial	600	UTA	19.16
703	- 294	30.5091	-91.185	E. Baton Rouge	Industrial	2278	Zone 3	19.20
696	-8428Z	30.7077	-91.016	E. Baton Rouge	Domestic	110	UTA	19.21
693	-5203Z	30.7816	-91.012	E. Feliciana	Irrigation/ Agriculture	235	UTA	19.22
704	- 872	30.5097	-91.182	E. Baton Rouge	Industrial	2331	Zone 3	19.24
706	- 544	30.5063	-91.189	E. Baton Rouge	Industrial	1952	Zone 2	19.25
695	-5562Z	30.9861	-91.149	E. Feliciana	Irrigation/ Agriculture	100	--	19.25
705	- 922	30.5497	-91.116	E. Baton Rouge	Public-Municipal	2600	Zone 3	19.27
700	- 118	30.7930	-91.012	E. Feliciana	Domestic	545	Zone 1	19.29

Table 2.4.12-212 (Sheet 26 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
698	-5202Z	30.9863	-91.148	E. Feliciana	Domestic	75	UTA	19.29
701	- 10	30.7586	-91.009	E. Feliciana	Domestic	85	UTA	19.29
702	- 9	30.7591	-91.009	E. Feliciana	Domestic	85	UTA	19.29
708	- 20	30.9530	-91.566	W. Feliciana	Public-Institution	596	Zone 2	19.37
707	-5318Z	30.9936	-91.509	W. Feliciana	Domestic	210	--	19.37
710	- 786	30.5055	-91.185	E. Baton Rouge	Industrial	2308	Zone 3	19.42
712	- 785	30.5038	-91.187	E. Baton Rouge	Industrial	1980	Zone 2	19.47
709	-5550Z	30.9497	-91.094	E. Feliciana	Domestic	218	--	19.48
711	-5070Z	30.8777	-91.036	E. Feliciana	Domestic	101	UTA	19.57
717	-1079	30.5922	-91.065	E. Baton Rouge	Irrigation/ Agriculture	220	UTA	19.60
713	- 89	30.9786	-91.127	E. Feliciana	Domestic	110	UTA	19.63
714	-5339Z	30.8899	-91.042	E. Feliciana	Domestic	110	UTA	19.64
715	- 201	30.8672	-91.029	E. Feliciana	Domestic	335	Zone 1	19.65
716	-5402Z	30.8791	-91.035	E. Feliciana	Domestic	110	UTA	19.67
718	-5166Z	30.8388	-91.017	E. Feliciana	Domestic	40	UTA	19.68
719	-5558Z	30.8863	-91.038	E. Feliciana	Domestic	95	--	19.70
728	- 399	30.5269	-91.136	E. Baton Rouge	Domestic	294	UTA	19.70
727	- 717	30.5591	-91.094	E. Baton Rouge	Domestic	242	UTA	19.71
720	-5445Z	30.8872	-91.039	E. Feliciana	Domestic	120	UTA	19.71
721	-5462Z	30.8722	-91.030	E. Feliciana	Domestic	110	UTA	19.71
725	- 23	30.9863	-91.531	W. Feliciana	Domestic	425	Zone 1	19.72
722	-5242Z	30.8694	-91.029	E. Feliciana	Domestic	120	UTA	19.73
723	-5566Z	30.8755	-91.032	E. Feliciana	Domestic	100	--	19.73
731	- 958	30.4974	-91.191	E. Baton Rouge	Industrial	648	UTA	19.76
724	-5409Z	30.8763	-91.031	E. Feliciana	Domestic	90	UTA	19.77
726	-5475Z	30.8913	-91.039	E. Feliciana	Irrigation/ Agriculture	110	UTA	19.80
729	-5122Z	30.8791	-91.032	E. Feliciana	Domestic	100	Zone 1	19.82
733	-1273	30.4988	-91.185	E. Baton Rouge	Industrial	1212	Zone 1	19.83
734	- 656	30.5027	-91.176	E. Baton Rouge	Industrial	2032	Zone 2	19.83

Table 2.4.12-212 (Sheet 27 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
730	-5127Z	30.8727	-91.028	E. Feliciana	Domestic	105	UTA	19.84
735	-1230	30.5044	-91.172	E. Baton Rouge	Industrial	1204	Zone 1	19.86
738	-1095	30.4966	-91.188	E. Baton Rouge	Industrial	646	UTA	19.88
739	- 954	30.4983	-91.183	E. Baton Rouge	Industrial	2104	Zone 2	19.90
732	-5241Z	30.8738	-91.028	E. Feliciana	Domestic	120	UTA	19.91
737	-5113Z	30.5600	-91.088	E. Baton Rouge	Irrigation/ Agriculture	189	UTA	19.92
742	- 737	30.5013	-91.175	E. Baton Rouge	Industrial	2029	Zone 2	19.95
736	- 295	30.9683	-91.103	E. Feliciana	Public-Municipal	450	Zone 1	20.01
745	-1191	30.4983	-91.179	E. Baton Rouge	Industrial	405	UTA	20.02
740	- 257	30.8075	-91.002	E. Feliciana	Public-Rural	2176	Zone 3	20.03
741	- 259	30.8075	-91.002	E. Feliciana	Public-Rural	1720	Zone 3	20.03
746	-8406Z	30.5313	-91.120	E. Baton Rouge	Domestic	100	UTA	20.04
747	-1030	30.5013	-91.172	E. Baton Rouge	Industrial	2040	Zone 2	20.04
749	- 557	30.4991	-91.176	E. Baton Rouge	Industrial	1250	Zone 1	20.06
743	-5465Z	30.8255	-91.006	E. Feliciana	Domestic	160	UTA	20.07
748	- 175	30.5600	-91.084	E. Baton Rouge	Domestic	275	UTA	20.08
751	- 362	30.4972	-91.179	E. Baton Rouge	Industrial	425	UTA	20.08
744	- 175	30.9622	-91.094	E. Feliciana	Domestic	70	UTA	20.09
753	- 420	30.5269	-91.124	E. Baton Rouge	Domestic	292	UTA	20.15
754	- 856	30.5000	-91.171	E. Baton Rouge	Industrial	2040	Zone 2	20.15
750	-5467Z	30.8072	-90.999	E. Feliciana	Domestic	155	UTA	20.19
762	- 353	30.4966	-91.176	E. Baton Rouge	Industrial	2395	Zone 3	20.21
760	- 700	30.5249	-91.125	E. Baton Rouge	Public-Municipal	2557	Zone 3	20.22
757	- 690	30.5691	-91.072	E. Baton Rouge	Domestic	2020	Zone 3	20.23
763	- 722	30.4961	-91.176	E. Baton Rouge	Industrial	2059	Zone 2	20.24
764	-1227	30.4908	-91.188	E. Baton Rouge	Industrial	2062	Zone 2	20.24
759	- 320	30.5719	-91.069	E. Baton Rouge	Domestic	1310	Zone 1	20.24
752	- 73B	30.8644	-91.017	E. Feliciana	Public-Municipal	1966	Zone 3	20.25
755	-5387Z	30.8333	-91.005	E. Feliciana	Domestic	120	UTA	20.27

Table 2.4.12-212 (Sheet 28 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
765	- 342	30.5252	-91.123	E. Baton Rouge	Domestic	1140	Zone 1	20.28
758	- 411	30.7102	-90.997	E. Baton Rouge	Domestic	95	UTA	20.29
756	- 107	30.9738	-91.103	E. Feliciana	Industrial	121	UTA	20.30
769	- 649	30.4963	-91.173	E. Baton Rouge	Industrial	1250	Zone 1	20.32
761	- 106	30.9744	-91.103	E. Feliciana	Irrigation/ Agriculture	298	Zone 1	20.35
771	- 178	30.5536	-91.084	E. Baton Rouge	Domestic	1287	Zone 1	20.38
772	- 423	30.5566	-91.081	E. Baton Rouge	Domestic	220	UTA	20.38
766	- 30	30.8197	-90.999	E. Feliciana	Domestic	220	Zone 1	20.39
774	- 962	30.4952	-91.173	E. Baton Rouge	Industrial	2066	Zone 2	20.39
775	- 701	30.5263	-91.118	E. Baton Rouge	Irrigation/ Agriculture	2604	Zone 3	20.42
776	- 779	30.5263	-91.118	E. Baton Rouge	Domestic	304	UTA	20.42
767	- 178	30.8511	-91.008	E. Feliciana	Domestic	80	UTA	20.42
768	-5128Z	30.9874	-91.117	E. Feliciana	Domestic	88	UTA	20.46
770	-5426Z	30.8341	-91.001	E. Feliciana	Irrigation/ Agriculture	160	UTA	20.46
777	- 311	30.9572	-91.588	W. Feliciana	Public-Institution	531	--	20.48
773	- 24	30.7327	-90.990	E. Feliciana	Domestic	84	UTA	20.49
779	- 351	30.4936	-91.173	E. Baton Rouge	Industrial	2434	Zone 3	20.49
780	- 490	30.4908	-91.179	E. Baton Rouge	Industrial	690	UTA	20.49
781	- 403	30.4933	-91.172	E. Baton Rouge	Industrial	1270	Zone 1	20.51
782	- 272	30.9586	-91.588	W. Feliciana	Public-Institution	531	Zone 2	20.55
784	- 473	30.4911	-91.176	E. Baton Rouge	Industrial	692	UTA	20.55
785	- 356	30.4869	-91.185	E. Baton Rouge	Industrial	441	UTA	20.56
783	- 381	30.5580	-91.076	E. Baton Rouge	Domestic	1115	Zone 1	20.56
786	- 567	30.4930	-91.171	E. Baton Rouge	Industrial	1245	Zone 1	20.57
778	- 176	30.9638	-91.084	E. Feliciana	Domestic	58	UTA	20.61
789	- 299	30.9586	-91.590	W. Feliciana	Public-Institution	545	Zone 2	20.65
796	- 398	30.4838	-91.187	E. Baton Rouge	Industrial	1285	Zone 1	20.70
788	-5472Z	30.8183	-90.993	E. Feliciana	Irrigation/ Agriculture	150	UTA	20.71

Table 2.4.12-212 (Sheet 29 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
787	- 183	30.8363	-90.998	E. Feliciana	Domestic	134	UTA	20.71
799	- 851	30.4836	-91.186	E. Baton Rouge	Industrial	2119	Zone 2	20.75
801	- 576	30.4880	-91.175	E. Baton Rouge	Industrial	1270	Zone 1	20.76
798	- 231	30.9555	-91.596	W. Feliciana	Industrial	650	Zone 2	20.76
790	-5082Z	30.8500	-91.001	E. Feliciana	Domestic	135	Zone 1	20.79
791	- 51	30.8433	-90.999	E. Feliciana	Domestic	420	Zone 1	20.80
792	- 181	30.8438	-90.999	E. Feliciana	Domestic	175	UTA	20.81
793	- 251	30.8638	-91.006	E. Feliciana	Public-Municipal	2014	Zone 3	20.81
802	- 12	30.9841	-91.564	W. Feliciana	Public-Institution	672	Zone 2	20.81
794	-5410Z	30.8202	-90.991	E. Feliciana	Domestic	120	Zone 1	20.82
795	- 182	30.8377	-90.996	E. Feliciana	Domestic	140	UTA	20.83
797	-5541Z	30.8441	-90.998	E. Feliciana	Domestic	170	--	20.86
807	- 34	30.4852	-91.178	E. Baton Rouge	Industrial	459	UTA	20.86
809	- 587	30.4833	-91.182	E. Baton Rouge	Industrial	2110	Zone 2	20.87
805	- 229	30.9858	-91.563	W. Feliciana	Public-Institution	660	Zone 2	20.88
810	- 499	30.4872	-91.173	E. Baton Rouge	Industrial	430	UTA	20.88
800	-5342Z	30.8677	-91.007	E. Feliciana	Domestic	100	UTA	20.89
803	-5351Z	30.8527	-91.000	E. Feliciana	Irrigation/ Agriculture	120	UTA	20.91
811	-1318	30.4822	-91.181	E. Baton Rouge	Industrial	607	--	20.95
804	- 189	30.8813	-91.012	E. Feliciana	Public-Institution	130	UTA	20.95
806	- 52	30.8525	-90.999	E. Feliciana	Domestic	1564	Zone 3	20.99
808	-5340Z	30.8505	-90.998	E. Feliciana	Domestic	130	UTA	20.99
812	- 523	30.5058	-91.133	E. Baton Rouge	Public-Municipal	1206	Zone 1	21.00
813	-1258	30.5777	-91.047	E. Baton Rouge	Public-Municipal	2025	Zone 3	21.05
814	- 928	30.5050	-91.132	E. Baton Rouge	Public-Municipal	2375	Zone 3	21.08
815	- 884	30.4844	-91.171	E. Baton Rouge	Industrial	2120	Zone 2	21.09
817	- 855	30.4797	-91.182	E. Baton Rouge	Industrial	2208	Zone 2	21.10
820	- 580	30.4841	-91.171	E. Baton Rouge	Industrial	1242	Zone 1	21.11
818	- 654	30.5058	-91.129	E. Baton Rouge	Public-Municipal	2382	Zone 3	21.12

Table 2.4.12-212 (Sheet 30 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
821	- 810	30.4816	-91.176	E. Baton Rouge	Industrial	2130	Zone 2	21.12
823	- 653	30.5052	-91.129	E. Baton Rouge	Public-Municipal	1153	Zone 1	21.15
822	- 319	30.5361	-91.086	E. Baton Rouge	Public-Commercial	1393	Zone 1	21.17
816	-5578Z	30.8219	-90.985	E. Feliciana	Irrigation/ Agriculture	140	--	21.21
825	- 769	30.5058	-91.126	E. Baton Rouge	Public-Municipal	2362	Zone 3	21.22
819	-5272Z	30.9358	-91.043	E. Feliciana	Irrigation/ Agriculture	280	Zone 1	21.24
826	- 756	30.5052	-91.126	E. Baton Rouge	Public-Municipal	1168	Zone 1	21.25
828	-7766Z	30.5147	-91.111	E. Baton Rouge	Domestic	360	UTA	21.29
827	- 298	30.9644	-91.599	W. Feliciana	Irrigation/ Agriculture	117	MRAA	21.30
824	- 299	30.8544	-90.994	E. Feliciana	Irrigation/ Agriculture	150	UTA	21.31
829	-8629Z	30.5158	-91.109	E. Baton Rouge	Domestic	330	UTA	21.31
834	-1301	30.4749	-91.184	E. Baton Rouge	Industrial	1260	Zone 1	21.33
832	-8612Z	30.5155	-91.108	E. Baton Rouge	Domestic	328	UTA	21.34
831	-1280	30.5672	-91.050	E. Baton Rouge	Public-Rural	1690	Zone 2	21.34
837	- 467	30.4738	-91.185	E. Baton Rouge	Industrial	1021	Zone 1	21.39
830	- 298	30.8588	-90.993	E. Feliciana	Irrigation/ Agriculture	320	Zone 1	21.42
838	-7651Z	30.5288	-91.088	E. Baton Rouge	Domestic	280	UTA	21.43
840	- 784	30.4730	-91.185	E. Baton Rouge	Industrial	1282	Zone 1	21.43
836	-7210Z	30.5647	-91.050	E. Baton Rouge	Domestic	265	UTA	21.43
833	- 300	30.8566	-90.992	E. Feliciana	Irrigation/ Agriculture	320	Zone 1	21.45
835	-5449Z	30.8580	-90.992	E. Feliciana	Domestic	200	Zone 1	21.48
839	- 28	30.7461	-90.972	E. Feliciana	Domestic	122	UTA	21.54
847	- 297	30.9672	-91.602	W. Feliciana	Irrigation/ Agriculture	126	MRAA	21.58
841	-5555Z	30.8227	-90.979	E. Feliciana	Irrigation/ Agriculture	210	--	21.58
842	-5137Z	30.8291	-90.980	E. Feliciana	Domestic	195	Zone 1	21.61

Table 2.4.12-212 (Sheet 31 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
843	-5297Z	30.8638	-90.992	E. Feliciana	Domestic	120	Zone 1	21.63
844	-5308Z	30.9308	-91.031	E. Feliciana	Irrigation/ Agriculture	200	Zone 1	21.64
845	-5069Z	30.9949	-91.096	E. Feliciana	Domestic	210	Zone 1	21.66
846	-5323Z	30.9936	-91.094	E. Feliciana	Domestic	185	Zone 1	21.67
848	- 88	30.9747	-91.070	E. Feliciana	Public-Institution	450	Zone 1	21.71
850	- 114	30.7433	-90.969	E. Feliciana	Domestic	110	UTA	21.71
849	-5300Z	30.9672	-91.062	E. Feliciana	Domestic	270	Zone 1	21.72
855	-8257Z	30.6666	-90.983	E. Baton Rouge	Domestic	120	UTA	21.75
851	-5170Z	30.8311	-90.978	E. Feliciana	Domestic	175	Zone 1	21.77
852	-5157Z	30.9963	-91.094	E. Feliciana	Domestic	70	UTA	21.80
853	-5249Z	30.9424	-91.037	E. Feliciana	Domestic	300	Zone 1	21.80
858	- 402	30.7080	-90.971	E. Baton Rouge	Domestic	126	UTA	21.80
854	-5408Z	30.9683	-91.061	E. Feliciana	Domestic	225	Zone 1	21.81
856	- 190	30.9411	-91.035	E. Feliciana	Domestic	180	Zone 1	21.82
857	-5312Z	30.8552	-90.985	E. Feliciana	Domestic	170	UTA	21.83
864	- 623	30.5424	-91.063	E. Baton Rouge	Public-Municipal	2652	Zone 3	21.83
859	- 232	30.8177	-90.973	E. Feliciana	Irrigation/ Agriculture	482	Zone 1	21.84
866	-1300	30.4702	-91.176	E. Baton Rouge	Industrial	585	UTA	21.84
861	-5481Z	30.7222	-90.968	E. Feliciana	Domestic	105	UTA	21.86
862	- 115	30.7219	-90.968	E. Feliciana	Domestic	115	UTA	21.86
860	-5547Z	30.9722	-91.064	E. Feliciana	Domestic	230	--	21.87
868	-1189	30.5102	-91.102	E. Baton Rouge	Irrigation/ Agriculture	350	UTA	21.87
863	-5493Z	30.9966	-91.092	E. Feliciana	Domestic	80	UTA	21.91
865	-5266Z	30.9177	-91.015	E. Feliciana	Public-Commercial	105	UTA	21.95
869	-5080Z	30.7474	-90.965	E. Feliciana	Domestic	120	UTA	21.96
867	-5041Z	30.8783	-90.992	E. Feliciana	Domestic	145	Zone 1	21.98
874	- 874	30.4638	-91.186	E. Baton Rouge	Public-Municipal	2250	Zone 2	22.00
870	- 66	30.8174	-90.970	E. Feliciana	Domestic	189	UTA	22.01

Table 2.4.12-212 (Sheet 32 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
876	- 813	30.4636	-91.186	E. Baton Rouge	Public-Municipal	2536	Zone 3	22.01
872	- 317	30.5505	-91.051	E. Baton Rouge	Irrigation/ Agriculture	1176	Zone 1	22.02
873	- 24	30.9516	-91.627	W. Feliciana	Public-Institution	907	Zone 3	22.02
871	-5392Z	30.9724	-91.059	E. Feliciana	Domestic	260	Zone 1	22.07
879	- 336	30.5622	-91.038	E. Baton Rouge	Domestic	1130	Zone 1	22.09
878	-1031	30.5930	-91.014	E. Baton Rouge	Public-Municipal	1976	Zone 3	22.09
875	-7160Z	30.6794	-90.973	E. Baton Rouge	Domestic	200	UTA	22.10
880	-1159	30.5399	-91.060	E. Baton Rouge	Irrigation/ Agriculture	255	UTA	22.11
877	-5393Z	30.8777	-90.989	E. Feliciana	Domestic	130	Zone 1	22.14
886	- 41	30.9672	-91.616	W. Feliciana	Public-Institution	484	Zone 2	22.18
882	- 156	30.7530	-90.961	E. Feliciana	Domestic	67	UTA	22.19
881	-5403Z	30.8747	-90.986	E. Feliciana	Domestic	130	Zone 1	22.21
884	- 113	30.8161	-90.966	E. Feliciana	Stock	178	UTA	22.22
883	-5422Z	30.9761	-91.060	E. Feliciana	Domestic	80	UTA	22.22
885	- 157	30.7530	-90.960	E. Feliciana	Domestic	63	UTA	22.22
890	-7290Z	30.5072	-91.096	E. Baton Rouge	Domestic	363	UTA	22.23
887	-8243Z	30.7058	-90.964	E. Baton Rouge	Irrigation/ Agriculture	130	UTA	22.27
888	- 256	30.8161	-90.965	E. Feliciana	Irrigation/ Agriculture	184	UTA	22.30
889	-5100Z	30.9141	-91.006	E. Feliciana	Domestic	85	UTA	22.32
895	- 764	30.6219	-90.992	E. Baton Rouge	Domestic	2510	Zone 3	22.36
893	-5516Z	30.7249	-90.960	E. Feliciana	Domestic	154	UTA	22.36
899	-6687Z	30.5013	-91.101	E. Baton Rouge	Domestic	380	UTA	22.36
891	-5182Z	30.9216	-91.010	E. Feliciana	Domestic	100	UTA	22.37
892	-5504Z	30.9138	-91.004	E. Feliciana	Domestic	230	Zone 1	22.38
896	-7283Z	30.5691	-91.026	E. Baton Rouge	Domestic	250	UTA	22.38
894	-5394Z	30.9019	-90.996	E. Feliciana	Domestic	280	Zone 1	22.42
900	- 995	30.5327	-91.060	E. Baton Rouge	Public-Municipal	2520	Zone 3	22.44
897	-5273Z	30.8772	-90.983	E. Feliciana	Domestic	150	Zone 1	22.47

Table 2.4.12-212 (Sheet 33 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
898	-5009Z	30.8749	-90.981	E. Feliciana	Domestic	135	Zone 1	22.47
903	- 513	30.6255	-90.987	E. Baton Rouge	Public-Commercial	196	UTA	22.53
904	-6873Z	30.5991	-91.001	E. Baton Rouge	Domestic	180	UTA	22.55
909	- 334	30.5374	-91.052	E. Baton Rouge	Domestic	1140	Zone 1	22.55
901	-5521Z	30.9774	-91.053	E. Feliciana	Domestic	93	UTA	22.56
902	- 227	30.8558	-90.972	E. Feliciana	Public-Institution	1078	Zone 2	22.58
906	- 832	30.6547	-90.973	E. Baton Rouge	Public-Municipal	2048	Zone 3	22.58
908	-5126Z	30.7647	-90.953	E. Feliciana	Domestic	130	UTA	22.63
905	-5065Z	30.9208	-91.004	E. Feliciana	Domestic	115	UTA	22.63
907	-5205Z	30.9811	-91.055	E. Feliciana	Domestic	240	Zone 1	22.65
914	-1007	30.4530	-91.187	E. Baton Rouge	Public-Institution	845	Zone 1	22.65
910	-5528Z	30.9811	-91.055	E. Feliciana	Domestic	100	UTA	22.67
913	-5488Z	30.5002	-91.094	E. Baton Rouge	Domestic	450	UTA	22.68
915	- 657	30.4641	-91.158	E. Baton Rouge	Public-Municipal	1618	Zone 1	22.68
911	-5139Z	30.9038	-90.991	E. Feliciana	Domestic	105	Zone 1	22.73
916	- 510	30.4641	-91.156	E. Baton Rouge	Public-Municipal	1605	Zone 1	22.73
917	- 938	30.4636	-91.157	E. Baton Rouge	Public-Municipal	1599	Zone 1	22.74
912	-5254Z	30.8830	-90.979	E. Feliciana	Domestic	100	UTA	22.79
918	- 939	30.4638	-91.155	E. Baton Rouge	Public-Municipal	1592	Zone 1	22.79
919	-8711Z	30.5122	-91.075	E. Baton Rouge	Public-Commercial	380	--	22.82
920	- 318	30.5150	-91.071	E. Baton Rouge	Domestic	1266	Zone 1	22.82
921	- 814	30.4636	-91.154	E. Baton Rouge	Public-Municipal	2168	Zone 2	22.83
922	- 658	30.4625	-91.156	E. Baton Rouge	Public-Municipal	1604	Zone 1	22.84
923	- 726	30.4627	-91.154	E. Baton Rouge	Public-Municipal	1601	Zone 1	22.88
928	-1253	30.4477	-91.189	E. Baton Rouge	Public-Municipal	2687	Zone 3	22.93
924	-7144Z	30.5836	-91.004	E. Baton Rouge	Domestic	220	UTA	22.94
925	-5759Z	30.5877	-91.001	E. Baton Rouge	Domestic	265	UTA	22.95
932	- 630	30.4474	-91.189	E. Baton Rouge	Public-Municipal	2253	Zone 2	22.95
927	- 808	30.6061	-90.989	E. Baton Rouge	Domestic	1966	Zone 3	23.00

Table 2.4.12-212 (Sheet 34 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
930	-7842Z	30.5858	-91.001	E. Baton Rouge	Domestic	240	UTA	23.00
926	-5529Z	30.9883	-91.054	E. Feliciana	Domestic	58	--	23.05
934	- 582	30.5477	-91.031	E. Baton Rouge	Domestic	330	UTA	23.06
929	-5035Z	30.8899	-90.978	E. Feliciana	Domestic	360	Zone 1	23.08
939	-8396Z	30.5336	-91.044	E. Baton Rouge	Domestic	210	UTA	23.09
933	-5042Z	30.8447	-90.959	E. Feliciana	Domestic	140	Zone 1	23.09
931	-5518Z	30.9808	-91.045	E. Feliciana	Domestic	250	Zone 1	23.10
937	-6268Z	30.5819	-91.002	E. Baton Rouge	Domestic	265	UTA	23.10
941	-8538Z	30.6036	-90.988	E. Baton Rouge	Irrigation/ Agriculture	180	UTA	23.12
936	-5011Z	30.7405	-90.945	E. Feliciana	Domestic	100	UTA	23.12
945	- 552	30.4786	-91.115	E. Baton Rouge	Public-Commercial	730	UTA	23.15
935	- 69	30.9297	-91.000	E. Feliciana	Domestic	185	Zone 1	23.16
938	-5062Z	30.8747	-90.969	E. Feliciana	Domestic	120	Zone 1	23.18
940	-5027Z	30.8705	-90.967	E. Feliciana	Domestic	140	Zone 1	23.18
943	-8738Z	30.5852	-90.998	E. Baton Rouge	Domestic	240	--	23.18
948	-1149	30.4480	-91.176	E. Baton Rouge	Public-Municipal	2694	Zone 3	23.22
949	-1150	30.4480	-91.176	E. Baton Rouge	Public-Municipal	2242	Zone 2	23.22
947	-1185	30.4952	-91.087	E. Baton Rouge	Irrigation/ Agriculture	460	UTA	23.22
946	-8736Z	30.5774	-91.003	E. Baton Rouge	Domestic	170	--	23.25
942	-5232Z	30.9794	-91.040	E. Feliciana	Domestic	250	Zone 1	23.26
944	- 65	30.9291	-90.997	E. Feliciana	Domestic	232	Zone 1	23.26
955	- 674	30.4488	-91.170	E. Baton Rouge	Industrial	2250	Zone 2	23.33
954	- 724	30.5430	-91.029	E. Baton Rouge	Domestic	2573	Zone 3	23.36
950	-5484Z	30.8830	-90.969	E. Feliciana	Domestic	160	UTA	23.37
953	-8832Z	30.5783	-91.000	E. Baton Rouge	Domestic	280	--	23.37
951	- 226	30.8708	-90.963	E. Feliciana	Public-Institution	1051	Zone 2	23.39
952	- 177	30.8663	-90.961	E. Feliciana	Public-Institution	21	UTA	23.43
957	-8903Z	30.5783	-90.998	E. Baton Rouge	Domestic	180	--	23.46

Table 2.4.12-212 (Sheet 35 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
962	- 592	30.4813	-91.100	E. Baton Rouge	Irrigation/ Agriculture	696	UTA	23.51
959	-8719Z	30.5783	-90.997	E. Baton Rouge	Domestic	250	--	23.51
960	-8484Z	30.5802	-90.995	E. Baton Rouge	Domestic	160	UTA	23.51
956	- 68	30.8774	-90.964	E. Feliciana	Domestic	385	Zone 1	23.52
961	-8599Z	30.5783	-90.996	E. Baton Rouge	Domestic	180	UTA	23.53
958	-5112Z	30.8794	-90.964	E. Feliciana	Domestic	146	Zone 1	23.54
963	-8337Z	30.6141	-90.973	E. Baton Rouge	Irrigation/ Agriculture	120	UTA	23.59
964	-7650Z	30.5780	-90.995	E. Baton Rouge	Domestic	225	UTA	23.59
966	-6672Z	30.5147	-91.053	E. Baton Rouge	Domestic	570	UTA	23.60
965	-8772Z	30.5761	-90.996	E. Baton Rouge	Domestic	240	--	23.61
968	-1308	30.4552	-91.144	E. Baton Rouge	Public-Municipal	1070	Zone 1	23.62
970	- 774	30.4550	-91.144	E. Baton Rouge	Public-Municipal	2143	Zone 2	23.65
967	-5504Z	30.5794	-90.993	E. Baton Rouge	Domestic	260	UTA	23.65
971	-1276	30.4547	-91.144	E. Baton Rouge	Public-Municipal	1075	Zone 1	23.66
972	- 927	30.4547	-91.144	E. Baton Rouge	Public-Municipal	1511	Zone 1	23.66
969	-8743Z	30.5758	-90.995	E. Baton Rouge	Irrigation/ Agriculture	260	--	23.69
973	- 751	30.4544	-91.143	E. Baton Rouge	Public-Municipal	2595	Zone 3	23.69
974	-1306	30.5427	-91.020	E. Baton Rouge	Public-Rural	1763	Zone 2	23.76
975	- 904	30.5424	-91.020	E. Baton Rouge	Public-Municipal	1876	Zone 2	23.79
976	-1037	30.5424	-91.020	E. Baton Rouge	Public-Municipal	2682	Zone 3	23.80
977	- 998	30.5780	-90.990	E. Baton Rouge	Public-Institution	2580	Zone 3	23.85
978	- 304	30.5777	-90.990	E. Baton Rouge	Public-Institution	1725	Zone 2	23.86
979	- 581	30.5777	-90.990	E. Baton Rouge	Public-Institution	2590	Zone 3	23.86
981	- 665	30.4463	-91.153	E. Baton Rouge	Domestic	116	UTA	23.91
984	-1157	30.4908	-91.074	E. Baton Rouge	Irrigation/ Agriculture	363	UTA	23.97
980	-5491Z	30.9891	-91.034	E. Feliciana	Domestic	290	Zone 1	23.97
982	-8771Z	30.6127	-90.966	E. Baton Rouge	Irrigation/ Agriculture	180	--	23.99

Table 2.4.12-212 (Sheet 36 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
992	- 768	30.4308	-91.188	E. Baton Rouge	Domestic	280	UTA	24.06
983	-5075Z	30.8252	-90.937	E. Feliciana	Domestic	120	Zone 1	24.06
986	- 75	30.7550	-90.929	E. Feliciana	Public-Institution	333	Zone 1	24.09
985	-5527Z	30.8922	-90.960	E. Feliciana	Domestic	115	UTA	24.10
997	- 151	30.4447	-91.149	E. Baton Rouge	Public-Municipal	2658	Zone 3	24.13
994	-1165	30.5277	-91.027	E. Baton Rouge	Irrigation/ Agriculture	300	UTA	24.13
987	-5252Z	30.8936	-90.960	E. Feliciana	Domestic	138	Zone 1	24.13
990	-5072Z	30.8311	-90.937	E. Feliciana	Domestic	130	Zone 1	24.14
991	-5265Z	30.7491	-90.928	E. Feliciana	Domestic	136	UTA	24.14
988	- 53	30.9897	-91.030	E. Feliciana	Domestic	317	Zone 1	24.14
989	-5147Z	30.8905	-90.958	E. Feliciana	Domestic	120	Zone 1	24.14
996	-8769Z	30.4944	-91.064	E. Baton Rouge	Irrigation/ Agriculture	360	--	24.15
999	-1354	30.4736	-91.094	E. Baton Rouge	Public-Municipal	880	Zone 1	24.15
1000	-1303	30.4733	-91.094	E. Baton Rouge	Public-Municipal	1707	Zone 2	24.17
995	-8541Z	30.6116	-90.964	E. Baton Rouge	Domestic	160	UTA	24.18
1002	- 771	30.4461	-91.143	E. Baton Rouge	Public-Municipal	1739	Zone 1	24.19
993	-5030Z	30.8922	-90.958	E. Feliciana	Domestic	135	Zone 1	24.20
1005	- 733	30.4463	-91.142	E. Baton Rouge	Public-Municipal	2637	Zone 3	24.22
1003	-1327	30.4736	-91.092	E. Baton Rouge	Irrigation/ Agriculture	515	--	24.22
1004	-1353	30.4727	-91.093	E. Baton Rouge	Public-Municipal	2480	Zone 3	24.22
1009	-1252	30.4463	-91.141	E. Baton Rouge	Public-Municipal	2633	Zone 3	24.24
1007	-1352	30.4724	-91.093	E. Baton Rouge	Public-Municipal	870	Zone 1	24.25
998	- 57	30.9916	-91.029	E. Feliciana	Stock	425	Zone 1	24.27
1011	- 503	30.4930	-91.063	E. Baton Rouge	Domestic	400	UTA	24.28
1001	-5538Z	30.8030	-90.929	E. Feliciana	Domestic	120	UTA	24.28
1015	- 333	30.5244	-91.026	E. Baton Rouge	Domestic	1101	Zone 1	24.30
1023	- 413	30.4449	-91.142	E. Baton Rouge	Public-Municipal	1745	Zone 1	24.31
1016	-8773Z	30.5650	-90.990	E. Baton Rouge	Domestic	250	--	24.32

Table 2.4.12-212 (Sheet 37 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
1020	- 446	30.4991	-91.054	E. Baton Rouge	Irrigation/ Agriculture	160	UTA	24.32
1006	-5423Z	30.7477	-90.925	E. Feliciana	Domestic	120	UTA	24.33
1008	-5148Z	30.8305	-90.933	E. Feliciana	Domestic	125	Zone 1	24.35
1010	-5169Z	30.8291	-90.933	E. Feliciana	Domestic	290	Zone 1	24.37
1017	-5568Z	30.7494	-90.924	E. Feliciana	Domestic	150	--	24.37
1012	-5255Z	30.8297	-90.933	E. Feliciana	Domestic	240	Zone 1	24.38
1027	-1035	30.4938	-91.059	E. Baton Rouge	Public-Municipal	973	Zone 1	24.38
1013	-5295Z	30.8286	-90.932	E. Feliciana	Domestic	135	Zone 1	24.38
1014	-5159Z	30.8894	-90.953	E. Feliciana	Domestic	115	UTA	24.39
1018	-5013Z	30.8113	-90.928	E. Feliciana	Domestic	140	UTA	24.41
1019	-5218Z	30.8474	-90.937	E. Feliciana	Domestic	100	Zone 1	24.41
1022	-5383Z	30.8288	-90.931	E. Feliciana	Domestic	110	Zone 1	24.43
1021	-5109Z	30.9033	-90.960	E. Feliciana	Domestic	95	UTA	24.43
1024	-5531Z	30.7513	-90.923	E. Feliciana	Domestic	120	--	24.44
1026	-5381Z	30.8277	-90.931	E. Feliciana	Domestic	115	Zone 1	24.46
1025	- 285	30.8986	-90.956	E. Feliciana	Public-Rural	2200	Zone 3	24.47
1028	- 111	30.7874	-90.924	E. Feliciana	Domestic	300	Zone 1	24.48
1030	-7125Z	30.6636	-90.936	E. Baton Rouge	Domestic	165	UTA	24.49
1029	- 247	30.7858	-90.923	E. Feliciana	Domestic	98	UTA	24.51
1032	- 33	30.5861	-90.972	Livingston	Domestic	238	UTA	24.53
1031	- 110	30.7572	-90.921	E. Feliciana	Domestic	127	UTA	24.54
1038	- 520	30.5652	-90.986	E. Baton Rouge	Domestic	2088	Zone 3	24.55
1036	-6223Z	30.6402	-90.943	E. Baton Rouge	Domestic	160	UTA	24.57
1035	-8077Z	30.6575	-90.937	E. Baton Rouge	Domestic	148	UTA	24.57
1040	- 227	30.5855	-90.971	Livingston	Public-Rural	225	UTA	24.58
1033	-5120Z	30.7841	-90.921	E. Feliciana	Domestic	135	UTA	24.59
1037	- 16	30.8100	-90.924	E. Feliciana	Domestic	126	UTA	24.61
1034	-5357Z	30.9055	-90.957	E. Feliciana	Domestic	110	UTA	24.62
1039	- 112	30.7894	-90.921	E. Feliciana	Stock	130	UTA	24.62

Table 2.4.12-212 (Sheet 38 of 39)
Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
1054	- 735	30.4394	-91.143	E. Baton Rouge	Domestic	481	UTA	24.63
1048	-1123	30.4861	-91.063	E. Baton Rouge	Public-Municipal	982	Zone 1	24.63
1041	-5077Z	30.8224	-90.926	E. Feliciana	Domestic	130	UTA	24.65
1045	-7634Z	30.6605	-90.934	E. Baton Rouge	Stock	170	UTA	24.66
1049	- 34	30.5819	-90.972	Livingston	Domestic	165	UTA	24.67
1042	-5130Z	30.8791	-90.944	E. Feliciana	Domestic	125	UTA	24.67
1050	-6120Z	30.5897	-90.967	Livingston	Domestic	250	UTA	24.68
1051	- 238	30.5805	-90.973	Livingston	Irrigation/ Agriculture	269	UTA	24.68
1058	-8235Z	30.5283	-91.014	E. Baton Rouge	Domestic	330	UTA	24.68
1053	-6220Z	30.5894	-90.967	Livingston	Domestic	225	UTA	24.69
1055	-6381Z	30.5805	-90.972	Livingston	Domestic	245	UTA	24.69
1043	-5078Z	30.9563	-90.989	E. Feliciana	Domestic	110	UTA	24.69
1046	-5343Z	30.8224	-90.925	E. Feliciana	Domestic	130	UTA	24.70
1057	- 36	30.5749	-90.976	Livingston	Domestic	266	UTA	24.70
1044	-5396Z	30.9455	-90.980	E. Feliciana	Domestic	80	UTA	24.71
1059	- 112	30.5902	-90.966	Livingston	Domestic	2002	Zone 3	24.71
1047	-5141Z	30.9322	-90.971	E. Feliciana	Domestic	55	UTA	24.73
1052	-5418Z	30.8230	-90.925	E. Feliciana	Domestic	120	UTA	24.74
1061	- 926	30.4861	-91.060	E. Baton Rouge	Public-Municipal	980	Zone 1	24.74
1056	-5124Z	30.9058	-90.955	E. Feliciana	Domestic	105	UTA	24.77
1065	- 331	30.5163	-91.024	E. Baton Rouge	Domestic	1118	Zone 1	24.77
1060	-5017Z	30.9611	-90.990	E. Feliciana	Domestic	160	Zone 1	24.80
1062	-8023Z	30.6397	-90.939	E. Baton Rouge	Domestic	205	UTA	24.80
1063	-6224Z	30.6394	-90.939	E. Baton Rouge	Domestic	155	UTA	24.81
1068	- 32	30.5861	-90.966	Livingston	Domestic	236	UTA	24.82
1067	-7108Z	30.6205	-90.947	E. Baton Rouge	Domestic	200	UTA	24.83
1066	-5112Z	30.6608	-90.931	E. Baton Rouge	Domestic	140	UTA	24.84
1069	- 414	30.5583	-90.985	E. Baton Rouge	Domestic	210	UTA	24.85
1075	- 329	30.5058	-91.033	E. Baton Rouge	Domestic	1140	Zone 1	24.86

Table 2.4.12-212 (Sheet 39 of 39) Water Supply Wells in Use East of the Mississippi River within a 25-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
1064	-5079Z	30.9577	-90.986	E. Feliciana	Domestic	105	UTA	24.87
1077	-5677Z	30.5111	-91.027	E. Baton Rouge	Domestic	365	UTA	24.88
1071	-6862Z	30.6247	-90.944	E. Baton Rouge	Domestic	200	UTA	24.89
1070	-1214	30.6580	-90.931	E. Baton Rouge	Public-Commercial	220	UTA	24.89
1073	-7126Z	30.6616	-90.930	E. Baton Rouge	Domestic	70	UTA	24.91
1076	-8537Z	30.6180	-90.947	E. Baton Rouge	Domestic	230	UTA	24.91
1078	-5109Z	30.6380	-90.938	E. Baton Rouge	Domestic	160	UTA	24.93
1072	-5131Z	30.9058	-90.951	E. Feliciana	Domestic	105	UTA	24.95
1074	-5036Z	30.9061	-90.951	E. Feliciana	Domestic	105	UTA	24.96
1079	-5609Z	30.6302	-90.940	E. Baton Rouge	Domestic	165	UTA	24.99
1081	-5731Z	30.6311	-90.939	E. Baton Rouge	Domestic	225	UTA	25.00
1082	-7009Z	30.6311	-90.939	E. Baton Rouge	Domestic	220	UTA	25.00
1083	-8194Z	30.6430	-90.934	E. Baton Rouge	Domestic	120	UTA	25.02
1084	-5694Z	30.6352	-90.937	E. Baton Rouge	Domestic	140	UTA	25.03
1085	-8847Z	30.6477	-90.932	E. Baton Rouge	Domestic	300	--	25.03
1080	-5168Z	30.9652	-90.988	E. Feliciana	Domestic	110	UTA	25.06

Source: Reference 2.4.12-224.

Table 2.4.12-213 (Sheet 1 of 3) Water Supply Wells in Use East of the Mississippi River within a 5-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
2	- 82	30.7672	-91.321	W. Feliciana	Domestic	510	Zone 1	1.06
4	- 84	30.7699	-91.342	W. Feliciana	Domestic	180	UTA	1.06
10	-5053Z	30.7416	-91.328	W. Feliciana	Domestic	410	Zone 1	1.07
5	- 241	30.7702	-91.343	W. Feliciana	Domestic	161	UTA	1.09
12	- 83	30.7405	-91.330	W. Feliciana	Domestic	115	UTA	1.12
6	- 65	30.7716	-91.340	W. Feliciana	Domestic	169	UTA	1.12
3	- 87	30.7705	-91.324	W. Feliciana	Industrial	497	Zone 1	1.13
8	- 64	30.7719	-91.340	W. Feliciana	Domestic	1647	Zone 3	1.13
13	-5276Z	30.7402	-91.329	W. Feliciana	Irrigation/ Agriculture	115	UTA	1.14
7	- 68	30.7638	-91.316	W. Feliciana	Domestic	483	Zone 1	1.18
14	- 88	30.7394	-91.329	W. Feliciana	Stock	520	Zone 1	1.20
9	- 94	30.7730	-91.326	W. Feliciana	Domestic	525	Zone 1	1.22
11	- 91	30.7688	-91.318	W. Feliciana	Domestic	485	Zone 1	1.25
16	- 72	30.7716	-91.346	W. Feliciana	Domestic	114	UTA	1.29
19	-5284Z	30.7380	-91.328	W. Feliciana	Domestic	120	UTA	1.31
15	- 86	30.7755	-91.328	W. Feliciana	Domestic	480	Zone 1	1.36
17	-5292Z	30.7763	-91.334	W. Feliciana	Domestic	120	--	1.37
18	- 17	30.7688	-91.314	W. Feliciana	Domestic	502	Zone 1	1.44
20	- 92	30.7608	-91.306	W. Feliciana	Domestic	520	Zone 1	1.66
21	- 56	30.7799	-91.340	W. Feliciana	Domestic	1486	Zone 3	1.66
24	- 245	30.7769	-91.357	W. Feliciana	Public- Commercial	120	UTA	2.00
25	- 244	30.7772	-91.357	W. Feliciana	Public- Commercial	120	UTA	2.01
22	- 73	30.7855	-91.338	W. Feliciana	Domestic	180	UTA	2.02
23	-5289Z	30.7802	-91.312	W. Feliciana	Domestic	150	UTA	2.08
26	-5335Z	30.7538	-91.299	W. Feliciana	Irrigation/ Agriculture	140	--	2.08
27	- 294	30.7874	-91.331	W. Feliciana	Public-Rural	285	Zone 1	2.14
28	- 283	30.7877	-91.331	W. Feliciana	Public-Rural	280	Zone 1	2.16

Table 2.4.12-213 (Sheet 2 of 3)
Water Supply Wells in Use East of the Mississippi River within a 5-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
29	- 251	30.7677	-91.297	W. Feliciana	Domestic	138	UTA	2.32
30	- 250	30.7469	-91.294	W. Feliciana	Domestic	110	UTA	2.46
31	-5283Z	30.7341	-91.299	W. Feliciana	Domestic	230	Zone 1	2.58
32	- 290	30.7894	-91.306	W. Feliciana	Public-Rural	1752	Zone 3	2.80
33	- 240	30.7974	-91.319	W. Feliciana	Stock	636	Zone 1	2.95
34	- 60	30.7977	-91.319	W. Feliciana	Stock	176	UTA	2.97
35	- 222	30.7833	-91.377	W. Feliciana	Public-Municipal	1526	Zone 3	3.17
36	- 270	30.7738	-91.384	W. Feliciana	Public-Municipal	1750	Zone 3	3.26
37	- 63	30.7088	-91.322	W. Feliciana	Industrial	1372	Zone 2	3.35
39	- 215	30.7083	-91.325	W. Feliciana	Industrial	2068	Zone 3	3.36
38	- 50	30.7088	-91.321	W. Feliciana	Industrial	1569	Zone 3	3.36
40	- 48	30.7086	-91.322	W. Feliciana	Industrial	2083	Zone 3	3.37
41	- 221	30.7669	-91.389	W. Feliciana	Industrial	145	MRAA	3.40
42	- 213	30.7963	-91.370	W. Feliciana	Domestic	1670	Zone 3	3.51
43	-5061Z	30.8030	-91.303	W. Feliciana	Irrigation/ Agriculture	210	Zone 1	3.68
44	- 81	30.7661	-91.395	W. Feliciana	Domestic	152	UTA	3.70
45	-5280Z	30.8075	-91.361	W. Feliciana	Domestic	190	UTA	3.88
46	-5240Z	30.8080	-91.361	W. Feliciana	Public- Commercial	140	UTA	3.90
47	-5286Z	30.8055	-91.368	W. Feliciana	Domestic	140	UTA	3.95
49	- 6	30.7097	-91.293	E. Feliciana	Domestic	190	UTA	4.04
48	- 64	30.7447	-91.266	E. Feliciana	Industrial	480	Zone 1	4.09
50	-5304Z	30.7769	-91.268	W. Feliciana	Domestic	120	MRAA	4.17
51	- 281	30.7444	-91.265	E. Feliciana	Industrial	1427	Zone 3	4.19
52	- 296	30.6949	-91.341	W. Feliciana	Public- Commercial	183	MRAA	4.26
53	-5306Z	30.8127	-91.295	W. Feliciana	Irrigation/ Agriculture	160	--	4.50
55	- 235	30.8047	-91.385	W. Feliciana	Public-Municipal	1675	Zone 3	4.52
56	- 36	30.8069	-91.383	W. Feliciana	Industrial	412	Zone 1	4.54
54	- 167	30.7966	-91.272	W. Feliciana	Domestic	100	UTA	4.58

Table 2.4.12-213 (Sheet 3 of 3)
Water Supply Wells in Use East of the Mississippi River within a 5-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
57	- 197	30.7711	-91.256	E. Feliciana	Domestic	38	UTA	4.71
58	-5305Z	30.7886	-91.262	W. Feliciana	Domestic	110	UTA	4.79
59	- 154	30.8266	-91.334	W. Feliciana	Domestic	718	Zone 2	4.84
63	- 286	30.7075	-91.275	E. Feliciana	Public-Commercial	210	UTA	4.86
61	- 153	30.8274	-91.333	W. Feliciana	Domestic	218	Zone 1	4.89
60	- 166	30.8069	-91.276	W. Feliciana	Domestic	380	Zone 1	4.89
64	-5288Z	30.8111	-91.386	W. Feliciana	Domestic	135	UTA	4.90
62	- 165	30.8116	-91.281	W. Feliciana	Domestic	126	UTA	4.93
66	- 79	30.7972	-91.403	W. Feliciana	Domestic	137	UTA	4.99

Table 2.4.12-214
Public Water Supply Systems in West Feliciana Parish

Name of System	Population Served
Town of St. Francisville	2304
Tunica Water System	428
West Feliciana Cons. WWKS District No. 13	8532
West Feliciana Water Works District No. 2	660
RBS	800
Tembec South Mill	850
Louisiana State Penitentiary	6362

Source: Reference 2.4.12-223.

Table 2.4.12-215
Water Supply Wells in Use East of the Mississippi River within a 2-Mi. Radius of the RBS Unit 3 Plant

Map ID	LADOT Well No.	Latitude	Longitude	Parish	Use/Subuse	Well Depth	Aquifer	Distance from Reactor Center in Miles
2	- 82	30.7672	-91.321	W. Feliciana	Domestic	510	Zone 1	1.06
4	- 84	30.7699	-91.342	W. Feliciana	Domestic	180	UTA	1.06
10	-5053Z	30.7416	-91.328	W. Feliciana	Domestic	410	Zone 1	1.07
5	- 241	30.7702	-91.343	W. Feliciana	Domestic	161	UTA	1.09
12	- 83	30.7405	-91.330	W. Feliciana	Domestic	115	UTA	1.12
6	- 65	30.7716	-91.340	W. Feliciana	Domestic	169	UTA	1.12
3	- 87	30.7705	-91.324	W. Feliciana	Industrial	497	Zone 1	1.13
8	- 64	30.7719	-91.340	W. Feliciana	Domestic	1647	Zone 3	1.13
13	-5276Z	30.7402	-91.329	W. Feliciana	Irrigation/ Agriculture	115	UTA	1.14
7	- 68	30.7638	-91.316	W. Feliciana	Domestic	483	Zone 1	1.18
14	- 88	30.7394	-91.329	W. Feliciana	Stock	520	Zone 1	1.20
9	- 94	30.7730	-91.326	W. Feliciana	Domestic	525	Zone 1	1.22
11	- 91	30.7688	-91.318	W. Feliciana	Domestic	485	Zone 1	1.25
16	- 72	30.7716	-91.346	W. Feliciana	Domestic	114	UTA	1.29
19	-5284Z	30.7380	-91.328	W. Feliciana	Domestic	120	UTA	1.31
15	- 86	30.7755	-91.328	W. Feliciana	Domestic	480	Zone 1	1.36
17	-5292Z	30.7763	-91.334	W. Feliciana	Domestic	120	--	1.37
18	- 17	30.7688	-91.314	W. Feliciana	Domestic	502	Zone 1	1.44
20	- 92	30.7608	-91.306	W. Feliciana	Domestic	520	Zone 1	1.66
21	- 56	30.7799	-91.340	W. Feliciana	Domestic	1486	Zone 3	1.66

FSAR 2.4.12 Figures

Due to the large file sizes of the figures for FSAR Section 2.4.12, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.4.13 ACCIDENTAL RELEASES OF RADIOACTIVE LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS

2.4.13.1 Mitigating Design Features

RBS COL 2.0-24-A

As described in DCD Sections 1.2, 3.8.4, and 11.2, mitigating design features of the liquid waste management system (LWMS) and the Radwaste Building that are considered acceptable by NRC Branch Technical Position (BTP) 11-6 are incorporated into the Unit 3 design to preclude the accidental release of liquid effluents. DCD Section 11.2.1 defines compliance with Regulatory Guide 1.143, Revision 2, for permanent plant systems, structures, and components (SSCs), and mobile liquid radioactive waste (radwaste) systems. This includes piping that begins at the interface valves in each line from other systems provided for collecting waste that may contain radioactive materials and includes related instrumentation and control systems (refer to Regulatory Guide 1.143, Section B, Paragraph 3). The radwaste system terminates at the point of controlled discharge to the environment, at that point of recycle to the primary or secondary water system storage tanks, or at the point of storage of packaged wastes. This includes the condensate storage tank (CST) and the radioactive LWMS piping from the first interface valve of the CST to the radwaste system and the LWMS discharge effluent piping. As described in DCD Section 9.2.6, the condensate storage and transfer system (CS&TS), which includes the CST, meets GDC 60 by compliance with Regulatory Guide 1.143 Position C.1.2 for provisions to prevent uncontrolled releases of radioactive material.

The mobile system tanks that are mounted on skids hold very small volumes of liquid radwaste during volume reduction activities and processing. Radwaste volume reduction and processing activities are manual operations that are closely monitored and supervised by plant radwaste personnel. Therefore, any accidental releases or leaks would be small in comparison to a permanent plant LWMS tank rupture and would be quickly remediated, thus posing no adverse effects to the groundwater or surface water environment.

Furthermore, pipes and other components within the LWMS or CS&TS have been designed with isolation features so that they can be quickly isolated if a spill event occurs or leaks develop. Again, the release would be quickly detected by plant personnel and remediated accordingly.

All below-grade tanks that contain radioactivity are located on Levels B1F and B2F of the Radwaste Building (refer to DCD Figure 1.2-25). The Radwaste Building is designed to the seismic requirements specified in DCD Section 3.8.4. In addition, all compartments containing high-level liquid radwaste tanks are steel lined up to a height capable of containing the release of all liquid radwaste in the compartment. Releases as a result of tank failure or leakage result in the release of the liquid radwaste to the compartment and then to the building sump system for containment in other tanks or emergency tanks.

The CST is the only at- or above-grade tank that contains radioactivity outside of containment. The basin surrounding the tank is designed to prevent uncontrolled runoff in the event of a tank failure. The enclosed space is sized to contain the total tank capacity. Tank overflow is also collected in this space. A sump located inside the retention area has provisions for sampling collected liquids prior to their discharge.

2.4.13.2 Liquid Effluent Release Evaluation

Subsection 2.4.13.1 demonstrates that the Unit 3 LWMS design would preclude the accidental release of radioactive liquid effluents to the environment. Nevertheless, in accordance with SRP 11.2, analyses of the bounding release of radioactive liquid effluents to the groundwater and consequently to the nearest sources of potable water in an unrestricted area were performed.

This subsection provides a conservative and bounding analysis of a postulated, accidental release of radioactive liquid effluents to the groundwater. The accident scenario is described, and the model used to evaluate radionuclide transport is presented, along with potential pathways of contamination to water users. The radionuclide transport analysis is described, and the results are summarized. The radionuclide concentrations are compared against the regulatory limits.

As discussed in the following subsections, there is no direct surface water pathway to the Mississippi River for the bounding release scenario considered.

2.4.13.2.1 Release Scenario

A liquid radwaste tank outside of containment is postulated to fail, coincident with the nonmechanistic failure of the above described mitigation design features, thus allowing the tank contents to be released to groundwater. The volume of the liquid assumed released and the associated radionuclide concentrations were selected to produce an accident scenario that leads to the most adverse contamination of groundwater.

Radwaste tanks outside of containment are located on Levels B1F and B2F of the Radwaste Building, as shown in DCD Figure 1.2-25. The radwaste tanks that have the largest volumes include the three equipment drain collection tanks and the two equipment drain sample tanks, all in the lowest level, B2F. Each of these tanks has a volume of approximately 37,000 gallons (140 m^3), according to DCD Table 11.2-2a.

Activity concentrations in various liquid radwaste tanks are provided in DCD Tables 12.2-13a through 12.2-13g. Of these tanks, the limiting tank in terms of radionuclide activity is the equipment drain collection tank; its activity is presented in DCD Table 12.2-13a (refer to DCD Table 2.0-2, for Subsection 2.4.13).

The scenario assumes that one of the equipment drain collection tanks fails and its contents are released directly to the groundwater. It should be noted that this accident scenario is extremely conservative, because the Radwaste Building is seismically designed in accordance with Regulatory Guide 1.143, Class RW-IIa, as described in DCD Section 12.2.1.4. In addition, each tank cubicle is provided with a steel liner, as described in DCD Section 11.2.2.3, to preclude any potential liquid releases to the environment.

2.4.13.2.2 Transport Model and Pathway

Based on the COL stage investigations of the Unit 3 power block and surrounding areas documented in Subsection 2.4.12, specific Unit 3 site characteristics related to groundwater and transport pathway soils were developed.

Figure 2.4.13-201 presents the conceptual model used to evaluate an accidental release of radioactive liquid effluent to groundwater. The key elements and assumptions of the model are described and discussed below.

As indicated above, the worst-case scenario assumes that one of the equipment drain collection tanks is the source of the release, with each tank having a capacity of 37,000 gal. and the radionuclide concentrations as presented in DCD Table 12.2-13a. These tanks are located on the lowest level of the Radwaste Building (Level B2F), which has a bottom floor elevation that is 52 ft. below the finished ground-level grade of 95 ft. msl. One of the tanks is postulated to nonmechanistically fail, and 80 percent of the liquid volume (29,600 gal.) would be released, following the guidance provided in BTP 11-6. It is further assumed that the entire 29,600 gal. would immediately enter the groundwater in the surrounding soils.

The assumption of instantaneous release to the surrounding groundwater following tank failure is highly conservative because it requires failure of the floor drain system, and it ignores the barriers presented by the steel liners that are incorporated into the tank cubicles, and the Radwaste Building structure and basemat, which are seismically designed.

In the worst-case accidental release scenario, radionuclides are released directly to the groundwater and then transported by groundwater to the nearest surface water body or well. The nearest surface water that is used as a drinking water source is the Mississippi River. The nearest potable water intake from the Mississippi River is approximately 87 mi. downstream from the point of expected contaminated groundwater entry. The nearest potable water well in an unrestricted area is Well No. 82.

Groundwater flow evaluation shows that the dominant direction of groundwater flow is west-southwest toward the Mississippi River (refer to Subsection 2.4.12.3.3). Grants Bayou is the closest surface water body that could potentially communicate with groundwater from the site and communicate with the Mississippi River, particularly under flooded conditions. The bed of Grants Bayou that is lower than the predicted flooded water table level is more than 5500 ft. from the Radwaste Building in a south-southeast direction, which is not the dominant direction of groundwater flow; however, Grants Bayou is conservatively considered as the closest surface water body in the dominant direction of groundwater flow in the accidental liquid release analysis.

Well No. 82 is in the north-northeast direction, approximately 5290 ft. from the Radwaste Building. Although Well No. 82 is not in the dominant direction of groundwater flow from the site and is, in fact, in the opposite direction of groundwater flow from the site, it is the closest potable water well in an unrestricted area and was conservatively considered as the closest potable water well in the dominant direction of groundwater flow in the accidental liquid release analysis.

For conservatism, this analysis was performed to determine the concentrations of radionuclides in groundwater for both Grants Bayou and Well No. 82 at assumed respective distances of 5400 ft. and 5000 ft. from the Radwaste Building release point. Both Grants Bayou and Well No. 82 were conservatively assumed to be in the direct path of groundwater flow from the site.

The Radwaste Building basemat elevation is below the water table (refer to representative Figure 2.4.13-201). The release pathway to the nearest potable water well is modeled through the Upland Terrace Aquifer (UTA) and toward Well No. 82. The release pathway to the nearest surface water body is modeled through the UTA and toward Grants Bayou. Groundwater flow is modeled to follow a straight line from the Radwaste Building toward Well No. 82 and Grants Bayou.

The analysis allows for and considers radionuclide decay during transport by groundwater. Radionuclide transport by groundwater is affected by adsorption by the surrounding soils. The RBS site is assumed to continually receive the average annual precipitation; precipitation that does not run off or is not lost to evapotranspiration infiltrates through the unsaturated zone and into the groundwater.

Site-specific parameters such as distribution coefficients, hydraulic conductivity, porosity, and hydraulic gradient, as used in the analysis, are provided in Table 2.4.13-201. Dilution of the radionuclide source term during the instantaneous release outside the Radwaste Building was not modeled in the analysis. Additionally, no screening of the radionuclide source term was performed (i.e., all radioisotope constituents of the source term in DCD Table 12.2-13a were included in the analysis).

Distribution (adsorption) coefficients (K_d values) were determined based on site-specific testing (Reference 2.4.13-205) of soil samples from the UTA, the Mississippi River Alluvial Aquifer (MRAA), and the Unit 1 construction fill. Construction fill for Unit 3 will be taken from the same borrow area as the Unit 1 construction fill. Measurements were obtained for cobalt, cesium, iron, iodine, nickel, plutonium, strontium, technetium, uranium, and zinc. The selection of radionuclides for the determination of distribution coefficients was based on the activity of the equipment drain collection tank source term and sensitivity analysis.

Radionuclides with long half-lives, daughter products with significant potential exposure risk, and mobility in soil/groundwater were selected. In the analysis, the lowest distribution coefficient values were used for each element tested, irrespective of their stratigraphic origin. Distribution coefficients for other elements in the analysis were assigned a value of zero, which is conservative because it assumes no retardation during transport.

Aquifer parameters were established for the UTA and the MRAA (refer to Subsection 2.4.12). For this accidental release groundwater transport model, the highest hydraulic conductivity and hydraulic gradient measured at the site were used for conservatism. Porosity values were obtained through laboratory tests using sample weight, moisture content, and specific gravity. A total porosity value of 0.36 was used with the effective porosity set to the minimum value of 0.24 previously reported in Subsection 2.4.13.2.4 of Reference 2.4.13-201 for similar soil conditions.

The travel times of the groundwater movement from the Radwaste Building to Well No. 82 and Grants Bayou were computed from a variation of Darcy's Law:

$$t = \frac{x}{V} = \frac{x}{KI/\theta}$$

Where:

t = Time to move distance x (yr),

x = Distance of contaminant movement (m),

V = Average interstitial groundwater velocity (m/yr),

K = Hydraulic conductivity (m/yr),

I = Hydraulic gradient, and

θ = Effective porosity.

The values of the parameters used are shown in Table 2.4.13-201. The computed travel times to Well No. 82 and Grants Bayou were 2.63 years and 2.84 years, respectively.

2.4.13.2.3 Radionuclide Transport Analysis

Radionuclide concentrations in groundwater along the transport pathway toward Well No. 82 and Grants Bayou as a result of an accidental release of the contents of an equipment drain collection tank directly to the groundwater were modeled using RESRAD-OFFSITE (Reference 2.4.13-202). The RESRAD-OFFSITE computer code evaluates the radiological dose and excess cancer risk to an individual who is exposed while located outside the area of initial (primary) contamination. The primary contamination, which is the source of all the releases modeled by the code, is a layer of soil below the Radwaste Building. The code models the movement of the contaminants from the primary contamination to user-defined points along the transport pathway.

The groundwater pathway mechanism is a first-order release model that considers the effects of different transport rates for radionuclides and progeny nuclides, while allowing decay during the transport process. Concentrations of each radionuclide transmitted to the assumed drinking water source (conservatively modeled as 5000 ft. from the Radwaste Building in Well No. 82 and 5400 ft. from the Radwaste Building in Grants Bayou, although the bayou is not used directly for drinking water) are determined by transport through the groundwater system, dilution by groundwater and infiltrating surface water from the overburden soils, adsorption, and decay.

Any radionuclides entering Grants Bayou are assumed to remain in the bayou for 1 year.

For Well No. 82, the longitudinal and transverse horizontal dispersivity values were estimated using Appendix C of Reference 2.4.13-203, based on Reference 2.4.13-204. The resultant longitudinal and transverse horizontal dispersivity values of 6.8 and 1.9 m, respectively, are conservative when compared to the longitudinal and transverse horizontal dispersivity values of 21.3 m (70 ft.) and 6.4 m (21 ft.) from Table 2.4-35 of Reference 2.4.13-201.

2.4.13.2.4 Compliance with 10 CFR 20

Table 2.4.13-202 lists the radionuclides predicted at Well No. 82 at a distance of 5000 ft. from the Radwaste Building and compares their concentrations to 10 CFR 20, Appendix B, Table 2, Column 2 limits. All radionuclide concentrations are well under the specified limits. The bounding activity with respect to the fraction of the 10 CFR 20 limits for Ruthenium-106 is more than a factor of 200 under the limits. Meeting the 10 CFR 20 limits at a well at 5000 ft. demonstrates that the radiological consequences of a postulated failure of the equipment drain collection tank are also acceptable for greater distances from the Radwaste Building (i.e., other wells).

Table 2.4.13-203 lists the radionuclides predicted at Grants Bayou at a distance of 5400 ft. from the Radwaste Building and compares their concentrations to the 10 CFR 20, Appendix B, Table 2, Column 2 limits. All radionuclide concentrations are well under the specified limits. The bounding activity with respect to the fraction of the 10 CFR 20 limits for Ruthenium-106 is more than a factor of 270 under the limits. Meeting the 10 CFR 20 limits at 5400 ft. demonstrates that the radiological consequences of a postulated failure of the equipment drain collection tank are also acceptable for greater distances from the Radwaste Building (i.e., the Mississippi River).

10 CFR 20, Appendix B, Table 2 imposes additional requirements when the identity and concentration of each radionuclide in a mixture are known. In this case, the ratio present in the mixture and the concentration otherwise established in 10 CFR 20 for the specified radionuclides not in a mixture may not exceed "1" (i.e., "unity"). The sum of fractions approach has been applied to the radionuclide concentrations for both pathways. Results are summarized in Tables 2.4.13-202 and 2.4.13-203. The sum of fractions for the mixtures at Well No. 82 and Grants Bayou are 0.0169 and 0.0139, respectively. Both are less than unity.

10 CFR 20, Appendix B states, "The columns in Table 2 of this appendix captioned 'Effluents,' 'Air,' and 'Water,' are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of §20.1302. The concentration values given in Columns 1 and 2 of Table 2 are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisieverts)." Thus, meeting the concentration limits of 10 CFR 20, Appendix B, Table 2, Column 2 results in a dose of less than 0.05 rem and, therefore, demonstrates that the requirements of 10 CFR 20.1301 and 10 CFR 20.1302 are met.

2.4.13.3 References

2.4.13-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report" through Revision 19, July 2006.

2.4.13-202 U.S. Department of Energy, *User's Manual for RESRAD-OFFSITE Version 2*, ANL/EVS/TM/07-1, DOE/HS-0005, NUREG/CR-6937, Argonne National Laboratory, Environmental Science Division, Argonne, Illinois, June 2007.

2.4.13-203 Boulding, J. R. and J. S. Ginn, *Practical Handbook of Soil, Vadose Zone, and Ground-Water Contamination, Assessment, Prevention, and Remediation*, Lewis Publishers, September 2003.

2.4.13-204 Electric Power Research Institute, "Estimation of Hydrodynamic Dispersivity in Selected Subsurface Materials," EPRI RP2485-05, Palo Alto, California, 1994.

2.4.13-205 Argonne National Laboratory, Analytical Chemical Laboratory, ACL Job No. 08-0183, September 2008.

Table 2.4.13-201 (Sheet 1 of 2)
Site-Specific RESRAD-OFFSITE Inputs

Parameter	Description	Value
Cobalt K_d (cm^3/g)	Radionuclide-specific distribution coefficient	91.3
Cesium K_d (cm^3/g)	Radionuclide-specific distribution coefficient	16.4
Iron K_d (cm^3/g)	Radionuclide-specific distribution coefficient	3620
Iodine K_d (cm^3/g)	Radionuclide-specific distribution coefficient	0.18
Nickel K_d (cm^3/g)	Radionuclide-specific distribution coefficient	46.4
Plutonium K_d (cm^3/g)	Radionuclide-specific distribution coefficient	102
Strontium K_d (cm^3/g)	Radionuclide-specific distribution coefficient	5.7
Technetium K_d (cm^3/g)	Radionuclide-specific distribution coefficient	0.0
Uranium K_d (cm^3/g)	Radionuclide-specific distribution coefficient	11.1
Zinc K_d (cm^3/g)	Radionuclide-specific distribution coefficient	75.2
Total porosity (unitless)	Total soil porosity, which is the ratio of the soil pore volume to the total volume	0.36
Effective porosity (unitless)	Effective porosity of a porous medium, which is the ratio of the part of the pore volume where water can circulate to the total volume of a representative sample	0.24
Hydraulic conductivity (m/yr)	The quantity of water that will flow through a unit cross-sectional area of a porous material per unit of time under a unit hydraulic gradient	27,815
Hydraulic gradient to surface water body and well (unitless)	Change in groundwater elevation per unit of distance in the direction of groundwater flow to a surface water body or well	0.0050
Distance to the nearest potable water well not in a restricted area (ft. [m])	Distance to the nearest off-site potable water well	5000 (1524)
Distance to the nearest surface water body (ft. [m])	Distance to the nearest off-site surface water body that contributes to a potable drinking water source	5400 (1646)
Precipitation (m/yr)	Site annual average precipitation	1.55

**Table 2.4.13-201 (Sheet 2 of 2)
Site-Specific RESRAD-OFFSITE Inputs**

Parameter	Description	Value
Dry bulk density (gm/cm^3)	Mass of (dry) solids in a unit volume of soil	1.68
Longitudinal Dispersivity to Well No. 82 (m)	Ratio between the longitudinal dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	6.8
Transverse Horizontal Dispersivity to Well No. 82 (m)	Ratio between the horizontal lateral dispersion coefficient and pore water velocity with a dimension of length. This value is based on the aquifer materials and the distance downgradient from the contaminant source.	1.9

Table 2.4.13-202 (Sheet 1 of 2)
Comparison of Liquid Release Concentrations with 10 CFR 20 Concentrations - Well No. 82

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration/ 10 CFR Limit
Ac-227	3.90E-25	5.00E-09	7.80E-17
Ag-110m	1.97E-09	6.00E-06	3.28E-04
Ba-140	6.68E-26	8.00E-06	8.35E-21
Ce-141	9.72E-16	3.00E-05	3.24E-11
Ce-144	8.06E-09	3.00E-06	2.69E-03
Cr-51	3.96E-15	5.00E-04	7.91E-12
Cs-134	7.82E-34	9.00E-07	8.68E-28
Cs-137	1.31E-10	1.00E-06	1.31E-04
Fr-223	5.38E-27	8.00E-06	6.73E-22
H-3	1.07E-06	1.00E-03	1.07E-03
I-129	1.66E-15	2.00E-07	8.30E-09
La-140	7.69E-26	9.00E-06	8.55E-21
Mn-54	1.26E-07	3.00E-05	4.19E-03
Nb-93m	1.85E-16	2.00E-04	9.26E-13
Nb-95	9.73E-12	3.00E-05	3.24E-07
Nb-95m	3.24E-14	3.00E-05	1.08E-09
P-32	5.48E-25	9.00E-06	6.09E-20
Pa-231	4.15E-24	6.00E-09	6.92E-16
Pb-211	3.76E-25	2.00E-04	1.88E-21
Pr-144	8.06E-09	2.00E-05	4.03E-04
Ra-223	3.76E-25	1.00E-07	3.76E-18
Re-187	1.53E-20	8.00E-03	1.91E-18
Rh-103m	1.83E-14	6.00E-03	3.05E-12
Ru-103	1.83E-14	3.00E-05	6.11E-10
Ru-106	1.46E-08	3.00E-06	4.85E-03
Sr-90	9.52E-10	5.00E-07	1.90E-03

Table 2.4.13-202 (Sheet 2 of 2)
Comparison of Liquid Release Concentrations with 10 CFR 20 Concentrations - Well No. 82

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration/ 10 CFR Limit
Tc-99	1.45E-13	6.00E-05	2.42E-09
Te-129	1.66E-15	4.00E-04	4.15E-12
Te-129m	2.55E-15	7.00E-06	3.65E-10
Th-227	3.757E-25	2.00E-06	1.88E-19
Th-231	3.112E-21	5.00E-05	6.22E-17
U-235	3.883E-21	3.00E-07	1.29E-14
Y-90	8.998E-09	7.00E-06	1.29E-03
Y-91	8.213E-12	8.00E-06	1.03E-06
Zr-93	1.35E-15	4.00E-05	3.37E-11
Zr-95	4.384E-12	2.00E-05	2.19E-07
SUM			**1.69E-02**

Table 2.4.13-203 (Sheet 1 of 2)
Comparison of Liquid Release Concentrations with 10 CFR 20 Concentrations - Grants Bayou

Nuclide	Maximum Concentration (μCi/ml)	10 CFR 20 Concentration (μCi/ml)	Max Concentration/ 10 CFR Limit
Ac-227	8.23E-25	5.00E-09	1.65E-16
Ag-110m	1.18E-09	6.00E-06	1.97E-04
Ba-140	2.53E-27	8.00E-06	3.16E-22
Ce-141	8.50E-17	3.00E-05	2.83E-12
Ce-144	5.21E-09	3.00E-06	1.74E-03
Cr-51	3.11E-16	5.00E-04	6.21E-13
Cs-134	5.05E-34	9.00E-07	5.61E-28
Cs-137	1.97E-10	1.00E-06	1.97E-04
Fr-223	1.14E-26	8.00E-06	1.42E-21
H-3	1.19E-06	1.00E-03	1.19E-03
I-129	2.39E-15	2.00E-07	1.20E-08
La-140	2.91E-27	9.00E-06	3.24E-22
Mn-54	8.60E-08	3.00E-05	2.87E-03
Nb-93m	1.19E-16	2.00E-04	5.96E-13
Nb-95	1.83E-12	3.00E-05	6.11E-08
Nb-95m	6.11E-15	3.00E-05	2.04E-10
P-32	2.18E-26	9.00E-06	2.42E-21
Pa-231	6.55E-24	6.00E-09	1.09E-15
Pb-211	8.01E-25	2.00E-04	4.01E-21
Pr-144	5.21E-09	2.00E-05	2.61E-04
Ra-223	8.01E-25	1.00E-07	8.01E-18
Re-187	9.45E-21	8.00E-03	1.18E-18
Rh-103m	2.03E-15	6.00E-03	3.38E-13
Ru-103	2.03E-15	3.00E-05	6.78E-11
Ru-106	1.08E-08	3.00E-06	3.61E-03
Sr-90	1.77E-09	5.00E-07	3.54E-03

Table 2.4.13-203 (Sheet 2 of 2)
Comparison of Liquid Release Concentrations with 10 CFR 20 Concentrations - Grants Bayou

Nuclide	Maximum Concentration (µCi/ml)	10 CFR 20 Concentration (µCi/ml)	Max Concentration/ 10 CFR Limit
Tc-99	1.11E-13	6.00E-05	1.85E-09
Te-129	1.52E-16	4.00E-04	3.79E-13
Te-129m	2.33E-16	7.00E-06	3.33E-11
Th-227	7.98E-25	2.00E-06	3.99E-19
Th-231	6.08E-21	5.00E-05	1.22E-16
U-235	6.09E-21	3.00E-07	2.03E-14
Y-90	1.75E-09	7.00E-06	2.51E-04
Y-91	1.43E-12	8.00E-06	1.78E-07
Zr-93	6.80E-16	4.00E-05	1.70E-11
Zr-95	8.26E-13	2.00E-05	4.13E-08
SUM			**1.39E-02**

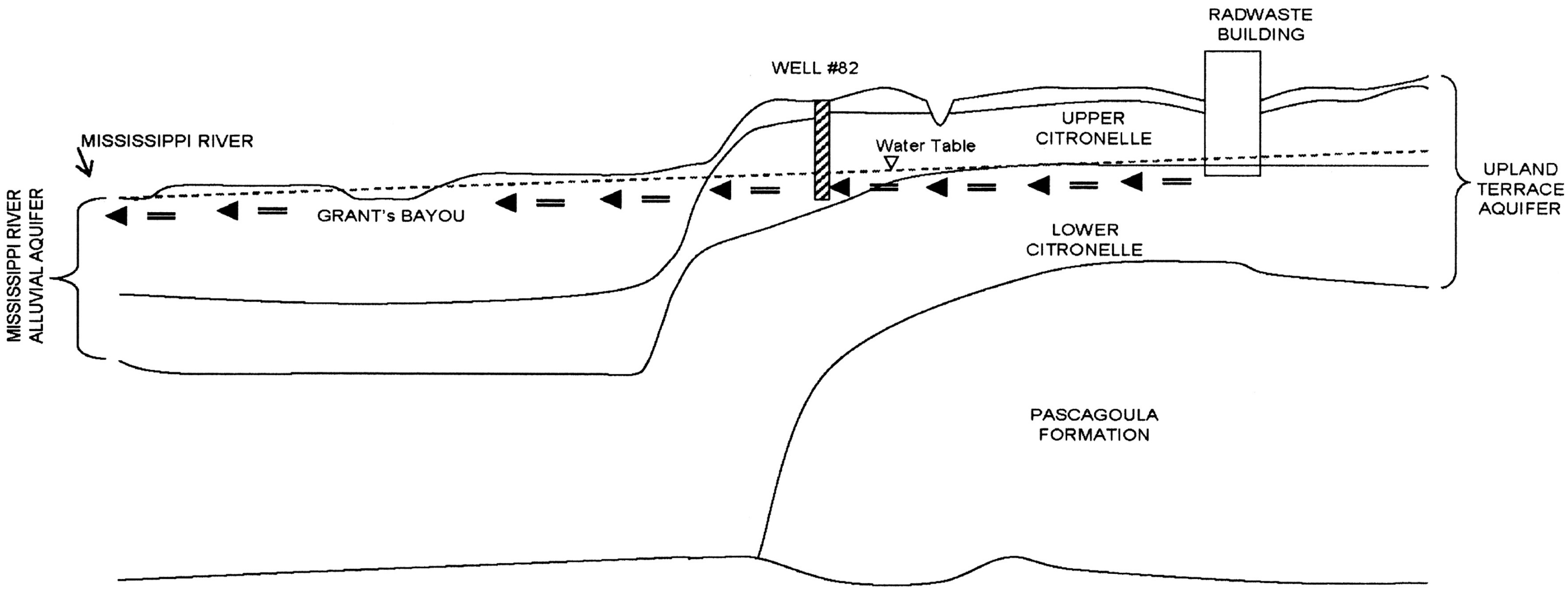

Figure 2.4.13-201. Conceptual Model for Evaluating Radionuclide Transport in Groundwater

2.4.14 TECHNICAL SPECIFICATIONS AND EMERGENCY OPERATION REQUIREMENTS

RBS COL 2.0-25-A

An evaluation was performed for the Unit 3 site to determine if any technical specifications or emergency protective measures were required to mitigate the impact of adverse hydrology-related events or other natural phenomena on safety-related structures, systems, and components (SSCs).

As described in SRP 2.4.14, relevant hydrological-related criteria include flood water surface elevation, hydrodynamic forces (i.e., due to groundwater), coincident wind-induced waves and runup, and water supply limitations caused by droughts and other natural phenomena.

2.4.14.1 Hydrological Event and Natural Phenomena Protection Requirements

This subsection evaluates the need for any technical specifications or emergency protective measures to mitigate the impact of adverse hydrology-related events or natural phenomena on safety-related SSCs.

As described in DCD Chapter 3, safety-related SSCs are protected by design from wind and tornado loading (DCD Section 3.3), flooding (DCD Section 3.4), missiles generated by natural phenomena (DCD Section 3.5), and seismic events (DCD Sections 3.7 and 3.8).

A site-specific analysis of the impact on SSCs from flooding is described in FSAR Section 2.4.10. FSAR Section 2.4.12 evaluates groundwater at the site. FSAR Section 2.4.3 evaluates the site-specific impact of coincident wind-induced waves and runup.

No technical specifications or emergency procedures are needed to protect SSCs from external flooding or other natural phenomena because the ESBWR standard plant design provides the necessary protection for safety-related SSCs and site-specific analyses indicate that the site maximum flood level and maximum groundwater level are bounded by the ESBWR Standard Plant site parameters as shown in Table 2.0-201 and coincident wind-induced waves and runup cannot affect safety-related SSCs at the site.

2.4.14.2 Adequate Water Supply Requirements

This subsection evaluates the need for any technical specifications or emergency protective measures to mitigate the impact of hydrology related events, droughts, or other natural phenomena on the plant's UHS.

As described in DCD Sections 9.2.1 and 9.2.5, the ESBWR uses a passive, safety-related decay heat removal system (UHS) contained within the Seismic Category I Reactor Building for heat removal capability following an accident, and does not depend on a separate safety-related reservoir outside of the Reactor

Building. The safety-related Seismic Category I Reactor Building protects the UHS from the effects of natural phenomena, including hydrology related events, droughts, or seismic events.

Technical Specification 3.7.1 provides requirements for ensuring an adequate water supply for the passive decay heat removal system is available for the first 72 hours following an accident. Requirements for sufficient long-term makeup supplied by the Seismic Category I fire water storage tanks are provided for in the RTNSS Availability Control Manual in DCD Chapter 19, Appendix 19A.

Therefore, there would be no adverse impact on the availability of the UHS resulting from adverse hydrologic events or other natural phenomena and thus no need for technical specifications or emergency procedures for the UHS to mitigate the consequences of these events.

2.5 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING

2.5.0 INTRODUCTION

This section provides information on the geological, seismological, and geotechnical characteristics of the RBS Unit 3 site and the region surrounding the site. The data and analyses in this section document Entergy Operation's evaluation of the suitability of the site. Section 2.5 provides sufficient information to support evaluation of the site-specific ground motion response spectra (GMRS) and provides information to permit adequate engineering solutions to geologic conditions and seismic effects at the RBS Unit 3 site. Section 2.5 provides an update to the geological, seismological, and geophysical database for the RBS Unit 3 site. This update is focused on data published since 1986 which indicates any significant change to the 1986 EPRI seismic source model (Reference 2.5.0-201), in accordance with Regulatory Guide 1.208 requirements.

Section 2.5 is organized as outlined in Regulatory Guide (RG) 1.206, as follows:

Subsection 2.5.1.1 describes the geologic and tectonic setting of the site region (200 mi [320 km] radius), and Subsection 2.5.1.2 describes the geology and structural geology of the site vicinity (25 mi. [40 km] radius), site area (5 mi. [8 km] radius), and site location (0.6 mi. [1 km] radius). The geological and seismological information presented in this subsection is used as a basis for evaluating the detailed geologic, seismic, and man-made hazards at the site.

Subsection 2.5.2 describes the methodology used to develop the GMRS for the RBS Unit 3 site. The selected starting point for developing the site specific ground motion assessments for the RBS site was the Probabilistic Seismic Hazard Analysis (PSHA) conducted by the EPRI SOG in the 1980s (Reference 2.5.0-201). Following guidance in NRC Regulatory Guides 1.165 and 1.208, the adequacy of the EPRI SOG hazard results were evaluated.

PSHA sensitivity analyses were conducted to test the effect of the new information on the seismic hazard. Using these results, an updated PSHA analysis was performed; the results of that analysis have been used to develop uniform hazard response spectra (UHRS) and the identification of the controlling earthquakes.

For this study, an updated earthquake catalog was created that includes additional historical and instrumental events through December 2006. The RBS site is located in an area of infrequent and low seismicity within the Gulf Coast Basin tectonic province. In addition to events within the site region, earthquakes that occurred in the Gulf of Mexico at greater distance from the RBS site were considered in the updated PSHA.

Sensitivity analyses showed that updates to the earthquake catalog for the site region did not produce a significant change in earthquake occurrence rates from those defined by the EPRI SOG earthquake catalog. The review of the EPRI SOG seismic sources and the sensitivity tests resulted in modifications to the EPRI SOG seismic sources as implemented in the EPRI 1989 calculations for the RBS site. Sensitivity analyses also showed that the updated characterization of repeated earthquakes near New Madrid should be incorporated into updated PSHA for the RBS site.

PSHA calculations were performed for response spectral accelerations at the seven structural frequencies provided in the EPRI 2004 ground motion model. Smooth response spectra for the controlling earthquakes were developed using spectral shapes developed in NUREG/CR 6728.

The horizontal GMRS for the RBS site were developed using the performance based approach defined in NRC Regulatory Guide 1.208. The reference location for the site GMRS was set at the top of the excavation at elevation 20 ft msl. The vertical GMRS were developed by multiplying the horizontal GMRS by vertical/ horizontal spectral ratios recommended for soil in NUREG/CR 6728.

Subsection 2.5.3 describes investigations performed to evaluate the potential for surface fault rupture at the RBS site, as well as the surrounding area, including compilation and review of existing data and literature, lineament analyses, discussions with current researchers in the area, field reconnaissance, geomorphic analyses, and review of seismicity data. Results of the surface faulting study indicate that there is no evidence of Quaternary tectonic or nontectonic surface faulting or fold deformation at the RBS site, and no capable tectonic sources have been identified within 25 mi. (40 km) of the site.

Subsection 2.5.4 discusses the stability and uniformity of subsurface materials and foundations. The soils within several hundred feet of the ground surface consist of alluvial silts, sands and clays and engineered fill derived from alluvial sources. The design plant grade is elevation 98.0 ft. NGVD. Within the footprint of the Seismic Category 1 structures, the upper soils will be excavated to elevation 20 ft. msl.

A subsurface investigation was performed that consisted of geotechnical borings, piezometer and monitoring well installations, cone penetrometer soundings (CPT), pressuremeter tests, geophysical surveys, and laboratory tests. A total of 52 borings were advanced; including 21 borings beneath the RBS Unit 3 Seismic Category I structures.

Laboratory testing performed for selected samples included index testing, triaxial and direct shear testing, one-dimensional consolidation testing, moisture-density relationship testing, chemical analysis and dynamic testing, including resonant column torsional shear, resonant column, and dynamic simple shear testing .

Groundwater levels were determined to be at a maximum of 58 feet msl with a design groundwater level of 60 ft. msl. The design groundwater level is 35 feet below plant grade. The analysis for liquefaction potential was performed using the design groundwater elevation of 60 ft. msl. Maximum lateral excavation limits will be approximately 700 ft., with a maximum excavation depth of 75 ft. Static stability analysis of the Seismic Category I structures was performed.

Subsection 2.5.5 discusses stability of slopes, including a description of the site grade.

2.5.0.1 References

2.5.0-201 Electric Power Research Institute (EPRI-SOG), "Seismic Hazard Methodology for the Central and Eastern United States," Technical Report NP-4726-A, Volumes 1-10, including seismicity catalog, 1988.

2.5.1 BASIC GEOLOGIC AND SEISMIC INFORMATION

RBS COL 2.0-26-A

This subsection presents information on the geologic and seismologic setting of the RBS Unit 3 site. Appendix C, "Investigations to Characterize Site Geology, Seismology and Geophysics," of U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," provides guidance on geological, seismological, and geophysical investigations that should be conducted to develop an up-to-date, site-specific earth science database that supports the site characterization and a site-specific probabilistic seismic hazard analysis (PSHA). Subsection 2.5.1 presents geologic and seismologic information about the site region (within a 200-mi. [320-km] radius); site vicinity (within a 25-mi. [40-km] radius); site area (within a 5-mi. [8-km] radius); and site location (within 0.6 mi. [1 km]) as outlined in the regulatory guide.

Several sources of information were used to develop the information summarized in this subsection. The primary sources of information from which detailed descriptions of the existing site and site region were obtained are incorporated by reference. (References 2.5.1-201 and 2.5.1-202)

Geologic, seismologic, and geotechnical information contained in the RBS Unit 1 USAR has been updated based on a review of data and information published since the August 1987 update and discussions with current researchers familiar with the regional and local geology. References reviewed are listed in Subsection 2.5.1.3. In addition, new geologic maps showing the distribution of surficial deposits in the site vicinity, site area, and site location have been prepared, and new geologic cross sections and subsurface contour maps have been prepared incorporating data from the RBS Unit 3 geotechnical site investigation.

Emphasis was placed on the identification of new information that would suggest significant differences from the information used to develop the Electric Power Research Institute (EPRI) seismic source characterization model (Reference 2.5.0-201) that forms the starting point for the assessment of seismic hazard at sites in the central and eastern United States (CEUS) (refer to Subsection 2.5.2). Regional compilations of information on the origin and development of the Gulf of Mexico basin provide more recent assessments of the tectonic evolution, structural framework of the region, and geophysical characteristics of the crust that were used to evaluate the seismic source characterization parameters.

The information in this subsection was developed in accordance with the NRC Regulatory Guides 1.206 and 1.208. Subsection 2.5.1.1 describes the regional geologic and tectonic setting, focusing primarily on the region within a 200-mi. (320-km) radius of the RBS Unit 3 site. The EPRI seismic hazard analysis (Reference 2.5.0-201) for the adjacent RBS Unit 1 identified the New Madrid Seismic Zone (NMSZ), which was the source of a large, geologically recent earthquake, as a distance greater than 200 mi. (320 km), but significant seismic source. This subsection presents updated information regarding the location, magnitude, and recurrence of this seismic source. Recent earthquakes of moderate size that occurred in the Gulf of Mexico during 2006 have implications for the characterization of seismic source zones that include the RBS site. The tectonic settings of these events are described in this subsection.

2.5.1.1 Regional Geology

The proposed location of the new unit at the RBS site in West Feliciana Parish is 3 mi. (5 km) southeast of St Francisville, Louisiana, and approximately 24 mi. (39 km) northwest of Baton Rouge, adjacent to the Mississippi River floodplain (refer to Figure 2.5.1-201).

The site region is divided into both physiographic and geologic provinces, which are shown in Figures 2.5.1-202 and 2.5.1-203, respectively. The site is located within the Gulf Coastal Plain physiographic province that comprises two primary geologic provinces: the Gulf Coast Basin and Mississippi Embayment (refer to Figure 2.5.1-203). These geologic provinces encompass a variety of geologic features, including localized uplifts, zones of salt migration, growth faults, pre-Quaternary tectonic faults, and basins. These provinces and geologic features are described in Subsections 2.5.1.1.2 and 2.5.1.1.5.

The Gulf Coastal Plain physiographic province has been dominated by marine and fluvial processes along the Gulf of Mexico continental margin for several hundred million years (Reference 2.5.1-203). Thick sedimentary sequences deposited by the Mississippi River within the Gulf Coastal Plain played an important role in the geologic processes of the region since post-Miocene time. The distribution of major geologic features and sedimentary units in the Gulf Coastal Plain and site region is shown in Figures 2.5.1-203 and 2.5.1-204.

Global climatic changes and tectonic events played important roles in the geologic history of the Gulf Coastal Plain. Tectonic and climatic events from the eastern coast of North America to as far west as the Rocky Mountains influenced the formation of sedimentary rocks, emplacement of igneous bodies, and deformation of the crust and overlying sedimentary section in the site region. The principal tectonic events include the Taconic, Acadian, and Allegheny orogenies that formed the Appalachian Mountains and the Ouachita orogenic belt; continental rifting that formed the Gulf of Mexico; and changes in regional stress that deformed the crust along the Reelfoot Rift and formed the Mississippi Embayment. Secondary processes such as igneous intrusion, basin settlement, and salt diapirism also played important roles in the geological development of the site region.

The site region is characterized by extremely low rates of earthquake activity (refer to Figure 2.5.1-210). Previous seismic hazard investigations, such as the original licensing studies for the site (Reference 2.5.1-201), the 1986 EPRI study (Reference 2.5.1-367), and the 2002 U.S. Geological Survey (USGS) National Seismic Hazard maps (Reference 2.5.1-206), all indicate that the rate of earthquake activity in the Gulf Coastal Plain is among the lowest in the United States. The geologic setting and modern tectonic framework suggest that the earthquake hazard for the site region will remain low for the foreseeable future. A detailed discussion of the regional tectonics is presented in Subsection 2.5.1.1.5.

2.5.1.1.1 Regional Physiography

The site region lies entirely within the Gulf Coastal Plain physiographic province (refer to Figure 2.5.1-202). This province extends 500 mi. (800 km) inland from the coast to include the Mississippi Embayment geologic province north of the site as shown in Figure 2.5.1-203. The Gulf Coastal Plain physiographic province is divided into subprovinces that include the Southern Hills, the Mississippi Alluvial Valley, the Delta Plain, the Prairie Coastwise Terrace, the Loess Hills, the Eastern Hills, the Western Hills, and the Chenier Plain (refer to Figure 2.5.1-202).

2.5.1.1.1.1 Southern Hills

The site is situated 1.9 mi. (3 km) northeast of the east bank of the Mississippi River on the uplands of the western edge of the Southern Hills subprovince (refer to Figure 2.5.1-202). The Southern Hills covers portions of southern Mississippi, southern Louisiana, and southeastern Texas. The topography is characterized by gently rolling hills and flat-topped ridges that range in elevation from +50 to +500 ft. (+15 to +150 m) mean sea level (msl) and generally decreases toward the Gulf Coast. (Reference 2.5.1-202)

2.5.1.1.1.2 Mississippi Alluvial Valley

The Mississippi Alluvial Valley subprovince lies to the south and west of the site (refer to Figure 2.5.1-202). In terms of geomorphology, the southern boundary of the section is based on the southern extent of the Pleistocene valley walls (Prairie Coastwise Terraces) (refer to Figure 2.5.1-204) (Reference 2.5.1-203). The geologic boundary between the Mississippi Alluvial Valley and Delta Plain subprovinces is based on the northern extent of the Atchafalaya River, which is the first true distributary of the Mississippi River and is located approximately 40 mi. (64 km) north of the site (Reference 2.5.1-203). This subprovince includes a number of interdistributary lowlands, basins, and ridges. Elevations generally range from +50 to +250 ft. (+15 to +76 m) msl. Higher elevations occur in tributary valleys, with highs of +300 ft. (+91 m) msl in the Ouachita River Valley and +500 ft. (+150 m) msl in the upper Red River Valley near the Ouachita Mountains. The topographic highs along the Mississippi River are remnants of older alluvial deposits that were mostly eroded and removed from the valley. The valley topography is relatively flat with a gentle southward gradient and is characterized by fluvial geomorphic features typical of a braided stream and meandering river system (e.g., valley train, oxbow lakes, meander belts, and floodplains). Deposits in the Mississippi Alluvial Valley consist primarily of Pleistocene to Holocene sediments derived from the Mississippi River and its tributaries. (Reference 2.5.1-202)

2.5.1.1.1.3 Delta Plain

The Delta Plain subprovince lies to the south of the site (refer to Figure 2.5.1-202). The topography of the Delta Plain is characterized by abandoned distributary channels, distributary levee ridges, and coalescing delta complexes near the mouth of the Mississippi River. The distributary levee ridges form the most prominent topographic features, but do not exceed Elevation +10 ft. (+3 m) msl. Distributary channels radiate in a fan shape and form apices of delta complexes (Reference 2.5.1-203). The morphologic expression of the channel and distributary features become markedly less pronounced with increasing age and eventually become buried as a result of coastal subsidence. (Reference 2.5.1-202)

2.5.1.1.1.4 Prairie Coastwise Terrace

The Prairie Coastwise Terrace subprovince occupies the area south of the site (refer to Figure 2.5.1-202). The Prairie Coastwise Terrace extends across southern Mississippi, southern Louisiana, and southeastern Texas. The topography of this subprovince is characterized by gently rolling hills and remnants of dissected terrace surfaces that range in elevation from +25 to +150 ft. (+7 to +46 m) msl and gradually decrease in elevation coastward. The Prairie Coastwise Terrace is underlain by terrace deposits of the late Pleistocene Prairie Complex. (Reference 2.5.1-202)

2.5.1.1.1.5 Loess Hills

The Loess Hills subprovince lies to the east of the Mississippi Alluvial Valley subprovince, both of which are located north of the site (refer to Figure 2.5.1-202). The Loess Hills extend along the eastern bank of the Mississippi River from Kentucky to southwestern Mississippi. The Loess Hills consist of an eastward thinning loess (silt) deposit that is 0 to 100 ft. (30 m) thick and extends 10 to 30 mi. (16 to 48 km) east of the Mississippi River. (References 2.5.1-203 and 2.5.1-207)

The topography of the Loess Hills is characterized by flat-topped ridgelines and fluvial terraces separated by deeply incised dendritic drainage systems. In the site region, the Loess Hills vary in elevation from +100 to +300 ft. (+30 to +91 m) msl. Erosion along the eastern edge of the Mississippi River floodplain has formed a steep escarpment along the western edge of the Loess Hills. (Reference 2.5.1-202)

The Loess Hills were formed through the deposition of successive sheets of silt during the late Quaternary. Up to five distinct periods of loess deposition are documented. Each of these deposits are separated by leached buried soils that represent significant periods of landscape stability. (References 2.5.1-208 and 2.5.1-207)

2.5.1.1.1.6 Eastern Hills

The Eastern Hills subprovince lies northeast of the site (refer to Figure 2.5.1-202). The Eastern Hills cover the area from central Mississippi and central Alabama to western Tennessee and extend to the eastern margin of the Gulf Coastal Plain. The topography is characterized by gently rolling hills that range in elevation from +100 to +600 ft. (+30 to +182 m) msl, which gradually decrease in elevation southward. The Eastern Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by tributaries of the Mississippi River. (Reference 2.5.1-202)

2.5.1.1.1.7 Western Hills

The Western Hills subprovince lies northwest of the site (refer to Figure 2.5.1-202). The Western Hills cover the area from central Louisiana to central Arkansas and extend westward into eastern Texas. The topography is characterized by gently rolling hills ranging in elevation from +200 to +700 ft. (+60 to +213 m) msl and gradually decrease in elevation southward. The Western Hills are underlain by Miocene to Paleocene sedimentary rocks and drained by the Arkansas River and Red River, two major tributaries of the Mississippi River. (Reference 2.5.1-202)

2.5.1.1.1.8 Chenier Plain

The Chenier Plain subprovince is located southwest of the site and occupies the area between the Prairie Coastwise Terrace subprovince and the Gulf of Mexico (refer to Figure 2.5.1-202). The Chenier Plain extends along the Louisiana and eastern Texas coastline. "Cheniers" are abandoned beaches of the Gulf of Mexico, with large expanses of Holocene marshes that developed on prograding mudflats. A typical Chenier ridge is less than 10-ft. (3-m) high, but may extend for miles or tens of miles. The topography of the Chenier Plain is characterized by low-lying coastal ridges and marshes. The most prominent features are abandoned beach ridges at elevations of between sea level and +25 ft. (+8 m) msl. Subtle variations in elevations, on the order of inches, have a pronounced effect on vegetation and habitat in the Chenier Plain. The only preserved pre-Holocene features are remnants of the Prairie Coastwise Terrace and emergent landforms developed above salt dome piercement structures. (References 2.5.1-203 and 2.5.1-202)

2.5.1.1.2 Regional Geologic Provinces

The Gulf Coastal Plain physiographic province comprises two geologic provinces: the Gulf Coast Basin and the Mississippi Embayment (refer to Figure 2.5.1-203). Both the Gulf Coast Basin and the Mississippi Embayment have distinct geologic histories.

2.5.1.1.2.1 Gulf Coast Basin

Most of the site region is situated within the Gulf Coast Basin geologic province (refer to Figure 2.5.1-203). The Gulf Coast Basin geologic province contains marine sediments deposited during episodic sea level transgressions and regressions and terrestrial sediments deposited on river floodplains and deltas along the continental margin. The sediments are composed of sand, silt, gravel, clay, marl, limestone, salt, and chalk that range in age from Jurassic to Holocene and form a seaward-thickening wedge more than 50,000 ft. (15,240 m) thick near the present Gulf of Mexico coastline. Development of the thick sedimentary wedge resulted in depression of the crust within the Gulf Coast Basin to depths of up to 7 mi. (11 km) (refer to Figure 2.5.1-205). (Reference 2.5.1-204)

The site is located in a relatively domeless area between the Interior Salt Basin and the Coastal Salt Basin (refer to Figure 2.5.1-203). South of the site, the sedimentary beds are interrupted by numerous east-west trending growth faults that become less steep with depth and become bedding-plane slips (refer to Subsection 2.5.1.1.5.2.1.7). These faults are activated by compaction and subsidence of the sediments and are not derived from basement tectonic structures. Some movement may be continuing on several of these growth faults. These growth faults are further discussed in Subsection 2.5.1.1.5.2.1.7.

The Gulf Coast Basin extends from the Gulf of Mexico to the buried Ouachita orogenic belt (refer to Figure 2.5.1-203). The basin formed during initial rifting of the Gulf of Mexico during the Triassic. As a result of continental rifting and formation of new oceanic crust, the properties of basement materials within the Gulf Coast Basin are transitional between continental and oceanic materials. In the northern part of the basin, the basement is defined as thick transitional crust reflecting continental affinity. In areas closer to the Gulf of Mexico oceanic plate, the crust is defined as thin transitional crust reflecting oceanic affinity (Reference 2.5.1-204). The basin has been affected by a long series of tectonic, volcanic, depositional, isostatic, and climatic processes, which are described in greater detail below.

2.5.1.1.2.2 Mississippi Embayment

The northern portion of the site region is located within the Mississippi Embayment geologic province. The Mississippi Embayment syncline is the primary structural element that affected regional stratigraphic patterns in the Lower Mississippi Valley in pre-Quaternary times (Reference 2.5.1-205). The geological province extends from the buried Ouachita Orogenic belt to the northern margin of the Gulf Coastal Plain and lies between the Appalachian Mountains in west-central Alabama and the Ouachita Mountains in southern Arkansas (refer to Figure 2.5.1-203). The Mississippi Embayment formed in response to crustal downwarping associated with the extension of the Reelfoot Rift (described in Subsection 2.5.1.1.5.4) within the North American craton during the Late Cretaceous. The Mississippi Embayment is underlain by Paleozoic strata and igneous and metamorphic basement rocks. The structure of the embayment is characterized by a south-southwest plunging syncline that continues southward across the Gulf Coast Basin (refer to Figure 2.5.1-206). The top of the Paleozoic section in the Mississippi Embayment defines a slightly asymmetric syncline, i.e., the western limb dips 0.59 degree, and the eastern limb dips 0.34 degree. (Reference 2.5.1-202)

2.5.1.1.3 Regional Geologic History

A discussion of the geologic history of the site region is presented chronologically from Precambrian and late Paleozoic to the present. A regional stratigraphic column is included as Figure 2.5.1-207.

2.5.1.1.3.1 Precambrian through Jurassic Periods

The crystalline basement of the North American craton in the central United States is wholly Precambrian in age, with the possible exception of basement rocks underlying the Gulf Coast Basin (References 2.5.1-204, 2.5.1-209, and 2.5.1-210). The central United States basement complex is divided into eight major cratonic elements (refer to Figure 2.5.1-208). These are the products of major Precambrian orogenic events, ranging in age from Archean (3.8 billion years [Ga]) to Middle Proterozoic (750 million years [Ma]) (Reference 2.5.1-209). The North American craton is inferred to have progressively enlarged to the south and east as a result of lateral accretion during successively younger Precambrian orogenies. (Reference 2.5.1-201)

Cratonic rocks of south-central North America extend to the southern margin of the Ouachita orogenic belt (refer to Figure 2.5.1-208). The exact nature of the basement materials beneath the Paleozoic sediments south of the Ouachita orogenic belt is equivocal. However, the basement materials are probably related to the formation of oceanic crust during rifting and evolution of the Gulf of Mexico (Reference 2.5.1-214). The Gulf of Mexico began forming in the Triassic by rifting of the super continent Pangea and the divergent motion of the North American and Afro-South American plates. (Reference 2.5.1-215)

Figure 2.5.1-203 shows the primary tectonic elements within the south-central part of the North American craton, including the Reelfoot Rift complex, the Paleozoic Ouachita orogenic belt, and the Appalachian Mountains. The Reelfoot Rift, and possibly other rift systems within the North American craton, were reactivated and experienced additional extension and intrusion during the early Mesozoic (References 2.5.1-211 and 2.5.1-212). The similarity in ages of rift systems within the craton suggests that they initially formed as failed arms of triple junctions during an episode of late Precambrian continental fragmentation that predated the Paleozoic Ouachita and Appalachian orogenies (Reference 2.5.1-213). The sequence of major geological events is summarized in Figure 2.5.1-209.

As the separation of Pangea continued through the Middle Jurassic, the Gulf Coastal Plain began to develop north of the Gulf of Mexico by the slow deposition of sediment on top of the Paleozoic sedimentary rocks. During the Triassic, sediments accumulated in grabens formed during rifting and block faulting, and by the mid-Jurassic, the region became a restricted seaway, with an evaporitic condition accumulating more than 9900 ft. (3000 m) of salt deposits (Reference 2.5.1-215). By the Late Jurassic, conditions changed to an open marine environment and resulted in the first major marine transgression into the Gulf Coast Basin and Mississippi Embayment (Reference 2.5.1-216). During the Cretaceous, a series of transgressive and regressive episodes and coincident crustal subsidence caused widespread deposition of carbonates over the Jurassic sediments and salt deposits throughout the Gulf Coast Basin. (Reference 2.5.1-217)

The presence of some continental red bed sediments of the Eagle Mills Formation in the northern Gulf Coastal Plain region has been considered to probably be related to fault graben development in the Triassic Period. In southern Arkansas, the Eagle Mills Formation was deposited unconformably upon Paleozoic rocks, and some igneous activity occurred. (Reference 2.5.1-201)

The seas transgressed northward in the Early Jurassic, and widespread evaporites, red beds, and carbonates of the Louann, Louark, and Cotton Valley Groups accumulated within the Gulf Coastal Plain. The Louann salt deposits with thicknesses of up to 5000 ft. (1500 m) formed at this time. The pattern of salt basins in this region suggests the initial salt accumulation occurred in regional grabens. The Louann salt beds are the source of the salt domes and other salt structures within the Gulf Coast region. (Reference 2.5.1-201)

The normal, graben type faulting that began at this time was related to the subsidence of the continental margin on the seaward side of the Paleozoic orogenic belt. These faults limit the inner extent of thick Jurassic sediments, including salt. Such faulting included the South Arkansas Pickens-Gilbertown fault zones. Scattered structural features developed intermittently throughout the Gulf Coastal Plain from local uplift and/or subsidence during the Mesozoic and Cenozoic Eras. (Reference 2.5.1-201)

2.5.1.1.3.2 Cretaceous Period

In the Mississippi Embayment, crustal subsidence continued into the Early Cretaceous, allowing marine deposition to extend further north and west toward the Ouachita Mountains (References 2.5.1-203 and 2.5.1-205). In the Early Cretaceous, general subsidence of the Gulf Coast region resulted in deposition of the Coahuilan and Comanchean Series unconformably over the Upper Jurassic beds as the Appalachian and Ouachita highlands were eroded. More than 10,000 ft. (3000 m) of such sediments were deposited in central and southern Mississippi during the Cretaceous. At the end of Comanchean deposition, the sedimentary depocenters had gradually shifted southward into central Louisiana and southern Mississippi as the seas withdrew. The region was uplifted and partially eroded at the end of the Early Cretaceous. During the middle Cretaceous, the area continued to be uplifted and partially eroded, although minor deposition occurred locally. (Reference 2.5.1-202)

In the Late Cretaceous, the Gulfian seas transgressed the region and unconformably overlapped the Early Cretaceous and older sediments along the shelf edge near the site. This extended into the northern Mississippi Embayment during middle Tuscaloosa deposition. The character of the sediments reflects strand line fluctuations and shows that a gradual northward transgression occurred. Elevation of the Sabine, Monroe Uplifts, and the Jackson Dome occurred during the advance of the Gulfian Sea, accompanied by extensive intrusion and extrusion of igneous materials. (References 2.5.1-220 and 2.5.1-201)

These features continued to be uplifted into the Oligocene (Reference 2.5.1-220). Formation of these volcanogenic structural highs, oriented across the axis of the Mississippi Embayment, isolated the northern part of the embayment from the Gulf Coast Basin to the south (Reference 2.5.1-203). Several growth faults may have originated in these Late Cretaceous sediments. (Reference 2.5.1-202)

The upward movement of salt from the parent Louann Formation possibly occurred from Late Jurassic into the Cretaceous Period due to a significant thickness of overlying sediments. The increased weight and other differences in physical properties between the salt and the more dense overlying materials caused the salt to move upward, piercing the overlying sediments. Thinning of some stratigraphic units over the salt domes proves that some salt movement occurred contemporaneously with deposition. Regional uplift at the close of the Late Cretaceous caused sea regression and extensive erosion of the emerged surface. Normal faulting occurred intermittently from the Cretaceous into the Quaternary. Generally, the faults are observed on the updip side of the thicker accumulated masses of sediments. (Reference 2.5.1-201)

2.5.1.1.3.3 Tertiary Period

During the Late Cretaceous and early Tertiary, the Laramide orogeny in western North America supplied voluminous quantities of terrigenous, siliciclastic sediment to the Mississippi Embayment and Gulf Coastal Basin (Reference 2.5.1-221). Paleocene marine sediments of the Midway Group were deposited unconformably on top of the Cretaceous sediments in the northernmost Mississippi Embayment (Reference 2.5.1-222). The Tertiary sediments are characterized by predominantly deltaic deposits with thin, widespread marine sediments between these thick deltaic beds. The sediments occurred in arcuate, lenticular masses with the axes of maximum deposition subparallel to the present coast. (Reference 2.5.1-201)

Subsidence of the Mississippi Embayment ceased in the Eocene because of a tectonic change from crustal extension to crustal shortening, with development of folds and faults along the Reelfoot Rift. (Reference 2.5.1-201)

During the Eocene, the seas advanced northward into the Mississippi Embayment as the subsidence of the Gulf Coast Basin allowed extensive sedimentation (Reference 2.5.1-221). The last major inundation of the Gulf Coastal Plain is indicated by the presence of the Oligocene, marine Vicksburg sediments. Later, the seas withdrew from the region, and widespread deltaic deposits characterize the remainder of the Tertiary Period. (Reference 2.5.1-202)

The sediment loading within the Gulf Coast Basin initiated normal faulting in the western and central areas of the Gulf Coastal Plain province. Younger fault systems were formed progressively coastward, updip of the areas of maximum deposition. The faults trend approximately parallel to the regional strike, which is approximately parallel to the coastline, and the downthrown blocks are generally toward the coast. These features are analogous to large scale slump structures. The faulting generally occurred from the Cretaceous into the Quaternary, and some faults indicate recurrent movement contemporaneously with later deposition. Fault displacements range up to several thousand feet. (Reference 2.5.1-201)

In the Oligocene, the locus of deposition shifted southward in response to progradation of sediments within the Mississippi Embayment. In the southern part of the basin, where the Cretaceous deposits are thickest, the weight of overlying sediments initiated the intermittent upward, diapiric movement of salt plugs and folds, which formed salt domes during the Tertiary (References 2.5.1-217 and 2.5.1-219). Localized tensional faults are associated with the salt domes. The growth of salt domes in the Mississippi and Northern Louisiana Salt Basins ceased in the Oligocene (Reference 2.5.1-217). South of the Mississippi Embayment, in the Gulf Coast Basin, minor sea level fluctuations resulted in the partial erosion of sediments. (Reference 2.5.1-202)

During the Cenozoic, the rate of deposition into the Gulf Coast Basin exceeded the rate of regional subsidence, resulting in gulfward progradation of the Gulf Coastal Plain by as much as 250 mi. (400 km). The rates of sedimentation, basin subsidence, and eustatic changes were not synchronous; therefore, transgressive and regressive cyclic deposits characterize the late Tertiary stratigraphic section. The basin depocenter, located along successive shelf edges, migrated across the Gulf Coast Basin throughout the Tertiary, reflecting changing sediment sources and volumes. (References 2.5.1-203, 2.5.1-216, and 2.5.1-223)

Sea level changes in the late Tertiary caused the deposition of the freshwater to brackish-water Hattiesburg and Pascagoula Formations (Miocene) and the alluvial Citronelle Formation (Pliocene) on the exposed Gulf Coastal Plain (Reference 2.5.1-202). The Citronelle Formation was originally deposited as fluvial sediments in a series of gently sloping plains under changing conditions of sedimentation as uplift occurred inland, with downwarping of the coastal margin. Further uplift resulted in some erosion of the Citronelle Formation. (Reference 2.5.1-201)

2.5.1.1.3.4 Quaternary Period

During the Pleistocene, massive volumes of sediment were transported to the Gulf Coast Basin by the Mississippi River, partly in response to advances and retreats of continental glaciers. The thickest accumulations of Pleistocene deposits occur along the present Louisiana shelf edge. The entire sedimentary wedge in the vicinity of the Louisiana shelf edge is approximately 50,000-ft. (15,000-m) thick. (Reference 2.5.1-203)

Terrace deposits formed as the Gulf Coastal Plain was successively eroded and covered by fluvial sands and gravels as a result of the eustatic rise and fall of sea level accompanying the four glacial and three interglacial stages of the northern part of the continent. These terrace deposits overlie the eroded Citronelle Formation or older beds within river channels. River entrenchment produced progressively younger terraces at decreasing elevations within the Mississippi Alluvial Valley. The late Wisconsin sea level rise submerged the late Pleistocene continental shelf and reached its present position approximately 3000 to 4000 years ago, defining the current configuration of the Gulf Coast margin. (Reference 2.5.1-203)

Loess deposits were draped across the uplands during the late Pleistocene in part of the Gulf Coastal Plain. These deposits are found along the eastern margin of the Mississippi River Valley and accumulated during the Wisconsin Glacial Stage as the Farmdale and younger Peorian loess sheets. (Reference 2.5.1-201)

The Holocene Epoch was characterized by the erosion of the Gulf Coastal Plain, with streams initially entrenched to considerable depth in a braided stream system. As the sea level rose, substratum sediments (coarse-grained alluvial deposits) were deposited within the Mississippi Alluvial Valley. As the river gradients decreased, finer top stratum sediments were deposited within the meandering river system floodplain. (Reference 2.5.1-201)

The migration of rivers within meander belts resulted in the diversion of several new river courses and the development of new meander belts within the Mississippi Alluvial Valley. A series of successive subdeltas were formed along the coast and subsequently abandoned as the Mississippi River course changed. Portions of the Gulf Coastal Plain experienced downwarping accompanied by normal faulting during the Holocene, and compaction of sediments and downwarping continue in some coastal areas to the present time. (Reference 2.5.1-201)

During the Holocene, and continuing to the present, the prograding clastic wedge of the Mississippi Delta continued to be affected by gravity-failure structures, such as the syndepositional growth faults observed in southern Louisiana and eastern Texas (refer to Figures 2.5.1-203 and 2.5.1-205). The growth faults typically are oriented parallel or subparallel to the depositional strike (east-west orientation) and are characterized by (1) down-to-the-south displacement; (2) notable thickening of displaced strata on the downthrown side; (3) an increase in stratigraphic throw with depth; and (4) a lack of significant seismic activity. Post-depositional gravity failures, or growth faults, are common intra-basin structures. (References 2.5.1-219 and 2.5.1-202)

2.5.1.1.4 Regional Stratigraphy

Regional stratigraphic units within the Gulf Coastal Basin are described from the youngest to the oldest in the following subsections. A geologic map of the site region is shown in Figure 2.5.1-204. Cross sections through the site region are shown in Figures 2.5.1-205 and 2.5.1-206. The major stratigraphic units are summarized in Figure 2.5.1-208.

2.5.1.1.4.1 Precambrian

Precambrian basement rocks are not exposed in the site region (refer to Figure 2.5.1-204). The depth to the basement rocks in the site vicinity is estimated to be between 10 and 12 mi. (16 and 19 km) (refer to Figure 2.5.1-211) (Reference 2.5.1-215). South of the buried Ouachita orogenic belt, within the site region, the Precambrian crystalline basement consists of highly attenuated, continental crust or transitional crust related to the formation of the Gulf of Mexico. Because of the depth of the crust in the Gulf Coast Basin, actual rock samples have not been obtained. However, based on seismic velocity surveys, the crust is thought to be transitional between continental and oceanic materials. (Reference 2.5.1-204)

2.5.1.1.4.2 Paleozoic Era

Paleozoic rocks are not exposed in the site region (refer to Figure 2.5.1-204). Beneath the site region, Paleozoic deposits consist of seven major stratigraphic series and 19 individual formations (Reference 2.5.1-203). Within the site region, the Paleozoic rocks plunge to depths as great as 30,000 ft. (9100 m) near Baton Rouge (Reference 2.5.1-203). Mississippian and Pennsylvanian deposits consist of interbedded shale, fine-grained sandstone, and minor limestone. Ordovician deposits consist of dolomite interbedded with thin beds of limestone, shale, and sandstone. Paleozoic rocks have an unconformable contact with the overlying Mesozoic rocks. The nature of the lower contact is unknown, but most likely is a nonconformity separating the upper Paleozoic deposits from crystalline basement rocks. (Reference 2.5.1-202)

2.5.1.1.4.3 Mesozoic Era

Mesozoic deposits in the site region consist of buried Triassic and Jurassic rocks and locally exposed Cretaceous marine and terrestrial sediments that accumulated in response to active rifting and marine transgressions and regressions. There are no Mesozoic deposits exposed at the surface within the site region (refer to Figure 2.5.1-204). Non-marine, Triassic, and Jurassic deposits in the site region were originally termed the Eagle Mills Formation or red beds (References 2.5.1-230 and 2.5.1-231). Later, the red bed sequence was further subdivided into the Late Triassic Eagle Mills Formation and the Middle Jurassic Werner, Luann, and Norphlet Formations (refer to Figure 2.5.1-207). Accumulation of sediment accelerated crustal subsidence and formation of the Mississippi Embayment in the northern Gulf Coast Plain. Each of the major stratigraphic systems of the Mesozoic Era are described in the following subsections. (Reference 2.5.1-202)

2.5.1.1.4.3.1 Triassic System

The Eagle Mills Formation is the only Late Triassic deposit identified in the site region (refer to Figure 2.5.1-207). This depositional sequence is not exposed at the surface, but has been penetrated by wells in southern Arkansas, eastern Texas, west-central Mississippi, northern Louisiana, south-eastern Mississippi, and southern Alabama at depths ranging from 984 to 9840 ft. (300 to 3000 m). Deposits of the Eagle Mills Formation consist of non-marine, clastic, varicolored (red, purplish, greenish-gray, or mottled) shales, mudstones, and siltstones with less abundant fine- to very fine-grained sandstone. Basal units of the Eagle Mills Formation contain pebbles and cobbles of Paleozoic limestone. The Eagle Mills Formation represents the deposits that filled grabens, half grabens, and rift basins in prograding alluvial fan, fluvial, deltaic plain, and freshwater lake environments. The lower contact of the Eagle Mills Formation is unconformable with Paleozoic rocks, and the upper contact is unconformable with the Jurassic Werner Formation. The Eagle Mills Formation changes in thickness over short distances, from less than 10 to more than 7200 ft. (3 to 2200 m) because of contemporaneous deposition in an active rift system. (Reference 2.5.1-202)

2.5.1.1.4.3.2 Jurassic System

Deposits of the Jurassic System include the Louann Group (Lower Jurassic), the Louark Group (Upper Jurassic), and the Cotton Valley Group (Upper Jurassic) (refer to Figure 2.5.1-207). These units are not exposed, but occur in the subsurface within the site region.

The Louann Group, which consists of the Louann Salt and Werner Formations, overlies the Late Permian or Jurassic deposits. The Werner Formation consists of a basal conglomerate, red clastics, and an upper anhydrite member. The Louann Salt Formation is a thick bed of salt with small amounts of gypsum and anhydrite. The Louann Salt ranges in thickness up to 5000 ft. (1524 m). (Reference 2.5.1-201)

The Louark Group, comprised of the Norphlet-Smackover-Haynesville sequence, is exposed in northeastern Mexico and is considered to be continuous with equivalent facies in the U.S. coastal plain. The Norphlet Formation consists of red clastic material that appears to grade basinward into darker, finer marine facies. The Norphlet has been reported to overlie the Louann Salt and older beds unconformably. In northern Louisiana, the overlying Smackover Formation is nearly 2000 ft. (600 m) thick and is composed predominantly of black carbonates with interbedded shale. In eastern Texas, this formation contains some dolomitic beds. The Haynesville Formation overlies the Smackover beds and is characterized by carbonates and evaporites, as well as some sandy and silty materials. (Reference 2.5.1-201)

The Cotton Valley Group is predominantly an arenaceous-argillaceous sequence that grades downdip into dark argillaceous-calcareous materials. This group, consisting of the basal Bossier Formation and the younger Schuler Formation, overlies the older beds unconformably. The Cotton Valley Group exceeds a thickness of 4000 ft. (1200 m) in the Gulf Coastal Plain. (Reference 2.5.1-201)

2.5.1.1.4.3.3 Cretaceous System

The subdivisions of the Cretaceous Systems are shown in Figure 2.5.1-207. Beneath the site, the top of the deposits of the Cretaceous System occur at a depth of approximately 15,000 ft. (4600 m) (refer to Figure 2.5.1-205).

2.5.1.1.4.3.3.1 Coahuilan Series

The Coahuilan Series comprises the oldest Cretaceous strata in the Gulf Coastal Plain and is divided into the basal Hosston Formation and the upper Sligo Formation. The Hosston Formation was deposited unconformably over older beds and consists of arenaceous materials updip that grade gulfward into dark shales and carbonates. Its maximum known thickness is approximately 3000 ft. (900 m). The overlying Sligo Formation grades from argillaceous-arenaceous strata to fossiliferous limestone and interbedded shale. (Reference 2.5.1-201)

2.5.1.1.4.3.3.2 Comanchean Series

The Comanchean Series of the Gulf Coastal Plain has been subdivided into the Washita-Fredricksburg Stage and the underlying Trinity Stage. The Trinity Stage exceeds 4000 ft. (1200 m) in thickness in the coastal province, and the subsurface section is divided, in ascending order, into the Pine Island, James, Rodessa, Ferry Lake, Mooringsport, and Paluxy Formations. In northern Louisiana, southern Arkansas, and northeastern Texas, the Trinity Stage is predominantly composed of calcareous-argillaceous strata. The Washita-Fredricksburg Stage has not generally been subdivided in Mississippi and adjacent areas. These sediments grade from the updip clastics to partly sandy and crystalline limestones gulfward. The thickness of this stage is considered to range up to approximately 2500 ft. (760 m) in the Gulf Coastal Plain. (Reference 2.5.1-201)

2.5.1.1.4.3.3.3 Gulfian Series

The Upper Cretaceous beds of the Gulfian Series rest unconformably on older rocks in the Gulf Coastal Province. This series has been subdivided into the Woodbine, Eagle Ford, Austin, Taylor, and Navarro Stages. The maximum thickness of the Gulfian Series is considered to be more than 6000 ft. (1800 m) in southern Texas, but generally averages approximately 2500-ft. (760-m) thick in much of the northern Gulf Coastal Plain. The Gulfian Series has a maximum combined thickness of more than 4000 ft. (1200 m) beneath the site (refer to Figure 2.5.1-205). The Gulfian Series in the updip areas of the Mississippi Embayment, and in Alabama, consists of predominantly arenaceous-argillaceous facies compared to the argillaceous-calcareous facies in the downdip areas. (Reference 2.5.1-201)

2.5.1.1.4.4 Cenozoic Era

2.5.1.1.4.4.1 Tertiary System

In the Gulf Coastal Province, the Tertiary deposits are part of a geosynclinal sedimentary complex consisting of continental, deltaic, and marine deposits (Reference 2.5.1-201). These deposits thicken from north to south across the region, with a maximum thickness of 50,000 ft. (15,200 m) in the Gulf of Mexico (Reference 2.5.1-202). Tertiary deposits are more than 15,000 ft. (4600 m) thick in the site vicinity (refer to Figure 2.5.1-205). The Tertiary sediments consist of terrigenous sediment eroded from the interior of North America and marine sediment deposited during marine transgressions and regressions. These deposits are divided into formations described in the following subsections.

2.5.1.1.4.4.1.1 Paleocene Series

Paleocene sediments are not exposed within the RBS site region (refer to Figure 2.5.1-204). The nearest exposure of the Paleocene Series lies to the northeast of the site region. The Paleocene Series is characterized by the Midway Stage that was deposited disconformably or unconformably over the Gulfian Series throughout most of the Gulf Coastal Plain. In Louisiana, the Midway Stage consists of the basal Clayton Formation and the upper Porters Creek Formation. The maximum known thickness of the Midway Stage is approximately 1200 ft. (370 m) in the Gulf Coastal Plain, and the strata are predominantly calcareous sands, silts, and clays. The top of the Midway Stage occurs at a depth of approximately 12,000 ft. (3700 m) (refer to Figure 2.5.1-205). (Reference 2.5.1-201)

2.5.1.1.4.4.1.2 Eocene Series

Eocene deposits are exposed in the northeast and northwest portions of the site region, but are not exposed in the RBS site vicinity (refer to Figures 2.5.1-205 and 2.5.1-211). The Eocene deposits consist of the Sabine, Claiborne, and Jackson Stages in ascending order. As shown in Figure 2.5.1-205, these stratigraphic groups occur beneath the site area at an approximate depth of 6000 ft. (1800 m), with an overall thickness of approximately 7000 ft. (2100 m).

The Sabine Stage is predominantly arenaceous-argillaceous strata with lesser amounts of carbonaceous materials and includes the Wilcox Group. The maximum known thickness of the Sabine Stage is approximately 5000 ft. (1500 m) in southeastern Texas, Louisiana, and southern Mississippi. Beneath the site, the top of the Wilcox Group is approximately 9000-ft. (2700-m) deep (refer to Figure 2.5.1-205). (Reference 2.5.1-201)

The Claiborne Stage includes a variety of lithologic types characterized by fossil content of a common age. In Louisiana, this sequence includes the Cane River, Sparta, Cook Mountain, and Cockfield Formations in ascending order. The maximum thickness of the Claiborne Stage in the Gulf Coastal Plain is approximately 6000 ft. (1800 m). Beneath the site, the combined thickness of the Clairborne Stage is approximately 2000 ft. (600 m) (refer to Figure 2.5.1-205). Updip facies of this stage are predominantly arenaceous-argillaceous in nature, whereas gulfward, the materials consist of argillaceous-calcareous facies. (Reference 2.5.1-201)

The Jackson Stage deposits are the youngest Eocene deposits and include all sediments deposited during the advance and retreat of the late Eocene Sea. These strata are predominantly calcareous in the eastern part of the Gulf Coast Province, argillaceous in the central part, and arenaceous in Texas (refer to Figure 2.5.1-207). The Jackson Stage is known to be more than 1700 ft. (500 m) thick in southern Texas. (Reference 2.5.1-201)

2.5.1.1.4.4.1.3 Oligocene Series

The Oligocene deposits (Vicksburg Group) are exposed in the northeastern and northwestern portions of the RBS site region (refer to Figure 2.5.1-204). The Oligocene Vicksburg Group includes limestone, clay, and arenaceous-argillaceous strata in the Gulf Coastal Plain. These sediments grade downdip into marine argillaceous beds that thicken in a gulfward direction. The Vicksburg sediments are approximately 300 ft. (90 m) thick along the regional strike near the site. (Reference 2.5.1-201)

2.5.1.1.4.4.1.4 Miocene-Pliocene Series

Miocene-Pliocene sediments are exposed extensively within the site region and in the northern part of the site vicinity (refer to Figures 2.5.1-204 and 2.5.1-223). The Miocene-Pliocene sediments in the site region compose the Fleming Group. The Fleming Group, also referred to as the Grand Gulf Group, is more than 8000 ft. (2400 m) thick in southern Louisiana. The Fleming Group sediments are essentially deltaic with marine fingers and contain extensive microfauna. Within the site region, the Fleming Group contains the Catahoula, Hattiesburg, and Pascagoula Formations. (Reference 2.5.1-201)

The basal Catahoula Formation of the Miocene Age consists of non-marine sandstones and clays in Louisiana, Texas, and Mississippi and conformably overlies the Vicksburg Group. Maximum thickness exceeds 5000 ft. (1500 m) in some areas. The Miocene Hattiesburg Formation is non-marine clay with thin sands overlying the Catahoula Formation conformably. The maximum thickness of the Hattiesburg Formation is reported to be approximately 450 ft. (140 m). The Pascagoula Formation overlies the Hattiesburg clay unconformably and consists of blue, green, and gray clay with sand. The maximum thickness of the Pascagoula Formation is greater than 1000 ft. (300 m). (Reference 2.5.1-201)

Gulfward, the Fleming Group sediments are replaced by marginal and marine deposits indicative of widespread cyclic strand fluctuations. In western Florida and eastern Alabama, equivalent beds consist of calcareous-arenaceous marine beds. (Reference 2.5.1-201)

The extensive microfossils of the Miocene-Pliocene sediments have enabled a subdivision of many subsurface deposits into biostratigraphic zones, based on key microfossils within the Gulf Coastal Province. The downdip sequences thicken from a few hundred feet to tens of thousands of feet, and much of the thickness occurs gulfward in short distances across normal faults. (Reference 2.5.1-201)

2.5.1.1.4.4.1.5 Pliocene-Pleistocene Series

In the southern portion of the site region, the Pliocene Series consists of interbedded marginal marine sediments that reach a maximum thickness of approximately 6000 ft. (1800 m) offshore. These deposits are overlain unconformably by the Upland Complex deposits (refer to Figure 2.5.1-208). (Reference 2.5.1-202)

Pliocene-Pleistocene sediments are exposed extensively within the site region (refer to Figure 2.5.1-204). The Pliocene-Pleistocene Upland Complex, also referred to as the Citronelle and Lafayette Formations, is one of the most regionally extensive deposits in the Gulf Coastal Plain (Reference 2.5.1-205). Remnants of Upland Complex are identified in a 10- to 50-mi. (16- to 80- km) wide band east of the Mississippi River and extend from the head of the Mississippi Embayment to the Gulf of Mexico (Reference 2.5.1-203). This formation covers the majority of southern Mississippi, south of Jackson, and crops out west of the Mississippi Alluvial Valley in south-central and southwestern Louisiana. (Reference 2.5.1-203)

The Upland Complex represents a widespread sand and gravel sheet deposited prior to regional stream entrenchment (Reference 2.5.1-234). Deposits of the Upland Complex generally consist of a basal gravel and coarse sand facies, overlain by a finer sand facies that grades into an upper silt-and-clay facies. Gravels are predominantly chert and quartz and are reddish in color, whereas the silt-and-clay facies vary in color from reddish to light gray and tan (Reference 2.5.1-235). Silicified wood is common near the base of higher terraces. Individual terraces range in thickness from tens to hundreds of feet and commonly are buried by loess. (Reference 2.5.1-202)

The age and origin of the Upland Complex deposits are controversial. Most references consider the deposits to be a combination of glacial outwash and non-glacial fluvial deposits of both the central United States and Appalachian Mountains provenance (References 2.5.1-203 and 2.5.1-236). Fluvial gravels were deposited in the Mississippi Valley during the Pliocene to early Pleistocene (Reference 2.5.1-237). The source of the Upland Complex terrace material was attributed to glacial outwash along the Mississippi River (Reference 2.5.1-224) and to erosion of the eastern Appalachian Mountains (References 2.5.1-240 and 2.5.1-236). The deposits most likely formed from a combination of both sources (Reference 2.5.1-203). Other Pliocene units in the site region include the Willis Formation in southeastern Texas, and Graham Ferry in southeastern Mississippi, eastern Alabama, and offshore (refer to Figure 2.5.1-207).

A prolonged period of low sea level in the early Pleistocene led to the entrenchment of upland areas and the erosion and partial redistribution of Pliocene glacial outwash and alluvial fan deposits (Reference 2.5.1-203). Inset terraces formed because of the reworking of Upland Complex deposits and grading of streams to sequentially lower base levels during the early Pleistocene. These reworked terrace deposits occur at progressively lower elevations and are generally finer grained than the source materials. These early Pleistocene terraces are part of the Upland Complex. At some localities, the deposits clearly originated from glacial outwash processes (Reference 2.5.1-203). The younger terrace deposits may represent a combination of alluvial fan and glacial outwash deposits that merged or interfingered at the mouth of tributary valleys (Reference 2.5.1-202). Deposits of the Upland Complex are described in greater detail in Subsection 2.5.1.2.

The Upland Complex is virtually flat-lying in southern Mississippi, but southward from the east-west Mississippi-Louisiana state line, the complex dips gulfward at an average rate of 12 ft/mi. The zone along which the increased gulfward dip occurs was designated the South Mississippi Uplift by Fisk (Reference 2.5.1-224). The deposits cap the uplands near the Mississippi-Louisiana state line and determine the regional topography. Surface elevations that exceed +400 ft. (+120 m) msl occur in southern Mississippi, but the ground surface slopes southward to Elevation +150 ft. (+46 m) msl in the site area and to Elevation +120 ft. (+37 m) msl farther south where the complex dips beneath younger Pleistocene terraces. In the Baton Rouge area, the complex contains important aquifers at depths of 400 and 600 ft. (120 and 180 m) beneath the Pleistocene sediments. (Reference 2.5.1-201)

2.5.1.1.4.4.2 Quaternary System

Quaternary deposits within the site region occur along the Mississippi Alluvial Valley Section and its tributaries, the Southern Hills Section of the Gulf Coastal Plain, and the Delta Plain (refer to Figure 2.5.1-202). Quaternary deposits predominantly include alluvial sediments related to the Mississippi River, lacustrine sediments, and eolian silt derived from sediment sources in the Mississippi Alluvial Valley. The composition, texture, and morphology of Quaternary sediments in the site region are strongly influenced by climatic changes and glacial cycles. The response of regional marine, alluvial and terrestrial systems to these changes is summarized in Table 2.5.1-201. (Reference 2.5.1-202)

During the Pleistocene, episodes of continental glaciation produced massive volumes of sediment that were transported through the Mississippi Alluvial Valley to the Gulf of Mexico. These sediments were deposited at various elevations due to climatic changes, local depositional environments (e.g., lakes formed behind glacial outwash deposits) and the isostatic effects of continental glaciations, sea level fluctuations, and region epeirogenic uplift. The major Holocene and Pleistocene units are described in the following subsections. (References 2.5.1-203, 2.5.1-224, and 2.5.1-205)

2.5.1.1.4.4.2.1 Pleistocene Series

2.5.1.1.4.4.2.1.1 Terrace Deposits

Pleistocene terrace deposits occur along most of the Mississippi Alluvial Valley and extend across the site region (Reference 2.5.1-203). The terraces are assigned different names in different parts of the site region (refer to Figure 2.5.1-207). Terrace deposits that occur in eastern Texas and southwestern Louisiana include the Beaumont and Lissie Terraces. Terrace deposits in southern Louisiana include the Prairie, Montgomery, Bentley, and Williana Terraces. Terrace deposits in southern Arkansas, northern Louisiana, and west-central Mississippi include valley trains, Deweyville Complex, Prairie Complex, and Intermediate Complex. In the site vicinity, these include undifferentiated terraces of the Prairie Complex and the Pliocene-Pleistocene Upland Complex. (Reference 2.5.1-205)

Investigations of the Quaternary geology of the Mississippi Alluvial Valley resulted in major updates and refinements of the seminal work of Fisk (Reference 2.5.1-224). The model of Fisk was revised because the sequence of continental glaciations leading to terrace formation along the Mississippi River is far more complex than thought in 1944, and the processes leading to terrace formation are better understood. Fisk's postulated model involves progressive narrowing and down cutting of the Mississippi Alluvial Valley. However, during the Pleistocene, the Mississippi Alluvial Valley progressively widened during down cutting, rather than narrowing (Reference 2.5.1-205). This observation indicates that some of the Pleistocene terraces of Fisk are now interpreted to be Pliocene to early Pleistocene Age (i.e., Upland Complex). Saucier also observed that Quaternary erosional surfaces or "strath" terraces are present in the site region and likely formed in response to base-level changes. (Reference 2.5.1-203)

Geological investigations in the Lower Mississippi Valley have produced a proliferation of informal stratigraphic names and terms used in a variety of contexts. Much of the uncertainty centers on the term "terrace" and the definition of "terrace sequences" in local and regional correlation schemes. In modern geomorphic studies, a terrace is a surface commonly associated with the aggradation of a sedimentary sequence that has been preserved as a relic above the level of the current system, but does not include the underlying deposit. (Reference 2.5.1-205)

To avoid the ambiguity surrounding the term "terrace," each of these regional-scale map units is designated a "complex." A "complex" is here defined as a geomorphic surface or set of temporally related surfaces, with an associated sedimentary sequence that may represent more than one depositional environment. Present stratigraphic thought suggests that each complex is a group of related alloformations. An allostratigraphic unit has been defined by the North American Commission on Stratigraphic Nomenclature in the 1983 North American Stratigraphic Code as an unconformity-bounded lithic unit of sedimentary rock. (Reference 2.5.1-239)

Pleistocene terrace deposits of the Deweyville Complex occur along the Ouachita and Saline Rivers, and equivalent terrace deposits are present in the site region (refer to Figure 2.5.1-204). The Deweyville Complex is similar in age to the Wisconsin Valley train deposits and is characterized by meander scars that are considerably larger than those observed along the present river courses (Reference 2.5.1-238). There is little direct information regarding this complex (Reference 2.5.1-203). Based on analogy with other terrace complexes, the Deweyville Complex most likely includes multiple fluvial environments, such as point bar, backswamp, and abandoned channel. The deposits consist of a fining upward sequence approximately 100-ft. thick. The coarser grained deposits of the Deweyville Complex, relative to other terrace complexes, may reflect higher stream discharges and energy levels than along the current fluvial system (Reference 2.5.1-240). This terrace is probably Mid-Wisconsin and 15,000 to 35,000 years old. (Reference 2.5.1-201)

Pleistocene terrace deposits of the Prairie Complex occur along the Gulf Coast from Texas to Alabama (refer to Figure 2.5.1-204). The Prairie Complex includes a wide range of sediments, including fluvial terrace deposits and colluvium, estuarine, deltaic, and marine deposits. The Prairie Complex deposits range in age from pre-Wisconsin to late-Wisconsin. (Reference 2.5.1-202)

2.5.1.1.4.4.2.1.2 Loess Deposits

Regionally extensive sheets of Pleistocene loess occur along the eastern edge of the Mississippi Alluvial Valley and the surrounding areas (refer to Figure 2.5.1-202). During near-maximum to early waning stages of glaciation, strong, seasonally prevailing, north to northwest winds carried large quantities of silt from un-vegetated areas of glacial outwash in the central United States, tens to hundreds of miles throughout the site region (refer to Table 2.5.1-201) (Reference 2.5.1-203). Individual loess sheets are well sorted, massive to subtly banded, unconsolidated, tan to brown silt. The maximum thickness is 50 ft., and most prominent outcrops of the loess occur east of the Mississippi Alluvial Valley and Delta Plain in a 10- to 30-mi. (16- to 50-km) wide zone across the site region (refer to Figure 2.5.1-202) (Reference 2.5.1-202).The loess deposits mantle the former landscape and consist predominantly of silt with minor sand and clay fractions. The loess has an internal stratigraphy with distinct silty layers separated by buried soils. (Reference 2.5.1-202)

The loess in central Mississippi generally overlies the Citronelle Formation unconformably. In southern Louisiana, the loess overlies the Pleistocene terrace formations in many places. In the site region, the loess sediments are considered to be equivalent to the Farmdale and Peoria loess sheets of Illinois, which were deposited during the Wisconsin Glacial Stage of the Pleistocene Epoch. (Reference 2.5.1-201)

2.5.1.1.4.4.2.2 Holocene Series

Within the site region, Holocene deposits are alluvium and loess within the Mississippi Alluvial Valley subprovince and within the Chenier Plain and Delta Plain subprovinces (Reference 2.5.1-203). Holocene deposits include braided-stream substratum and topstratum deposits. The substratum sediments are generally medium-grained sands that grade downward into coarser sands and gravels and were deposited in the entrenched valleys as the sea level rose after the Pleistocene Epoch. As the Holocene braided regimen changed to the present meandering regimen, the floodplain was created, and the topstratum sediments of fine sands, silts, and clays were deposited within the alluvial plain. Typical topstratum environments of deposition include natural levees, backswamps, abandoned courses, alluvial aprons, point bars, and abandoned channel deposits. (Reference 2.5.1-201)

Holocene alluvial and deltaic deposits thicken from a few tens of feet in the northern portion of the site region to greater than 600 ft. (180 m) in the southern portion of the site region. Their composition varies depending on the specific type of depositional environment. The meander belt deposits commonly form an upward-fining sequence that grades from a basal gravel and coarse sand into a sand facies capped by silt and clay facies. Backswamp deposits consist of overbank sediments (silt and fine sand) along with a large component of organic material. The Delta and Chenier Plains consist of Mississippi deltaic sediments that were deposited episodically in beach environments by longshore transport. The thickness and aerial distribution of Holocene alluvial deposits are variable and occur as interfingering lenses of sand silt and clay (Reference 2.5.1-203). The thicknesses of the alluvial deposits are more fully discussed in Subsection 2.5.1.2.3.

2.5.1.1.5 Regional Tectonic Setting

The seismotectonic framework of a region, which includes the basic understanding of existing tectonic features and their relationship to the contemporary stress regime and seismicity, forms the foundation for assessments of seismic sources. In the probabilistic seismic hazard study performed by EPRI-SOG in 1988 (Reference 2.5.0-201), seismic source models were developed for the CEUS based on tectonic setting; the identification and characterization of "feature-specific" source zones; and the occurrence, rates, and distribution of historical seismicity. The EPRI models reflected the general state of knowledge of the geosciences community in the middle to late-1980s. (Reference 2.5.0-201)

Since the EPRI-SOG study, additional geologic, seismologic, and geophysical research has been performed in the site region. This subsection presents a summary of the current state of knowledge of the regional tectonic setting and highlights the more recent information that is relevant to the identification of seismic sources for the RBS site. The following subsections describe the region in terms of the following:

- The contemporary tectonic stress environment (Subsection 2.5.1.1.5.1).
- Primary structural provinces and tectonic features within a 200-mi. (320-km) radius of the site (Subsection 2.5.1.1.5.2).
- Significant seismic sources at distances greater than 200 mi. (320 km) (Subsection 2.5.1.1.5.3).
- Regional gravity and magnetic data (Subsection 2.5.1.1.5.4).

Historical seismicity is briefly described in Subsection 2.5.1.1.5.5 and discussed in more detail in Subsection 2.5.2.

2.5.1.1.5.1 Contemporary Tectonic Stress Environment

The RBS site region lies within two stress provinces - the Mid-Plate (mid-continent) stress province in the northern half of the region and the Gulf Coast province in the southern half. The two provinces are distinguished based on various indicators, including earthquake focal mechanisms, stress-induced elliptical borehole enlargements (or borehole "breakouts"), measurements of hydraulic fracturing stress, and offsets of young faults. The RBS site lies near the boundary between the two provinces. (References 2.5.1-241 and 2.5.1-242)

The Mid-Plate stress province is characterized by a relatively uniform east-northeast compressive stress field extending from the mid-continent east toward the Atlantic continental margin and possibly into the western Atlantic basin (Reference 2.5.1-242). Zoback and Zoback (Reference 2.5.1-242) note that although localized stresses may be important in places, the overall uniformity in the Mid-Plate stress pattern suggests a far-field source, and the range in orientations coincides with both absolute plate motion and ridge push directions for North America. Modeling of various tectonic processes using an elastic finite-element analysis has indicated that distributed ridge forces are capable of accounting for the dominant east-northeast trend of maximum compression throughout much of the North American plate east of the Rocky Mountains. (Reference 2.5.1-243)

Based on an analysis of well-constrained focal mechanisms of North American Mid-Plate earthquakes, earthquakes in the CEUS occur primarily on strike-slip faults that dip between 43 and 80 degrees, primarily in the range of 60 to 75 degrees. The analysis demonstrates that CEUS earthquakes occur primarily in response to a strike-slip stress regime. (Reference 2.5.1-244)

The Gulf Coast stress province is defined primarily by the presence and orientation of active listric growth faulting in the Gulf Coast region (Reference 2.5.1-241). The state of stress within the province appears to be uniform, with the greatest principal stress vertical and the least principal stress perpendicular to the continental margin (south-southeast) (Reference 2.5.1-242). Zoback and Zoback (Reference 2.5.1-245) note that the seaward extension and growth faulting within the Coastal Plain sediments are quite dissimilar to the compressional stress in the Mid-Plate. The southward oriented extension along the Gulf Coast probably reflects crustal loading and deformation within the Mississippi River deltaic complex in the Gulf of Mexico and may be different than the state of stress in the underlying basement (References 2.5.1-242 and 2.5.1-245). The reverse focal mechanism for the 2006 moment magnitude (M) 5.8 earthquake in the abyssal plain region of the Gulf of Mexico (refer to Subsection 2.5.2) is consistent with regional east-northeastward directed compressive stress, suggesting that the state of stress in the underlying basement may be consistent with that of the Mid-Plate stress province.

2.5.1.1.5.2 Regional Tectonic Structures (within 200-Mi. (320-Km] Radius)

The south-central United States is a passive continental margin with no relative differential motion between the Gulf of Mexico oceanic plate and the North American continental plate (Reference 2.5.1-246). The region is one of low earthquake activity and low stress and is cited as an example of a stable continental region. (References 2.5.1-247, 2.5.1-248, 2.5.1-249, and 2.5.1-250)

Principal tectonic features in the site region and surrounding portions of the CEUS are shown in Figure 2.5.1-203. The tectonic features shown in this figure reflect the cumulative deformation of tectonic events throughout the Paleozoic, Mesozoic, and Cenozoic Eras. A chronology of events that influenced the development and distribution of tectonic features in the RBS site region is described below and summarized in Figure 2.5.1-209.

The majority of the site region lies within the Gulf of Mexico Basin (refer to Figure 2.5.1-203). The northern part of the site region encompasses structures associated with the Ouachita orogenic belt. Tectonic features within these two structural provinces are described below. Geophysical data that provide supporting information on crustal scale structural features in the site region are discussed in Subsection 2.5.1.1.5.4.

2.5.1.1.5.2.1 Gulf of Mexico Basin

The RBS site is located in the Gulf of Mexico Basin (also referred to as the Gulf Coast Basin or Gulf Basin) that includes the present Gulf of Mexico and adjacent rift basins (Reference 2.5.1-251). The Gulf of Mexico Basin is a circular structural basin filled with 0 to 9 mi. (0 to 15 km) of sedimentary rocks, ranging in age from Late Triassic to Holocene (refer to Figure 2.5.1-211). (Reference 2.5.1-252)

Based on seismic reflection, seismic refraction, gravity, magnetic, and subsidence techniques, the gross characteristics and boundaries between the various types of crust under the Gulf of Mexico Basin have been identified. The crust under the Gulf of Mexico Basin is divided into four major types: oceanic, thin transitional, thick transitional, and continental (refer to Figure 2.5.1-211). The crust beneath the central part of the basin is oceanic in character; it is surrounded by continental crust, which has been greatly attenuated by rift-related extension underneath much of the basin. Continental crust refers to crust that predated the formation of the Gulf of Mexico and was significantly modified (i.e., extended, thinned, or intruded) by the Middle Jurassic or later rifting. Transitional crust is crust that was originally continental, but was significantly extended and thinned, and probably intruded with magma during Middle and Late Jurassic rifting. Thick transitional crust was only somewhat thinned during rifting, and there are many blocks that appear relatively unthinned but are surrounded by regions of greater thinning. Thin transitional crust was fairly uniformly thinned without lateral variation during rifting. Oceanic crust was formed under the deep Gulf of Mexico Basin during the Late Jurassic. Seafloor spreading probably continued for approximately 5 to 10 Ma. Since the cessation of seafloor spreading, transitional crust and oceanic crust cooled and subsided, allowing the deposition of thick sedimentary sequences in the Gulf of Mexico Basin. (Reference 2.5.1-204)

Ewing (Reference 2.5.1-252) subdivides the structural framework of the Gulf of Mexico Basin into three major structural provinces, which correspond to the three major lithofacies provinces that persisted from the Late Jurassic to the Holocene. These include (1) the northwestern progradational margin (from northeastern Mexico to Alabama); (2) the eastern carbonate margins (the Florida and Yucatan platforms); and (3) the western compressional margin (refer to Figure 2.5.1-212). The RBS site lies within the northwestern progradational margin province, which is subdivided into an Interior Zone (mostly Mesozoic structures) and a Coastal Zone (mostly Cenozoic structures). In the Interior Zone area, a broad, Late Triassic-Early Jurassic rift complex was followed by subsidence. Salt mobilized to form interior salt diapiric provinces, and Late Mesozoic uplifts and related igneous activity interrupted the subsidence history. The area experienced only minor Cenozoic reactivation of structures, gentle uplift, and tilting. Structures within this zone include the Pickens-Gilbertown and Southern Arkansas fault zones; the Wiggins Uplift (arch), the Jackson Dome, Monroe Uplift, and Sabine Uplift; and the salt diapirs within the Mississippi and North Louisiana Salt Basins (refer to Figures 2.5.1-203 and 2.5.1-212). (Reference 2.5.1-252)

The Mississippi Salt Basin is bounded on the southern (gulfward) side by a relatively domeless belt 90-mi. (140-km) wide that separates it from the Coastal Salt Basin farther south (refer to Figure 2.5.1-203). Consequently, a thinning or absence of salt in the domeless area has been inferred and attributed to a rise in the basement separating the two salt basins. (Reference 2.5.1-201)

In the Coastal Zone, the Mesozoic strata are buried beneath a thick wedge of Upper Cretaceous and Cenozoic coarse clastic sediments. These sediments have prograded the shelf margin hundreds of kilometers seaward and generated "growth fault" systems and coastal and offshore salt diapir provinces (Reference 2.5.1-252). The growth faults are interpreted as aseismic gravitational collapse features that slip basinward under sedimentary load (References 2.5.1-202 and 2.5.1-254). Active growth faults (i.e., gulf-margin normal faults) generally trend east-west and are located along the Cretaceous shelf edge extending over large distances (many extend hundreds of kilometers) in the vicinity of the modern Gulf Coast (refer to Figure 2.5.1-213) (References 2.5.1-216 and 2.5.1-202). Active movement along most of the growth fault zones is thought to have occurred during periods of rapid localized sediment deposition, primarily during the Miocene and Oligocene Epochs (5- to 36-million years ago). Many of the growth faults have been reactivated in recent times and currently show evidence of surface deformation (Reference 2.5.1-253).The gulf-margin normal faults, however, exist in sediments and poorly lithified rocks that may be unable to support the stresses required for the propagation of significant seismic ruptures that could cause damaging ground motions. These faults also may be mechanically decoupled from the underlying crust. For these reasons, these faults are judged to be Class B[a] (Reference 2.5.1-254). The site lies near the northern extent of Gulf Coast growth faults (refer to Figure 2.5.1-213). Growth faults in the site region are discussed in Subsection 2.5.1.1.5.2.1.7.

Structures within the Gulf Coast Basin that are within the site region are shown in Figure 2.5.1-213 and are described in the following subsections.

2.5.1.1.5.2.1.1 Pickens-Gilbertown and Southern Arkansas Fault Zones

The Pickens-Gilbertown and Southern Arkansas fault zones are a system of faults that extend from southwestern Alabama through west-central Mississippi (Reference 2.5.1-252) to southern Arkansas and eastern Texas (refer to Figures 2.5.1-203 and 2.5.1-213). These two fault zones together are more than 500-mi. (800-km) long in a zone typically less than 25-mi. (40-km) wide (refer to Figures 2.5.1-203 and 2.5.1-213).The Pickens-Gilbertown and Southern Arkansas fault zones consist of a series of grabens developed in Paleozoic to middle Tertiary deposits, on the gulfward side of the Ouachita orogenic belt (References 2.5.1-201 and 2.5.1-251), and include these fault zones in the Gulf Rim fault zone, which form the northern margin to the Gulf Basin.

The Pickens-Gilbertown and Southern Arkansas fault zones offset Mesozoic and Cenozoic deposits. Mesozoic and Cenozoic deposits thicken gulfward across the fault zones indicating syndepositional down-to-the-south movement. Movement

a. Crone and Wheeler (Reference 2.5.1-254) define Class A features as those for which geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin. Class B features are those for which the fault may not extend deeply enough to be a potential source of significant earthquakes or for which the currently available geologic evidence is not definitive enough to assign the feature to Class C or to Class A. Class C features are those for which geologic evidence is insufficient to demonstrate the existence of a tectonic fault, Quaternary slip, or deformation associated with the feature.

along the Pickens-Gilbertown and Southern Arkansas fault zones displaces Miocene Age sediments as much as 200 ft. (60 m), but Pliocene and Pleistocene Age deposits are not offset. Pre-Miocene deposits are offset up to 1000 ft. (300 m) at depth, and similar age deposits on opposite sides of the fault zones are as much as tenfold thicker on the down-dropped, gulfward side of the structure. The Pickens-Gilbertown and Southern Arkansas fault zones were formed by gravitational collapse related to large sedimentary loads in the Tertiary Age Gulf Coastal Plain, or continental shelf. The Pickens-Gilbertown and Southern Arkansas fault zones are Tertiary Age analogues to the currently active gulf-margin normal faults. (Reference 2.5.1-202)

Unfaulted Pliocene and Pleistocene Upland Complex terrace deposits overlie the Pickens-Gilbertown fault zone in the vicinity of the Alabama River (Reference 2.5.1-255). The continuity of Pliocene and Pleistocene deposits across the fault zone indicates that the Pickens-Gilbertown fault zone is not active. Seismic data and continuity of stratigraphy documented from deep exploration wells indicate that the Southern Arkansas fault zone has not been active since the Miocene time. (Reference 2.5.1-202)

Little historical seismicity has occurred along the Pickens-Gilbertown and Southern Arkansas fault zones (refer to Figure 2.5.1-213). Six earthquakes of m_b (short period body wave magnitude) 3.3 to 3.9 occurred along the southeastern portion of the Pickens-Gilbertown fault zone near the Mississippi-Alabama border within the site region, and three additional earthquakes (m_b less than 4.4) occurred along the trend of the fault zone in southern Alabama, outside of the site region. These earthquakes occurred at the 1.8- to 3.6-mi. (3- to 6-km) depth of fluid recovery in active well fields, suggesting that they were most likely triggered earthquakes related to hydrocarbon recovery (Reference 2.5.1-257). No earthquakes greater than m_b 3.3, the lower threshold used by EPRI (Reference 2.5.0-201) have been recorded along the Southern Arkansas fault zone in the site region.

2.5.1.1.5.2.1.2 Wiggins Uplift

The Wiggins Uplift (also known as the Wiggins Arch) lies in southernmost Mississippi and in southeastern Louisiana, approximately 30 mi. (50 km) northeast of the RBS site (refer to Figure 2.5.1-203). It is bounded on the north by the Mississippi Salt Basin and on the south by the deep Cenozoic-filled basin of the Coastal Zone. The uplift probably represents a block of thicker, possibly Paleozoic continental crust left behind during Late Triassic-Jurassic rifting and may have fault-bounded margins (Reference 2.5.1-252). It is characterized by the absence of salt, local absence of the lower part of the Upper Jurassic Sequence, and reduced sedimentation rates during some of the Cretaceous. (Reference 2.5.1-258)

Saucier (Reference 2.5.1-203) describes the Wiggins Arch as a secondary structural feature that has affected late Tertiary and Quaternary formations. Rather than a simple, arcuate anticline, the structure is an irregular, complex composite of several structural anomalies with evidence of igneous intrusion and faulting along its flanks. Saucier states that deep stratigraphy indicates the structure is a comparatively young structure with little or no movement occurring before the early Eocene. The crest of the arch is a topographically prominent broad, hilly ridge from which both Tertiary and Quaternary deposits slope gently to the north and quite steeply to the south into a zone of growth faults. Burnett and Schumm (Reference 2.5.1-259) and Jurkowski et al. (Reference 2.5.1-260) report evidence from leveling surveys (unadjusted) that indicate the structure is experiencing uplift of several millimeters per year. Saucier (Reference 2.5.1-203) indicates that this is thought to be a possible continuing crustal response to the high sedimentary loading occurring in the Mississippi Delta region.

Crone and Wheeler (Reference 2.5.1-254) classify the Wiggins Uplift as a Class B[a] feature solely because of results reported in studies by Burnett and Schumm (Reference 2.5.1-259). Crone and Wheeler state that the Burnett and Schumm studies offer the only evidence of possible Quaternary uplift of the feature, based on changes in stream channel sinuosity and morphology and channel incision, but the data are only considered to be suggestive of Quaternary deformation. No evidence of movement on specific faults is offered. High geodetic uplift rates are judged to be incompatible with the geologic and tectonic setting of the region and may be due to nontectonic processes. Crone and Wheeler conclude that if Quaternary deformation is occurring on this structure, it is not clear if the deformation is tectonic or related to other nontectonic processes such as salt tectonics or differential subsidence. (Reference 2.5.1-254)

2.5.1.1.5.2.1.3 Jackson Dome

The Jackson Dome is a circular, 16-mi. (26-km) diameter volcanic plug located at the southern margin of the Mississippi Embayment near the city of Jackson in west-central Mississippi (refer to Figure 2.5.1-203). The dome was formed by the arching of strata above a deep-seated igneous intrusion. The dome became active in the Early Cretaceous, continued to rise through post-Oligocene time, and has a total structural relief of approximately 10,000 ft. (3050 m). Outcrops of the Oligocene Vicksburg Group, including the Glendon Limestone, are preserved on the dome's northwestern flank (Reference 2.5.1-261). Although the dome appears to be dormant, radiometric dates in the State No. 2 Fee Well show a 26-million year gap in activity between 101- and 75-million year old igneous rocks, suggesting long intervals between periods of activity (Reference 2.5.1-261). Interpreted seismic lines along the flanks of the Jackson dome have identified

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a. Crone and Wheeler (Reference 2.5.1-254) define Class A features as those for which geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin. Class B features are those for which the fault may not extend deeply enough to be a potential source of significant earthquakes or for which the currently available geologic evidence is not definitive enough to assign the feature to Class C or to Class A. Class C features are those for which geologic evidence is insufficient to demonstrate the existence of a tectonic fault, Quaternary slip, or deformation associated with the feature.

several faults in the Jackson area, including an east-west-trending fault south of Florence, Mississippi, and six additional northwest-southeast trending faults that extend from the dome's eastern flank (Reference 2.5.1-261). The youngest unit offset by these faults is the Upper Cretaceous Eutaw Formation. Saucier (Reference 2.5.1-203) notes that movement does not appear to have significantly affected surface elevations or influenced the course of the Pearl River that developed across the feature in the late Tertiary. Bograd speculated that a 1927 earthquake, which shook houses as far away as Meridian, Mississippi, occurred on a fault in the Jackson area (Reference 2.5.1-262). However, there is no clear association of earthquake activity with faults associated with the Jackson Dome. (Reference 2.5.1-202)

2.5.1.1.5.2.1.4 Monroe Uplift

The Monroe Uplift, a secondary structure along the northern rim of the Gulf of Mexico Basin, is a broad (approximately 90 mi. [150 km] in diameter), relatively flat-topped dome that was active during the Mesozoic and Cenozoic Eras (Reference 2.5.1-203). The uplift straddles southern Arkansas, northern Louisiana, and west-central Mississippi (refer to Figure 2.5.1-203). The Monroe Uplift is a subsurface structure defined largely on the basis of unconformities and stratigraphic pinch-outs of Jurassic through Upper Cretaceous rocks; it sits astride and interrupts the peripheral graben system. The uplift is associated with Late Cretaceous igneous activity. The Monroe Uplift developed as a discrete structural feature in the Late Cretaceous when uplift resulted in as much as 10,000 ft. (3 km) of strata being eroded from the top of the feature. Uplift ended in the Late Cretaceous, and the feature was buried by Paleocene and younger sediments (Reference 2.5.1-252). Saucier suggests the structure may be an isostatic adjustment of the basement in response to the formation of adjacent basins and that older Tertiary formations markedly thin onto the uplift and exhibit unconformities that reflect intermittent movement over a long period. (Reference 2.5.1-203)

There is no conspicuous geomorphic expression of the Monroe Uplift at the surface, but analysis of the area's fluvial geomorphology is cited as evidence of Quaternary uplift (Reference 2.5.1-254). Burnett and Schumm (Reference 2.5.1-259) evaluated fluvial geomorphic features distributed across the uplift and concluded that the rivers were adjusting to modern deformation. Upstream of the uplift, the river had less bank erosion, a reduced sinuosity, lower channel and valley gradient, and lower channel depth than downstream (Reference 2.5.1-259). Burnett and Schumm found that the river terraces showed a convex pattern across the Monroe Uplift and inferred active uplift in the Pleistocene and Holocene. (Reference 2.5.1-202)

Crone and Wheeler classify the Monroe Uplift as a Class B feature based on the results of the Burnett and Schumm (Reference 2.5.1-259) and Schumm (Reference 2.5.1-263) studies, but note that the geologic and geodetic evidence provided in these reports is not compelling. The reported 5-mm/yr geodetic uplift rate is exceedingly high and is incompatible with the geologic and tectonic setting of the Gulf Coast province; on this basis, Crone and Wheeler judge it to be suspect as an accurate reflection of a long-term uplift rate. They note that the geologic rates of 0.01 to 1.4 mm/yr reported by Schumm (Reference 2.5.1-263) are more consistent with the regional geologic setting, but it is not clear if this uplift rate occurs seismically or aseismically. (Reference 2.5.1-254)

2.5.1.1.5.2.1.5 Sabine Uplift

The Sabine Uplift is a volcanic dome located in east Texas and western Louisiana (refer to Figure 2.5.1-203). The dome has a roughly oval shape, approximately 124-mi. (200-km) long in the north-south direction and 93-mi. (150-km) wide in the east-west direction. The uplift is a flat-topped structural high that was active in post-middle Eocene time. No active faulting or seismicity has been associated with the Sabine Uplift. (Reference 2.5.1-202)

2.5.1.1.5.2.1.6 Salt Diapirs

Salt structures are present within the Gulf Coastal province as domal or anticlinal to ridge-like diapiric folds (refer to Figure 2.5.1-214). These features vary in magnitude, height, and areal extent. In the Gulf Coastal Plain, two separate salt basins have been defined as the Northern or Interior Salt Basin and the Southern or Coastal Salt Basin (refer to Figure 2.5.1-215). These two basins have been subdivided into smaller basins. The Interior Salt Basin consists of the East Texas (Tyler), North Louisiana, and Mississippi Salt Basins. The Coastal Salt Basin subdivisions are the South Texas and Houston Embayment Salt Basins, as well as the South Louisiana and Outer Shelf Salt Dome Basins. More than 300 separate salt features are known in the Gulf Coastal province. (Reference 2.5.1-201)

Salt within the Interior Salt Basins originated from the Middle Jurassic Louann Salt, and salt migration structures are concentrated in an approximately 100-mi. (160-km) wide zone extending from southwestern Alabama to eastern Texas (refer to Figure 2.5.1-215). The source depth for the Louann Salt is around 15,000 ft. (4570 m) and becomes progressively deeper to the south. Salt domes in the Interior Salt Basin were active from Late Cretaceous to Oligocene and have not been active since. (Reference 2.5.1-202)

Salt domes in the Coastal Salt Basin began to form in the Miocene and have been active through the Quaternary. The source depth for the Louann Salt in the Coastal Salt Basin is approximately 35,000 ft. (10,700 m) and approaches 65,000 ft. (19,800 m) in the vicinity of the southernmost offshore salt domes. Salt migration in the Coastal Salt Basin deforms the ground surface. The Five Islands structural uplift is a northwest-southeast trending line of salt domes in south central Louisiana. These domes are expressed at the surface and deform a subsurface Quaternary gravel, suggesting Pleistocene activity. (Reference 2.5.1-202)

In the U.S. Gulf Coastal Plain, the upper part of many salt structures is circular in shape with the lateral diameter ranging to 6 mi. (10 km). At times, the domal mass rises as a spine from deeper anticlinal ridges. Some domes are mushroomed at the top, and some have cap rock consisting of anhydrite, calcite, and gypsum. Salt domes with appreciable relief have pierced the lower overlying beds, flowed upward, and may have penetrated all of the younger beds near the surface. Many salt domes in Louisiana had recurrent growth that sometimes modified relict structures as the salt moved upward (Reference 2.5.1-219). Some salt masses within the gulf region have penetrated upward through more than 25,000 ft. (7600 m) of overlying sediment. (Reference 2.5.1-201)

Numerous salt structures control accumulations of hydrocarbons, sulfur, and gypsum. Faulting is commonly found associated with salt structures and is generally interpreted as normal faulting. Simple doming of sediments over salt stocks is sometimes restricted to beds immediately overlying the top of the salt or cap rock. The salt structures are not found on the higher portion of major uplifts within the Gulf Coastal Plain. Murray (Reference 2.5.1-219) suggests that their absence is caused by salt flowage from structurally or topographically high regions to lower areas and/or positive relief of the uplift during or just after deposition of the salt. (Reference 2.5.1-201)

2.5.1.1.5.2.1.7 Gulf-Margin Normal Faults

The Gulf Coast salt dome area is essentially coincident with the area in southern Louisiana containing a series of en echelon normal growth faults. The zones trend roughly east-west, are approximately 8- to 20-mi. (13- to 32-km) apart, and can be traced for distances of 100 mi. (160 km) or more. (References 2.5.1-219 and 2.5.1-203)

The opening of the Gulf of Mexico during the Triassic formed a south-facing rifted margin (References 2.5.1-229 and 2.5.1-266). A thick package of Jurassic and younger sediments was deposited along this margin that included the Louann Salt and overlying carbonate and clastic marine sediments. This sedimentary sequence is in excess of 7 mi. (11 km) thick in the vicinity of the Gulf-margin normal faults. The Louann Salt is inferred to form a sliding layer mobilizing the overlying sedimentary section, forming a series of mostly seaward-facing normal faults and Gulf-margin normal faults, that border the northern Gulf of Mexico (Reference 2.5.1-254). Fault-plane dips are steepest at shallow depths (typically approximately 70 degrees) and flatten with increasing depth (Reference 2.5.1-267). These faults are interpreted to merge into bedding plane displacements or terminate in salt bodies.

The expansion ("growth") of strata on the downthrown side of faults relative to the equivalent units on the upthrown side indicates that the faulting occurred contemporaneously with deposition (Reference 2.5.1-268). On the downthrown side, the beds commonly dip northward into the fault plane in reverse of normal regional dip. This produces a "rollover" structure, a gently plunging elongate anticline whose axis parallels the fault. These characteristics resemble the features of gigantic slump blocks thought to occur as the result of sedimentary loading rather than due to a tectonic origin. Because petroleum is commonly entrapped in the "rollover" structures, these faults have been extensively studied using geophysical data, subsurface well control, and correlations based on paleontological and paleoenvironmental interpretation. (Reference 2.5.1-201)

The growth faults typically occur within the limits of the outer shelf environment, an unstable position susceptible to gulfward slumping under sedimentary load. The tendency to slump is accentuated by the gulfward lateral movement of the underlying shale and salt as the sedimentary load is emplaced from the north. As the shelf builds gulfward, the outer shelf zone of growth fault slumping shifts; older faults die out upward as the local environment shifts through a stable inner shelf to a deltaic and ultimately a fluviatile environment. Sediments of these types, 5000-ft. (1500-m) thick or more, overlie and bury the inactive faults. (Reference 2.5.1-201)

Micropaleontologic data provide correlations across the faults and permit interpretations of sedimentary environments and water depths. The overall upper Tertiary depositional pattern is a regressive deltaic plain across southern Louisiana. The depositional pattern requires a deep water basin into which the unstable shelf can build and slump. Similar patterns existed during earlier regressive sequences such as the lower Tertiary Wilcox and the middle Cretaceous Tuscaloosa Formations. The presence of the underlying Mobile-Tunica Flexure designated by Howe (Reference 2.5.1-234) explains why there is an inner, northward limit to the south Louisiana growth faults. The thick middle- to late-Cenozoic clastics accumulated in the deeper basin south of the flexure where instability led to slumping and the development of growth faults south of the hinge line that divided the shallow, more stable shelf area from the deep southern basin. The thick Tuscaloosa sediments accumulated in the deep basin south of the shelf edge. (Reference 2.5.1-201)

Periods of movement on the faults range in age from late Eocene to Holocene, depending on the location of the Mississippi River depocenter. The current Gulf Margin Normal faults are localized along the subsurface Cretaceous shelf edge and experience high rates of aseismic slip. Growth faults in the site region include the Tepetate-Baton Rouge, Denham Springs-Scotlandville, Lake Hatch, Golden Meadow, Lake Sand, Grand Chenier, Lake Arthur, and Mamou faults, and other unnamed fault zones (refer to Figure 2.5.1-216). (Reference 2.5.1-202)

Several growth faults have been identified south of the RBS site (refer to Figure 2.5.1-216) that represent recently reactivated surface expressions of deep-seated Tuscaloosa Group growth faults (Reference 2.5.1-269). The Tepetate-Baton Rouge fault system was recognized independently both from subsurface and geomorphic evidence (References 2.5.1-224 and 2.5.1-270). One fault in this system, the Baton Rouge Fault, forms a prominent scarp exceeding 20 ft. (6 m) in relief through southern Baton Rouge, where it displaces the Port Hickey (Lower Prairie) Terrace surface of the Sangamon interglacial age. This fault system has been mapped on the surface as a narrow zone of en echelon faults trending east-southeast along the northern margin of the Lake Pontchartrain Basin to the Pearl River. West of Baton Rouge, it cannot be recognized on the Holocene Mississippi River floodplain, but the fault system extends fairly continuously across southern Louisiana into Texas (Reference 2.5.1-219). There is displacement on the Deweyville Terrace surface (mid-Wisconsin Age) at the Amite River, 18 mi. (29 km) east of the Mississippi River. Murray reports that some movement along the Baton Rouge fault zone is recent (References 2.5.1-219 and 2.5.1-201). Current activity along the fault is indicated based on the surface scarps and the cracking of road pavements and structural damage to overlying buildings. (References 2.5.1-268, 2.5.1-269, and 2.5.1-271)

Figure 2.5.1-217 is a cross section presenting the subsurface evidence for the dip and throw of the Baton Rouge Fault. The dip is typical, being steepest near the surface and flattening with depth. As shown in Figure 2.5.1-217, the subsurface fault displacement ranges from 220 to 460 ft. (67 to 140 m), with an average vertical displacement of 345 ft. (105 m). In the Baton Rouge area, a total displacement of approximately 250 ft. (76 m) affects the 400- and 600-ft. aquifers. These are the downdip subsurface projections of the Citronelle Formation aquifers. On this evidence, the interpretation is made that the fault commenced its activity after deposition of the Citronelle Formation (late Pliocene Epoch). (Reference 2.5.1-201)

Slip rate estimates for the Baton Rouge fault vary from a Pleistocene rate of 0.002 to 0.003 in. per year (0.05 to 0.08 mm per year) (References 2.5.1-254 and 2.5.1-270) to historical rates of 0.35 in. per year (9 mm per year), determined by leveling surveys conducted by the Louisiana Water Research Institute (Reference 2.5.1-272). Rates as high as 1.6 in. per year (4 cm per year) have been measured from a global positioning system (Reference 2.5.1-202). Leveling surveys suggest that the current rate of vertical movement is approximately 2 mm per year (0.08 in. per year) (References 2.5.1-201 and 2.5.1-273) to 3 to 5 mm per year (Reference 2.5.1-274). A comparison of benchmark elevations from the 1960s and 1980s has shown that slip rates along normal faults in southwestern Louisiana range from approximately 0.1 in. per year (2 mm per year) to as much as 0.2 in. per year (6 mm per year) (Reference 2.5.1-267). Based on the leveling data, Heltz concludes that episodic fault movements have occurred in the area throughout recent geologic history.

Despite the numerous growth faults in the region and the evidence for ongoing displacement, seismicity within the Gulf Coastal Basin is sparse (References 2.5.1-202 and 2.5.1-253). There is virtual unanimity among investigators that the Gulf-margin normal faults are aseismic and that the faulting is contained entirely in the sedimentary sequence and does not extend into the basement (Reference 2.5.1-201). Because the faults are located in poorly lithified rocks and sediments, they may not be able to support the stresses required for the propagation of significant seismic ruptures that could cause damaging ground motions (References 2.5.1-202 and 2.5.1-254). The progressive flattening of the fault planes with depth results in the faults becoming bedding plane slip in the lower part of the sedimentary sequence where the displacement dissipates as plastic movement. These faults neither reach the basement nor arise from basement tectonic movement. The key factors involved in their formation include overloading in areas of voluminous sedimentation, differential compaction of the deposited sediments, high fluid pressures, and gravity sliding on (and salt flow within) a layer of plastic salt.

2.5.1.1.5.2.1.8 Postulated Northwest and Northeast Trending Faults

Fisk (Reference 2.5.1-224) postulated numerous northwest and northeast trending faults and fault zones almost exclusively on the basis of regional lineaments and other surface features, as shown in Figure 2.5.1-218 (Reference 2.5.1-201). From his identification of lineaments in the Lower Mississippi River Valley area, Fisk postulated the presence of eight principal fault zones and several lesser ones, as shown in Figure 2.5.1-218. The postulated Red River Fault Zone, which is shown trending northwest-southeast through Alexandria and Baton Rouge, Louisiana, is of interest with respect to the site. Fifteen postulated faults were delineated in this zone by Fisk (Reference 2.5.1-224), extending down the Red River Valley and into southeastern Louisiana. Several additional postulated faults that are of secondary interest are shown northeast of and parallel to this trend and include the fault shown trending from near Monroe, Louisiana, to near Natchez, Mississippi. The absence of subsurface evidence for faulting along the lineaments mentioned above is substantiated by numerous borings in some of the areas. An examination of aerial photographs and photograph mosaics performed as part of the RBS Unit 1 USAR confirmed the roughly linear nature of the Red River Fault Zone escarpment; however, it failed to reveal any additional surface evidence for faulting. (Reference 2.5.1-201)

More recently, McCulloh (Reference 2.5.1-275) examined the lineaments of Fisk (Reference 2.5.1-224) with respect to newer satellite imagery and LiDAR data. Although many of the same lineaments are seen using these newer images, none of the Fisk lineaments were found to be faults; instead, they may correspond to regional fracture patterns. (Reference 2.5.1-275)

Zimmerman and Sassen (Reference 2.5.1-276) and Zimmerman (References 2.5.1-277, 2.5.1-278, and 2.5.1-279) inferred the existence of three strike-slip faults approximately 40-mi. (60-km) apart that strike approximately N24ºE through central and northern Louisiana and adjacent parts of Arkansas and Mississippi, and one strike-slip fault that strikes N62ºW through central western Mississippi and southeastern Arkansas that intersects the northeast trending faults (refer to Figure 2.5.1-219). These postulated wrench faults were inferred from alignments and spatial associations of various geological and hydrological anomalies encountered during an analysis of data from petroleum wells. Meloy and Zimmerman (Reference 2.5.1-280) concluded that the northeast-striking inferred faults do not link northward with the Reelfoot Rift, which hosts the NMSZ, and, therefore, do not present a significant earthquake hazard.

In their compilation of Quaternary faults and tectonic features in the eastern United States, Crone and Wheeler (Reference 2.5.1-254) assign the inferred Louisiana wrench faults to Class C[a] because: (1) convincing evidence for the existence of the faults is not presented and (2) most of the examples presented to illustrate the various indicators of faulting along northeast or northwest trends have alternative explanations that do not involve the inferred vertical faults. Two of the indicators, imagery lineaments and changes and straight reaches in river courses, are subjective and irreproducible, but no tests of reliability are mentioned. Igneous intrusions that are tentatively attributed to the inferred wrench faults do not align along the postulated faults. Although five of the eight geological and hydrological indicators that were used to infer the faults are stated to record processes that operated as recently as the Holocene (Table 1 of Reference 2.5.1-277, Figure 2 of Reference 2.5.1-278, and Figure 2 of Reference 2.5.1-279), no clear evidence is given for any Holocene activity.

2.5.1.1.5.2.2 Ouachita Orogenic Belt

The Ouachita orogenic belt defines the northern edge of the Gulf Coastal Basin, the southern margin of the Mississippi Embayment, and the southern edge of the North American craton (refer to Figure 2.5.1-203). The Ouachita orogenic belt is the eroded core of a mountain belt that formed during continental collision and formation of the supercontinent Pangea in the Paleozoic (refer to Figure 2.5.1-209); the Ouachita orogenic belt extends from western Alabama through northern Mississippi, central Arkansas, southeastern Oklahoma, and eastern Texas (refer to Figure 2.5.1-220). The Ouachita orogenic belt consists of an arcuate salient of complexly folded, thrust-faulted, and metamorphosed rocks that, like the Appalachian Mountains, includes accreted oceanic crust of Proterozoic Age. (Reference 2.5.1-281)

The Ouachita orogenic belt is up to 50-mi. (80-km) wide and 1260-mi. (2027-km) long, although approximately 80 percent of its length is buried beneath Mesozoic and Tertiary sediments of the Mississippi Embayment (Reference 2.5.1-202). The belt includes three regional subdivisions, including the Southeastern Ouachitas, the Ouachita Mountains, and the Subsurface Ouachitas of Texas. The topography of the Ouachita orogenic belt is expressed by a low relief erosional surface that was buried by Jurassic sediments in the Gulf Coastal Plain. Across the Gulf Coastal Plain from Alabama to southern Texas, this erosional unconformity dips toward the Gulf of Mexico at an angle of less than 1 degree (Reference 2.5.1-281). Repeated episodes of deformation formed asymmetrical folds and

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a. Crone and Wheeler (Reference 2.5.1-254) define Class A features as those for which geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin. Class B features are those for which the fault may not extend deeply enough to be a potential source of significant earthquakes or for which the currently available geologic evidence is not definitive enough to assign the feature to Class C or to Class A. Class C features are those for which geologic evidence is insufficient to demonstrate the existence of a tectonic fault, Quaternary slip, or deformation associated with the feature.

low- and high-angle thrust faults that involve middle- to upper-Paleozoic rocks along the edge of the North American craton (Reference 2.5.1-282). Middle- to upper-Paleozoic rocks are unconformably overlain by late Paleozoic rocks not involved in the Ouachita orogeny. Deformation along the Ouachita orogenic belt ceased in late Paleozoic time. Throughout the entire length of the Ouachita orogenic belt, the base of the orogen is defined by a major decollement, along which allochthonous marine sedimentary rocks are thrust northward over North American cratonic rocks. The northern side the Ouachita orogenic belt overlies 21 to 24 mi. (34 to 39 km) of North American continental crust (Reference 2.5.1-283). On the southern, or Gulf Coast side, the Ouachita orogenic belt overlies transitional continental crust. (References 2.5.1-202, 2.5.1-204, and 2.5.1-283)

Two major stratigraphic units collectively known as the Ouachita facies compose the majority of rocks in the Ouachita orogenic belt. The lower stratigraphic unit, referred to as the pre-orogenic off-shelf facies, ranges from Late Cambrian to Early Mississippian, and is approximately 9500-ft. to 11,000-ft. (2900-m to 3350-m) thick. This lower stratigraphic unit consists of shale, sandstone, and micrite that grade upward to chert, siliceous shale, and novaculite. The upper stratigraphic unit is referred to as the synorogenic facies. This unit ranges from Late Mississippian (Meramecian) to Early Permian (Wolfcampian) and represents more than 50,000 ft. (15,240 m) of shelf-delta clastic deposits that originated in foreland basins and outboard deep water clastic wedge deposits. The shelf-delta deposits of the foreland basin were deformed by folding and faulting during the Ouachita orogeny (Reference 2.5.1-281). On the northern side of the Ouachita orogenic belt, Carboniferous Age shelf-delta deposits (upper stratigraphic unit) occur in the subsurface foreland basin and extend southward into the frontal thrusts in Mississippi. Southwest of the orogenic belt, undifferentiated pre-orogenic and synorogenic rocks are present. (Reference 2.5.1-202)

In Mississippi, the decollement beneath the southeastern Ouachitas ramps downward into the shelf strata of the Appalachian Mountains and interleaves with the decollement beneath the southern part of the Appalachian Mountains (Reference 2.5.1-281). The intersection of the Ouachita orogenic belt and the thrust faults of the Appalachian Mountains leads to a cross-cutting fault pattern. Although many large Paleozoic thrust faults of regional extent are mapped through the Ouachita orogenic belt, none display geological evidence of Quaternary activity. (Reference 2.5.1-202)

Several potential Quaternary active fault zones within the Ouachita orogenic belt have been identified by geomorphic evidence of basin asymmetry and localized evidence of faulting in road-cuts and trenches, weak clustering of earthquake epicenters, and liquefaction features (Reference 2.5.1-284). The potential faults are identified along the Arkansas River, Saline River, and Ouachita River in northern Louisiana and Arkansas (Reference 2.5.1-202). These structures are included in the Saline River source zone and are discussed below in Subsection 2.5.1.1.5.3.3.

2.5.1.1.5.3 Significant Seismic Sources at Distances Greater than 200 Mi. (320 Km)

The EPRI-SOG evaluation (Reference 2.5.0-201) indicates that the seismic sources associated with the Reelfoot Rift in the New Madrid, Missouri region are significant contributors to the hazard at the RBS site. These sources, as well as a potentially active source in the Saline River, Arkansas region, are described below.

2.5.1.1.5.3.1 Reelfoot Rift

The Reelfoot Rift represents a northeast-trending fault system originating in the Precambrian or Early Cambrian during the extension of the North American continent (refer to Figure 2.5.1-208) (References 2.5.1-282 and 2.5.1-285). The Reelfoot Rift extends from southern Illinois at the northern end of the Mississippi Embayment, to east-central Arkansas, and northern Mississippi beneath the Ouachita orogenic belt (Reference 2.5.1-282). As shown in Figure 2.5.1-203, the closest approach from the Reelfoot Rift to the site is approximately 300 mi. (480 km). The Reelfoot Rift now accommodates crustal shortening due to northeast-southwest directed regional compressive stress (References 2.5.1-242 and 2.5.1-245). The Reelfoot Rift is approximately 45-mi. (72-km) wide and 180-mi. (290-km) long, with as much as 25,000 ft. (7620 m) of structural relief (Reference 2.5.1-286). An alignment of magnetic intrusive rocks defines the rift boundaries (References 2.5.1-211, 2.5.1-285, and 2.5.1-287). Within the Reelfoot Rift, Upper Paleozoic through middle Cretaceous strata are absent, and a major unconformity exists between Late Cretaceous and Early Paleozoic strata (Reference 2.5.1-288). The Reelfoot Rift comprises a number of distinct structural features, including the Commerce Geophysical Lineament, western margin of Reelfoot Rift, Crowleys Ridge, Sikeston Ridge, NMSZ, and the eastern margin of Reelfoot Rift (References 2.5.1-289 and 2.5.1-254). The NMSZ is the primary seismically active tectonic feature within the Reelfoot Rift and is described in Subsection 2.5.1.1.5.3.2. (Reference 2.5.1-202)

The geologic history of the Reelfoot Rift includes numerous episodes of uplift, subsidence, intrusion, and sedimentation (refer to Figure 2.5.1-209). During the Precambrian to Cambrian, the Reelfoot Rift formed as a result of continental rifting and crustal extension of the North American continent (Reference 2.5.1-282). In the Late Cambrian, rifting ceased, and the Reelfoot Rift was filled with Paleozoic marine clastic and carbonate rocks (Reference 2.5.1-288). During the middle Cretaceous time, the Reelfoot Rift was reactivated, forming an arch that resulted in the erosion and removal of Late Paleozoic to middle Cretaceous rocks of the Late Cambrian Reelfoot Rift. (References 2.5.1-282, 2.5.1-284, and 2.5.1-202)

Reactivation of the Reelfoot Rift in the middle Cretaceous was accompanied by the emplacement of igneous rocks along the rift margins (References 2.5.1-284 and 2.5.1-290). The emplacement of plutons and crustal arching in the middle Cretaceous may have been related to the North American continent passing over the Bermuda Hot Spot (Reference 2.5.1-284). Cox and Van Arsdale (Reference

2.5.1-284) suggest that the reactivation of the Reelfoot Rift occurred in the middle Cretaceous rather than the Jurassic and could not have been related to the opening of the Gulf of Mexico (Reference 2.5.1-288). The reactivation of rift structures in the Late Cretaceous to Eocene caused crustal subsidence and formation of the Mississippi Embayment subprovince of the Gulf Coastal Plain and initial deposition of alluvial sediment from the Mississippi River over Jurassic carbonates in the northern Gulf of Mexico. Regional stress changed from extension to compression in the late Eocene, causing minor folding and faulting (e.g., the Crittenden County Fault) within the Reelfoot Rift (References 2.5.1-288 and 2.5.1-291). Oligocene and Miocene strata are absent in the Mississippi Embayment, and deposits in the Gulf Coast Basin indicate that the embayment was subaerially exposed and subjected to erosional processes during this time. Pliocene to Pleistocene glacial outwash deposits of the Upland Complex unconformably overlie Eocene deposits in the Mississippi Embayment. The Mississippi Embayment was entrenched during the Pleistocene and Holocene, resulting in progressive flights of terraces incised into Upland Complex deposits along the Mississippi River and its tributaries. (References 2.5.1-203 and 2.5.1-202)

Potentially active faults within the Mississippi Embayment may be associated with the Precambrian, middle Cretaceous, Late Cretaceous, or early Tertiary faults of the Reelfoot Rift (Reference 2.5.1-285). The potentially active faults may have been reactivated in the late Eocene, when the regional stress field changed from extension to northeast-southwest compression. Extensive geophysical investigations of the Reelfoot Rift have been completed for a variety of purposes, including deep crustal dynamics, oil exploration, active tectonics, and geotechnical projects (Reference 2.5.1-288). These geophysical investigations indicate that many faults in the Reelfoot Rift do not offset post-Cretaceous deposits (Reference 2.5.1-286). However, Tertiary and Quaternary Age faults are identified beneath the margins of Crowley's Ridge (References 2.5.1-292 and 2.5.1-293), Sikeston Ridge (References 2.5.1-294 and 2.5.1-295), Blytheville Arch (References 2.5.1-296, 2.5.1-297, 2.5.1-298, and 2.5.1-299), Benton Hills (Reference 2.5.1-300), Reelfoot Fault (References 2.5.1-301, 2.5.1-302, 2.5.1-303, and 2.5.1-304), Bootheel Lineament (References 2.5.1-295 and 2.5.1-305), Crittenden County Fault (References 2.5.1-291 and 2.5.1-306), the Big Creek Fault zone (References 2.5.1-307 and 2.5.1-308), Commerce Geophysical Lineament (Reference 2.5.1-309), and one of the west-bounding faults of the Reelfoot Rift. (References 2.5.1-293 and Reference 2.5.1-202)

With the exception of seismicity associated with the NMSZ (described below), seismicity within the Reelfoot Rift is diffuse (refer to Figure 2.5.1-213). Seismicity patterns indicate that pre-1985 and post-1985 earthquake occurrences have been relatively constant. (Reference 2.5.1-202)

Forte and others (Reference 2.5.1-310) present viscous flow models for North America based on high resolution seismic tomography that suggest a possible driving mechanism for the intraplate seismicity in the New Madrid region. From an analysis of these flow models, it is postulated that the descent of the ancient

Farallon slab into the deep mantle beneath central North America induces a highly localized flow and stresses directly below the NMSZ. This localization arises as a result of structural variability in the Farallon slab and the low-viscosity of the sub-lithospheric upper mantle. The mantle-flow-induced surface depression and associated local focusing of bending stresses in the upper crust may operate analogously to previous crustal loading scenarios, with the difference that the slab-related loads reside in the mantle. (Reference 2.5.1-310)

2.5.1.1.5.3.2 New Madrid Seismic Zone

The NMSZ lies within the Reelfoot Rift and is defined by post-Eocene to Quaternary faulting and historical seismicity. The NMSZ, which is approximately 124-mi. (200-km) long and 25-mi. (40-km) wide, extends from southeastern Missouri to northeastern Arkansas and northwestern Tennessee (refer to Figure 2.5.1-203) (Reference 2.5.1-201). Although the NMSZ lies outside of the site region, it remains a significant contributor to the seismic hazard at the site of the proposed RBS facility.

Research conducted since 1986 indicates that a distinct fault system is embedded within this source zone. The fault system consists of three distinct segments (refer to Figure 2.5.1-220). These three segments include a southern northeast-trending dextral slip fault referred to as the Cottonwood Grove Fault and Blytheville Arch, a middle northwest-trending reverse fault referred to as the Reelfoot Fault, and a northern northeast-trending dextral strike-slip fault referred to as the New Madrid North fault (also referred to as the East Prairie Fault) (References 2.5.1-288, 2.5.1-298, 2.5.1-311, 2.5.1-312, and 2.5.1-254). In the current east-northeast to west-southwest directed regional stress field, Precambrian and Late Cretaceous Age extensional structures of the Reelfoot Rift have been reactivated as right-lateral strike-slip and reverse faults. (References 2.5.1-313 and 2.5.1-202)

The NMSZ produced three large-magnitude earthquakes (estimates range from M 7.1 to 8.4) between December 1811 and February 1812 (References 2.5.1-314, 2.5.1-315, 2.5.1-316, 2.5.1-313, 2.5.1-317, 2.5.1-318, and 2.5.1-319). The actual size of these pre-instrumental events is not known with certainty and is based primarily on various estimates of damage intensity and amount and pattern of liquefaction. (Reference 2.5.1-202)

The December 16, 1811, earthquake is inferred to be associated with strike-slip displacement along the southern portion of the NMSZ, either on the Blytheville Arch-Cottonwood Grove Fault or Blytheville Arch-Bootheel Lineament (refer to Figure 2.5.1-220) (References 2.5.1-317 and 2.5.1-313). The southern portion of the NMSZ extends for approximately 70 mi. (110 km) from northeastern Arkansas through the eastern corner of the Missouri "Bootheel" (References 2.5.1-288 and 2.5.1-254). This southwestern part of the NMSZ follows the pre-middle Ordovician subsurface Blytheville Arch and coincides with the axis of the Reelfoot Rift. Johnston estimated the December 1811 event to have an M 8.1 ± 0.31 (References 2.5.1-317 and 2.5.1-316); Johnston later reevaluated the intensity data for the region, and concluded that the event had a magnitude of M 7.2 to 7.3.

Bakun and Hopper (Reference 2.5.1-314) also reevaluated the intensity data and derived a preferred magnitude of M 7.6 for the December 1811 event. (Reference 2.5.1-202)

The February 7, 1812 New Madrid earthquake is associated with reverse displacement along the middle part of the NMSZ (Figure 2.5.1-220; References 2.5.1-303, 2.5.1-304, 2.5.1-313, 2.5.1-314, and 2.5.1-317). This earthquake most likely occurred along the northwest-trending Reelfoot Fault that extends approximately 43 mi. (69 km) from northwestern Tennessee to southeastern Missouri (References 2.5.1-320 and 2.5.1-321). The Reelfoot Fault is a northwest-trending southwest-vergent reverse fault (References 2.5.1-304 and 2.5.1-322). The Reelfoot Fault forms a topographic scarp developed as a result of fault-propagation (References 2.5.1-304, 2.5.1-321, and 2.5.1-323. Kelson et al. (Reference 2.5.1-304) investigated near-surface deformation along the trace of the scarp and found evidence for three events within the past 2400 years. The most recent event was associated with the 1811-1812 earthquake sequence. The penultimate event is estimated to have occurred between A.D. 1260 and 1650. The pre-penultimate event occurred prior to approximately A.D. 780-1000 (Reference 2.5.1-303). A range of recurrence intervals for the Reelfoot Fault are estimated between 150 to 900 years, with a preferred range of approximately 400 to 500 years (Reference 2.5.1-304). The geometry and reverse sense of motion of the Reelfoot Fault implies that the fault serves as a step-over segment between the southern and northern portions of the fault (References 2.5.1-288 and 2.5.1-254). Johnston (Reference 2.5.1-317) estimated a magnitude of M 8.0 ± 0.33 for the February 1812 event. Hough et al. (Reference 2.5.1-316) later reevaluated the intensity data for the region and concluded that the February event had a magnitude of M 7.4 to 7.5. Bakun and Hopper (Reference 2.5.1-314) reevaluated the intensity data from the 1811-1812 sequence and derived a preferred magnitude of M 7.8 for the event. (Reference 2.5.1-202)

The January 23, 1812 earthquake is inferred to be associated with strike-slip displacement on the East Prairie Fault along the northern portion of the NMSZ (Figure 2.5.1-220; Reference 2.5.1-313). The northern portion of the NMSZ extends 45 mi. (72 km) in a northeast direction through southeastern Missouri and approximately coincides with the northwestern boundary of the Reelfoot Rift (Reference 2.5.1-313). The interpretation that the January 1812 earthquake occurred along the New Madrid North Fault of the NMSZ is based on fault mechanics and limited historical data and is more poorly constrained than interpretations of the December 16, 1811 and February 7, 1812 earthquakes. Baldwin et al. (Reference 2.5.1-294) conducted paleoseismic investigations along this segment of the fault. Although they have identified liquefaction evidence for the 1811-1812 earthquake sequence, their data do not support the presence of a major throughgoing fault with repeated late Holocene events. (Reference 2.5.1-202)

Johnston (Reference 2.5.1-317) estimated a magnitude of M 7.8 ± 0.33 for the January 1812 event. Hough et al. (Reference 2.5.1-316) later reevaluated the intensity data for the region and concluded that the January event had a magnitude of M 7.1. Bakun and Hopper (Reference 2.5.1-314) reevaluated the intensity data from the 1811-1812 sequence and derived a preferred magnitude of M 7.5 for the January 23, 1812 event.

Because there is little surface expression of faults within the NMSZ, earthquake recurrence estimates are based largely on dates of paleoliquefaction and offset geological features (References 2.5.1-304, 2.5.1-324, and 2.5.1-325). These data suggest strong earthquakes occurred around A.D. 900 ± 100, A.D. 1450 ± 150, and A.D. 1810 ± 130 (References 2.5.1-324, 2.5.1-326, 2.5.1-327, and 2.5.1-328). Kelson et al. (Reference 2.5.1-304) dated the penultimate event that deformed the scarp of the Reelfoot Fault between A.D. 1260 and 1650 and an older event between A.D. 780 and 1000. (Reference 2.5.1-202)

Paleoseismic investigations suggest that the recurrence interval for surface deforming earthquakes in the NMSZ is approximately 200 to 800 years (References 2.5.1-324, 2.5.1-329, 2.5.1-330, 2.5.1-331, 2.5.1-332, 2.5.1-304, 2.5.1-326, and 2.5.1-328). The 200- to 800-year recurrence estimate, with a preferred estimate of 500 years, is significantly shorter than the 5000-year earthquake recurrence interval used in the 1986 EPRI study based on extrapolation of historical seismicity (refer to the discussion in Subsection 2.5.2). Tuttle et al. (Reference 2.5.1-324) documents evidence that prehistoric sand blows, like those formed during the 1811-1812 earthquakes, are probably compound structures resulting from multiple earthquakes closely clustered in time (i.e., earthquake sequences).

A wide range of slip rates are reported for the NMSZ. Slip rate estimates include data from geodetic measurements that range from 0.2 to 0.3 in. per year (5 to 7 mm per year) (Reference 2.5.1-333) to no detectable deformation (Reference 2.5.1-334), and geologic rates that range from 0.07 to 0.24 in. per year (1.8 to 6.2 mm per year) for the Holocene, and 0.00001 to 0.00008 in. per year (0.0003 to 0.002 mm per year) for the late Cretaceous to late Eocene (References 2.5.1-321 and 2.5.1-335). Mueller and Pujol (Reference 2.5.1-322) report a slip rate of 0.07 to 0.08 in. per year (1.8 to 2.0 mm per year) along the northern and southern portions of the NMSZ, based on the geometric relationships (fault strike and slip vectors) with the Reelfoot Fault. (Reference 2.5.1-202)

The upper-bound maximum magnitude values used by the EPRI-SOG teams range from m_b 7.2 to 7.9 (refer to the summary in Subsection 2.5.2). More recent estimates of M_{max}, as previously described, have generally been within this range. The most significant updates of source parameters for the NMSZ since the 1986 EPRI SOG study (Reference 2.5.1-367) are the reduction in the mean recurrence interval to approximately 500 years and consideration of clustered event sequences.

2.5.1.1.5.3.3 Saline River Source Zone

The Saline River source is a potentially active seismic source that was not recognized at the time of the 1986-1988 EPRI-SOG study (Reference 2.5.0-201). Based on more recent information, this source zone was identified as a potentially active seismic source and further characterized as part of the investigations completed for the NRC-approved Grand Gulf Nuclear Station (GGNS) Unit Early Site Permit (ESP) Site Safety Analysis Report (SSAR) (Reference 2.5.1-202). The following description of this source zone is summarized from the GGNS Unit 3 ESP SSAR. (Reference 2.5.1-202)

At its closest approach, the Saline River source zone is located approximately 200 mi. (320 km) northwest of the RBS site (refer to Figure 2.5.1-213). It lies within the Ouachita orogenic belt and structurally overlies the southwestward subsurface extension of the Proterozoic Reelfoot Rift. The Saline River source zone is located primarily in southeastern Arkansas and northwestern Mississippi, with a minor extension into northern Louisiana (refer to Figure 2.5.1-213). The source zone is defined based on geomorphic, geologic, and seismologic data that is suggestive of Holocene and late Pleistocene deformation and paleoseismicity (References 2.5.1-336 through 2.5.1-339). Evidence for late Pleistocene deformation is not conclusive and may be explained by activity along the Reelfoot Rift and/or through non-tectonic processes such as isostatic adjustments from glacial loading to the north or sediment loading within the Mississippi Embayment and/or Mississippi Delta fan complex. (Reference 2.5.1-202)

Basin analysis techniques were used to assess possible tectonic influences on the location and orientation of the Ouachita, Saline, and Arkansas rivers (Reference 2.5.1-336). Based on the distribution and ages of river terraces, progressive, southwestward river migration and drainage basin asymmetry reflect southwestward tilting of a series of northwest-trending structural blocks (Reference 2.5.1-340). These northwest-trending, tilted structural blocks are bordered by assumed northwest-trending normal or oblique slip faults and are interpreted to control the patterns, position, and orientation of these major drainages. (Reference 2.5.1-202)

Surface expression of the Saline River source zone includes topographic lineaments and linear drainage patterns. Six small-displacement fault splays have been identified in trenches and road-cuts near Monticello, Arkansas (References 2.5.1-284 and 2.5.1-337). Two of these faults trend in a northwest direction parallel to the Saline River. Four subsidiary faults strike east-northeast. Relationships observed in the fault exposures indicate strike-slip, normal, and reverse senses of displacement. One fault splay underlies a gentle anticline that deforms alluvium with an age of 640 calendar years before present (BP) (Note: All ages are reported as 2-sigma calibrated radiocarbon years before A.D. 1950 [present]). This fold is interpreted to be a fault-propagation fold related to Holocene activity along the Saline River fault zone. (References 2.5.1-339 and 2.5.1-202)

Stream incision into terraces of known age was assessed to estimate the total amount and rate of block uplift and the amount and rate of vertical separation on the assumed bordering faults within the Saline River source zone. Estimates of incision rates for various terrace surfaces were used as a proxy for vertical slip-rates and yielded rates ranging from 0.002 to 0.046 in. per year (0.05 to 1.7 mm per year). Observations made in trench and road-cut exposures were also used to determine slip rates and recurrence intervals on faults in the Saline River source zone. Based on geologic relationships in trenches near Monticello, Arkansas (Sites 3 and 4 of Reference 2.5.1-337), a subsidiary northeast-trending fault is offset approximately 100 ft. (30 m) by a northwest-trending fault that possibly deforms Upland Complex deposits. Based on the 100-ft. (30-m) offset of the secondary fault and a 1- to 4-million year age range of the Upland Complex, the fault slip-rate was estimated to be 0.0003 to 0.001 in. per year (0.008 to 0.03 mm per year). Because this fault is likely a subsidiary fault within a larger fault zone, this slip-rate is a minimum bounding estimate for the rate of deformation within the Saline River source zone. (Reference 2.5.1-202)

Liquefaction-related features have been identified locally within the Saline River source zone in Ashley County and Desha County, Arkansas (Reference 2.5.1-338). The liquefaction features are recognized on the surface as sand blows. These surficial sand blows were trenched (Reference 2.5.1-338) at five locations to document their stratigraphic relationships and provide estimates of event ages. Estimated ages provide evidence for several Holocene liquefaction events; however, these events could also be associated with seismic events in the NMSZ. (Reference 2.5.1-202)

2.5.1.1.5.4 Regional Gravity and Magnetic Data

The character of basement rock and structures in the site region are not well defined in many areas because of the thick Cenozoic clastic sediments that attenuate seismic energy, combined with the presence of Jurassic to Upper Cretaceous carbonates and evaporites and mobile salt that make imaging difficult. Gravity and magnetic maps available for the conterminous United States provide information used to evaluate crustal properties and basement structures in the site region and adjacent parts of the northern Gulf of Mexico Basin (References 2.5.1-341, 2.5.1-342, and 2.5.1-204). Figures 2.5.1-221 and 2.5.1-222 show recent gravity and magnetic anomaly maps based on gravity and magnetic anomaly data that have been more recently compiled and integrated into digital databases by the U.S. Geological Survey (USGS). (Reference 2.5.1-343)

Figure 2.5.1-221 shows the RBS site in a relative gravity low between regions characterized by higher gravity anomalies. The gravity high that encompasses the northern part of Louisiana and southern Mississippi is interpreted to be mafic crust (transitional basement formed during rifting) (Reference 2.5.1-342). An inferred Upper Triassic-Lower Jurassic graben in the nearshore region of the northern Gulf of Mexico as shown by Salvador (Reference 2.5.1-229) coincides with the southern gravity anomaly in the site region.

2.5.1.1.5.5 Regional Seismicity

The RBS site is located in an area of infrequent and low seismicity within the Gulf Coast Basin tectonic province. Figure 2.5.1-210 indicates the locations of earthquakes within the RBS site region and adjacent areas of the southern United States and Gulf of Mexico. A discussion of the updated earthquake catalog for the RBS site region is provided in Subsection 2.5.2.1.1. Table 2.5.1-202 lists the earthquakes in the updated catalog that have occurred within the RBS site region. The earthquakes in the updated earthquake catalog (refer to Figure 2.5.1-210) are color-coded to indicate those events included in the EPRI-SOG earthquake catalog for the time period of 1758 to 1985, historical events added to the EPRI-SOG catalog, and those events that occurred after the EPRI-SOG catalog (1985 to 2006).

Seismicity within the RBS site region is sparse and minor; only 36 earthquakes larger than m_b 3.0 have occurred since 1758 within the site region, and none of them exceeded m_b 4.3. Only five events are located within 50 mi. (80 km) of the RBS site, including the m_b 4.2, Donaldsonville, Louisiana, earthquake of October 19, 1930. No earthquakes are located within 5 mi. (8 km) of the site. The two closest earthquakes are the November 19, 1958, m_b 3.2 event located 19 mi. (31 km) from the site; and the February 3, 1905, m_b 3.7 earthquake, located 22 mi. (36 km) from the site.

Estimates of the Modified Mercalli Intensity (MMI) are available for 18 earthquakes in the updated catalog for the site region. Maximum intensities larger than MMI IV are reported for nine events. These include the Donaldsonville, Louisiana, earthquake of October 19, 1930; the New Orleans, Louisiana, earthquake of November 6, 1958; and the Baton Rouge earthquake of November 19,1958. The epicentral MMI of these four earthquakes were VI, IV, and V, respectively, and their respective distances from the RBS site were 50 mi. (80 km), 94 mi. (152 km), and 19 mi. (31 km) (Reference 2.5.1-201). The other events occurred at greater distances from the RBS site (more than 94 mi. [150 km]).

In addition to earthquakes within the site region, the New Madrid, Missouri earthquake sequence of 1811-1812 was felt in the northern part of Louisiana with a MMI V-VI and in the southern part of the state with a MMI III-IV (Reference 2.5.1-253). Although not felt within the region, the March 27, 1964 Prince William Sound, Alaska earthquake reportedly caused water oscillations in the New Orleans area, with a peak-to-peak amplitude of approximately 6 ft. with a period of approximately 5 sec. (Reference 2.5.1-253)

Seismicity that is occurring beyond the site region is considered in the updated seismic hazard analysis described in Subsection 2.5.2. The NMSZ, which lies at a distance of greater than 300 mi. (480 km), has been the locus of repeated large magnitude earthquakes that contribute to the hazard at the RBS site (refer to Subsection 2.5.2.4.1.1). The occurrence of two moderate earthquakes in the Gulf of Mexico in 2006 has implications to the evaluation of seismicity for the Gulf Coast Basin source zones that include the RBS site. Recent earthquakes in the Gulf Coast Basin include the February 10, 2006, m_b 5.4 earthquake that occurred 230-mi. (370-km) south of the RBS site and the M 5.8 (m_b 6.08) earthquake on September 10, 2006, which occurred approximately 420-mi. (680-km) southeast of the site. These earthquakes are discussed in detail in Subsection 2.5.2.1.2.2.

2.5.1.2 Site Geology

This subsection presents information on the physical setting, geological history, and subsurface conditions within the site vicinity (25-mi. [40-km] radius), site area (5-mi. [8-km] radius), and site location (0.6-mi. [1-km] radius) of the proposed RBS Unit 3.

2.5.1.2.1 Site Physiography and Geomorphology

The RBS site straddles the eastern boundary of the Mississippi Alluvial Valley and the Southern Hills physiographic subprovinces (refer to Figure 2.5.1-202). The site is approximately 1.8-mi. (2.9-km) northeast of the Mississippi River and adjacent to the Mississippi River floodplain (refer to Figures 2.5.1-202 and 2.5.1-226). The site sits on the dissected uplands formed by the Pleistocene terrace deposits and the Citronelle Formation. Within the site location, the average elevation of the floodplain is approximately +38 ft. (+11 m) msl, and the average upland elevation is approximately +95 ft. (+29 m) msl (refer to Figure 2.5.1-226). (Reference 2.5.1-201)

In the site area, the Mississippi River floodplain is characterized by a natural levee located at the river's edge. The levee has a maximum elevation of approximately +46 ft. (+14 m) msl, and the ground surface slopes down from the river to an elevation of +36 ft. (+11 m) msl near the valley wall (refer to Figure 2.5.1-226). The floodplain surface is flat and only slightly eroded. Drainage is poor, and swampy conditions are widespread. (Reference 2.5.1-201)

The Mississippi River floodplain extends into the site area on the southwest. At this point, the entire floodplain is 27 mi. (45 km) wide. Near the site, the Mississippi River meanders close to the northeastern margin of the floodplain at the base of the bluffs forming the eastern valley wall (refer to Figure 2.5.1-226). The amplitude of the Mississippi River meander loops usually exceeds 6 mi. (10 km). Consequently, the river impinges directly against the valley wall at Tunica Bluff, located 18 mi. (29 km) upstream from the site, and at Port Hickey located 6 mi. downstream. The river approaches the valley wall at St. Francisville, Louisiana, located 2 to 3 mi. (3 to 5 km) upstream from the site, and meanders westward into the floodplain at Iowa Point, between Tunica and St. Francisville, where it is 9 mi. (14 km) from the east valley wall. (Reference 2.5.1-201)

The main uplands are formed by the Citronelle Formation of Late Pliocene to early Pleistocene, covered by a thin blanket of loess. The upland surfaces are generally of higher elevation and more sculptured than the younger terraces that overlap upland erosional slopes. Natural drainage is generally good with most surface water collecting in deep erosional gullies, which form the principal relief in the otherwise gently sloping surface. Localized swamp conditions exist in some depressed areas, although most runoff is collected in the various forks of Grants Bayou, a small perennial stream that flows through the area east and south of the site (refer to Figure 2.5.1-225). Within the site location, the uplands rise to an average of approximately +125 ft. (+38 m) msl. A maximum elevation of +147 ft. (+45 m) msl is present in isolated locations within the site area, particularly to the east. (Reference 2.5.1-201)

Remnants of the Pleistocene Age Prairie terraces are mapped between the elevation of the Holocene floodplain and the elevation of the older Citronelle Formation (refer to Figure 2.5.1-225). These terrace remnants were previously mapped as the Port Hickey terraces during the RBS Unit 1 investigations (refer to the discussion in Subsection 2.5.1.2.3.1.2.1.1). These terraces, which were formed during the interglacial stages, are generally flat-topped at definitive elevations between the elevation of the Citronelle Formation and the elevation of the Holocene floodplain. The Lower Prairie Complex (Port Hickey) Terrace is the only terrace that has been identified in the site area. (Reference 2.5.1-201)

The late Pleistocene Port Hickey Terrace is of Sangamon Age, the last interglacial stage. The sections of this terrace along the Mississippi River in the site area are typified by flat areas at elevations of approximately +103 to +105 ft. (+31 to +32 m) msl, whereas the Port Hickey Terraces along Grants Bayou are slightly higher in elevation at approximately Elevation +107 to +110 ft. (+33 to +34 m) msl, due to the higher gradient of the bayou during the depositional stage. This terrace is less eroded than the Citronelle Formation that it overlaps, but is deeply dissected by drainage gulleys originating in the Citronelle Formation. Drainage is only fair, with some swampy areas found in localized depressions. (Reference 2.5.1-201)

A portion of the footprint for the RBS Unit 3 lies in the area excavated for Unit 2 (refer to Figure 2.5.1-227). The current surface elevation at the bottom of the excavation varies between approximately +65 and +75 ft. (+20 and +23 m) and represents the excavation after being partially backfilled. The slopes along the existing excavation are continuations of the original excavation slopes that extended to Elevation +20 ft. (+6 m) msl, prior to being backfilled to the current elevation (Reference 2.5.1-201). The ground surface in the unexcavated portion of the Unit 3 area is the flat top of the Prairie Terrace at elevations between Elevation +95 and +108.5 ft. (+29 and +33 m) msl (refer to Figure 2.5.1-226). The majority of the area immediately surrounding the excavation has been regraded as part of the Unit 1 construction (refer to Figures 2.5.1-225 and 2.5.1-226). The ground surface above the excavation gradually rises to the north, and the Citronelle Formation is exposed above the level of the Prairie terrace. The ground surface is dissected to the west by a seasonal tributary of Grants Bayou. This tributary has been diverted into a lined channel beginning at a point west of the previous Unit 2 excavation and extending several hundred feet to the south (refer to Figure 2.5.1-226). East of the plant area, the terrace is interrupted by another tributary and the main channel of Grants Bayou. The terrace is continuous to the south for 3000 ft. (900 m) where it is again interrupted by Grants Bayou. The south slope of the terrace surface along Grants Bayou is evident with a change in elevation from +108.5 ft. msl to +104 ft. (+33 to +32 m) msl over a distance of 3000 ft. (900 m) (refer to Figure 2.5.1-225). Some other changes in elevation occur where drainage features extend back into the essentially undissected area of the terrace.

2.5.1.2.2 Site Geologic History

The geological formations underlying the site area and site location record a long history of tectonic stability and deposition. The formations include both marine and terrestrial sediments that reflect distinct changes in the depositional environments, climatic conditions, and glacial-eustatic cycles. The geologic history for the site area and site location from the Cenozoic Era to the present is discussed below; regional geological history is discussed in Subsection 2.5.1.1.3.

2.5.1.2.2.1 Cenozoic Era

2.5.1.2.2.1.1 Tertiary Period

During the Tertiary Period, large volumes of sediment continued to accumulate in the Gulf Coast Basin, with sedimentation rates eventually exceeding the rate of regional subsidence. This resulted in formation of growth faults and salt diapirs. Sea level retreat in the late Tertiary resulted in deposition of Miocene units, such as the Pascagoula Formation. The Pascagoula Formation was deposited in fresh water and brackish estaurine-lagoonal environments.

The Citronelle Formation was deposited on a broad apron of coalescing floodplains that occupied a wide belt between the Mississippi River and the Atlantic Coast. Heavy mineral suites indicate that these deposits originated from the north-northeast. The source of the Citronelle sediments is probably Appalachian. The Citronelle Formation was deposited during the Pliocene; its age is at best controversial, but is probably Pliocene, based on fossil flora and pollen evidence. Supporting the Pliocene date is the evidence that present incised river valleys were well established by at least early Pleistocene. (Reference 2.5.1-203)

2.5.1.2.2.1.2 Quaternary Period

Partially due to advances and retreats of continental glaciers during the Pleistocene, massive amounts of sediment continued to be deposited in the Gulf Coast Basin, reaching thicknesses of greater than 50,000 ft. (15 km). During this time, alluvial material was deposited in the Mississippi Alluvial Valley and extensive blankets of loess covered the landscape, including the Peoria Loess, which has been dated between 22,000 and 12,000 years BP. (Reference 2.5.1-203)

Initial deposition of Pleistocene terraces, including the Prairie Terraces, began approximately 12,000 years ago, when the Mississippi River followed a course along the western side of its alluvial valley, and continued uniformly across the eastern part of the western floodplain until approximately 4000 years ago, when the river shifted to a course along the eastern side of the valley. Backswamp deposits continued to accumulate along the flanks of the new meander belt; however, meandering of the river within the new meander belt caused erosion and removal of large areas of backswamp deposits. These deposits were replaced largely with point bar deposits, and deposits that accumulated in abandoned channel environments. (Reference 2.5.1-201)

Loess deposits in the site area occur as a blanket comprised of several discrete loess sheets that drape upland formations of Quaternary and Tertiary Ages. Multiple lines of evidence have been used to date the Peoria Loess including numerous radiocarbon and thermoluminescence dates, and this loess is dated as late Wisconsin Age. The majority of the measured dates fall between 22,000 and 12,000 years BP, which is compatible with dates measured on valley trains originating from Late Wisconsin glaciation. (Reference 2.5.1-203)

The Holocene is characterized by erosion, with formation of deep drainages followed by deposition along streams in the Mississippi Alluvial Valley and floodplains as sea levels rose. Holocene erosion and alluvial sedimentation has been accompanied by subsidence along growth faults in and south of the site vicinity. (Reference 2.5.1-201)

2.5.1.2.3 Site Geologic Conditions

The characteristics of the individual deposits that occur in the site area and site location are described below in Subsection 2.5.1.2.3.1. Geologic maps of the site vicinity, area, and location are shown in Figures 2.5.1-223, 2.5.1-224, and 2.5.1-225, respectively. Geologic cross sections are shown in Figure 2.5.1-229 for the site vicinity and Figure 2.5.1-231 for the site location. A map showing the RBS Unit 3 investigation is shown in Figure 2.5.1-232, and cross sections at the site are shown in Figures 2.5.1-233, 2.5.1-234, 2.5.1-235, and 2.5.1-236.

2.5.1.2.3.1 Site Stratigraphy

Extensive geological and geotechnical data for the site area and site location are available as a result of the investigations completed for the existing RBS site (Reference 2.5.1-201). In addition to the existing data for RBS Unit 1, more than 60 new soil borings, nine Cone Penetrometer Tests (CPTs), two down-hole geophysical survey locations, and geological field observations were completed during this study to evaluate geologic conditions at the location of the RBS Unit 3. The new soil borings were advanced to depths ranging from 36.5 to 550 ft. (19 to 168 m) and penetrated strata ranging in age from the Holocene to the Pliocene (refer to Figure 2.5.1-231). The CPTs were advanced to depths of less than 20 ft. (6 m) (early refusal) to 133 ft. (40.5 m), terminating in sands and gravels of the terrace deposits of the Pliocene-Pleistocene Age (Figure 2.5.1-231). A summary of the boring depths is presented in Subsection 2.5.4.

A site location stratigraphic framework (refer to Table 2.5.4-208) was developed from field data including boring samples, Standard Penetration Tests (SPTs), CPTs, geophysical profiles from the site investigation (refer to Figure 2.5.1-231), and geologic mapping (refer to Figure 2.5.1-225). Field classifications and test results were reviewed by geologists and geotechnical engineers and compared with the laboratory test data to arrive at the final geologic unit classification. The site location stratigraphic framework was confirmed by comparison and correlation of the RBS Unit 3 data with the data from the RBS Unit 1 USAR (Reference 2.5.1-201) (refer to Table 2.5.1-203). Details of the field procedures used during the Unit 3 investigation are presented in Subsection 2.5.4. Classification of material included the evaluation of textural composition, particle size, shape and gradation, relative density and consistency, color, moisture content, and structure. Detailed boring logs, including correlation of stratigraphic units, are presented in Appendix 2AA.

Subsurface materials encountered during the site investigations at the RBS site (refer to Table 2.5.1-203) are grouped into the following categories:

- Modern fill including both general fill and engineered fill that was placed during the construction of RBS Unit1.
- Pleistocene loess deposits that cover the terrace deposits.
- Pleistocene and Pliocene terrace deposits.
- Miocene and Pliocene strata underlying the entire site.

Of these units, only the second category (Pleistocene Loess) is not present beneath the RBS Unit 3 power block. The spatial distribution of these materials is shown in Figures 2.5.1-233 through 2.5.1-236.

The site stratigraphy documented during the RBS Unit 3 site investigation generally agrees with the stratigraphy presented in the RBS Unit 1 USAR. The nomenclature used to identify the units has been changed to more closely follow the current stratigraphic nomenclature (refer to Table 2.5.1-203). Material descriptions and contacts from the site investigation are consistent with the RBS Unit 1 USAR as indicated in the geologic cross section (refer to Figures 2.5.1-233 through 2.5.1-236), which includes the Unit 1 borings. The original Unit 1 borings are shown on the sections, including the material that was removed and replaced with fill during the construction of RBS Unit 1.

Deep stratigraphy of the site vicinity and area is based on surface outcrops and subsurface information obtained from oil and gas wells (refer to Figure 2.5.1-243). Oil and gas drilling near the site has provided reliable subsurface information, including data for the lower Cenozoic beds, to a depth exceeding 3.5 mi. (5.6 km).

Data from three oil and gas tests near the site have been used to help develop the Site Stratigraphic Column, presented as Figure 2.5.1-228 from the surface beds into the Paleocene stage. These wells are as follows:

1. Moncrief No. 1 Rosedown Plantation with a total depth of 18,760 ft.
2. Cotton No. 1 McGill with a total depth of 15,700 ft.
3. Amoco No. 1 Smith with a total depth of 17,126 ft.

A northwest-southeast cross section (K-K') through the site, which includes stratigraphic data from the No. 1 Rosedown Plantation Well and the No. 1 Smith Well and two other wells, is shown in Figure 2.5.1-229. (Reference 2.5.1-201)

2.5.1.2.3.1.1 Tertiary Sediments

Tertiary sediments are exposed within the northernmost portion of the site vicinity, as shown in Figure 2.5.1-223. Beneath the site area, the tertiary system is predominantly composed of the Wilcox Group and Fleming Groups (refer to Figure 2.5.1-229). These groups are regressive sand and clay deposits with respective thicknesses of approximately 3600 and 6500 ft. (1100 and 2000 m). The Midway and Claireborne-Jackson-Vicksburg sediments are relatively thin, having a total thickness of approximately 3300 ft. (1000 m) beneath the site. (Reference 2.5.1-201)

The lower Tertiary sequence (Paleocene, Eocene, and Oligocene) is discussed in Subsection 2.5.1.1.4.4 and further discussed in the RBS Unit 1 USAR (Reference 2.5.1-201). Since the lower Tertiary sequence is encountered at a significant depth beneath the site, the discussion of the Tertiary System is limited to the shallower Miocene and Pliocene sediments.

2.5.1.2.3.1.1.1 Miocene-Pliocene Series

The Miocene-Pliocene Fleming Group is approximately 6500 ft. (2000 m) thick at the site (refer to Figure 2.5.1-229). It contains predominantly fluvial and deltaic sediments with some interbedded shallow-water marine deposits. The lower Catahoula Formation is generally undivided except for the Tatum limestone member, which forms a prominent subsurface marker zone in the site area at a depth of approximately 5000 ft. (1500 m) (refer to Figure 2.5.1-229). This limestone member is thinner and more clayey compared to its occurrence farther southeast. (Reference 2.5.1-201)

North of the site, the upper 2000 ft. (600 m) of the Fleming Group has been subdivided into the Hattiesburg and Pascagoula Formations (refer to Figure 2.5.1-228). The Hattiesburg Formation consists of non-marine clay with thin sands. The Pascagoula Formation is further subdivided into an unnamed lower member of the Miocene Age, a middle Homochitto member of the Miocene-

Pliocene Age, and an upper Fort Adams member of the Pliocene Age. (Reference 2.5.1-201)

The Pascagoula Formation was the oldest formation encountered by the borings in the site area. Twenty-one of the borings completed during the Unit 3 investigation encountered the Pascagoula clay (Appendix 2AA). The deepest penetrations into the clay were at boring locations RB-31 and TB-10 (refer to Figures 2.5.1-231 and 2.5.1-235). These borings penetrated to a depth of approximately 550 ft. (168 m) each. Both borings encountered the Pascagoula clay at depths of approximately 120 to 140 ft. (37 to 43 m), resulting in penetrations of more than 400 ft. (122 m) into the formation. Previously, at the site, the deepest penetrations into the formation were less than 100 ft. (30 m) in the immediate area of Unit 1 (Reference 2.5.1-201). None of the borings for the investigations at the RBS site have penetrated the entire sequence of the Pascagoula Formation (Appendix 2AA).

The upper surface of the Pascagoula Formation is irregular as a result of post-depositional channeling and erosion (Reference 2.5.1-344). An east-west geologic cross section of the site location is shown in Figure 2.5.1-235. As shown in the figure, the clay surface is generally deeper closer to the Mississippi River valley where the clay has been eroded beneath the Holocene alluvium. A contour map of the top of the Pascagoula clay surface is presented in Figure 2.5.1-237. This contour map was generated using data from the previous Unit 1 investigation, the current Unit 3 site investigation and borings from a third investigation performed for proposed Units 3 and 4 (Reference 2.5.1-345). The extent of the contouring is limited to the areas where sufficient data were present and roughly corresponds to approximately two-thirds of the site location. Within the contoured area, the clay surface generally varies between elevations of +50 to -60 ft. (+15 to -18 m) msl (refer to Figure 2.5.1-237). Within the immediate area of Unit 3, the surface varies between -35 and -45 ft. (-11 and -14 m) msl (refer to Figures 2.5.1-233 and 2.5.1-234).

In the RBS Unit 1 USAR, the surface of the Pascagoula clay was interpreted to be an east-west running channel that runs beneath the units (Reference 2.5.1-201). The southern limits of the channel are evidenced by the rising surface of the underlying Pascagoula Formation clays. The analysis completed for Unit 3, which included data from further away from Unit 1, suggests that the channel is running more northeast-southwest than previously interpreted.

The uppermost stratum of the Pascagoula Formation predominantly consists of moist, greenish-gray clay. Geotechnical properties of the clay are discussed in detail in Subsection 2.5.4; a brief summary of the clay is presented here. As discussed in Subsection 2.5.4, the clay is characteristically hard in consistency and varies between high and low plasticity. Within the clay, post-depositional features observed in the borings include black spots, calcareous nodules, and ferrous partings (refer to Appendix 2AA). As noted in the RBS Unit 1 USAR, strength testing suggests possible dessication of the upper 5 to 10 ft. (1.5 to 3 m) of the formation. This desiccation would be consistent with the RBS Unit 1 USAR interpretation that the surface was weathered prior to the deposition of the overlying Citronelle Formation. (Reference 2.5.1-201)

In the upper portion of the Pascagoula Formation observed during the Unit 3 investigation, layers of sand and silt are common, as indicated in Figures 2.5.1-232 through 2.5.1-235. These layers within the formation are typically not continuous across the site; therefore, tracing marker beds between borings was not possible. The two deeper soil borings encountered a significant sand layer at elevations of approximately -280 to -390 ft. (-85 to -119 m) msl (refer to Figure 2.5.1-232). Based on Boring RB-31A, the sand encountered was very dense, poorly graded sand with generally less than 10 percent fines (Appendix 2AA). Based on the elevation of the sand, the sand is interpreted as the Zone 1 Aquifer discussed in Subsection 2.4.12. Below the sand, Borings RB-31A and TB-10A indicate continuation of the hard clay (refer to Appendix 2AA).

2.5.1.2.3.1.1.2 Pliocene-Pleistocene Series

The Upland Complex in the site area was formed predominantly by fluvial sand and gravel deposits that Matson designated as the Pliocene Citronelle Formation. Fisk subdivided the uplands deposits into three Pleistocene terrace formations: Williana, Bentley, and Montgomery. Both Doering and Parsons challenged this interpretation, identifying the deposits as a single formation that was considered to be the Citronelle Formation. (Reference 2.5.1-201)

The Citronelle Formation is found stratigraphically between the overlying Prairie Terrace deposits and the underlying Pascagoula Formation along the Mississippi River and Grants Bayou. Along the Mississippi River, the Port Hickey Terrace sediments are identified by their heavy minerals, derived from glacial outwash to the north and transported downstream by the Pleistocene Mississippi River. Identification of heavy minerals did not distinguish between the two deposits along Grants Bayou because the Port Hickey Terrace sediments are considered to be reworked materials from the Citronelle Formation uplands. Nevertheless, there is sufficient evidence to distinguish between Port Hickey Terrace sediments and the underlying Citronelle Formation. (Reference 2.5.1-201)

In the context of this FSAR, the Citronelle Formation is divided into an upper and lower formation. This informal break in the formation follows the previous investigation's separation of the sands and clayey sands and the sands and gravelly sands (refer to Table 2.5.1-203). The break is made to simplify discussions within the text. As defined here, the upper Citronelle Formation generally consists of sands and clayey sands. Following the Unit 1 USAR, the chief distinguishing characteristic of the Citronelle Formation, compared to the overlying terrace deposits, is the red color from the advanced post-depositional oxidation of the sediments (Reference 2.5.1-201) (refer to Figure 2.5.1-230). In the Unit 3 power block area, the Upper Citronelle Formation consists mainly of fine to coarse sands with varying amounts of fines. In the Unit 3 power block area, this layer has been removed and replaced with fill. Borings for the Unit 3 investigation primarily encountered the layer outside of the excavation and along the margins of the excavation where the borings intersected the previous excavation slopes. Where borings encountered the full thickness of the unit, the upper Citronelle generally has a thickness ranging from 20 to 60 ft. (6 to 18 m) and is encountered above elevations -50 ft. (-15 m) msl. The general lack of gravel within the upper Citronelle serves as one of the major distinguishing characteristics between the lower and upper portions of the formation. Detailed discussion of the geotechnical characteristics of the upper Citronelle Formation is presented in Subsection 2.5.4.

The lower Citronelle Formation is equivalent to the sands and gravelly sands described in the RBS Unit 1 USAR (refer to Table 2.5.1-203). As noted in the RBS Unit 1 USAR, the continuity of the gravelly layers beneath the site suggests that the gravels are one deposit, interpreted to be the buried channel deposit. As previously discussed, contouring of the top of the Pascagoula Formation suggests that the channel is running roughly northeast-southwest beneath Unit 3 (refer to Figure 2.5.1-237).

In the Unit 3 power block area, the lower Citronelle Formation consists of sands with varying amounts of gravel (Appendix 2AA). Detailed discussion of the geotechnical properties of the lower Citronelle Formation are presented in Subsection 2.5.4. As described in the detailed logging of the Units 1 and 2 excavation, the lower Citronelle sediments are commonly cross bedded and contain sporadic lenses of coarse sediments (Reference 2.5.1-201) (refer to Figure 2.5.1-230). Layers of silt, clay, and silty and clayey sands are interlayered within this formation (refer to Appendix 2AA). Discontinuous layers of clays and silts near the bottom of the formation were generally identified and grouped with the formation based on the color of the sediments. Sediment colors other than grayish-green were not considered Pascagoula Formation. As noted in the borings, a typical feature of this layer is the presence of gravel sized clay balls and clay coated gravel pieces near the base of the layer (refer to Appendix 2AA). These features were identified and discussed in the RBS Unit 1 USAR and in the detailed geologic mapping of the Units 1 and 2 excavation where clay fragments generally ranging from 2 to 12 in. (5 to 30 cm) in diameter were encountered. These clay fragments were interpreted to be rip-up clasts generated by the turbulent erosion of the underlying Pascagoula Formation. (Reference 2.5.1-201)

As with the upper Citronelle Formation, portions of the lower Citronelle Formation were removed to Elevation +20 ft. (+6 m) msl during the excavation for Units 1 and 2 (Reference 2.5.1-201). Where the entire thickness of the lower Citronelle Formation was encountered, the thickness varied from 40 to 50 ft. (12 to 15 m) (refer to Figures 2.5.1-232 through 2.5.1-235).

2.5.1.2.3.1.2 Quaternary Sediments

Holocene and Pleistocene sediments are exposed within the site area and location (refer to Figures 2.5.1-224 and 2.5.1-225). These sediments were deposited by fluvial processes along the Mississippi River and its tributaries and eolian processes that formed the extensive loess deposits along the eastern margin of the Mississippi Alluvial Valley.

2.5.1.2.3.1.2.1 Pleistocene Series

The distribution of Pleistocene sediments within the site area and site location is shown in Figures 2.5.1-224 and 2.5.1-225. The Pleistocene sediments include both terrace and loess deposits, which are discussed in the following subsections.

2.5.1.2.3.1.2.1.1 Terrace Deposits

Pleistocene terrace deposits occur through the eastern half of the site area (refer to Figure 2.5.1-224) and are exposed extensively within the site location (refer to Figure 2.5.1-225). The Port Hickey Formation is part of the Prairie Allogroup (equivalent to the Lower Prairie Terrace) (Reference 2.5.1-346) and was deposited during the Sangamon Interglacial Stage (Reference 2.5.1-201). In the site location, the terrace is generally at an elevation between +100 and +130 ft. (+30 and +40 m) msl, with a gradient that gradually rises to the north. Terrace deposits younger in age than the Port Hickey Terrace deposits are located just south of the site area, along Thompson Creek. These may be considered Deweyville Terrace (Prairie Intermediate Complex) deposits; however, due to uncertainty regarding correlations, these deposits have been mapped as Quaternary Undifferentiated alluvium (refer to Figure 2.5.1-224).

In the site location, where not disturbed by the Unit 1 construction, the Port Hickey Terrace surface is at an elevation of approximately +108.5 ft. (+33 m) msl and has the typical clayey terrace topstratum that is underlain, in part, by the Port Hickey Terrace sand substratum. Where the Port Hickey substratum is absent, the topstratum is underlain by the fine sands and clayey sands of the Citronelle Formation. Based on the detailed mapping of the Unit 1 excavation, the distinguishing characteristics between the Port Hickey and the Citronelle Formations were color, fineness, and lack of gravel lenses (Reference 2.5.1-201). The color of the sediments was the primary factor in identifying formation because, generally, the Citronelle Formation deposits were orange, brown, or reddish, while the Port Hickey Terrace deposits were yellow, brown, and gray (Reference 2.5.1-201) (refer to Figure 2.5.1-237). The Port Hickey topstratum was distinguished from the substratum based on the fines content being greater than the coarse fraction. (Reference 2.5.1-201)

In the immediate Unit 3 plant area, the Port Hickey deposits have been partially or completely removed during the construction of the RBS Unit 1. Where not removed, the Port Hickey topstratum silts and clays are approximately 10-ft. (2-m) thick, and the substratum terrace sands are approximately 6-ft. (2-m) thick or less (refer to Figures 2.5.1-232 through 2.5.1-235).

2.5.1.2.3.1.2.1.2 Loess Deposits

The entire uplands in the site area are blanketed by eolian deposits (loess) 10 ft. (3 m) or less in thickness (Reference 2.5.1-201). Previous mapping of the loess demonstrated greater thickness farther northwest adjacent to the valley wall of the Mississippi River floodplain. In areas where the loess thickness exceeds 14 ft. (4 m), local snails and other calcareous materials are preserved. Based on radiocarbon dating, Snowden and Priddy dated these loess deposits at 18,000 to 25,000 years old. (References 2.5.1-227 and 2.5.1-201)

In the site location, the majority of the loess has been removed and replaced with fill. Only a few borings completed during the Unit 3 investigation encountered loess, primarily the borings west of the Unit 2 excavation (refer to Figure 2.5.1-231). Where encountered, the loess is described as a lean to fat clay to silty clay. Trace organics and black spots were observed in the boring samples. The deepest loess was encountered in the area of the Unit 3 cooling tower to the southwest of the Unit 3 power block (refer to Appendix 2AA).

2.5.1.2.3.1.2.2 Holocene Series

In the site area, Holocene deposits are exposed along the Mississippi River to the west of the site and its tributaries, including Alligator Bayou to the west and Grants Bayou to the south of the site location (refer to Figures 2.5.1-224 and 2.5.1-225). Within the Holocene floodplain immediately adjacent to the Mississippi River, a natural levee borders the river and achieves an elevation of approximately +46 ft. (+14 m) msl. In the backswamp area, elevations as low as -31 ft. (-9 m) msl are found (refer to Figure 2.5.1-226). The Holocene topstratum silts and clays extend to an elevation of approximately -50 ft. (-15 m) msl in the site area. These silts and clays are underlain by deep deposits of alluvial sands extending below an elevation of -117 ft. (-35 m) msl, the maximum penetration of Unit 1 borings in this area (Reference 2.5.1-201). None of the borings completed during the Unit 3 investigation encountered any Holocene deposits.

The Holocene floodplain of the lower Mississippi Valley records a time of meander belt formation. Holocene meander belt deposits typically consist of a relatively thin top stratum of lenticular, gray and brown clay, silt, and fine sand deposited in point bar and natural levee environments. These deposits vary in thickness from 50 to 85 ft. (15 to 26 m) at the site vicinity. (Reference 2.5.1-201)

The floodplain marks the surface of a thick sequence of alluvium deposited in an entrenched valley that varies in elevation from -100 to -250 ft. (-30 to -76 m) msl in the latitude of the site (compared to elevations exceeding +100 ft. msl on the uplands at the top of the bounding valley walls). The entrenched valley was formed by the vertical and lateral erosion by the Mississippi River during the first two or more lowered stands of sea level coinciding with maximum glaciation. (Reference 2.5.1-201)

2.5.1.2.3.1.2.3 Modern Fill

During the Unit 3 investigation, two types of fill were identified within the Unit 3 site location: general fill and engineered fill. According to the RBS Unit 1 USAR, excavated loess and Port Hickey Formations were used as general fill for site development (Reference 2.5.1-201). During the Unit 3 investigation, this general fill was encountered in several borings primarily outside of the Unit 2 excavation. Some fill was also used within the bottom of the Unit 2 excavation. As observed in the Unit 3 borings, the fill varied in thickness and composition, depending on the source and location (refer to Appendix 2AA).

Engineered fill was used to backfill the Unit 2 excavation from Elevation +20 ft. (+6 m) msl to the current surface of approximately Elevation +65 ft. (+20 m) msl. The engineered fill is different than the general fill used at other locations within the immediate Unit 1 area. According to the RBS Unit 1 USAR, the engineered fill or "Seismic Category I Backfill" was specifically graded sand obtained from an off-site source (Reference 2.5.1-201). The gradation of the backfill was controlled within specific limits by washing and sorting the backfill multiple times. The fill was placed and compacted in a controlled manner, resulting in a fill that had a mean relative density of 93.8 percent with a standard deviation of 9.9 percent. Detailed discussion of the engineered fill is presented in the RBS Unit 1 USAR, and geotechnical characteristics of the fill as encountered in the Unit 3 investigation are discussed in Subsection 2.5.4. (Reference 2.5.1-207)

The thickness of the engineered fill encountered in the Unit 3 borings was dependent upon the location of the boring with respect to the excavation for Unit 2. As indicated in Figures 2.5.1-232 through 2.5.1-235, the maximum thickness of the engineered fill within the Unit 3 power block was approximately 50 ft.

2.5.1.2.3.2 Site Structural Geology

Evaluation of structural geology within the site vicinity included a review of previous investigations, consultation with geologists who are experts on the local area, evaluation of recently available LiDAR data, and field reconnaissance and detailed mapping. The results of LiDAR evaluations and field reconnaissance are discussed in Subsection 2.5.3.

2.5.1.2.3.2.1 Previous Investigations

The site lies approximately 5 mi. (8 km) to the north of the Gulf Coast growth fault zone, which includes the Baton Rouge, Denham Springs-Scotlandville, Zachary, and other east-west trending normal faults (refer to Figures 2.5.1-216 and 2.5.1-223). The northern limit of the growth faults generally corresponds to the northern extent of the Coastal Salt Basin. A westward projection of the Zachary Fault, the growth fault nearest the site, passes approximately 5.5-mi. (8.8-km) south of the site (refer to Figure 2.5.1-223). The site is in a relatively domeless area. The nearest salt dome is 6-mi. (10-km) south of the site (refer to Figure

2.5.1-215). The studies for RBS Unit 1 identified no growth faults to a depth of approximately 13,500 ft. (4000 m) in the sedimentary sequence underlying the site, and no growth faults were found at the surface within a 5-mi. (8-km) radius of the site (refer to Figure 2.5.1-223). (Reference 2.5.1-201)

As part of the investigation of the structural geology of the site vicinity for RBS Unit 1, the records of deep subsurface investigations (petroleum well logs and seismic reflection profiles) were reviewed, and high-altitude imagery, aerial photographs and topographic maps of the site and surrounding area interpreted. Detailed investigations of the site area included the following:

1. Photogeologic studies and geologic mapping of the site and surrounding area. Table 2.5.1-204 lists the remote sensing imagery and aerial photography that were used in the RBS Unit 1 USAR investigations. (Reference 2.5.1-201)

2. Evaluation of longitudinal terrace profiles. Terrace profiles that were constructed along approximately north-south-trending streams and across the latitude of the site were examined for evidence of possible faulting. (References 2.5.1-348 and 2.5.1-201).

3. Evaluation of seismic profiles in the site area. A deep seismic reflection profile acquired in 1970 clearly shows reflections considered to be the middle Tertiary Tatum limestone and Wilcox Group. This profile, which extends from 3.5-mi. (5.6-km) south of the site to 5-mi. (8-km) north of the site, shows no offsets in these reflectors (refer to Figures 2.5.1-223 and 2.5.1-238). Additional seismic reflection survey data for the site and near-site extending to depths of approximately 13,500 ft. (4000 m) were reviewed as part of the RBS Unit 1 studies. Four deep reflection seismic profiles made in 1982 that traverse the site area provide a clear picture of the deeper Cretaceous structure. (Reference 2.5.1-201)

4. Stratigraphic correlations of available electric well logs were reviewed to ascertain whether indications of faulting might be present. (Reference 2.5.1-201)

Based on these data, the site is underlain by a thick (more than 15,000 ft. [4500 m]), generally conformable sequence of gently southward-dipping Tertiary sedimentary rocks. Beneath the site, the Tertiary deposits generally dip 1.5 to 3 degrees or less in a south to south-southwest direction. The continuous, uninterrupted, southward dip of the formations and the absence of faulting and salt domes were confirmed by an examination of the October 1970 north-south seismic profiles located less than 1.5-mi. (2.4-km) east of the plant area (refer to Figure 2.5.1-238) and by the 1982 seismic profiles located in the site area. The 1970 profile clearly shows reflections that are correlated with the mid-Tertiary Tatum limestone, the Wilcox Group. These reflectors are not offset from 3.5-mi.

(5.6-km) south of the site to 5-mi. (8-km) north of the site (refer to Figure 2.5.1-238). (Reference 2.5.1-201)

2.5.1.2.3.2.2 Faults and Folds

2.5.1.2.3.2.2.1 Growth Faults within the Site Vicinity (25-Mi. [40-Km] Radius)

The site lies north of the major east-west-trending zone of growth faults. Known surface faults within the site vicinity include the Baton Rouge Fault, Denham Springs-Scotlandville Fault, Baker Fault, the Zachary Fault, and the unnamed fault near Slaughter (refer to Figures 2.5.1-223, 2.5.1-239, and 2.5.1-240). McCulloh (Reference 2.5.1-349) presents a summary of the known and hypothesized surface faults in East Baton Rouge Parish. Table 2.5.1-205 is a summary of the surface faults within a 25-mi. (40-km) radius of the site.

The Baton Rouge Fault is part of the Tepetate-Baton Rouge fault system. The fault was first described in 1956 by Durham and Peeples (Reference 2.5.1-270) and by Parsons in 1967 (Reference 2.5.1-348). The first detailed maps of the surface trace were prepared by Roland et al. (Reference 2.5.1-271) and McCulloh (Reference 2.5.1-349). The fault is well expressed at the surface where it traverses the city of Baton Rouge. This, combined with the extensive subsurface oil exploration data, makes this fault system one of the better known Gulf Coastal growth faults. The Tepetate-Baton Rouge fault system is mapped on the surface as a narrow zone of en echelon faults that trends east-southeast along the northern margin of the Lake Pontchartrain Basin to the Pearl River. The fault dips steeply near the surface and flattens with depth. Subsurface displacement on the Baton Rouge Fault ranges from 220 to 460 ft. (67 to 140 m), with an average vertical displacement of 345 ft. (105 m). In the Baton Rouge area, a total displacement of approximately 250 ft. (76 m) affects the 400-ft. and 600-ft. aquifers of the Citronelle Formation. This indicates that the most recent faulting began after deposition of the Citronelle Formation (Late Pliocene). (Reference 2.5.1-201) Based on the displacement distribution and evidence of stratigraphic growth of the downthrown strata below a depth of 10,000 ft. (3050 m), McCulloh (Reference 2.5.1-349) concludes that the Pleistocene faulting represents the reactivation of an early Tertiary growth fault.

The fault forms a prominent scarp (e.g., profile D-D' in Figures 2.5.1-241 and 2.5.1-242). Locally, the fault scarp is reported to be more than 20-ft. (6-m) high where it traverses the Port Hickey (Lower Prairie) Terrace surface of Sangamon Interglacial Age in the southern part of the city. It is not recognized on the Holocene Mississippi River floodplain, but the fault system extends fairly continuously across southern Louisiana into Texas. The Baton Rouge Fault displaces the Deweyville Terrace surface (mid-Wisconsin Age) at the Amite River, 18-mi. (29-km) east of the Mississippi River (Reference 2.5.1-201). The Pleistocene reactivation of the Baton Rouge Fault is generally attributed to sedimentary loading in the Gulf of Mexico (References 2.5.1-270 and 2.5.1-350). The Baton Rouge Fault shows evidence of continued movement, including cracked road pavement, deformed foundation slabs, and deformed walls. There are some indications that recent movement along the fault has been accelerated by groundwater withdrawal during the last century (References 2.5.1-273 and 2.5.1-271) and is occurring at several centimeters per decade, whereas pre-European settlement movement on the fault is estimated at 0.002 in. per year (0.06 mm per year) (References 2.5.1-349 and 2.5.1-269). Maximum subsidence in the Baton Rouge area for the period 1964 to 1976 is reported as 6 in. (15 cm). (References 2.5.1-351 and 2.5.1-201)

Holocene and historical activity on the Baton Rouge Fault has been documented by cracking of pavement and structures in Baton Rouge (References 2.5.1-271, 2.5.1-349, and 2.5.1-352), as well as by a first-order leveling survey that showed 2 in. (6 cm) of displacement in the interval between 1939 and 1969 (Reference 2.5.1-273), which corresponds to an average slip-rate of 0.1 in. per year (2 mm per year). By resurveying existing bench marks, Kebede (Reference 2.5.1-274) obtained an average slip-rate of approximately 0.1 to 0.2 in. per year (3 to 5 mm per year).

The Denham Springs-Scotlandville Fault is an east-west-trending growth fault that has been mapped as a single continuous trace (References 2.5.1-348 and 2.5.1-271) and as two separate, en echelon traces (Reference 2.5.1-359). The trace shown in Figure 2.5.1-223 is based on mapping by McCulloh. (Reference 2.5.1-349)

Unlike the Baton Rouge Fault, the Denham Springs-Scotlandville Fault is not well expressed in the subsurface except at deep (Wilcox and older) levels (References 2.5.1-354 and 2.5.1-349), which McCulloh attributes to the comparatively small Pleistocene displacement and the sparse well control in the area (Reference 2.5.1-349). The 400-ft. and 600-ft. aquifers do not seem to be disturbed across the Denham Springs-Scotlandville Fault, which suggests the displacement is less than the displacement on the Baton Rouge Fault. The Denham Springs-Scotlandville Fault displaces the Port Hickey (Lower Prairie) Terrace surface 5 to 7 ft. (1.5 to 2 m) on average. (Reference 2.5.1-201)

The Baker Fault, a postulated fault trace, is shown in Figure 2.5.1-223, 5-mi. (8-km) north of the Denham Springs-Scotlandville Fault. A 0-ft. to 15-ft. (3-m to 4.5-m) high east-west scarp marks the Irene (Intermediate)-Port Hickey (Lower Prairie) Terrace boundary (refer to Figure 2.5.1-223). Lower Prairie (Port Hickey) Terraces lie across both eastern and western projections of the postulated fault scarp; there is no evidence that these terraces are displaced. The existence of the Baker fault is speculative because there is no subsurface evidence to substantiate the existence of the fault (References 2.5.1-271 and 2.5.1-349). The scarp may simply be the erosional boundary of the Irene (Intermediate) Terrace (Reference 2.5.1-201). Parsons (Reference 2.5.1-348) attributed as much as 400 ft. (120 m) of displacement at a depth of 2000 ft. (610 m) to the Baker Fault. Because of the small displacement and the sparse well control, this displacement cannot be substantiated. (Reference 2.5.1-349)

The Zachary Fault is located 8-mi. (13-km) southeast of the site and would project to within 5.5 mi. (8.8 km) of the site (refer to Figure 2.5.1-223). The fault trends east-west, and the fault plane displays the characteristic steep southward dip in the shallow subsurface, flattening gradually to less than a 45 degree dip below 10,000 ft. (3048 m) (Reference 2.5.1-201). Approximately 2-mi. (3-km) south of the Zachary fault escarpment and 11-mi. (18-km) southeast of the site, the Alsen oil field (discovered in 1957) was produced from the top of the Wilcox Formation at approximately 10,000 ft. (3048 m) deep from the "rollover" structure on the downthrown side of an east-west trending growth fault. This fault is considered the subsurface extension of the Zachary Fault.

The Zachary Fault displaces the Irene Terrace surface (down to the south) 10 to 15 ft. (3 to 4.5 m) (Reference 2.5.1-201). In accordance with the nomenclature being used by the Louisiana Geological Survey in its current mapping program (refer to Table 2.5.1-206), the Irene Terrace probably correlates to the older of the Prairie Terraces or possibly the Irene alloformation of middle Pleistocene Age. The fault was reported not to affect the Port Hickey (Lower Prairie) Terrace surface (Reference 2.5.1-201), but recent mapping of the Zachary quadrangle (Reference 2.5.1-361) suggests that the Zachary Fault also disrupts the Lower Prairie Terrace surface. Topographic profile C-C' constructed from LiDAR data (refer to Figures 2.5.1-241 and 2.5.1-242) across the Zachary Fault shows a 13-ft. (4-m) high scarp where the fault crosses a Lower Prairie surface.

A postulated unnamed fault is located near Slaughter. Evaluation of LiDAR data has revealed a previously unidentified scarp approximately 3-mi. (5-km) north of the Zachary fault that is interpreted by McCulloh and Heinrich (Reference 2.5.1-355) to be a possible growth fault (refer to Figure 2.5.1-223). The postulated fault is located 9-mi. (15-km) east of the site and has approximately 3 ft. (1 m) of relief where it crosses Lower Prairie and Intermediate Terraces (Reference 2.5.1-361). The western projection of this fault passes approximately 1.5-mi. (2.5-km) south of the site (refer to Figure 2.5.1-223).

2.5.1.2.3.2.2.2 Faults within a 5-Mi. Radius

No evidence of surface faulting is present within the site area. Two deep (Cretaceous) structures that do not appear to displace the overlying (Tertiary) strata, designated FA and FB, were interpreted from the 1982 Amoco seismic profile data (refer to Figures 2.5.1-225 and 2.5.1-243). These faults lie along the projected trend of faults shown to extend up into Eocene strata, as shown on the regional cross section (between Borings 14 and 15 on CC', Figure 2.5.1-205). The Amoco data were reported to show that the shallow Tertiary horizons, such as the Miocene reflector in a depth bracket of 7000 to 9000 ft. (2130 to 2750 m), are excellent reflectors that do not exhibit faulting. The top of the Cretaceous in a depth bracket of 3500 to 15,000 ft. (1070 to 4600 m) was shown to be an excellent reflector. A slight indication of a possible down to the south fault (FA) at this horizon, as well as in the underlying Austin chalk reflector, was observed. This indication was not seen in the shallow Tertiary reflectors or in the deeper lower

Cretaceous reflector. This indication strikes N80°W at the top of the Upper Cretaceous horizon beneath the site. (Reference 2.5.1-201)

The top of the Lower Cretaceous in a depth bracket of 18,000 to 22,000 ft. (5500 to 6700 m) was readily identifiable in the 1982 seismic profiles. This horizon represents the shelf edge that was subsequently buried by a southward thickening wedge of Tuscaloosa sediments above it and below the Austin chalk. As reported in the RBS Unit 1 USAR, the Lower Cretaceous appears to have an indication of a fault (FB) downthrown to the south, with a possible fault strike of N80°E at the Lower Cretaceous horizon approximately 3000 ft. (915 m) north of the site at a depth of approximately 20,000 ft. (6100 m). The inferred fault dies out upward and does not appear to offset Upper Cretaceous reflectors in the vicinity of the site. (Reference 2.5.1-201)

Figure 2.5.1-243 shows the location of FA at the top of the Cretaceous (depth of 13,500 ft. [4110 m]) and the location of FB at the lower Cretaceous horizon (depth of 18,000 ft. [5500 m]). These features are evident only on the 1982 seismic lines; therefore, they are shown in Figure 2.5.1-243 to terminate prior to intersecting any other seismic lines. (Reference 2.5.1-201)

Based on investigations reported in the RBS Unit 1 USAR and mapping of the excavations for Category I structures for Units 1 and 2 (Reference 2.5.1-357), growth faults (also referred to as "slump fault structures" in the RBS Unit 1 USAR) were not identified to a depth of 13,500 ft. (4100 m) in the sedimentary sequence under the site nor within a 5-mi. (8-km) radius of the site. The site is located in a "relatively domeless area," and no evidence of any type of salt structure was discerned on aerial photographs within a 10-mi. (16-km) radius of the site. The NRC concurred that no growth faults could be identified above a depth of 13,500 ft. (4100 m), and there is no evidence of surface faulting or potential for new surface faulting within 5 mi. (8 km) of the RBS site. (Reference 2.5.1-356)

Additional description of Faults FA and FB is provided in Subsection 2.5.3.2.

2.5.1.2.3.2.3 Unconformities

The subsurface deposits exposed within the site area are separated by erosional unconformities. The unconformities indicate that erosion, rather than tectonic deformation, is responsible for the elevation differences across the surfaces of the deposits.

2.5.1.2.3.2.4 Other Structures

2.5.1.2.3.2.4.1 Salt Domes

The Coastal Louisiana Salt Basin lies south of the site. The nearest deep-seated salt dome is the Port Hudson Dome, 6-mi. southeast of the plant area (Reference 2.5.1-358). The University domal structure, 25 mi. (40 km) to the south southeast, is probably another deep-seated salt dome. The nearest shallow piercement salt dome is Bayou Choctaw, located 29-mi. (47-km) south of the plant area. Other more distant salt domes are shown in Figure 2.5.1-215. (Reference 2.5.1-201)

Piercement salt domes are prominent subsurface structures with associated normal faults in the Gulf Coastal Plain. These salt structures become progressively more pronounced southward as both the overburden on the deeply buried salt and the salt itself thicken. The structural relief is due to the uplift of salt domes and to the subsidence in adjacent areas due to the lateral movement of the salt into the domes. The salt domes are readily detected by gravity and seismic surveys and frequently by geomorphic features. The examination of aerial photographs for evidence of surface features indicative of salt structures was extended to a distance of 10 to 15 mi. (16 to 24 km) in all directions from the site. No surface evidence of any type of salt features was discerned on the aerial photographs or photograph mosaics. (Reference 2.5.1-201)

2.5.1.2.4 Site Area Geologic Hazard Evaluation

No geologic hazards have been identified within the RBS site area. No geologic units at the site are subject to dissolution. No deformation zones were encountered in the exploration or excavation for RBS Unit 1, and none have been encountered in the site investigation for RBS Unit 3. (Reference 2.5.1-201)

Volcanic activity typically is associated with subduction zones or "hot spots" in the earth's mantle, neither of which are present within the RBS site region. Therefore, no volcanic activity is anticipated in the region.

2.5.1.2.5 Site Engineering Geology Evaluation

2.5.1.2.5.1 Engineering Soil Properties and Behavior of Foundation Materials

Engineering soil properties, including index properties, static and dynamic strength, compressibility, settlement, and liquefaction potential, are discussed in Subsection 2.5.4.

Evaluation and mapping of the variability and distribution of properties for the foundation bearing soils will be completed as the excavation for RBS Unit 3 is completed.

2.5.1.2.5.2 Slope Stability

Stability of the slopes within the RBS Unit 3 location is discussed in Subsection 2.5.5.

2.5.1.2.5.3 Zones of Alteration, Weathering, and Structural Weakness

No unusual weathering profiles have been encountered during the site investigation. No dissolution of underlying geologic materials is expected to affect foundations. Mapping of any noted desiccation, weathering zones, joints, or fractures will be performed and evaluated during excavation of RBS Unit 3.

2.5.1.2.5.4 Deformational Zones

No evidence of faulting, folding, or other geologic hazards was encountered in the excavation for RBS Units 1and 2. (Reference 2.5.1-201)

Excavation mapping and evaluation is required during the excavation and construction of RBS Unit 3.

No capable tectonic sources, as defined by Regulatory Guide 1.208, exist in the RBS site region. Field investigations for the Unit 3 COLA verify the conclusions from the RBS Unit 1 USAR that no growth faults project to the surface through the RBS site (refer to Subsection 2.5.1.2.3.2.2).

2.5.1.2.5.5 Prior Earthquake Effects

Detailed investigation of the RBS Units 1 and 2 excavation and available outcrops examined during this investigation have not indicated any evidence for prior earthquake activity that affected Pleistocene deposits. (Reference 2.5.1-357)

2.5.1.2.5.6 Conditions Caused by Human Activities

Potential sources of human-induced geologic issues that could affect the RBS Unit 3 site include the following: local and regional petroleum production, groundwater withdrawal and related decline of groundwater levels, and changes in slope stability due to earthwork.

Within 10 mi. of the RBS site, there are four oil and gas fields: the Port Hudson to the southeast, the Moore-Sams to the southwest, the St. Francisville to the west, and the Freeland to the east (refer to Figure 2.5.1-244) (Reference 2.5.1-359). The most recent production information as obtained from the Louisiana Department of Natural Resources (LDNR) SONRIS database (Reference 2.5.1-359) indicates that only the Moore-Sams and Port Hudson fields to the south are producing oil and gas. The Freeland and St. Francisville fields ceased production in the 1980s (Reference 2.5.1-359). The principal production target for these fields is the base of the Upper Cretaceous Tuscaloosa Formation at a depth of approximately 3 mi. below the surface. The Tuscaloosa Formation consists of interbedded conglomerate, sandstone and shale deposited over a thick sequence of Lower Cretaceous limestones (Reference 2.5.1-360). Petroleum entrapment is primarily a result of the movement of the underlying Jurassic Louann Salt and growth faults, producing parallel fault blocks and associated roll-over structures that have effectively prevented updip movement of the petroleum. Beneath the RBS Unit 3 location, the stratigraphy is uninterrupted by growth faults and, consequently, the petroleum has migrated updip to the north. The nearest fields to the north of the site are located near the Mississippi-Louisiana border where petroleum entrapment is due to a decreased regional dip that allows irregular sand bodies to form slight stratigraphic entrapments. (Reference 2.5.1-201)

According to the RBS Unit 1 USAR, 14 wells and numerous seismic lines have been completed within the site vicinity (Figure 2.5.1-243). A review of the LDNR database indicates 15 wells within the site vicinity (refer to Figure 2.5.1-244). Most of these wells were dry and none of the wells are currently producing petroleum (refer to Figure 2.5.1-244). The Moore-Sams and Port Hudson fields to the south of the RBS Unit 3 site are still currently producing petroleum (Reference 2.5.1-359). The potential effects of the petroleum withdrawal south of the RBS Unit 3 site are discussed in Subsection 2.5.4.

Additional effects of human activities, including subsidence related to groundwater withdrawal, are discussed in Subsection 2.5.4. The stability of slopes, including any human-made slopes within the RBS site location, is discussed in Subsection 2.5.5.

2.5.1.2.6 Site Groundwater Conditions

A detailed discussion of groundwater conditions is provided in Subsection 2.4.12.

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Table 2.5.1-201
Process Model Showing Regional Responses to Basic Glacial/Interglacial Cycle in the Mississippi Alluvial Valley

Glacial Cycle		Sea Level Response	Coastal/Deltaic Response	Alluvial Valley Response	Tributary Stream Response	Upland Response
Interglacial		Highstand	Deltaic/Chenier Plains	Aggradation	Stability and Soil Formation	Slow Degradation Soil Formation
		Minor Oscillations		Meander Belt Formation		Soil Formation
			Delta Lobes on Shelf	Minor Degradation	Meander Belt Formation	
	Waning Glaciation	Rising		Valley Train Development	Aggradation	Loess Deposition (Local Aggradation)
			Trench Filling		Possible Alluvial Drowning in Lower Reaches	
				Maximum Aggradation	Instability	
Glaciation	Glacial Maximum	Lowstand	Broad Exposed Shelf	Outwash Deposition and Initial Degradation		
			Shelf Margin Deltas		Degradation	Major Erosion and Dissection
				Degradation	Terrace Formation	
			Stream Entrenchment and Extensions		High Discharges	
	Waxing Glaciation	Falling	Rapid Shoreline Regression	Stream Regime Change (Meandering to Braided)	Regime Adapts to Increasing Discharges	Slow Degradation

Modified from Reference 2.5.1-205.

Table 2.5.1-202
Historical Earthquakes within 200 Mi. (320 Km) of the RBS Site with $m_b \geq 3.0$

RBS COL 2.0-26-A

Date	Latitude	Longitude	Body Wave Magnitude (m_b)
May 7, 1842	30.77	-91.92	3.90
November 28, 1868	31.31	-92.46	4.14
January 9, 1870	31.14	-92.29	4.54
April 16, 1872	32.36	-88.70	4.20
October 23, 1886	30.68	-88.09	3.84
May 21, 1893	33.61	-91.21	3.84
February 13, 1898	31.45	-91.30	3.12
February 3, 1905	30.50	-91.10	4.06
February 6, 1909	30.42	-88.93	3.36
November 13, 1927	32.30	-90.20	3.50
December 15, 1927	28.90	-89.40	3.90
July 28, 1929	28.90	-89.40	3.90
October 19, 1930	30.10	-91.00	4.30
June 28, 1941	32.30	-90.80	3.34
September 20, 1947	31.90	-92.60	3.64
October 17, 1952	30.10	-93.70	3.47
February 1, 1955	30.40	-89.10	4.40
September 27, 1956	31.90	-88.40	4.14
November 6, 1958	29.90	-90.10	3.47
November 19, 1958	30.50	-91.20	3.30
October 15, 1959	29.80	-93.10	3.80
April 24, 1964	31.42	-93.81	3.59
June 4, 1967	33.55	-90.84	4.29
May 4, 1977	31.96	-88.44	3.29
June 9, 1978	32.04	-88.60	3.29
December 11, 1978	31.91	-88.47	3.49
February 13, 1981	30.00	-91.80	3.44
October 16, 1983	30.24	-93.39	3.79
July 16, 1993	31.75	-88.34	3.69
June 10, 1994	33.01	-92.67	3.19
March 25, 1996	32.13	-88.67	3.29
August 11, 1996	33.58	-90.87	3.39

References 2.5.1-202, 2.5.1-367, 2.5.1-368, 2.5.1-369, 2.5.1-370, and 2.5.1-371.

RBS COL 2.0-26-A

Table 2.5.1-203
Summary of Site Location Stratigraphic Units and Correlation to Previous Studies

Epoch	RBS Unit 1 USAR		RBS Unit 3 FSAR	
Modern	None		Engineered Fill	
			Fill	
Holocene	Loess		Loess	
Pleistocene	Port Hickey	Top Stratum Silts and Clays	Port Hickey	Top Stratum
		Sands and Clayey Sands		Port Hickey
Plio-Pleistocene	Citronelle	Sands and Clayey Sands	Citronelle	Upper
		Sands and Gravels		Lower
Miocene	Pascagoula		Pascagoula	

Table 2.5.1-204
Remote Sensing Imagery and Aerial Photography Used in the RBS Unit 1 USAR Investigations

RBS COL 2.0-26-A

Type of Imagery	Name	Source	Date	Scale
Aerial Photographs	West Feliciana Parish	USDA	1941 and 1952	1:20,000
Photograph Mosaics	East Feliciana Parish	USDA	1941 and 1957	Not stated
Photograph Mosaics	West Feliciana Parish	USDA	1959	Not stated
Photograph Mosaics	East Baton Rouge Parish	USDA	1941 and 1959	Not stated
Color Infrared Photography	"Mission 289"	NASA	1974	1:120,000
Landsat Multispectral Scanner Imagery		NASA	1976 and 1978	1:1,000,000

Modified from Reference 2.5.1-201.

Table 2.5.1-205
Known Faults in the Site Vicinity

RBS COL 2.0-26-A

Fault	Description	Closest Distance to RBS Unit 2 (Mi.)	Age of Most Recent Displacement
Baton Rouge Fault	East-west trending growth fault; formed during the early Tertiary and reactivated during the Pleistocene	24	Historical
Denham Springs-Scotlandville Fault	East-west trending growth fault; formed during the early Tertiary and reactivated during the Pleistocene	19	Historical
Baker Fault	Postulated fault; existence of fault not substantiated based on subsurface data	13	Pleistocene; >75 ka; pre-dates the formation of the Port Hickey (lower Prairie) Terrace
Unnamed Fault Near Slaughter	Postulated fault scarp identified using LiDAR data existence of fault not substantiated based on subsurface data	9	Pleistocene (?)
Zachary Fault	Inferred east-west trending growth fault that formed during the early Tertiary and reactivated during the Pleistocene	8	Pleistocene; possibly <75 ka; some investigators report that the lower Prairie Terrace may be displaced
FA	Subsurface fault; top Cretaceous not displaced	<1	Pre-Upper Cretaceous
FB	Subsurface fault; top Cretaceous not displaced	<1	Pre-Upper Cretaceous

RBS COL 2.0-26-A

Table 2.5.1-206
Correlation of Alluvial Stratigraphic Units on Geologic Maps Compiled for the RBS Site Vicinity/Area/Location

Age	Site Vicinity (25-Mi. [40-Km] Radius)[a] (Figure 2.5.1-223)		Site Area (5-Mi. [8-Km] Radius)[b] (Figure 2.5.1-224)		Site Location (0.6 Mi. [1 Km] Radius) (Figure 2.5.1-225)		Previous RBS Nomenclature[c]
Holocene	Qal — Alluvium		Hua - Holocene Undifferentiated Alluvium Hb - Backswamp Deposits Hmd 1 - Distributary complex of Mississippi River (MR) Hml 1 - Natural Levee of MR Hmm 1 - Mississippi Meander Belt		Qal	Undifferentiated alluvium - Undifferentiated Holocene and/or latest Pleistocene alluvial deposits	Holocene Floodplain
	Qnl — Natural Levees						
Latest Pleistocene	Qtd — Deweyville Terrace (*not mapped in site vicinity*)		Qua — Quaternary Undifferentiated Alluvium Qaf — Quaternary Alluvial Fan Deposits				
Late Pleistocene	Qtp — Prairie Terraces	Three levels are recognized; two along alluvial valleys, the lower coalescing with its broad coastwise expression; the third, still lower, observed intermittently gulfward.	Pp — Prairie Allogroup Undifferentiated	Ppl — Prairie Allogroup, Lower Surface	Qp3 — Lower Prairie Terrace	Prairie Allogroup, Late Sangamon — Younger of the Prairie Allogroup temporal phases	Port Hickey Formation
				Ppu — Prairie Allogroup, Upper Surface	Qp2 — Upper Prairie Terrace	Prairie Allogroup, Early Sangamon — Older of the Prairie Allogroup temporal phases	Irene Terrace?
Pleistocene	Qti — Intermediate Terraces	Composed of terraces formerly designated as Montgomery, Irene, and most of the Bentley.		Pi — Prairie Allogroup, Intermediate	Qp1 — Intermediate Terrace	Irene Alloformation	Irene Terrace?
Plio-Pleistocene	Qth — High Terraces	Composed of terraces formerly designated as Williana, Citronelle, and the highest Bentley.	Pouc — Citronelle Formation Also referred to (informally) as the Upland Complex		TQ1 — Citronelle Formation	Upland Allogroup	Citronelle Formation

a) Based on Reference 2.5.1-340.
b) Based on References 2.5.1-341 through 2.5.1-344. Provisional unit designations subject to revision based on results of ongoing mapping by the Louisiana Geological Survey (stratigraphic nomenclature subject to revision).
c) Based on Reference 2.5.1-201.

FSAR 2.5.1 Figures

Due to the large file sizes of the figures for FSAR Section 2.5.1, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.5.2 VIBRATORY GROUND MOTION

RBS COL 2.0-27-A This subsection provides a detailed description of the vibratory ground-motion assessments that were performed for the proposed RBS Unit 3 site. The subsection begins with a review of the approaches outlined in NRC Regulatory Guides 1.165 and 1.208 for conducting the vibratory ground-motion studies. Following this review of the regulatory framework used for the project, results of the seismic hazard evaluation are documented and the site-specific ground-motion response spectra (GMRS) for horizontal and vertical motions are developed.

NRC Regulatory Guide 1.165 provides guidance on the methods acceptable to the NRC to satisfy the requirements of the seismic and geologic regulation, 10 CFR 100.23, for assessing the appropriate safe-shutdown earthquake (SSE) ground-motion levels for new nuclear power plants. Regulatory Guide 1.165 states that an acceptable starting point for this assessment at sites in the central and eastern United States (CEUS) is the probabilistic seismic hazard analysis (PSHA) methodologies and seismic sources used by the Electric Power Research Institute and Seismic Owners Group (EPRI-SOG) in the 1980s (References 2.5.2-201 and 2.5.2-202). The EPRI-SOG study involved a comprehensive compilation of geological, geophysical, and seismological data; evaluations of the scientific knowledge concerning earthquake sources, maximum earthquakes, and earthquake rates in the CEUS by six multidisciplinary teams of experts in geology, seismology, and geophysics; and, separately, development of state-of-knowledge earthquake ground-motion modeling, including epistemic and aleatory uncertainties.[a] The uncertainty in characterizing the frequency and maximum magnitude of potential future earthquakes associated with these sources, and the ground motion that may be produced, was assessed and explicitly incorporated in the seismic hazard model.

Regulatory Guide 1.165 further specifies that the adequacy of the EPRI-SOG hazard results must be evaluated in light of new data and interpretations and evolving knowledge pertaining to seismic hazard evaluation in the CEUS. Appendix E, Section E.3, of Regulatory Guide 1.165 outlines a three-step process for this evaluation, as follows:

1. Evaluate whether recent information suggests significant differences from the previous seismic hazard characterization.

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a. Epistemic uncertainty is uncertainty attributable to incomplete knowledge about a phenomenon that affects the ability to model it. Epistemic uncertainty is reflected in a range of viable models, model parameters, multiple expert interpretations, and statistical confidence. In principle, epistemic uncertainty can be reduced by the accumulation of additional information. Aleatory uncertainty (often called aleatory variability or randomness) is uncertainty inherent in a nondeterministic (stochastic, random) phenomenon. Aleatory uncertainty is accounted for by modeling the phenomenon in terms of a probability model. In principle, aleatory uncertainty cannot be reduced by the accumulation of more data or additional information.

2. If potentially significant differences are identified, perform sensitivity analyses to assess whether those differences have a significant effect on the site hazard.

3. If Step 2 indicates that there are significant differences in the site hazard, then the PSHA for the site is revised by either updating the previous calculations or, if necessary, performing a new PSHA. If not, the previous EPRI-SOG results may be used to assess the appropriate SSE ground motions.

Regulatory Guide 1.165 calls for the SSE ground motions to be based on the site PSHA results for a reference probability of the median 10^{-5} hazard level. The basis for the selected reference probability is described in Appendix B of Regulatory Guide 1.165.

Regulatory Guide 1.208 provides additional guidance on performance goal-based methods acceptable to the NRC to satisfy the requirements of the seismic and geologic regulation, 10 CFR 100.23, for assessing the appropriate site-specific performance goal-based ground motions for new nuclear power plants. Specifically, the performance-based approach described in American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standard 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities* (Reference 2.5.2-203) may be used to define site-specific performance goal-based GMRS at the ground surface based on mean hazard results. The development of mean seismic hazard results is to be based on a site-specific PSHA combined with site-specific site amplification analyses. The procedures to be used to perform the PSHA and site amplification studies are similar to those described in Regulatory Guide 1.165, but additional detailed guidance is provided in Regulatory Guide 1.208. Regulatory Guide 1.208 also provides guidance on an alternative approach for addressing the lower-bound magnitude used in the PSHA, based on the likelihood that earthquakes of various sizes can produce potentially damaging ground motions. The ground-motion measure used to correlate with the threshold of potential damage is cumulative absolute velocity (CAV). The alternative approach (using the CAV filter) is used to develop the final GMRS for the RBS Unit 3 site.

This subsection discusses the following aspects of vibratory ground motion:

- Seismicity (Subsection 2.5.2.1).
- Geologic and Tectonic Characteristics of the Site and Region (Subsection 2.5.2.2).
- Correlation of Earthquake Activity with Seismic Sources (Subsection 2.5.2.3).
- Probabilistic Seismic Hazard Analysis and Controlling Earthquake (Subsection 2.5.2.4).

- Seismic Wave Transmission Characteristics of the Site (Subsection 2.5.2.5).
- Ground-Motion Response Spectrum (Subsection 2.5.2.6).

2.5.2.1 Seismicity

An important component in developing a seismic hazard model for the RBS site is the seismic history of the region. The selected starting point for developing the site-specific PSHA for the RBS site is the EPRI-SOG (Reference 2.5.2-201) seismic hazard model for the CEUS. The data used to assess earthquake occurrence rates for the seismic sources in the EPRI-SOG model were those in the earthquake catalog.

The first step in the three-step process for evaluating the adequacy of this model for the assessment of seismic hazards at the RBS site involved an assessment of the effect of recent information on the characterization of the seismicity of the southeastern United States. The development of an updated earthquake catalog for the site region (200-mi. [320-km] radius) and surrounding area is described in Subsection 2.5.2.1.1. Information on significant earthquakes is provided in Subsection 2.5.2.1.2. In addition to the discussion of significant earthquakes within the site region, this subsection also discusses recent earthquakes in the Gulf of Mexico that post-date the EPRI-SOG catalog. Although these events fall outside the site region, they occurred within some of the EPRI-SOG background seismic source zones that include the RBS site and thus, have implications for assessment of maximum magnitudes in these source zones, as discussed in Subsection 2.5.2.4.1.2. In addition, further assessment of catalog completeness and earthquake recurrence parameters for the offshore region was required, as discussed in Subsection 2.5.2.4.1.5.

2.5.2.1.1 Earthquake Catalog

Earthquake occurrence rates for the seismic sources developed in the EPRI SOG study were based on the EPRI-SOG CEUS earthquake catalog that was developed for the time period of 1627 through February 1985. The EPRI-SOG catalog has gone through two significant revisions. Seeber and Armbruster (Reference 2.5.2-204) conducted a thorough review of the catalog, revising the magnitude estimates and locations of many events, removing some events as non-earthquakes and adding others. The revised earthquake catalog is the National Center for Earthquake Engineering Research (NCEER-91) catalog, denoted as NCEER-91 (Reference 2.5.2-205). Subsequently, Mueller et al. reviewed the NCEER-91 catalog along with additional information and developed a catalog of independent[b] earthquakes for use in the 2002 U.S. Geological Survey (USGS) National Seismic Hazard Mapping Program (Reference 2.5.2-206). The version of this catalog, which is referred to as the USGS 2002 CEUS catalog, is obtainable from the USGS National Seismic Hazard Mapping Project Website (Reference 2.5.2-207).

The USGS 2002 CEUS catalog was further updated as part of studies for the Tennessee Valley Authority (TVA) Bellefonte site (Reference 2.5.2-208). The updated catalog incorporated new information on location and magnitude of historical earthquakes and included 174 newly identified historical earthquakes, principally from studies by Metzger, Metzger et al., and Munsey (References 2.5.2-209, 2.5.2-210, and 2.5.2-211). Details of the development of the Bellefonte Geotechnical, Geological, and Seismological (GG&S) earthquake catalog are provided in Reference 2.5.2-208.

The catalog for the RBS site consists of the Bellefonte GG&S earthquake catalog extended to 23°N and to 107°W and from 1776 through December 2006, using the listing of recent earthquakes obtained from the following sources:

- Advanced National Seismic System (ANSS) Website (Reference 2.5.2-212).
- USGS National Earthquake Information Center Website (Reference 2.5.2-213).
- Southeastern U.S. Seismic Network (SEUSSN) Website operated by Virginia Tech Seismological Observatory (Reference 2.5.2-214).
- International Seismological Center Bulletin (Reference 2.5.2-215).

The body-wave magnitude scale, m_b, was used as the uniform magnitude scale in the original EPRI-SOG earthquake catalog and is the magnitude scale used in the catalog developed for the RBS study. Estimated seismic moments are provided for the site region catalog in Appendix 2.5.2AA. The values listed were estimated by first estimating moment magnitude using the three relationships described in Subsection 2.5.2.4.2.3, then computing seismic moment from each moment magnitude estimate using the Hanks and Kanamori relationship (Reference 2.5.2-216), and finally, averaging the results.

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b. Consistent with the methodology employed in the EPRI-SOG study (Reference 2.5.2-201), the PSHA formulation used in this study is based on the model that the temporal occurrence of earthquakes conforms to a Poisson process, implying independence between the times of occurrence of earthquakes. Thus, it is necessary to remove dependent events (such as foreshocks and aftershocks) from the earthquake catalog before estimating earthquake frequency rates.

Figure 2.5.2-201 (References 2.5.2-217, 2.5.2-218, and 2.5.2-219) shows the spatial distribution of earthquakes in the project earthquake catalog. The final composite catalog contains 997 independent historical and instrumental earthquakes with body-wave magnitude scale (m_b) ≥ 3 that occurred from 1758 to 2006 in the region extending between latitudes 23°N to 37°N and from longitudes 72°W to 107°W. This area incorporates the site region and all seismic sources contributing significantly to the RBS site earthquake hazard. Figure 2.5.2-202 shows the locations of earthquakes within the site region and 50 mi. (80 km), respectively, of the RBS site.

The earthquakes are color-coded on Figures 2.5.2-201 and 2.5.2-202 to indicate those events included in the EPRI-SOG earthquake catalog for the time period of 1758 to 1985, historical events added to the EPRI-SOG catalog, and those events that occurred after the EPRI-SOG catalog (1985 to 2006). The added historical earthquakes and the earthquakes occurring since the EPRI-SOG study have spatial distributions similar to those of the earthquakes contained in the EPRI-SOG catalog (Figures 2.5.2-201 and 2.5.2-202).

Appendix 2.5.2AA lists the earthquakes in the updated catalog that have occurred between 1842 and 2005 within the RBS site region. Only 36 earthquakes are located within the site region, and none of these events exceeds m_b 5 (Appendix 2.5.2AA). Two earthquakes have occurred at approximately 19 and 22 mi. (31 and 36 km) from the RBS site. No events have occurred within 5 mi. (8 km) of the site. The size distribution of these earthquakes consists of 31 events with $3 \leq m_b < 4$, and 5 events with $4 \leq m_b < 5$. Estimates of the Modified Mercalli Intensity (MMI) are available for 7 earthquakes. Maximum intensities larger than MMI IV are reported for 4 events, one of which reached a maximum intensity of VI. Strong ground-motion recordings are not available for any of these earthquakes.

In addition to these events, earthquakes that occurred in the Gulf of Mexico at a greater distance from the RBS site were considered. In all, there are 17 additional earthquakes of $m_b \geq 3$ recorded from 1963 to January 1, 2007; 11 events of magnitude $3 \leq m_b < 4$; 3 events of magnitude $4 \leq m_b < 5$; 2 events of magnitude $5 \leq m_b < 6$; and only 1 event, with a magnitude exceeding m_b 6 (m_b 6.08), which occurred at nearly 422 mi. (680 km) from the RBS site. Estimates of MMI and strong motion records are not available for these earthquakes.

Focal depths in the range of 0.6 to 7 mi. (1 to 11 km) are reported for 14 earthquakes with m_b between 3 and 4.3; about half of the earthquakes have a fixed depth of 3 mi. (5 km). The earthquakes do not show any correlation between depth and magnitude.

2.5.2.1.2 Significant Earthquakes

2.5.2.1.2.1 Significant Earthquakes in the Site Region (200-mi. [320-km] radius)

Seismicity within the site region is sparse and minor; earthquake magnitudes do not exceed m_b 4.3 (Figure 2.5.2-202). Following are descriptions of the two m_b 4.3 earthquakes that have occurred within the site region:

- **February 1, 1955**. This earthquake was strongly felt by many people along a 20-mi. (32-km) strip of the Mississippi Gulf Coast. The earthquake shaking caused windows and dishes to rattle. (Reference 2.5.2-220).

- **June 4, 1967**. The earthquake was felt in a large area, including parts of Arkansas, Mississippi, Louisiana, and Tennessee. In the epicentral area, a few cases of cracked plaster were reported (Reference 2.5.2-221). The USGS Earthquake Hazard Program's Web page of Louisiana Earthquake History describes this event as a Magnitude 3.8 (Reference 2.5.2-222). The m_b magnitude assigned to it by EPRI is 4.3 (Reference 2.5.2-201).

The Donaldsonville earthquake with m_b 4.2 occurred within 50 mi. (80 km) of the RBS site. Following is a description of that event (Reference 2.5.2-222):

- **October 19, 1930**. The earthquake was located near Donaldsonville, Louisiana. It was felt over a 15,000-sq. mi. area of southeastern Louisiana, and was recorded on the seismograph at Georgetown University, in Washington, D.C. The shaking caused damage to chimneys and broke windows in Napoleonville and Gonzales; it cracked plaster and overturned objects at White Castle; and caused minor damage in other towns (overturned objects, rattled windows and doors). The earthquake was felt in New Orleans and in the Baton Rouge area.

2.5.2.1.2.2 Recent Gulf of Mexico Earthquakes

Two earthquakes having $m_b > 5$ and a smaller event occurred in the northern Gulf of Mexico during 2006 (Figure 2.5.2-202). A summary of the reported magnitudes for these and earlier events and distances from the RBS site is provided in Table 2.5.2-201. An unusual surface-wave magnitude (M_s) 5.2 earthquake occurred off the coast of Louisiana, approximately 230 mi. (370 km) south of New Orleans, on February 10, 2006 (References 2.5.2-223 and 2.5.2-224). This earthquake was the largest to occur in the Gulf of Mexico since the (**M**)~5 event of July 24, 1978 (Reference 2.5.2-225), which represents the best-recorded earthquake in the region prior to the February 10, 2006, event (Reference 2.5.2-224). Two previous earthquakes, in 1994 (m_b 4.2) and 2000 (m_b 5.05), also occurred in the same area (within an error of approximately 31 mi. [50 km]) of the February 10, 2006, event (Figure 2.5.2-202). Following the February 2006 event, another unusual event with source characteristics similar to those of the February event occurred on

April 18, 2006, less than 30 mi. (100 km) offshore of the tip of Louisiana's Birdfoot Delta. This earthquake, which was not detected or located by the USGS's National Earthquake Information Center (NEIC) using traditional P-wave arrivals, generated surface waves of an amplitude typical for a shallow event of approximately **M** 4.6 (Reference 2.5.2-223). A larger **M** 5.8 occurred on September 10, 2006, approximately 207 mi. (330 km) southeast (Reference 2.5.2-226), in an abyssal plain environment. This earthquake, which was felt in parts of Florida, Georgia, Alabama, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas, as well as in the Bahamas and the Yucatan Peninsula in Mexico, did not generate a significant tsunami (References 2.5.2-226 and 2.5.2-227). Felt reports at Alexandria, Louisiana, were intensity IV (Reference 2.5.2-226).

The source characteristics of the largest events recorded in the Gulf of Mexico, the 1978 and recent 2006 events are quite different, suggesting that different types of triggering mechanisms may give rise to earthquakes in this region. In contrast to the unusual February and April 2006 earthquakes, which did not provide good teleseismic waveforms, the faulting geometry and size of both the 1978 and September 2006 earthquakes were well constrained by standard centroid-moment-tensor (CMT) analysis (Reference 2.5.2-224). As described below, the source characteristics of the February and April 2006 events are best explained as being gravity-driven displacements on a shallow, low-angle detachment surface within or at the base of a thick sedimentary wedge; the 1978 and September 2006 earthquakes, which occurred within basement rocks at depths of greater than 9.3 mi. (15 km), have source characteristics more typical of tectonic events.

Based on the focal depth (9.3 mi. [15 km]) and reverse-faulting focal mechanism, Frohlich (1982; Reference 2.5.2-225) concluded that the 1978 earthquake occurred within the basement and was typical of other intraplate events that probably occurred along relatively inactive structural trends that may represent zones of weakness in the crust. Frohlich postulated that the event may have been related to stresses associated with the downwarping of the lithosphere caused by accumulation of sediments from the Mississippi River (Reference 2.5.2-225). Different focal mechanisms are reported for this event. Frohlich (Reference 2.5.2-225) shows a reverse faulting mechanism on an east-northeast trend, whereas the global CMT catalog solution shows a reverse-faulting mechanism on a northwest trend (Reference 2.5.2-228).

The September 10, 2006, earthquake, which had a deep hypocenter (13.6 mi. [22 km] according to the USGS solution; 19.6 mi. [31.7 km] according to the Harvard solution [Reference 2.5.2-226]), is recognized as a typical tectonic event (Reference 2.5.2-229). The USGS did not associate this earthquake with a specific causative fault. The September earthquake occurred near the transition between oceanic crust and thin transitional crust, as shown by Sawyer et al.

(Reference 2.5.2-230), in an area where there are a number of northwest-trending basement faults and structures (Reference 2.5.2-231), as well as an interpreted northwest-trending regional basement structure that is inferred to have been related to rifting and opening of the Gulf of Mexico in the Mesozoic (Reference 2.5.2-232).

In contrast to the 1978 and September 2006 earthquakes, the February 10, 2006, earthquake is notable for the unusual characteristics of the teleseismic waveforms it generated. In particular, the teleseismic seismograms contain little high-frequency energy and are not fit well by traditional double-couple source models typical of tectonic faulting mechanisms. A moment-tensor source can be used to model the surface waves generated by the February 10, 2006, earthquake if the earthquake centroid is placed within a few miles of the earth's surface in a medium with a very low shear modulus. The seismograms are fit well by a single-force source, i.e., a model of sliding on a shallow, sub-horizontal surface. The depth of the source for the February 10 event was likely less than 3.7 to 5 mi. (6 to 8 km). The most plausible explanation for the mechanism for the February 10, 2006, earthquake and the similar event on April 18, 2006, is that of a gravity-driven displacement occurring on a low-angle detachment surface within the sedimentary wedge (Reference 2.5.2-224).

Peel (Reference 2.5.2-233) describes the structural context of the February 2006 earthquake and reviews possible seismogenic processes that could operate within the region. He refers to the February event, which is located within the Green Canyon Block 344, as the GC344 event. The location of this event is close to a major down-to-the-northwest basement step, corresponding to a downdip change in basement character. Peel (Reference 2.5.2-233) notes that this boundary also corresponds to a change in character of the regional magnetic pattern, and is probably the boundary between stretched continental crust (updip) and stretched basinal crust, possibly oceanic in character (downdip). The location of the GC344 event also overlies the boundary between autochthonous and allochthonous deep salt, which appears to correspond to the basement boundary. The autochthonous deep salt is overlain in turn by a thick section of Jurassic-to-Upper-Miocene cover sediment that has moved a distance of approximately 3 to 6 mi. (5 to 10 km) toward the south-southeast as a result of gravity spreading of the whole margin. Southwards movement and folding of this sediment package occurred during the Paleogene and Miocene, and there appears to have been no further movement since the early Pliocene. Since that time, southwards movement appears to be concentrated at a higher level within the Sigsbee Salt Nappe, a major allochthonous salt canopy spread out over the folded unit. Spreading of this salt unit began during the middle Miocene, reached a peak during the late Miocene and early Pliocene, and continues to the present day.

As reported by Peel (Reference 2.5.2-233), seismic imaging shows that the Sigsbee Salt Nappe contains large recumbent folds and a major basal shear zone. The salt nappe was dominantly emplaced by large-scale glacier-like flow from the north-northwest, with a minor component of local vertical feeding through diapir throats. On top of the Sigsbee salt is a sediment package (carapace) of

Upper Miocene, Pliocene, and Pleistocene sediments that is dominated by salt withdrawal basins and salt walls. Some of the salt withdrawal basins have subsided all the way to the base of the Sigsbee Nappe, forming significant sediment-on-sediment contact areas known as welds. Peel (Reference 2.5.2-233) observes that a likely welded area can be mapped close to GC344, and concludes that the most likely mechanism for the earthquake was movement on the base of the Sigsbee Salt, with faulting occurring where suprasal basin sediments are grinding against the base salt weld. The probable seismic expression of this mechanism would be low-angle faulting at a depth of approximately 5 to 6 mi. (8 to 10 km) below sea level. The predicted movement is likely to be generally southward, but a wide range of movement direction (± 90 degrees) is possible due to partitioning of movement within the Sigsbee Nappe (Reference 2.5.2-233).

Angell and Hitchcock (Reference 2.5.2-234) invoke a possible model of fault characteristics that could contribute to seismic rupture of a growth fault in which areas of both stick-slip and creep modes of displacement coexist on a single fault surface. They note that these conditions might occur along a fault plane where salt has evacuated and that the result is a sediment-sediment contact at the base of the growth fault (Reference 2.5.2-234).

Gangopadhyay and Sen (Reference 2.5.2-229) suggest a mechanism for earthquakes in the Gulf of Mexico that involves stress concentration resulting from the contrast in mechanical properties between salt and surrounding sediments driven by tectonic loading. The results of modeling suggest that some locations of relatively high shear stress correlate well with the spatial distribution of seismicity in the northern Gulf of Mexico, thereby suggesting a possible causal association (Reference 2.5.2-229).

2.5.2.2 Geologic and Tectonic Characteristics of the Site and Region

As outlined previously, Appendix E, Section E.3, of Regulatory Guide 1.165, Step 1, specifies that recent information should be reviewed to evaluate if this information indicates significant differences from the previous seismic hazard. Subsection 2.5.1 presents a summary of available geological, seismological, and geophysical data for the site region, site vicinity (25-mi. [40-km] radius), and site area (5-mi. [8-km] radius) that provides the basis for evaluating seismic sources that contribute to the seismic hazard to the RBS site. This subsection presents a description of the seismic source characterizations from the EPRI-SOG evaluation (Subsection 2.5.2.2.1), followed by a summary of general approaches and interpretations of seismic sources used in more recent seismic hazard studies (Subsection 2.5.2.2.2). Subsection 2.5.2.3 and 2.5.2.4 present evaluations of the new information relative to the EPRI-SOG seismic source evaluations.

2.5.2.2.1 EPRI-SOG Source Evaluations

During the 1980s, the SOG conducted a comprehensive seismic hazard methodology development program at the EPRI. The SOG program emphasized earth science assessments of alternative explanations of earthquakes in the CEUS, with a particular emphasis on a systematic understanding and expression of uncertainties. Seismic sources and associated interpretations necessary for hazard calculations at any nuclear power plant site in the CEUS were developed. Six earth science teams (ESTs) provided input interpretations: Bechtel Group, Dames & Moore, Law Engineering, Rondout Associates, Weston Geophysical, and Woodward-Clyde Consultants. Each team produced a report (Volumes 5 through 10 of EPRI-SOG) (Reference 2.5.2-201) that provided descriptions of how the seismic sources were identified and defined.

The seismic source characterizations developed by the EPRI-SOG expert teams were used to conduct PSHAs for nuclear power plant sites in the CEUS that were reported in EPRI. The calculations performed for each site excluded the seismic sources defined by each EPRI-SOG expert team that, in combination, contributed less than 1 percent to the total hazard computed from all sources defined by that expert team. Tables 2.5.2-202 through 2.5.2-207 list the seismic sources for each of the six EPRI-SOG teams that were included in the EPRI PSHA calculations for the RBS site. These seismic sources are shown on Figures 2.5.2-203 through 2.5.2-208 and are described in Subsections 2.5.2.2.1.1 through 2.5.2.2.1.6.

The EPRI identification of seismic sources that are significant to assessing the seismic hazard at the RBS site was based on calculations made with the ground-motion models presented in EPRI-SOG (References 2.5.2-202 and 2.5.2-201). Since that time, there have been advances in the characterization of earthquake ground motions for CEUS earthquakes. These advances are described in Subsection 2.5.2.4.2. Because the potential contribution of a seismic source to the hazard at a site is dependent in part on the ground-motion model used to compute the hazard, the identification of the significant EPRI-SOG seismic sources was re-examined using updated ground-motion models. This examination is presented in Subsection 2.5.2.4.3.1. The additional seismic sources defined by the EPRI-SOG expert teams in the site region are also listed in Tables 2.5.2-202 through 2.5.2-207, and are described in the following subsections. Many of the seismic sources described by the EPRI-SOG teams are also described in Subsection 2.5.1.1.5.

2.5.2.2.1.1 Bechtel (BEC) Team Seismic Sources

The EPRI (Reference 2.5.2-202) calculations for the RBS site included two seismic sources defined by the Bechtel team (Reference 2.5.2-235) (Figure 2.5.2-203). These sources are listed in Table 2.5.2-202 and are described below.

- **Gulf Coast Region (Source BEC-BZ1)**. The RBS site lies within the Gulf Coast region (Source BZ1). This zone is a large background source that extends from the continental shelf off eastern Florida to the western coastal plain of Texas and encompasses the majority of the site region. This background source zone was defined based on geopotential (gravity and magnetic anomaly data) and seismic data (Reference 2.5.2-235). The Bechtel team assigned a maximum earthquake magnitude of m_b 5.4 to 6.6 to this source (Reference 2.5.2-236).

- **New Madrid Fault Zone (BEC-30)**. This source was defined based on distinct microseismicity patterns, seismic reflection profiles, and the occurrence of the 1811-1812 earthquake sequence. The Bechtel team assigned a maximum earthquake magnitude of m_b 7.4 to 7.5 to this source (Reference 2.5.2-236)

2.5.2.2.1.2 Dames & Moore (DAM) Team Seismic Sources

The EPRI (Reference 2.5.2-202) calculations for the RBS site included four seismic sources defined by the Dames & Moore team (Reference 2.5.2-237; Figure 2.5.2-204). These sources are listed in Table 2.5.2-203 and are described below.

- **Southern Coastal Margin (Source DAM-20)**. The RBS site lies within the Southern Coastal Margin (Source 20), which extends from the continental shelf off eastern Florida, along the Texas coastal plain, and into Mexico. This source zone encompasses the majority of the site region. This source zone was defined based on its fairly low, diffuse seismicity. The zone represents the down warping miogeosynclinal wedge of sediment that accumulated within the Gulf Coast Basin since the Cretaceous. The more recently recognized Saline River source zone partially overlies the northern part of the Southern Coastal Margin zone (Reference 2.5.2-236).

- **Reelfoot Rift (Source DAM-22)**. This source zone was defined based on focal mechanisms that indicate a pattern of linear, segmented seismicity, and information regarding earthquake structure within the zone. This zone contains the highest level of seismicity in eastern North America.

- **New Madrid Compression Zone (Source DAM-21)**. This source was defined as an independent source within the Reelfoot Rift (Source 22), based on the long, linear zone of microseismicity between Marked Tree, Arkansas, and the area north of New Madrid, Missouri. Large earthquakes in 1811 and 1812, as well as recurrent seismicity, have occurred within this zone.

- **Ouachita Fold Belt (Source DAM-25)**. This source zone consists of a major segment of the Ouachita-Wichita Mountains in Arkansas and Oklahoma and was defined based on historical and instrumental patterns of recent microseismicity. Kinks or bends within the fold belt may correlate with failed arms of former continental rifts. The Saline River source zone partially overlies the southeastern part of the Ouachita fold belt (Reference 2.5.2-236).

2.5.2.2.1.3 Law Engineering (LAW) Team

The EPRI (Reference 2.5.2-202) calculations for the RBS site included two seismic sources defined by the Law Engineering team (Reference 2.5.2-238; Figure 2.5.2-205). These sources are listed in Table 2.5.2-204 and described briefly below.

- **Southern Coastal Block (Source LAW-126)**. The RBS site lies within the Southern Coastal Block (Source 126). This background seismic source zone is assumed to represent an area of similar crustal structure at seismogenic depths. The southern boundary of this zone was defined based on low-amplitude, broad-wavelength magnetic anomalies that extend from the southeast Texas-Mexico border to the continental shelf offshore Florida; the northern boundary was defined by the Paleozoic edge of the North American craton (Reference 2.5.2-239). The Saline River source zone partially overlies Law Engineering's Southern Coastal Block (Reference 2.5.2-236).

- **Postulated Faults in Reelfoot Rift (Source LAW-18)**. This source zone is associated with the area of occurrence of the 1811 and 1812 earthquakes

2.5.2.2.1.4 Rondout Associates (RND) Team

The EPRI (Reference 2.5.2-202) calculations for the RBS site included two seismic sources defined by the Rondout Associates team (Reference 2.5.2-240; Figure 2.5.2-206). These sources are listed in Table 2.5.2-205 and described briefly below.

- **Gulf Coast to Bahamas Fracture Zone (Source RND-51)**. The RBS site and surrounding region lie almost entirely within the Gulf Coast to Bahamas Fracture Zone (Source 51). This source zone was defined separately because of differences in the orientation of the stress regime between the Paleozoic crust within the zone and the Appalachian crust of roughly the same age to the east and northeast. The new Saline River source zone partially overlies Rondout's Gulf Coast/Bahamas source zone (Reference 2.5.2-236).

- **New Madrid Seismic Zone (NMSZ) (Source RND-1)**. This source was defined based on the location of the 1811-1812 earthquake sequence and the boundary of intense seismicity presented in Stauder (Reference 2.5.2-241). The zone was divided into three elements roughly coincident with the 1811 and 1812 earthquakes. A new source characterization for repeated large-magnitude events in the NMSZ has been overlain on the NMSZ of Rondout Engineering.

2.5.2.2.1.5 Weston Geophysical (WGC) Team

The EPRI (Reference 2.5.2-202) calculations for the RBS site included two seismic sources defined by the Weston Geophysical team (Reference 2.5.2-242; Figure 2.5.2-207). These sources are listed in Table 2.5.2-206 and described briefly below.

- **Gulf Coast Background (Source WGC-107)**. This source zone was defined as an independent background source that does not contain any other seismic source regions. This zone extends from Texas to Florida (Reference 2.5.2-242). The new Saline River source zone partially overlies Weston's Gulf Coast background source zone.

- **New Madrid Fault Zone (Source WGC-31)**. This source was defined based on a dense pattern of microseismicity. The team also considered the New Madrid fault combined with the Reelfoot Rift WGC (Source WGC-32) as an optional source geometry. A new source characterization for repeated large-magnitude events in the NMSZ has been overlain on Weston's New Madrid fault zone.

2.5.2.2.1.6 Woodward-Clyde Consultants (WCC) Team

The EPRI (Reference 2.5.2-202) calculations for the RBS site included two seismic sources defined by the Woodward-Clyde Consultants team (Reference 2.5.2-243; Figure 2.5.2-208). These sources are listed in Table 2.5.2-207 and are briefly described below.

- **Source WCC-B42**. The River Bend Background (B42) Zone is a large areal background source centered on the RBS Unit 1 site; it is a quadrilateral with sides approximately 2 degrees in length and width (Figure 2.5.2-208). This zone is not based on any geological, geophysical, or seismological features.

- **Disturbed Zone of Reelfoot Rift (Source WCC-40)**. This source zone was defined based on the occurrence of the 1811-1812 earthquake sequence, a well-located trend of microseismicity, and a disturbed zone identified by seismic reflection data.

2.5.2.2.2 Post-EPRI Seismic Source Characterizations

Seismic hazard studies conducted in the RBS site region since completion of the 1988 EPRI-SOG study are described in the following subsections (Reference 2.5.2-201).

2.5.2.2.2.1 USGS Earthquake Hazard Mapping Source Characterization Model

As part of the USGS National Seismic Hazard Mapping Program, updated seismic hazard maps for the conterminous United States were produced in 2002 and 2008 (References 2.5.2-244 and 2.5.2-245). Input for revising the source characterization used in the 1996 hazard maps (Reference 2.5.2-246) was provided by researchers through a series of regional workshops. Key issues that were addressed in the 2002 and 2008 updated source characterizations included new information regarding the location, size, and recurrence of repeated large-magnitude earthquakes in the New Madrid source region. Although the USGS program does not use formal expert elicitation and full uncertainty quantification, the resulting seismic hazard model provides information on the current understanding of the seismic potential of the study region and the catalog of recorded earthquakes.

The USGS source model and earthquake catalog (in body-wave magnitude [m_b]) developed by the USGS are shown on Figure 2.5.2-209. The updated earthquake catalog for the 2008 USGS model extends through 2006. The general approach used by the USGS for modeling distributed seismicity in the CEUS is based on gridded, spatially smoothed seismicity in large background zones (Reference 2.5.2-206).

Two broad regions are defined with different M_{max} maximum magnitudes in the USGS 2008 model: an extended margin zone (maximum magnitude [M_{max}] = **M** 7.5) and a craton zone (M_{max} = **M** 7.0). In addition, the USGS source model includes an East Tennessee regional source zone, and alternative fault-line sources for repeated large magnitude earthquakes in the NMSZ (Figure 2.5.2-209). The maximum magnitude probability distribution assigned to the northern section of the New Madrid fault source is **M** 7.1 (0.15), **M** 7.3 (0.2), **M** 7.5 (0.5), and **M** 7.8 (0.15). The maximum magnitude probability distribution assigned to the southern and central sections is **M** 7.3 (0.15), **M** 7.5 (0.2), **M** 7.7 (0.5), and **M** 8.0 (0.15). The USGS model uses a mean recurrence time of 500 years and 750 years for repeated large-magnitude earthquakes in the New Madrid region. These are weighted equally for the northern section. Additionally, a 1000-year branch was added to the 2008 recurrence model with an assigned weight of 0.1. The USGS 2008 model assumes a time-independent behavior and allows for the occurrence of earthquake clusters (References 2.5.2-206 and 2.5.2-245).

The 2008 model to the CEUS hazard includes the following updates:

- An updated catalog through 2006 that accounts for magnitude uncertainty.
- A reduction in the magnitudes in the northern NMSZ by 0.2 units and added logic-tree branch for a recurrence rate of 1/750 years.
- An added logic-tree branch for a 1/1000-year recurrence rate of earthquakes in New Madrid.
- Implementation of a temporal cluster model for New Madrid earthquakes.
- A modified model for the fault geometry for New Madrid to include five hypothetical strands and increased the weight on the central strand to 0.7.
- A revised dip of the Reelfoot fault to 38 degrees.
- A maximum magnitude distribution for seismicity-derived hazard sources.
- A revised geometry of the large Charleston zone that extends it farther offshore to include the Helena Banks fault zone.
- Added documentation for logic trees.
- Inclusion of an alternative set of earthquake occurrence rates that incorporate the effects of magnitude uncertainty.

2.5.2.2.2.2 Grand Gulf Unit 3 COLA

Entergy Operations, Inc. (EOI) (Reference 2.5.2-236), as part of a COL application for the Grand Gulf Unit 3 site near Port Gibson in Claibourne County, Mississippi, updated the following aspects of the 1986 - 1988 EPRI-SOG seismic source model:

- A characteristic earthquake model for the New Madrid seismic zone was added. This model is similar to the updates to the New Madrid seismic source characterization discussed in Subsection 2.5.2.4.1.1.
- A new source, the Saline River source zone, was added. This source is described in Subsection 2.5.2.4.1.3.
- Maximum magnitude probability distributions for the Gulf of Mexico source zones used in the EPRI-SOG source model were revised based on the occurrence of two moderate earthquakes in the Gulf of Mexico. These revisions are essentially the same as those discussed in Subsection 2.5.2.4.1.2.

2.5.2.2.2.3 FSAR South Texas Units 3 and 4 COLA

The South Texas Project Nuclear Operating Company (STPNOC) updated the EPRI-SOG seismic source parameters for Gulf of Mexico source zones as part of a recent COL application for the South Texas Project (STP) site near Bay City, Texas. The STP FSAR incorporated contributions from seismic sources in the Gulf of Mexico that had not been included in the original EPRI methodology. It also updated the maximum magnitude probability distributions of Gulf of Mexico source zones based on the occurrence of two moderate earthquakes in the Gulf of Mexico (Reference 2.5.2-247).

2.5.2.3 Correlation of Earthquake Activity with Seismic Sources

Regulatory Guide 1.165 indicates that earthquake activity should be correlated with seismic sources. The distribution of earthquake epicenters from the EPRI (pre-1985) catalog, as well as the more recent (post-1985) instrumental events and updated historical earthquakes for the site region with respect to the EPRI-SOG sources are shown on Figures 2.5.2-203 through 2.5.2-208. Comparison of the updated earthquake catalog to the EPRI-SOG earthquake catalog and EPRI-SOG sources yields the following conclusions:

- The updated earthquake catalog does not show a pattern of seismicity within the site region different from that exhibited by earthquakes in the EPRI-SOG catalog that would suggest a new seismic source, in addition to those included in the EPRI-SOG characterizations.

- The updated earthquake catalog shows similar spatial distribution of earthquakes to that shown by the EPRI-SOG catalog, suggesting that no significant revisions to the geometry of seismic sources defined in the EPRI-SOG characterization is required based on seismicity patterns.

- The updated catalog does not show any earthquakes within the site region that can be associated with a known geologic structure.

- The closest source of major seismic activity is the New Madrid, Missouri area, which lies at a distance of greater than 290 mi. (480 km) (Figure 2.5.2-210). Concentrations of seismicity in the vicinity of New Madrid were recognized and considered by the EPRI-SOG teams, as discussed in Subsection 2.5.2.2.1.

- The largest historical earthquakes in CEUS, the 1811-1812 New Madrid earthquake sequence, appear to be associated with a system of faults within the central Reelfoot Rift (Subsection 2.5.1.1.5.3). Paleoliquefaction studies indicate that repeated large-magnitude earthquakes have occurred in the epicentral region of the 1811-1812 New Madrid earthquake sequence (refer to the discussion in Subsection 2.5.1.1.5.3). Alternative source locations, maximum magnitudes, and recurrence for repeated large-magnitude, New Madrid-type earthquakes are discussed in Subsection 2.5.2.4.1.

- The updated catalog includes two earthquakes that are larger in magnitude than some of the upper- and/or lower-bound values used by EPRI-SOG teams to characterize the M_{max} distribution of source zones within which these earthquakes occurred. These earthquakes are the February 10, 2006, m_b 5.54 earthquake, and the September 10, 2006, m_b 6.08 earthquake. These events require revisions to some of the ESTs M_{max} distributions for background source zones, as described below in Subsection 2.5.2.4.1.2.

- As discussed in Subsection 2.5.2.1.2.2, the February 10, 2006, m_b 5.54 earthquake, which does not exhibit typical source characteristics of a tectonic earthquake, has been potentially associated with specific geologic structures near the edge of the continental shelf. The September 10, 2006, m_b 6.08 earthquake, which has a tectonic signature, has not been tied to any unique geologic structure. This event occurred near the transition between oceanic and thin transitional crust, in extended basement crust having northwest-trending normal faults that are favorably oriented for reactivation in the present tectonic regime (refer to the discussion in Subsection 2.5.2.1.2.2).

- The February 10, 2006, m_b 5.54 earthquake has been proposed to be the result of a gravity-driven displacement on a shallow, low-angle detachment surface within or at the base of a thick sedimentary wedge (Reference 2.5.2-224), possibly related to a sediment-sediment contact (weld) at the base of a growth fault at the edge of the continental shelf (References 2.5.2-233 and 2.5.2-234). This hypothesis suggests a potential association between seismicity in the Gulf of Mexico and normal growth faults at the edge of the continental shelf; however, no other events within the updated catalog have been attributed to such mechanisms. The edge of the continental shelf generally is encompassed by the various EST areal source zones for the Gulf of Mexico and environs, and as such, increases in maximum magnitude to account for the February 10, 2006 Em_b[c] 5.5 (m_b 5.54 this study), as well as the September 10, 2006 Emb 6.1 (mb 6.08 this study) earthquake to adequately account for any potential association between earthquakes within the Gulf of Mexico and normal faults along the edge of the continental shelf (Reference 2.5.2-247).

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c. Em_b - Expected estimate of body wave magnitude defined in EPRI-SOG (Reference 2.5.2-201). Em_b values assigned to the 2006 earthquakes in the STP 3 and 4 COLA differ slightly from the RBS catalog because of different versions of magnitude conversion relationships used in the two studies.

- The updated earthquake catalog adds several magnitude m_b 3 to 5 earthquakes in the time period covered by the EPRI-SOG catalog (principally prior to 1910). The effect of these additional events on estimated seismicity rates is assessed in Subsection 2.5.2.4.1.2.

2.5.2.4 Probabilistic Seismic Hazard Analysis and Controlling Earthquakes

This subsection describes the PSHA conducted for the RBS site. Following the procedures outlined in Appendix E, Section E.3, of Regulatory Guide 1.165, Subsections 2.5.2.4.1 and 2.5.2.4.2 discuss new information on seismic source characterization and ground-motion characterization, respectively, that is potentially significant relative to the EPRI-SOG (Reference 2.5.2-201) seismic hazard model. Subsection 2.5.2.4.3 presents the results of PSHA sensitivity analyses used to test the effect of the new information on the seismic hazard. Using these results, an updated PSHA analysis was performed, as described in Subsection 2.5.2.4.4. The results of that analysis are used for the development of uniform hazard response spectra (UHRS) and the identification of the controlling earthquakes (Subsection 2.5.2.4.4.2).

2.5.2.4.1 New Information Relative to Seismic Sources

This subsection describes potential updates to the EPRI-SOG seismic source model. Seismic source characterization data and information that could affect the predicted level of seismic hazard include the following:

- Identification of possible additional seismic sources in the site vicinity.
- Changes in the characterization of the rate of earthquake occurrence for one or more seismic sources.
- Changes in the characterization of the maximum magnitude for seismic sources.

Based on the review of new geological, geophysical, and seismological information that is summarized in Subsection 2.5.1, the review of seismic source characterization models developed for post-EPRI-SOG seismic hazard analyses (Subsection 2.5.2.2.2), and a comparison of the updated earthquake catalog to the EPRI-SOG evaluation (Subsection 2.5.2.3), the EPRI-SOG source models have been modified for the RBS Unit 3 COLA as follows:

- Fault sources are added for repeated large-magnitude earthquakes in the NMSZ, as shown in Figure 2.5.2-210.
- The maximum magnitude distribution for selected EPRI-SOG team sources are updated based on updated earthquake catalog events.
- The Saline River source zone in southern Arkansas is added, as shown in Figure 2.5.2-210.

- An additional earthquake catalog completeness zone in the Gulf of Mexico has been added to incorporate the contribution of offshore seismicity into the hazard analysis for the RBS site.

2.5.2.4.1.1 Updated Characterization of Large-Magnitude New Madrid Seismic Zone Earthquakes

The NMSZ extends from southeastern Missouri to southwestern Tennessee and is located more than 290 mi. (480 km) north of the RBS Unit 3 site (Figure 2.5.2-210).

The NMSZ produced a series of large-magnitude earthquakes between December 1811 and February 1812 (References 2.5.2-248 through 2.5.2-251). A detailed discussion of recent information about the location, size, and frequency of repeated large-magnitude events that have occurred in the NMSZ is provided in Subsection 2.5.1.1.5.3.2.

The updated characterization of fault sources that are judged to be the sources for the 1811 - 1812 earthquake sequence and similar paleo-earthquake sequences in the NMSZ follows the characterization initially developed in the Exelon Generation Company (EGC) early site permit (ESP) application for the Clinton ESP site (Reference 2.5.2-252) and subsequently implemented, with only one exception in the Bellefonte 3 and 4 COLA (Reference 2.5.2-253). The Bellefonte model uses a time period of interest of 50 years rather than the longer period of 60 years used in the Clinton ESP application. The summary of the updated characterization model outlined below is based on the more complete discussion from the Bellefonte FSAR (Reference 2.5.2-253).

The locations of the faults that make up the New Madrid central fault system sources relative to the RBS site are shown in Figure 2.5.2-210. The logic tree used to represent the uncertainty in the seismic source characterization model for the NMSZ central fault system is shown in Figure 2.5.2-211.

NMSZ Central Faults Source Geometry

Three fault sources are included in the updated characterization of the central fault system of the NMSZ: (1) the New Madrid South (NS) fault; (2) the New Madrid North (NN); and (3) the Reelfoot fault (RF). The first three levels of the logic tree for these sources address the uncertainty regarding the location and extent of the causative faults that ruptured during the 1811 - 1812 earthquake sequence. This uncertainty is represented by alternative geometries for the NN, NS, and RF faults, as shown in Figure 2.5.2-212 and Figure 2.5.2-213. These alternative geometries affect the distance from earthquake ruptures on these fault sources to the RBS Unit 3 site.

NMSZ Central Faults Maximum Earthquake Magnitude

The next level of the logic tree addresses the maximum magnitude for earthquakes on the three New Madrid fault sources. As discussed in Subsection 2.5.1.1.5.3.2, researchers have suggested that the sizes of prehistoric earthquakes associated with these sources are similar to the 1811 and 1812 earthquakes. Using the concept of characteristic earthquakes, seismic source characterizations of the New Madrid seismic source zone typically consider the 1811 and 1812 earthquakes to represent the maximum earthquake for this source. As illustrated in Figure 2.5.2-214, the frequency of repeated large earthquakes interpreted from paleoliquefaction data is greater than the frequency obtained by extrapolating a Gutenburg-Richter recurrence relationship fit to the observed seismicity rate for smaller-magnitude earthquakes. A characteristic earthquake recurrence curve better fits the more frequent, repeated large-magnitude events observed in the paleoliquefaction record. Table 2.5.2-208 summarizes recent estimates of the magnitude of the New Madrid 1811 and 1812 main shocks. Table 2.5.2-209 presents the resulting characteristic magnitude distribution for each of the three faults based on weights assigned to the various magnitude estimates, as discussed in Reference 2.5.2-253. The alternative sets of ruptures allow for sequences of multiple large-magnitude earthquakes in which the arguments for the high- versus low-magnitude assessments for the individual faults are considered to be highly correlated, as shown in the logic tree in Figure 2.5.2-211 and given in Table 2.5.2-209.

The magnitudes listed in Table 2.5.2-209 are considered to represent the size of the expected maximum earthquake rupture for each fault within the NMSZ. Following the development of the characteristic earthquake recurrence model by Youngs and Coppersmith (Reference 2.5.2-254), as modified by Youngs et al. (Reference 2.5.2-255), the size of the next characteristic earthquake is assumed to vary randomly about the expected value following a uniform distribution over the range of ± 1/4 magnitude units. This range represents the aleatory variability in the size of individual characteristic earthquakes.

NMSZ Central Faults Earthquake Recurrence

The paleoseismic record of the NMSZ includes evidence from paleoliquefaction, sediment rupture and deformation, fluvial response, and biotic response.

Estimates of the recurrence interval for New Madrid characteristic earthquakes include a Poisson and renewal model. The Brownian Passage Time (BPT) model developed by Ellsworth et al. (Reference 2.5.2-256) and Matthews et al. (Reference 2.5.2-257) was used by EGC to represent the distribution of the time between earthquake sequences in the renewal model.

Figure 2.5.2-215 shows the uncertainty distributions for the mean repeat time between New Madrid earthquake sequences obtained by EGC (Reference 2.5.2-258). The occurrence rates for New Madrid large-magnitude earthquake sequences were estimated using the distributions for mean repeat time shown on

Figure 2.5.2-215. Table 2.5.2-210 lists the discrete distributions for mean repeat time and the equivalent Poisson rates. The Poisson and renewal recurrence models are given equal weight (Figure 2.5.2-211).

The paleoliquefaction data gathered in the New Madrid region indicate that the prehistoric earthquakes have occurred in sequences closely spaced in time relative to the time period between sequences, similar to the 1811 - 1812 sequence. Figure 2.5.2-216 shows the estimated earthquake sizes and event locations for the 1811 - 1812 sequence and the two previous sequences. These data indicate that the RF has ruptured in all three sequences, but the NN and NS sources may have produced earthquakes on the order of one magnitude unit smaller than the 1811 and 1812 earthquakes in some previous sequences. As discussed in Reference 2.5.2-253, the revised model for New Madrid sequences consists of two alternative models of rupture or earthquake sequences. In Model A, all ruptures are similar in size to the 1811 and 1812 earthquakes. In Model B, one-third of the sequences are the same as Model A, one-third contain a smaller rupture of the NN, and one-third contain a smaller rupture of the NS. The difference in magnitude from the 1811 and 1812 ruptures was set to be no more than one-half magnitude unit, and no ruptures are allowed to be less than **M** 7. All three earthquakes were included in the hazard calculation in all rupture sequences.

2.5.2.4.1.2 New Maximum Magnitude Information

Geological and seismological data published since the 1986 EPRI seismic source model are summarized and discussed in Subsection 2.5.1 and Subsection 2.5.2.1, respectively. Based on a review of these data and the updated source characterizations implemented in the STP COLA (Reference 2.5.2-247), the weighted ranges of maximum magnitude for some of the EST background source zones that extend into the Gulf of Mexico and contain the RBS site (referred to as the Gulf Coastal Source Zones [GCSZs]) are revised. A comparison of the M_{max} distributions of EPRI EST characterizations of GCSZs and modifications for the STP COLA is provided in Table 2.5.2-211.

M_{max} values for some of the GCSZs were updated in the STP COLA (Reference 2.5.2-247) based on the occurrence of two earthquakes that occurred after the development of the EPRI 1986 source model. These two earthquakes, the February 10, 2006 Em_b 5.5 earthquake and the September 10, 2006 Em_b 6.1 earthquake, are of greater magnitude than the lower-, and in some cases, upper-bound M_{max} values of some of the GCSZs in which the earthquakes occur or to which the earthquakes are in very close proximity (Figure 2.5.2-202). The STP COLA updated the M_{max} distribution for a particular GCSZ only when two conditions are met: (1) one or both of the 2006 moderate-magnitude earthquakes can be determined to have occurred inside the source zone with reasonable certainty, and (2) the observed Em_b magnitude for the largest earthquake in the zone is greater than the minimum m_b magnitude of the EPRI 1986 source model M_{max} distribution. These criteria resulted in updates to five of the six EST GCSZs

M_{max} distributions (Table 2.5.2-211). The updated distributions were developed by following the original methodology used by the ESTs in the 1986 EPRI study, as described in their respective volumes (Reference 2.5.2-201) and the EQHAZARD Primer (Reference 2.5.2-259) as closely as possible.

The STP COLA did not update the maximum magnitude distribution for the Woodward Clyde Consultants South Texas background zone because the Gulf of Mexico earthquakes occurred outside of its boundaries. However, the February 10, 2006 Em_b earthquake occurred near the boundary of the Woodward-Clyde Consultants River Bend background zone (Figure 2.5.2-208). Accordingly, the maximum magnitude distribution for this source was updated, as indicated in Table 2.5.2-211.

2.5.2.4.1.3 Updated Saline River Source Zone

The Saline River source zone is located in southeastern Arkansas approximately 145 mi. (230 km) north-northwest of the RBS site (Figure 2.5.2-210). A detailed discussion of recent information about the location, size, and frequency of events that have occurred in the Saline River source zone is provided in Subsection 2.5.1.1.5.3.3. The summary of the updated characterization model outlined below is based on a more complete discussion from the Grand Gulf COLA (Reference 2.5.2-236).

The existence of the Saline River source zone is based on the coincidence of liquefaction, sparse seismicity, late Tertiary and possibly Pleistocene fault rupture, and geomorphic asymmetry of drainage basins. Because of uncertainties in the origin of liquefaction and geomorphic features, the existence of the source zone is given a probability of 50 percent (Reference 2.5.2-236). Geologic evidence of faulting is not sufficient to define with certainty the presence of a distinct capable fault within the Saline River source zone.

Source Geometry

The Saline River source zone (Reference 2.5.2-236) encompasses all of the geomorphic, liquefaction, seismicity, and geologic data that suggest the existence of a localized seismic source. The source zone is defined by the intersection of the southwestward extension of the Proterozoic Reelfoot Rift and the Paleozoic Ouachita orogenic belt. The source zone geometry is defined based on the interpretation that northeast-trending faults in the continental basement within the Reelfoot Rift may structurally interact with northwest-trending faults in the overlying Ouachita orogenic belt. As with the NMSZ, faults within this zone of intersection may be reactivated because of east northeast-directed regional compressive stress. The northwestern boundary of the zone is defined based on a projection of the Northern Boundary fault of the Reelfoot Rift (Reference 2.5.2-260). The southeastern boundary is defined based on the southward projection of Reelfoot Rift-related marginal faults. The southwestern boundary of the seismic zone is defined based on the southern rifted margin of the North American craton. The Reelfoot Rift is a Proterozoic structure within the continental basement of the North American craton that was truncated by southward-directed rifting of the Gulf of Mexico in Triassic time. The northeastern boundary of the seismic zone is defined by the northernmost occurrence of basin asymmetry along the Arkansas River (Reference 2.5.2-236).

Characteristic Earthquake Magnitude

The characteristic earthquake magnitude is estimated from observations of faulting noted in trenches along the Saline River fault (Reference 2.5.2-261) and the extent of liquefaction features observed in Ashley and Desha Counties (Reference 2.5.2-262). As shown in Figure 2.5.2-217, the range of characteristic magnitudes and weightings is **M** 6.0 (0.3), **M** 6.5 (0.6), and **M** 7.0 (0.1) (Reference 2.5.2-236). The **M** 6.0 and 6.5 estimates are based on the empirical relationship between the size of a liquefaction field and earthquake magnitude (Reference 2.5.2-263) and encompass the upper-bound estimate provided by Cox et al. (Reference 2.5.2-261). The occurrence of **M** 6.5 earthquakes along the Saline River source zone is also consistent with the observation of minor surface fault rupture. Both the limited occurrence of liquefaction features and evidence for minor discontinuous surface fault ruptures are consistent with earthquake magnitudes in the **M** 6.0 to 6.5 range. An **M** 7.0 characteristic earthquake is also considered in the magnitude assessment. Although the occurrence of a larger magnitude event is a possibility, the geological data do not support the occurrence of an earthquake of this size. A sensitivity analysis was performed by Entergy Operations, Inc. (Reference 2.5.2-236) and calculated the size of the 0.1 g isoseismal contour for an **M** 7.0 event. This area represents the likely size of the area that would exhibit surface manifestation of liquefaction in susceptible deposits. The radius of the 0.1 g isoseismal, using the 2-sigma ground-motion attenuation relations (Reference 2.5.2-264), is approximately 70 mi. (120 km). The lack of such extensive liquefaction features, and minor expression of evidence of surface faulting, supports the higher weighting on the **M** 6.0 to 6.5 characteristic earthquake magnitude than the **M** 7.0 magnitude.

Earthquake Recurrence

The earthquake recurrence models are based on data presented by Cox (References 2.5.2-262, 2.5.2-265, and 2.5.2-266). Both the exponential earthquake recurrence model (Reference 2.5.2-267) and the characteristic earthquake recurrence model (Reference 2.5.2-268) were considered and are weighted 0.1 and 0.9, respectively (Figure 2.5.2-217). The characteristic earthquake recurrence model is given a predominant weighting of 0.9 because there is a record of several earthquake cycles and a sequence of geomorphic terraces that provide a geological basis to estimate rates of tectonic deformation. The exponential recurrence model is given a lower weighting of 0.1 because of the sparse seismicity in the area and incomplete historical record (Reference 2.5.2-232).

The characteristic earthquake recurrence is estimated using both paleoliquefaction data and fault slip-rate data. The recurrence of the characteristic earthquake using paleoliquefaction data is assigned a weight of 0.6 (Figure 2.5.2-217). The recurrence of the characteristic earthquake using fault slip-rate data is assigned a weight of 0.4. A higher weight of 0.6 was assigned to the recurrence model using paleoliquefaction data because these data are better constrained through paleoseismic field investigations, and several earthquake cycles are recorded. The recurrence times for characteristic earthquakes based on the paleoliquefaction data are estimated at 390, 1725, and 3500 years. Weights of 0.2, 0.4, and 0.4, respectively, are assigned to these recurrence estimates. The shortest recurrence time of 390 years represents the average recurrence time for five events during the period 200 years B.P. (A.D. 1800) to 1700 years B.P., the shortest allowable time period. The 1725-year recurrence time represents the average recurrence time for five events occurring between 150 and 5320 years B.P. The 3500-year recurrence time represents the maximum recurrence based on the dated maximum interval between liquefaction events at the Montrose site in Ashley County.

The recurrence times for characteristic earthquakes based on slip-rate data are estimated for each characteristic earthquake magnitude (**M** 6.0, 6.5, and 7.0). The recurrence time is estimated by dividing the characteristic displacement by the slip rate. Characteristic displacement is derived from the empirical relationship between earthquake magnitude and average displacement from Wells and Coppersmith (Reference 2.5.2-269). Fault slip rates estimated for the Saline River seismic zone were derived from both geomorphic analysis and paleoseismic investigations conducted by Cox (Reference 2.5.2-261). The slip rates obtained vary from 0.05 to 1.7 mm/yr, using incision as a proxy for uplift rate, and from 0.008 mm/yr to 0.03 mm/yr, using offset piercing points observed in trenches. The values and weights (in parentheses) selected for use in the recurrence model are 0.01 mm/yr (0.1), 0.05 mm/yr (0.3), and 0.1 mm/yr (0.6).

The earthquake recurrence times for each of the **M** 6.0, 6.5, and 7.0 characteristic earthquakes were calculated based on the slip rates described above and the displacements estimated based on the empirical relationships between magnitude and displacement (Reference 2.5.2-269). The recurrence intervals vary because the amount of displacement required to produce these earthquakes varies; larger earthquakes require greater displacement than smaller earthquakes. As shown in Figure 2.5.2-217, the **M** 6.0 characteristic earthquake recurrence times for the range of slip rates and assigned weights (described above) are 1000 years (0.6), 2000 years (0.3), and 10,000 years (0.1), respectively. For **M** 6.5 characteristic earthquakes, the recurrence times and assigned weights are 3000 years (0.6), 6000 years (0.3), and 30,000 years (0.1), respectively. For **M** 7.0 characteristic earthquakes, the recurrence times and assigned weights are 12,500 years (0.6), 25,000 years (0.3), and 125,000 years (0.1), respectively (Reference 2.5.2-236).

2.5.2.4.1.4 Earthquake Occurrence Rates within EPRI-SOG Completeness Regions

Subsection 2.5.2.1.1 describes the development of an updated earthquake catalog for the RBS site region. This updated catalog includes modifications to the

EPRI-SOG catalog by subsequent researchers, the addition of earthquakes that have occurred after completion of the EPRI-SOG seismic source characterization studies (post-March 1985), and the identification of additional earthquakes in the time period covered by the EPRI-SOG evaluation for the project region (1758 to March 1985). The effect of the new catalog information was assessed by evaluating the effect of the new data on earthquake magnitude estimates and on earthquake recurrence estimates within the RBS site region.

The earthquake recurrence rates computed in the EPRI-SOG evaluation included a correction to remove bias introduced by uncertainty in the magnitude estimates for individual earthquakes (Reference 2.5.2-201). The bias adjustment was implemented by defining an adjusted magnitude estimate (m_b*) for each earthquake and then computing the earthquake recurrence parameters by maximum likelihood using earthquake counts in terms of m_b*. The adjusted magnitude is defined by the relationship:

$$m_b{}^* = m_b - \beta\sigma^2_{m_b|m_b\,instrumental}/2 \qquad \text{Equation 2.5.2-1}$$

where m_b is based on instrumentally recorded m_b magnitudes and by the relationship:

$$m_b{}^* = m_b + \beta\sigma^2_{m_b|X}/2 \qquad \text{Equation 2.5.2-2}$$

when m_b is based on other size measures *X*, such as maximum intensity (I_0) or felt area (Reference 2.5.2-201). The change in sign in the correction term from negative in Equation 2.5.2-1 to positive in Equation 2.5.2-2 reflects the effects of the uncertainty in the conversion from size measure *X* to m_b. Parameter β is the Gutenberg-Richter *b*-value in natural log units. Values of m_b* were computed for the earthquakes in the updated catalog using the assessed uncertainties in the magnitude estimates and a value of β equal to 0.95 × ln(10) based on the global *b*-value of 0.95 assigned to the CEUS by Frankel et al. and Petersen, et al. (References 2.5.2-244 and 2.5.2-245). Values of $\sigma_{m_{b|x}}$ range from 0.55 for m_b estimated from maximum intensity, to 0.3 to 0.5 for m_b estimated from various other magnitude scales or felt area (Reference 2.5.2-201). The value of $\sigma_{m_b|m_b instrumental}$ is typically set at 0.1.

The EPRI-SOG procedure for computing earthquake recurrence rates was based on a methodology that incorporated data from both the period of complete catalog reporting and the period of incomplete catalog reporting (Reference 2.5.2-201).

For the period of incomplete reporting, a probability of detection, (P^D) was defined that represented the probability that the occurrence of an earthquake would ultimately be recorded in the earthquake catalog for the region. The CEUS was subdivided into 13 "completeness regions" that represented different histories of earthquake recording (Reference 2.5.2-201). Figure 2.5.2-218 shows the two completeness regions (2 and 3) that cover the area within 200 mi. (320 km) of the RBS site. It should be noted that the EPRI-SOG catalog contained only a few events in the Gulf of Mexico and no completeness region was defined for this area. The assessment of catalog completeness for the Gulf of Mexico and the incorporation of recent seismicity in that area are discussed in Subsection 2.5.2.4.1.5.

The total time span of the EPRI-SOG catalog was then divided into six time intervals. Then using the observed seismicity and information on population density and the history of earthquake reporting across the CEUS, the probability of detection was estimated for each time interval within each completeness region for six magnitude intervals. Earthquake recurrence estimates were then made using the "equivalent period of completeness," (T^E), for each completeness region and all of the recorded earthquakes within the usable portion of the catalog. The T^E value is computed by the expression:

$$T_{ij}^{E} = \sum_{k} T_k \times P_{ijk}^{D} \qquad \text{Equation 2.5.2-3}$$

where P_{ijk}^{D} is the probability of detection for completeness region (i), magnitude interval (j), and time period (k) of length (T_k) (Reference 2.5.2-201). The estimated values of P^D for all of the completeness regions are given in EPRI-SOG (Reference 2.5.2-201).

The updated earthquake catalog includes newly identified earthquakes for the time period covered by the EPRI-SOG catalog, reassessment of the sizes of previously identified events, and earthquakes that have occurred after completion of the EPRI-SOG evaluation. The event counts for the EPRI-SOG and updated catalogs are given in Table 2.5.2-212. For the RBS site region, the difference in the number of earthquakes in the EPRI-SOG and updated catalog for the time up to 1985 is very small. The impact of the change in the number of events in a particular time interval on the probability of detection within the EPRI-SOG completeness zones was approximately estimated by multiplying the value of PD reported in EPRI-SOG (Reference 2.5.2-201) by the ratio of the earthquake count from the updated earthquake catalog to the earthquake count from the EPRI-SOG catalog, with a maximum value of 1.0 for the updated value of PD. These assessments are presented in Table 2.5.2-212.

The effect of the updated earthquake catalog on earthquake occurrence rates was assessed by computing earthquake recurrence parameters for the portions of the EPRI-SOG completeness Region 3 that lies within the RBS site region. The truncated exponential recurrence model was fit to the seismicity data using maximum likelihood. Earthquake recurrence parameters were computed using the EPRI-SOG catalog and T^E values and using the updated catalog and the updated T^E values. It was assumed that the P^D for all magnitudes is unity for the time period of March 1985 to January 1, 2007. The resulting earthquake recurrence rates for the portion of completeness Region 3 with the RBS site region are compared in Figure 2.5.2-219. The data labeled "Updated (all events)" includes earthquakes that were flagged as aftershocks in the EPRI-SOG catalog, and the data labeled "Update (no EPRI-SOG aftershocks)" have these events removed before calculating the recurrence parameters. Two sets of calculations were performed, one using unconstrained likelihood and one in which a prior of 1.0 was imposed on the *b*-value. EPRI-SOG (Reference 2.5.2-201) used the approach of applying a prior distribution for the *b*-value in the maximum likelihood estimation of seismicity parameters. The use of the prior on *b*-value stabilized the estimate of seismicity parameters in areas with only a few earthquakes. The earthquake occurrence rates computed with the updated catalog are essentially the same as those obtained using the original EPRI-SOG catalog.

Based on comparisons shown in Figure 2.5.2-219, the earthquake occurrence rate parameters developed in the EPRI-SOG evaluation adequately represent the seismicity rates within the site region within the EPRI-SOG completeness regions. The impact of the seismicity in the Gulf of Mexico is assessed in Subsection 2.5.2.4.1.5.

2.5.2.4.1.5 Evaluation of Catalog Completeness within the Gulf of Mexico

The original EPRI completeness regions do not cover the Gulf of Mexico region. As a consequence, the earthquake recurrence parameters in that area had not been computed in the EPRI-SOG (Reference 2.5.2-201) study. Improved seismic networks have increased the detection of events in the Gulf of Mexico, and the occurrence of the two moderate events discussed in Subsection 2.5.2.1.1 indicates that seismicity in this area needs to be considered a potential contributor to the seismic hazard at the RBS site.

A new catalog completeness region covering the Gulf of Mexico has been created for this purpose. The region is bounded to the north by EPRI-SOG (Reference 2.5.2-201) completeness Regions 2 and 3; to the east by Region 13; it extends south to latitude 24°N. The extent of this region is shown in Figure 2.5.2-201, and its relationship to the EPRI-SOG EST seismic sources is shown in Figures 2.5.2-203 through 2.5.2-208.

The P^D values for the new Gulf of Mexico completeness region were estimated adopting the same procedure used in the EPRI-SOG study (Reference 2.5.2-201). The methodology employs a matrix of probability of detection of earthquakes for selected time and magnitude intervals. A time interval ranging from 1984 through 2006 was added to the intervals used in the EPRI-SOG (Reference 2.5.2-201) assessment to include the most recent earthquakes in the analysis.

The P^D values for the Gulf of Mexico region were evaluated using the EPRI-SOG software package EQPARAM under the same conditions applied in the EPRI-SOG study (Reference 2.5.2-201), as follows:

- No spatial smoothing of parameter a.
- Medium smoothing of parameter b.
- Moderate smoothing of the probability of detection.
- Monotonicity in over body-wave magnitudes and time intervals.
- Probability of detection fixed to 1 for certain body-wave magnitude and time intervals.

The process used for spatially smoothing seismicity parameters a, b, and P^D is described in the EPRI-SOG study (Reference 2.5.2-201). In addition, the P^D value is not computed for the time intervals prior to 1950 because no events are reported prior to that date. Table 2.5.2-213 shows the assessed P^D values for this region. These values were used to compute the earthquake occurrence parameters for the EPRI-SOG EST source zones that include portions of the Gulf of Mexico.

2.5.2.4.2 New Information Relative to Earthquake Ground Motions

2.5.2.4.2.1 Models for Median Ground Motions

The EPRI (Reference 2.5.2-202) calculation of seismic hazard characterized epistemic uncertainty in median (mean log) earthquake ground motions by using three strong-motion attenuation relationships: McGuire et al. (Reference 2.5.2-270), Boore and Atkinson (Reference 2.5.2-271), and Nuttli (Reference 2.5.2-272), combined with the response spectral relationships of Newmark and Hall (Reference 2.5.2-273). These relationships were based to a large extent on modeling earthquake ground motions using simplified physical models of earthquake sources and wave propagation.

Estimating earthquake ground motions in the CEUS has been the focus of considerable research since completion of the EPRI-SOG studies. The research has produced a number of ground-motion attenuation relationships. EPRI completed a study in 2004 to update methods used to characterize the estimation of strong ground motion in the CEUS for application in PSHA for nuclear facilities (Reference 2.5.2-274). This study was conducted following the SSHAC guidelines for a Level III analysis (Reference 2.5.2-275). SSHAC provided guidance on the appropriate methods to use for quantifying uncertainty in evaluations of seismic hazard (Reference 2.5.2-275). In an SSHAC Level III analysis, the responsibility for developing the quantitative description of the uncertainty distribution for the quantity of interest lies with an individual or team designated the Technical Integrator. The Technical Integrator is guided by a panel of experts whose role is to provide information, advice, and review. In the EPRI study, a panel of six ground-motion experts was assembled (Reference 2.5.2-274). During a series of workshops, the experts provided advice on the available CEUS ground-motion attenuation relationships that were considered appropriate for estimating strong ground motion in the CEUS. The experts also provided information on the appropriate criteria for evaluating the available ground-motion models. The Technical Integrator then used this information to develop a composite representation of the current scientific understanding of ground-motion attenuation in the CEUS.

The EPRI study recommended four alternative sets of median ground-motion models (termed model clusters) to represent alternative modeling approaches for defining the median ground motions as a function of earthquake magnitude and source-to-site distance (Reference 2.5.2-274). Three of these ground-motion clusters are appropriate for use in assessing the hazard from moderate-sized local earthquakes occurring randomly in source zones, and all four are to be used for assessing the hazard from sources whose hazard contribution is from large-magnitude earthquakes.

EPRI (Reference 2.5.2-274) proposed the logic-tree structure to be used with these models that is shown on the left-hand side of Figure 2.5.2-220. The first (leftmost) level of the logic tree shown in the figure provides the weights assigned to the three median cluster models appropriate for local sources. The second level addresses the appropriate ground-motion cluster model to use for large-magnitude distant earthquake sources. For the RBS site, these sources are New Madrid-related sources (those defined in both the EPRI-SOG model, listed in Tables 2.5.2-202 through 2.5.2-207, and the model for repeated large-magnitude earthquakes at New Madrid). Two alternatives are provided: (1) to use the cluster model used for the local sources, and (2) to use the Cluster 4 model. The effect of this logic structure on the PSHA is that by following the branch for Cluster 1 at the first node, two options are available: (1) to use the Cluster 1 model for the large-magnitude sources, and (2) to use Cluster 4 for the large-magnitude sources and Cluster 1 for all other sources. This same logic is repeated for the branches for Clusters 2 and 3. The rift version of the Cluster 4 model was used for the New Madrid sources.

EPRI provided estimates of the epistemic uncertainty in the median ground-motion model for each cluster (Reference 2.5.2-274). As shown by the third level of the logic tree (Figure 2.5.2-220), the uncertainty in each cluster median model is modeled by a three-point discrete distribution with ground-motion relationships for the 5th, 50th, and 95th percentiles of the epistemic uncertainty in the median attenuation relationship for each ground-motion cluster.

The EPRI (Reference 2.5.2-274) median ground-motion median models for Clusters 1, 2, and 3 were based in large part on the CEUS ground-motion models developed by Silva et al. (Reference 2.5.2-276), Atkinson and Boore (Reference 2.5.2-277), and Campbell (Reference 2.5.2-278), respectively. Silva et al. (Reference 2.5.2-279) and Atkinson and Boore (Reference 2.5.2-280) have since developed updated versions of their models. In addition, Tavakoli and Pezashk (Reference 2.5.2-281) present a hybrid ground-motion model for the CEUS based on the approach developed by Campbell (Reference 2.5.2-278). These newer models are compared to the EPRI (Reference 2.5.2-274) models in Figure 2.5.2-221.

The two plots on the left of Figure 2.5.2-221 compare the EPRI (Reference 2.5.2-274) 5th percentile, 50th percentile, and 95th percentile 10 Hertz (Hz) and 1 Hz median models for ground-motion Cluster 1 with the three single-corner stochastic models developed by Silva et al. (Reference 2.5.2-279). The updated models all fall well within the range of the EPRI (Reference 2.5.2-274) models.

The two plots in the center of Figure 2.5.2-221 compare the EPRI (Reference 2.5.2-274) 5th percentile, 50th percentile, and 95th percentile 10 Hz and 1 Hz median models for ground-motion Cluster 2 with the model developed by Atkinson and Boore (Reference 2.5.2-280). The Atkinson and Boore (Reference 2.5.2-280) model uses rupture distance as the distance measure, while the EPRI (Reference 2.5.2-274) Cluster 2 models use Joyner-Boore distance. The comparisons shown in Figure 2.5.2-221 were made assuming that the top of rupture for the **M** 5 earthquake is at a depth of 2.5 mi. (4 km), based on a mean point-source depth of 3.7 mi. (6 km) (Reference 2.5.2-276). The median ground motions produced by the updated Atkinson and Boore (Reference 2.5.2-280) model fall within the range of or below the EPRI (Reference 2.5.2-274) Cluster 2 medians except for distances less than about 4.3 mi. (7 km) for large magnitude earthquakes.

The two plots on the right of Figure 2.5.2-221 compare the EPRI (Reference 2.5.2-274) 5th, 50th, and 95th percentile 10 Hz and 1 Hz median models for ground-motion Cluster 3 with the model developed by Tavakoli and Pezeshk (Reference 2.5.2-281). The Tavakoli and Pezeshk (Reference 2.5.2-281) model predictions generally fall within the range of the EPRI (Reference 2.5.2-274) Cluster 3 medians except for small magnitudes at short rupture distances.

As presented in Subsection 2.5.2.4.4, large-magnitude earthquakes at very small distances are not a significant contributor to the hazard. Also, small-magnitude earthquakes have only a small contribution to the low-frequency (LF) hazard. On the basis of the comparisons shown in Figure 2.5.2-221, it is concluded that the EPRI (Reference 2.5.2-274) median ground-motion models are appropriate for use in computing the hazard for the RBS site.

2.5.2.4.2.2 Models for Ground-Motion Aleatory Variability

The EPRI study (Reference 2.5.2-274) also provided a characterization of the aleatory variability in CEUS ground motions based on an assessment of information available at the time. More recently, EPRI conducted a study focused in part on evaluating the appropriate aleatory variability for CEUS ground motions (Reference 2.5.2-282). The thrust of the study was to identify reasons why the aleatory variability for CEUS motions may be different than that observed for the large empirical database of strong ground motion in the western United States and other tectonically active regions, and then evaluate the extent to which these reasons are supported by empirical data. The result of the EPRI study was a recommended model for aleatory variability for CEUS ground motions (Reference 2.5.2-282).

The EPRI (Reference 2.5.2-282) model for aleatory variability in CEUS ground motions is represented by the fourth and fifth levels of the ground-motion logic tree shown in Figure 2.5.2-220. The fourth level of the logic tree addresses the overall aleatory model. Two alternatives were defined: (1) Model 1A is based on western United States (WUS) aleatory variability with an additional component of intra-event variability for CEUS earthquakes, and (2) Model 1B is unmodified WUS aleatory variability. Model 1A was favored based on the available data.

The EPRI model included an additional component of aleatory variability to account for variability in source depth at small source-to-site distances when the Joyner-Boore distance measure is used for ground-motion models based on point-source numerical simulations (Reference 2.5.2-274). EPRI (Reference 2.5.2-282) evaluated the empirical evidence for additional aleatory variability at small Joyner-Boore distances and concluded that the adjustments proposed by EPRI (Reference 2.5.2-274) were not supported by empirical data. Instead, the following three alternatives were recommended:

1. Model 2A - No adjustment.

2. Model 2B - An additional 0.12 standard error in the natural log of ground-motion amplitude.

3. Model 2C - An additional 0.23 standard error.

The additional standard error is to be combined with Model 1A or 1B as the sum of variances to produce the final standard error for Joyner-Boore distances less than or equal to 6.2 mi. (10 km). A log-linear decrease in the additional standard error is to be applied over the distance range of 6.2 to 12.4 mi. (10 to 20 km), with no additional adjustment for distances greater than 12.4 mi. (20 km). These alternative models define the fifth level of the logic tree shown in Figure 2.5.2-220. These additional standard error models are applied to the EPRI median models that use the Joyner-Boore distance measure (Clusters 1, 2, and 4) (Reference 2.5.2-274).

2.5.2.4.2.3 Conversion from Body-Wave to Moment Magnitude

The last level of the ground-motion logic tree shown in Figure 2.5.2-220 addresses the relationship between body-wave magnitude, m_b, and moment magnitude, **M**. This conversion is required because the EPRI ground-motion models (References 2.5.2-274 and 2.5.2-282) are defined in terms of **M**, whereas the EPRI-SOG recurrence rates are defined in terms of m_b. The epistemic uncertainty in the conversion between m_b and **M** was addressed by using the three m_b-**M** relationships.

1. By Atkinson and Boore (Reference 2.5.2-277):

$$\mathbf{M} = -0.39 + 0.98 m_b \quad \text{for } m_b \leq 5.5$$
$$\mathbf{M} = 2.715 - 0.277 m_b + 0.127 m_b^2 \quad \text{for } m_b > 5.5$$
Equation 2.5.2-4

2. By Johnston (Reference 2.5.2-283):

$$\mathbf{M} = 1.14 + 0.24 m_b + 0.0933 m_b^2$$
Equation 2.5.2-5

3. By EPRI (Reference 2.5.2-219):

$$m_b = -10.23 + 6.105\mathbf{M} - 0.7632\mathbf{M}^2 + 0.03436\mathbf{M}^3$$
Equation 2.5.2-6

These three models are assigned equal weight, because the models are all credible. Note that one model is given an extra digit in the last place so that the weights sum to exactly 1.0.

2.5.2.4.3 PSHA Sensitivity Analysis

This subsection describes the sensitivity studies that were carried out to address any need for changes in the EPRI-SOG PSHA model used in EPRI (Reference 2.5.2-202). Based on the assessments in Subsection 2.5.2.4, and consistent with the requirements of Regulatory Guide 1.165, Regulatory Position E.3, the following PSHA model adjustments were studied as part of PSHA sensitivity tests for the RBS site:

- Selection of appropriate set of seismic sources for each EPRI-SOG expert team.
- Sensitivity to new data relative to the occurrence of large earthquakes in the NMSZ.

- Sensitivity to the updated maximum magnitude distributions for seismic sources extending into the Gulf of Mexico.

- Sensitivity to the updated seismicity parameters for seismic sources extending into the Gulf of Mexico.

- Sensitivity to the updated maximum magnitude distributions for Gulf Coast seismic zone sources.

- Sensitivity to adjustment in earthquake occurrence rates based on the updated earthquake catalog.

Sensitivity analyses were not conducted to address the effect of the updated ground-motion models developed by EPRI (References 2.5.2-274 and 2.5.2-282) because these have become the standard set of models for the assessment of seismic hazards for proposed new power plants.

2.5.2.4.3.1 Selection of EPRI-SOG Seismic Sources

As discussed above in Subsection 2.5.2.2.1, the specific subset of EPRI-SOG seismic sources to include for each EST was assessed using the updated EPRI ground-motion models that will be used to compute the PSHA for the RBS site (References 2.5.2-274 and 2.5.2-282). The sources examined included those within 200 mi. (320 km) of the site and those at larger distances with somewhat higher rates of seismicity. These calculations were performed for each individual team. Seismic sources were added until additional sources produced less than a 1 percent increase in the frequency of exceedance in the 10^{-4} to 10^{-5} range. The source contributions were tested for 10 Hz and 1 Hz ground motions. The calculations were performed using the preferred set of ground-motion models for each ground-motion cluster (i.e., the highest weighted path through the logic tree for each ground-motion cluster). This corresponds to the use of the 50th percentile cluster median model and aleatory variability Models 1A and 2A. A single m_b-**M** conversion relationship was used (Reference 2.5.2-277).

Subsection 2.5.2.4.1.2 presents revised maximum magnitude distributions for sources that extend into the Gulf of Mexico, and Subsection 2.5.2.4.1.5discusses updated calculation of seismicity parameters for an extension of the EPRI-SOG catalog completeness regions into the Gulf of Mexico. Both of these updates to the EPRI-SOG seismic source characterization are expected to be implemented in the PSHA for the RBS site. Therefore, these modifications were made prior to the assessment of the appropriate set of EPRI-SOG seismic sources. The calculations were also performed including the contributions from the source of repeated large earthquakes at New Madrid described in Subsection 2.5.2.4.1.1 and the Saline River source described in Subsection 2.5.2.4.1.3, as these sources are also expected to be included in the PSHA for the RBS site.

EPRI (Reference 2.5.2-274) provided ground-motion models for two regions of the CEUS, the mid-continent region that covered most of CEUS and the Gulf

Coast region. The Gulf Coast region was originally defined by EPRI (Reference 2.5.2-219) as an area with a higher rate of ground-motion attenuation than the remaining portion of the CEUS. This region is shown in relationship to the EPRI-SOG EST sources in Figures 2.5.2-203 through 2.5.2-208. The Gulf Coast ground-motion models were used for those sources where the travel path is primarily through the Gulf Coast region, and the mid-continent model was used for those sources where a substantial portion of the travel path is through the mid-continent region.

2.5.2.4.3.1.1 Bechtel Team Seismic Sources

Figure 2.5.2-222 shows the mean hazard curves computed for the Bechtel team's sources listed in Table 2.5.2-202 and shown in Figure 2.5.2-203. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid Fault Zone Source 30. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone BZ1.

2.5.2.4.3.1.2 Dames & Moore Team Seismic Sources

Figure 2.5.2-223 shows the mean hazard curves computed for the Dames & Moore team's sources listed in Table 2.5.2-203 and shown in Figure 2.5.2-204. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid-related Sources 21 and 22. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone 20 and the Ouchita Fold Belt Source 25.

2.5.2.4.3.1.3 Law Engineering Team Seismic Sources

Figure 2.5.2-224 shows the mean hazard curves computed for the Law Engineering team's sources listed in Table 2.5.2-204 and shown in Figure 2.5.2-205. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid-related Source 18. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone 126.

2.5.2.4.3.1.4 Rondout Associates Team Seismic Sources

Figure 2.5.2-225 shows the mean hazard curves computed for the Rondout Associates team sources listed in Table 2.5.2-205 and shown in Figure 2.5.2-206. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid-related Source 1. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone 51.

2.5.2.4.3.1.5 Weston Geophysical Team Seismic Sources

Figure 2.5.2-226 shows the mean hazard curves computed for the Weston Geophysical team's sources listed in Table 2.5.2-206 and shown in Figure 2.5.2-207. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid-related Source 31. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone 107.

2.5.2.4.3.1.6 Woodward-Clyde Consultants Team Seismic Sources

Figure 2.5.2-227 shows the mean hazard curves computed for the Woodward-Clyde Consultants team's sources listed in Table 2.5.2-207 and shown in Figure 2.5.2-208. The figure shows only the contributions from the sources in the vicinity of the RBS site. The EPRI (Reference 2.5.2-274) ground-motion Cluster 4 models are only applied to the New Madrid-related Source 40. The EPRI (Reference 2.5.2-274) Gulf Coast ground-motion models are applied to the Host Source Zone B42.

2.5.2.4.3.2 PSHA Sensitivity to Revisions of EPRI-SOG Sources and Additional Sources

Figure 2.5.2-228 shows the effect of possible revisions of the EPRI-SOG seismic sources on the total hazard at the RBS Site. Both the modifications to the maximum magnitude distributions for Gulf of Mexico sources and the inclusion of additional seismicity in the Gulf of Mexico result in increases in the calculated hazard at the RBS site. Figure 2.5.2-229 shows the effect of inclusion of the source of repeated large earthquakes at New Madrid and the Saline River source on the total hazard for the RBS site. The inclusion of the source of repeated large New Madrid earthquakes increases the total mean hazard, particularly for 1 Hz spectral acceleration. Updating the maximum magnitude distributions for the EPRI-SOG New Madrid sources to prevent double counting of large earthquakes produces a small decrease in the hazard from the EPRI-SOG source. However, this decrease occurs at ground-motion levels where the source of repeated large earthquakes at New Madrid is the dominant source and thus has limited effect on the total hazard. The Saline River source has a small contribution to the total hazard at the RBS site.

Based on these results, the updated PSHA for the RBS site is conducted using the updates to the maximum magnitude distributions for the EPRI-SOG seismic sources described above and given in Tables 2.5.2-202 through 2.5.2-207. The updated seismicity parameters that account for earthquakes occurring in the Gulf of Mexico completeness region are also included. The source of repeated large earthquakes at New Madrid and the Saline River source are both included in the analysis.

2.5.2.4.4 PSHA for the RBS Site

The PSHA for the RBS site was conducted using the updated seismic source model described in Subsection 2.5.2.4.3.2. Earthquake ground motions were modeled using the median ground-motion models and the ground-motion aleatory variability models developed by EPRI (References 2.5.2-274 and 2.5.2-282). The logic tree defining the epistemic uncertainty in the ground-motion characterization is shown in Figure 2.5.2-220.

The hazard analysis was conducted using the m_b magnitude scale because the earthquake occurrence rates for the EPRI-SOG seismic sources are defined in terms of mb magnitudes. Epistemic uncertainty in the conversion from m_b magnitudes to moment magnitudes (**M**) for ground-motion estimation was modeled by using the three equally weighted conversion relationships listed in Figure 2.5.2-220. Conversion of the moment magnitude estimates for the size of the repeated earthquakes associated with New Madrid and for the maximum magnitude distributions for the Saline River source into m_b magnitudes for summation of the hazard was done in a consistent manner such that the original value of **M** was recovered for ground-motion estimation. For example, when the Atkinson and Boore (Reference 2.5.2-277) relationship was used to convert m_b to **M** for ground-motion estimation, its inverse was used to convert the **M** values for the New Madrid and Saline River earthquakes into m_b values.

Earthquakes occurring in the EPRI-SOG seismic sources were modeled as epicenters, and the EPRI models for distance adjustment and additional aleatory variability resulting from the use of epicenters to model earthquakes were applied (Reference 2.5.2-274). The models based on the assumption of a random rupture location with respect to the epicenter were used. Earthquakes occurring on the New Madrid source of repeated large earthquakes were modeled as extended ruptures, and the distance adjustment and additional aleatory variability models were not applied to these sources.

EPRI concluded that there was no basis for truncation of the lognormal distribution for ground-motion amplitude other than the strength of the subsurface materials (Reference 2.5.2-282). Accordingly, untruncated lognormal distributions for earthquake ground motions were used in the PSHA.

The EPRI ground-motion models represent the ground motions for a generic hard rock condition in the CEUS (Reference 2.5.2-274). Thus, the site-specific PSHA results presented in this subsection represent the motions on outcropping rock, with a shear wave velocity (V_s) in excess of approximately 2743 meters per second (m/s) (9000 feet per second [fps]). The effect of the sediments overlying this generic rock condition on defining the hazard at other locations is addressed in Subsections 2.5.2.5 and 2.5.2.6.

The initial generic CEUS hard rock hazard was computed using a fixed lower bound magnitude of m_b 5.0. These results were used to develop the appropriate response spectra and time histories for the site response analyses. Once the site amplification functions were developed, a second hazard assessment was performed incorporating the CAV approach to define the minimum magnitude truncation for the PSHA.

2.5.2.4.4.1 PSHA Results for Generic Hard Rock Conditions

PSHA calculations were performed for response spectral accelerations at the seven structural frequencies provided in the EPRI ground-motion model: 0.5, 1.0, 2.5, 5, 10, 25, and 100 Hz (peak ground acceleration [PGA]) (Reference 2.5.2-274). Figures 2.5.2-230 through 2.5.2-236 show the resulting mean hazard curves and the 5th, 16th, 50th (median), 84th, and 95th fractile hazard curves for each ground-motion measure. These values are listed in Tables 2.5.2-214 through 2.5.2-220. At low spectral frequencies ($\leq$1 Hz) the mean hazard approaches or exceeds the 84th percentile hazard due to the relatively large epistemic uncertainty in the ground-motion models at these frequencies as compared to that for higher-frequency ground motions (e.g., refer to Figure 2.5.2-221).

Figure 2.5.2-237 shows the contribution of the three source types to the mean hazard for 10 Hz and 1 Hz spectral acceleration. As found in the sensitivity test described in Subsection 2.5.2.4.3.2, the source of repeated large earthquakes at New Madrid produces comparable hazard or larger hazard than that obtained from the updated EPRI-SOG sources for 10 Hz motions, and it dominates the hazard for 1 Hz motions. The Saline River source has a small contribution to the hazard at the RBS site.

Figure 2.5.2-238 shows the effect of the alternative ground-motion cluster models on the mean hazard. As described in Subsection 2.5.2.4.2.1, the Cluster 4 model is only used for seismic sources where the hazard is dominated by large magnitude earthquakes. Thus, the results labeled Cluster 4 represent the mean hazard computed by using only the Cluster 4 models for the large magnitude sources (e.g., the repeated large earthquake source at New Madrid) combined with the weighted average of the hazard obtained from the other three cluster models for all other sources. In general, the use of the Cluster 3 ground-motion model produces the highest hazard.

Figure 2.5.2-239 shows the effect of the epistemic uncertainty in the median ground-motion models for each cluster on the mean hazard. The uncertainty in the hazard is somewhat greater for low frequency motions than for high-frequency (HF) motions, reflecting greater uncertainty in the median LF ground-motion models. Examination of the hazard results led to the conclusion that the alternative aleatory variability models developed by EPRI (Reference 2.5.2-282) produced similar hazard.

Figure 2.5.2-240 shows the effect of using the alternative m_b-**M** conversion relationships on the computed mean hazard. Similar estimates of seismic hazard are obtained using each of the relationships. The effect of the alternative models on the hazard disappears at ground-motion levels where the hazard is dominated by the source of repeated large earthquakes at New Madrid. As discussed previously, the alternative models were used in such a way that the moment magnitudes for the repeated large earthquakes specified in Figure 2.5.2-211 are always used for ground-motion estimation.

Figure 2.5.2-241 shows the range in the computed hazard from just the updated EPRI-SOG sources and the mean hazard obtained from the seismic source models for the individual teams. The difference between the individual teams' results is somewhat greater for 10 Hz motion than for 1 Hz motions.

The other model uncertainties that were found to have a significant contribution to the uncertainty in the hazard were the uncertainty in the seismicity parameters for the 10 Hz motions and the uncertainty in the expected magnitude of the repeated large earthquakes occurring at New Madrid.

2.5.2.4.4.2 Uniform Hazard Spectra for Generic CEUS Rock and Identification of Controlling Earthquakes

The mean hazard results listed in Tables 2.5.2-214 through 2.5.2-220 were interpolated to obtain uniform hazard response spectra (UHRS) for generic CEUS hard rock conditions. The spectra were computed for mean annual frequencies of exceedance of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6}. These spectra are shown in Figure 2.5.2-242 and listed in Table 2.5.2-221.

Figures 2.5.2-243 through 2.5.2-246 show the deaggregation of the mean hazard for the four values of exceedance frequency. Following the procedure outlined in Appendix D of Regulatory Guide 1.208, the deaggregation is conducted for two frequency bands: (1) the average of the 5 Hz and 10 Hz hazard results representing the HF range, and (2) the average of the 1 Hz and 2.5 Hz hazard results representing the LF range. The results shown on the figures were obtained by first computing the percentage contribution of events in each magnitude-distance bin individually for the four spectral frequencies (1, 2.5, 5, and 10 Hz). The HF deaggregation was then obtained by averaging these values for 5 and 10 Hz, and the LF deaggregation obtained by averaging the results for 1 and 2.5 Hz. The HF deaggregation shows a progression from domination of the hazard by large, distant earthquakes at a mean exceedance frequency of 10^{-3} to dominance by nearby small to moderate magnitude earthquakes at a mean exceedance frequency of 10^{-6}. This effect can be seen in the change in shapes of the UHRS, which become more sharply peaked at 25 Hz as the contributions from nearby smaller magnitude earthquakes increase. The LF deaggregation indicates that the distant large magnitude earthquakes dominate the hazard at the 10^{-3}, 10^{-4}, and 10^{-5} levels of exceedance frequency. At an exceedance frequency of 10^{-6}, the nearby, smaller-magnitude earthquakes have a larger contribution to the hazard.

Appendix C of Regulatory Guide 1.165 specifies how the deaggregation results are used to define what are called controlling earthquakes for the HF and LF motions. These earthquakes represent the weighted mean magnitude and weighted geometric mean distance, where the weights are defined by the relative contributions to the total hazard for each magnitude and distance interval. Table 2.5.2-222 lists the mean magnitudes and geometric mean distances computed for the HF and LF spectral frequency ranges for the four mean annual frequency-of-exceedance levels. The values for the LF hazard are listed considering all earthquakes and considering only those earthquakes occurring at distances greater than 62 mi. (100 km), consistent with the procedure outlined in Appendix C of Regulatory Guide 1.165.

The approaches to be used to compute the effects of the RBS site sediments on the generic hard rock motions are described in McGuire et al. (Reference 2.5.2-284). These approaches define what are called reference earthquakes (REs). The REs are defined in the same manner as the controlling earthquakes defined in Appendix C of Regulatory Guide 1.165.

Comparison of the computed controlling or RE magnitudes and distances with the deaggregation results indicates that, in many cases, the mean magnitude and mean distance correspond to a magnitude-distance bin that has a relatively small contribution to the hazard, particularly for the HF hazard results. The site response approaches described in McGuire et al. (Reference 2.5.2-284) address this problem by using a range of magnitude-distance pairs to reflect the distribution of earthquakes contributing to the HF and LF hazard. Typically, two or three deaggregation earthquakes (DEs) are adequate to represent the distribution of earthquakes contributing to the hazard. For the RBS site, the bimodal distribution of magnitude contribution suggests that two DEs should adequately represent the distribution of magnitude contributions to the hazard. These are designated DEL and DEH for the low-magnitude and high-magnitude DEs, respectively.

For the RBS site, the DEL and DEH magnitude-distance values were defined to represent the modes in the magnitude-distance deaggregation. As shown by the red and green color coding in Figures 2.5.2-243 through 2.5.2-246, two magnitude distance domains were identified that represent peaks in the deaggregated hazard, and in combination, they account for greater than 99 percent of the hazard. The DE magnitude and distances are computed as the weighted mean values over the defined domains. The resulting DEs are listed in Table 2.5.2-222. The weight assigned to each DE is defined by the relative contribution of the earthquakes in the magnitude distance domain to the total hazard. The resulting weights are listed in the right-hand column of Table 2.5.2-222. The weighted combination of the DEs also produces a magnitude-distance pair that is very close to the RE.

2.5.2.4.4.3 Response Spectra for Reference Earthquakes

Smooth response spectra were developed to represent each of the REs listed in Table 2.5.2-222. These spectra were developed using the EPRI (Reference 2.5.2-274) median ground-motion models, the EPRI (Reference 2.5.2-282) aleatory variability models, and the spectral shape functions for CEUS ground motions presented in McGuire et al. (Reference 2.5.2-284). The McGuire et al. (Reference 2.5.2-284) spectral shape models are also used to extrapolate the EPRI median ground-motion model from a frequency of 0.5 Hz down to a frequency of 0.1 Hz (spectral period of 10 seconds) to construct response spectra for the HF RE events. The magnitudes and distances for these events fall within the ranges of values considered by McGuire et al. (Reference 2.5.2-284) in developing their spectral shapes. These RE response spectra are shown in Figures 2.5.2-247 through 2.5.2-250 for exceedance frequencies of 10^{-3}, 10^{-4}, 10^{-5}, and 10^{-6}, respectively.

The LF RE events represent large earthquakes occurring at large distances from the RBS site. The ability of the McGuire et al. (Reference 2.5.2-284) spectral shape models to represent the LF portion of the spectrum for these events was examined by comparing the predicted spectral shape with spectral shapes of recent CEUS ground-motion models that provide ground-motion values at frequencies below 0.5 Hz. Figure 2.5.2-251 presents response spectral shapes for a moment magnitude 7-3/4 earthquake at a distance of 336 mi. (540 km). This magnitude is the average moment magnitude converted from the m_b value of 7.3 representing the LF REs, and the distance is the closest distance to the source of the repeated large earthquakes at New Madrid. The spectral shapes are presented in terms of pseudo-spectral velocity, as this provides a clearer picture of the LF spectral shape. The spectral shapes are normalized by the predicted amplitude at a frequency of 0.5 Hz, as it is the extrapolation below 0.5 Hz that is of interest. Normalized spectral shapes are presented for the two McGuire et al. (Reference 2.5.2-284) CEUS spectral shape models and for a number of recently developed models. Shown are normalized spectral shapes obtained using the models of Campbell (Reference 2.5.2-278), Silva et al. (Reference 2.5.2-279), Atkinson and Boore (Reference 2.5.2-280), Tavakoli and Pezeshk (Reference 2.5.2-281), and Somerville et al. (Reference 2.5.2-285). The recently developed ground-motion models suggest that the extrapolation of the response spectral shape below 0.5 Hz for this large, distant earthquake is closer to constant spectral velocity (1/T spectral acceleration scaling). Therefore, constant spectral velocity scaling was used to extend the LF RE spectra from 0.5 Hz to 0.1 Hz.

The extrapolation from 0.5 Hz to 0.1 Hz requires an assessment of the aleatory variability in spectral acceleration at frequencies less than 0.5 Hz. The EPRI (Reference 2.5.2-282) models are based on empirical ground-motion models developed as part of the Pacific Earthquake Engineering Research (PEER) Center's Next Generation Attenuation (NGA) Project. The five NGA ground-motion models available from PEER (References 2.5.2-286 through 2.5.2-290) include estimates of aleatory variability for spectral frequencies between 0.1 and 100 Hz. These models indicate that the standard deviation of the natural log of spectral acceleration is, on average, 15 percent higher at a frequency of 0.1 Hz than it is at a frequency of 0.5 Hz. A linear increase in aleatory variability with decreasing log frequency from 0 percent at 0.5 Hz to 15 percent at 0.1 Hz was used to extend the EPRI (Reference 2.5.2-274) aleatory variability models down to a frequency of 0.1 Hz. The calculation is then repeated for each combination of median, aleatory variability, and m_b-**M** conversion defined in the ground-motion model logic tree (Figure 2.5.2-220). A weighted average of these spectra is then computed using the weights defined in Figure 2.5.2-220. The resulting spectral shape is then smoothed and rescaled to match on average the UHRS at 1 and 2.5 Hz. The resulting LF RE response spectra are shown in Figures 2.5.2-247 through 2.5.2-250.

As shown in Figures 2.5.2-247 through 2.5.2-250, the rock UHRS at 0.5 Hz typically lie above the LF RE spectra. The rock UHRS was extended from 0.5 Hz down to 0.1 Hz by computing a second LF RE spectrum that matches the UHRS at 0.5 Hz. This additional spectrum is denoted by the "LF Extended" spectral shape shown in Figures 2.5.2-247 through 2.5.2-250. This spectral shape was developed using constant spectral velocity scaling, as it primarily represents the hazard from a large, distant earthquake.

2.5.2.4.4.4 Response Spectra for Site Response

The site-specific surface spectra for the RBS site are developed following Approach 3 of McGuire et al. (Reference 2.5.2-284). This approach uses magnitude- and amplitude-dependent site amplification functions to scale the rock hazard to the surface conditions. These amplification functions are developed from site response analyses conducted using input motions representative of the range of earthquake magnitudes contributing to the hazard and for a range of ground-motion amplitudes. The deaggregation of the site hazard presented in Subsection 2.5.2.4.4.2 shows contributions from both small and large magnitudes. To represent this range, response spectral shapes were developed for three earthquake magnitudes: **M** 5.5, **M** 6.5, and **M** 7.7. The spectral shapes were developed in terms of moment magnitudes to be consistent with the magnitude scale used in the EPRI (Reference 2.5.2-274) ground-motion models used in the hazard calculation. Figure 2.5.2-252 shows the three spectral shapes. The **M** 5.5 and **M** 6.5 spectral shapes were developed using the same procedure as that described in Subsection 2.5.2.4.4.3 for the HF RE spectra. A source distance of 22 km was used to represent a nearby earthquake. The computed response spectra were then normalized by PGA (100 Hz spectral acceleration) to produce the spectral shapes. The **M** 7.7 spectral shape represents the hazard contribution from the New Madrid source of repeated large earthquakes. The spectral shape for this magnitude was created using the procedure described in Subsection 2.5.2.4.4.3 for the LF RE spectra. Constant spectral velocity scaling was used to extend the spectrum from 0.5 Hz to 0.1 Hz. Only the single-corner spectral shape model from McGuire et al. (Reference 2.5.2-284) was used for interpolation between the seven spectral frequencies defined in the EPRI (Reference 2.5.2-274) ground-motion model, as this shape provided a better fit to the response spectra for a large distant earthquake (Figure 2.5.2-251). However, the resulting spectral shape between 25 Hz and 100 Hz appeared to be too high in comparison with the spectral shapes predicted for a large, distant earthquake by the various ground-motion models used to develop Figure 2.5.2-251. Therefore, the high frequency portion of the **M** 7.7 spectral shape was adjusted to lower the amplitudes above 25 to provide a smooth transition to 100 Hz, as shown in Figure 2.5.2-252.

2.5.2.5 Seismic Wave Transmission Characteristics of the Site

The UHRS shown in Figure 2.5.2-242 represent ground motions occurring under generic CEUS hard rock conditions. As described in Subsection 2.5.1.2.3, the materials underlying the RBS site consist of a deep deposit of sands and clays, thus necessitating an assessment of site amplification to develop the site surface motions.

Site response analyses were conducted to evaluate the effect of the sedimentary deposits on the generic CEUS hard rock ground motions. The intent of these analyses is to develop ground motions at the surface that are hazard consistent with the hazard levels defined for the generic rock conditions. This hazard consistency is achieved through the use of the site response Approach 3 outlined in NUREG/CR-6728 (Reference 2.5.2-284). The following steps are involved in this approach:

1. Characterize the dynamic properties of the subsurface materials.
2. Randomize these properties to represent their uncertainty and variability across the site.
3. Based on the deaggregation of the rock hazard, define the distribution of magnitudes contributing to the hazard and develop response spectra appropriate for these earthquakes.
4. Obtain appropriate rock site time histories to match the response spectra defined in Step 3.
5. Compute site amplification functions that define the median site amplification and its variability.
6. Integrate the probabilistic site amplification function with the rock hazard to develop soil surface hazard curves.
7. Interpolate the soil surface hazard curves to obtain soil surface UHRS.

Step 3 of this process is described in Subsection 2.5.2.4.4.2. Steps 6 and 7 are described in Subsection 2.5.2.6. Steps 1, 2, 4, and 5 are presented in this subsection.

2.5.2.5.1 Dynamic Properties of the RBS Site

2.5.2.5.1.1 Site Stratigraphy and Seismic Velocities

The development of the design seismic-wave velocity profile for the RBS site is described in Subsection 2.5.4.7.3. This profile is summarized in Table 2.5.2-223 and is shown in Figures 2.5.2-253 and 2.5.2-254. The surface elevation is 97.5 ft. The material between Elevation 97.5 and Elevation 20 ft. will consist of granular backfill placed during construction. The first in situ soil layer is encountered at Elevation 20 ft. and is the granular Lower Citronelle Formation. The soils between Elevation -45 ft. and Elevation -281 ft. consist of clays of the Pascagoula Formation. The sandy Pascagoula Zone 1 aquifer is encountered between Elevation -281 ft. and -426 ft. Clays of the Pascagoula Formation are again encountered below Elevation -426 ft.

The velocity profile at greater depth is shown in Figure 2.5.2-254. The site stratigraphy and velocity profile at depth were interpreted from data from three deep wells in the site region. At a depth of approximately 9000 ft., these borings encountered sediments of the Wilcox group. There is an appreciable increase in velocity in the sediments of the Wilcox group and the deeper sediments.

The shear-wave velocities of the sediments within the upper 500 ft. are based on velocity measurements obtained at the RBS site. The shear-wave velocities at depth are interpreted from the compression-wave velocities measured in the deep wells. The compression-wave velocities in the Pascagoula sediments were assessed from the compression wave velocity data measured at the site. The compression-wave velocity in the Lower Citronelle Formation and in the granular fill below the water table was set at the compression-wave velocity for water since these materials will be below the design water table. The compression-wave velocity in the fill above the water table was interpreted from the assigned shear-wave velocities using a Poisson's ratio of 0.2 based on published values for dense granular soils. The standard deviation in the shear-wave velocities is based on the site measurements.

2.5.2.5.1.2 Density

Table 2.5.2-223 lists the assigned average unit weight of the subsurface materials. The values for the materials within the upper 500 ft. are based on RBS site data. The increase in velocity within the Wilcox Group is indicative of greater consolidation of these materials, as a small increase in total unit weight is assumed to occur.

2.5.2.5.1.3 Shear Modulus and Damping

Subsection 2.5.4.2.2.2 describes the results of dynamic testing of the RBS site soils. Based on these results, published relationships were selected to define the strain dependent shear modulus and damping ratios for the site soils. The EPRI (Reference 2.5.2-219) relationships for a depth range of 120 to 250 ft. were found to be consistent with the laboratory test data for the granular fill and Lower Citronelle soils, and EPRI (Reference 2.5.2-219) relationships for a depth range of 500 to 1000 ft. were found to be consistent with the laboratory test data for the Pascagoula sands. The Vucetic and Dobry (Reference 2.5.2-291) relationships for clayey soils with a plasticity index (PI) of 30 were found to be consistent with the laboratory data for the Pascagoula clays above the Pascagoula sands, and those for a PI of 50 were found to be consistent with the data for the Pascagoula clays below the sands. These relationships are shown in Figure 2.5.2-255.

Site response analysis studies have shown that consistency with observed strong ground motions is usually achieved using the assumption that the deeper sediments behave linearly during earthquake shaking (e.g., Reference 2.5.2-292). Therefore, the sediments below the lower Pascagoula clay layer were assumed to behave linearly. The damping within these materials was established using the following procedure.

The site response analyses were conducted using an updated version of program SHAKE originally developed by Schnabel et al. (Reference 2.5.2-293). The energy lost in shear-wave propagation was measured by the shear-wave quality factor, Q_S, which can be equated to two other representations of energy loss in wave-propagation analysis. For the linear viscoelastic wave-propagation modeling used in the computer program SHAKE, the material damping, ξ, is obtained by the relationship:

$$\xi = \frac{1}{2Q_S} \qquad \text{Equation 2.5.2-7}$$

Parameter Q_S is also related to the high-frequency attenuation parameter κ developed by Anderson and Hough (Reference 2.5.2-294) by the relationship:

$$\kappa = \frac{H}{Q_S V_S} \qquad \text{Equation 2.5.2-8}$$

where H is the thickness of the crust over which the energy loss occurs, typically taken to be 0.6 to 1.2 mi. (1 to 2 km) (Reference 2.5.2-295). Silva and Darragh (Reference 2.5.2-295) find that Q_S is proportional to shear-wave velocity:

$$Q_S = \gamma V_S \qquad \text{Equation 2.5.2-9}$$

where γ is the constant of proportionality. Using this assumption, the amount of high frequency attenuation in the i^{th} layer of a velocity profile, κ_i, is given by the relationship:

$$\kappa_i = \frac{H_i}{\gamma V_{Si}^2}$$ Equation 2.5.2-10

where H_i is the layer thickness and V_{Si} is the layer shear-wave velocity. Given the total value of κ appropriate for the site, one can solve for the corresponding value of γ. Using the resulting value of γ and Equations 2.5.2-7, 2.5.2-8, and 2.5.2-10, the appropriate damping values for each layer are then obtained.

Values of site κ derived from strong motion recordings on deep soil site are typically in the range of 0.05 to 0.07 second (References 2.5.2-292 and 2.5.2-294). Entergy Operations, Inc. (Reference 2.5.2-236) used a conservative value of 0.04 second to model the energy loss in Mississippi Embayment sediments, and this value is adopted for the analysis of the RBS site.

The value of κ of 0.04 second represents the total site κ. This includes the value already contained in the hard rock input ground motions and the value contributed by the damping in the sediments assigned based on the relationships listed in Table 2.5.2-223. The ground-motion models for the CEUS were developed assuming a shallow crustal κ of approximately 0.006 second (Reference 2.5.2-274). The amount contributed by the layers with assigned damping relationships is obtained from the low-strain damping shown in Figure 2.5.2-255 using Equations 2.5.2-7 and 2.5.2-8. The result is a κ value of 0.012 second.

The process of randomizing the site velocities described below in Subsection 2.5.2.5.1.5 introduces additional velocity reversals that may scatter energy, effectively acting as an addition to the total site κ. The impact of site randomization on the total site κ was assessed by running two analyses with low levels of input motion. One analysis used the randomized velocity profiles, and one analysis used a smoothed base case profile with uniform velocities for each major geologic unit (e.g., a single uniform velocity for the Lower Citronelle Formation and a single uniform velocity for the Pascagoula Formation). Figure 2.5.2-256 compares the median response spectra for the surface motions from these two cases. The response spectra for the two cases are essentially the same, indicating that the randomization is not introducing a significant amount of energy scattering.

Therefore, subtracting 0.006 second and 0.012 second from the assigned total of 0.04 second leaves a residual κ of 0.022 second that is used to compute the damping for the deeper layers. The resulting damping ratios are on the order of 0.7 percent for the sediments in layers 15 and 16 and 0.5 percent in the deeper layers.

2.5.2.5.1.4 Response Analysis Profiles

Regulatory Guide 1.208 states that the site SSE (specified by the ground-motion response spectrum [GMRS]) is to be defined at the ground surface or at the top of the first competent layer, nominally with a velocity of 1000 fps or greater. This point is taken to be the top of the Lower Citronelle Formation at Elevation 20 ft. This is the first in situ layer encountered within the planned area for placement of the new unit. In addition to the GMRS, foundation input response spectra (FIRS) are needed at the base of the Reactor/Fuel Building (R/FB), the Control Building (CB), and the Fire Water Service Complex (FWSC). Foundation elevations for these structures are 31.9 ft., 48.6 ft., and 89.8 ft., respectively. All of these structures will be founded on granular fill. Ground-motion estimates are also needed for the finished plant grade at Elevation 97.5 ft.

The purpose of the site response analyses is to define the amplification of ground motions from the generic CEUS hard rock conditions (shear-wave velocity of approximately 9300 fps) to the site surface conditions. The depth to a shear-wave velocity of 9300 fps or greater at the RBS site is in excess of 17,000 ft. (Figure 2.5.2-254). However, the site period for the profile shown in Figure 2.5.2-254 is a little more than 15 seconds. In fact, the period of the profile above the Wilcox Group (depth of 8900 ft.) is just over 10 seconds. Thus, the site amplification from a at a depth at the top of the Wilcox Group should capture the site amplification in the frequency range of interest (frequencies greater than or equal to 0.1 Hz or periods less than or equal to 10 seconds). Figure 2.5.2-257 shows mean site amplification functions for cases with the transition to hard rock placed at the top of the Wilcox Group at two depths: 8900 ft. and 17,600 ft. These two cases produce essentially the same site amplification in the frequency range of interest. Therefore, the site response analyses for horizontal motions were conducted placing the transition to the CEUS hard rock velocity at the top of the Wilcox Group at a depth of approximately 8900 ft. The fact that the estimated velocity at this depth is below 9300 fps does not have a significant effect on the computed site amplification for frequencies of 0.1 Hz and greater.

Site response analyses were conducted to develop site amplification functions for each of the above locations. These analyses were conducted with all of the material above the specified elevation removed, consistent with guidance in Regulatory Guide 1.208.

2.5.2.5.1.5 Randomization of Dynamic Properties

Site response analyses were conducted using randomized shear-wave velocity profiles to account for variations in shear-wave velocity. The randomized profiles were generated using the shear-wave velocity correlation model developed in Silva et al. (Reference 2.5.2-292). In this model, the shear-wave velocity in the sediment layers are modeled as correlated, lognormal distributed variables. The expression for the correlation coefficient between the velocities in two adjacent layers, ρ, is given by:

$$\rho(h,t) = (1-\rho_d(h))\rho_t(t) + \rho_d(h) \qquad \text{Equation 2.5.2-11}$$

where $\rho_d(h)$ represents the depth-dependent correlation (generally increasing with increasing depth), and $\rho_t(t)$ is the thickness-dependent correlation (generally decreasing with increasing layer thickness). The factors $\rho_d(h)$ and $\rho_t(t)$ are obtained from the expressions:

$$\rho_d(h) = \begin{cases} \rho_{200}\left[\dfrac{h+h_0}{200+h_0}\right]^b & \text{for} \quad h \le 200\text{ m} \\ \rho_{200} & \text{for} \quad h > 200\text{ m} \end{cases} \qquad \text{Equation 2.5.2-12}$$

and

$$\rho_t(t) = \rho_0 \exp\left[-\left(\frac{t}{\Delta}\right)^{\alpha}\right] \qquad \text{Equation 2.5.2-13}$$

where h is the average of the midpoint depths of layers i and i-1, and t is the difference between those midpoint depths. The correlation model parameters developed in Silva et al. for stiff soil sites were used in the simulations (Reference 2.5.2-292). The parameters for this model are as follows: ρ_0 = 0.99, ρ_{200} = 0.98, Δ = 3.9, h_0 = 0, α = 1, and b = 0.344. The standard deviations for the natural log of shear-wave velocity listed in Table 2.5.2-223 were obtained from the RBS site measurements. A minimum value of 0.1 was used for the deeper layers to account for the limited sample of data. Layer thicknesses were randomized from a uniform distribution over the range in layer thicknesses listed in Table 2.5.2-223.

Sixty randomized V_S profiles were generated for each analysis profile. Figures 2.5.2-258 and 2.5.2-259 show the randomized velocity profiles develop for the GMRS site response analysis. The statistics of the randomized profiles are compared to the input target values for median velocity and standard deviation (sigma) of $\ln(V_S)$ in Figure 2.5.2-260. Figures 2.5.2-261 and 2.5.2-262 show the randomized velocity profiles developed for the finished grade site response analysis. The statistics of the randomized profiles are compared to the input target values for median velocity and standard deviation (sigma) of $\ln(V_S)$ in Figure 2.5.2-263.

The modulus reduction and damping relationships were also randomized, as shown in Figures 2.5.2-264 through 2.5.2-267. The standard deviation in the modulus reduction and damping were based on recommendations provided in Silva et al. (Reference 2.5.2-292). The damping ratio curves were limited to a maximum of 15 percent damping, as recommended in Appendix E of Regulatory Guide 1.208.

The damping in the sedimentary rocks beneath the soil profile was also randomized in the analysis. The standard deviation of $\ln(\kappa)$ was set equal to 0.3, consistent with the variability in κ used in McGuire et al. (Reference 2.5.2-284) and EPRI (Reference 2.5.2-296). The corresponding damping ratio in the sedimentary rock layers was then computed using the randomized sedimentary rock layer velocities and thicknesses and the randomly selected value of κ.

2.5.2.5.2 Acceleration Time Histories for Input Rock Motions

Response spectral shapes were developed for **M** 5.5, 6.5, and 7.7 earthquakes, as described in Subsection 2.5.2.4.4.4. Thirty time histories were developed for each spectral shape from the time history sets given in McGuire et al. (Reference 2.5.2-284). The selected time histories were scaled to approximately match the target spectral shape using a limited number of iterations of the program RASCALS (Reference 2.5.2-297). Figure 2.5.2-268 shows the response spectra for the 30 time histories scaled to match the three spectral shapes.

The purpose of randomization of the site properties is to account for natural variability in defining the site response. Part of the natural variability results from variability in the ground motions of an individual earthquake. That is why only weak scaling of the time histories was performed. The weak scaling produces recordings that have, in general, the desired relative frequency content of the target spectra while maintaining a degree of natural variability. The use of a range of earthquake magnitudes along with a large number of recordings provides adequate coverage of the frequency band of interest. The acceleration time histories represent free-field outcropping motions for generic CEUS hard rock.

2.5.2.5.3 Site Amplification Functions

Site amplification functions were performed for the three target magnitude spectral shapes. The 60 randomized velocity profiles were paired with the 60 sets of randomized modulus reduction and damping curves (one profile with one set of modulus reduction and damping curves). Each of the 30 scaled time histories was used to compute the response of two profile-soil property curves sets. The input time histories were scaled to peak acceleration ground-motion levels in the range of 0.001 g to 3.0 g. For each analysis, the response spectrum for the computed surface motion was divided by the response spectrum for the input motion to obtain a site amplification function. Figure 2.5.2-269 shows examples of the statistics of the 60 individual site amplification functions for one analysis case. Shown are the median (mean log amplification), 16th percentile (mean - 1 standard error log amplification), 84th percentile (mean + 1 standard error log amplification), and arithmetic mean amplification.

Figure 2.5.2-270 shows the effect of the input ground-motion level on the site amplification for the GMRS analysis profile. Shown are mean amplification functions computed using a weighted combination of site amplifications computed using **M** 5.5 and **M** 7.7 input motions. The weights used are those obtained for the HF and LF DEs listed in Table 2.5.2-222. The level of input motion has a strong effect on the site amplification for spectral frequencies greater than about 1 Hz. The statistics for the level of effective strain computed in the analyses for the 10^{-4} and 10^{-5} input ground motions are shown in Figures 2.5.2-271 and 2.5.2-272, respectively. The effective strains are generally less than 0.1 percent, except for a few analysis cases at the 10^{-5} input motion level.

Figures 2.5.2-273 and 2.5.2-274 show the mean GMRS and FIRS amplification functions for 10^{-4} and 10^{-5} levels of input motion, respectively. There is only a small difference in the site amplification for the various FIRS elevations levels.

Implementation of Approach 3 from McGuire et al. (Reference 2.5.2-284) requires specification of the site amplification function in terms of magnitude and ground-motion amplitude. Figures 2.5.2-275 through 2.5.2-281 show the computed site amplifications for the individual analyses for the GMRS profile plotted versus the level of input rock motion for spectral frequencies of 100 Hz, 25 Hz, 10 Hz, 5 Hz, 2.5 Hz, 1 Hz, and 0.5 Hz, respectively. The variation in site amplification with amplitude of input motion can be well fit by the relationship:

$$\ln[AF(m,f)] = a(m,f) + b(m,f)\ln\left[\frac{PSA + c(m,f)}{c(m,f)}\right] \qquad \text{Equation 2.5.2-14}$$

This relationship is similar to the basic formulation for site effects used in the new NGA ground-motion models (e.g., Reference 2.5.2-289). Parameter a(m,f) defines the amplification for linear response at low amplitude of motion, parameter b(m,f) determines the degree of nonlinear response, and parameter c(m,f) controls the ground-motion level at which nonlinear behavior is manifested. Examination of the results presented in Figures 2.5.2-275 through 2.5.2-281 indicates that the amplification is magnitude-dependent for spectral frequencies of 2.5 Hz and higher, and magnitude-independent for spectral frequencies of 1 and 0.5 Hz. The analysis results also indicate that the amplifications for the **M** 5.5 and **M** 6.5 input motions were similar, while those for the distant large-magnitude **M** 7.7 motions were significantly different. Accordingly, parameters a(m,f), b(m,f), and c(m,f) were fit with the following functional form:

$$a = a_1 + a_2 / \cosh\left(a_3 \times \max(M - a_4, 0)\right) \qquad \text{Equation 2.5.2-15}$$

Equation 2.5.2-15 defines an "S-curve" relationship that varies smoothly from the value a_1 at large magnitudes to the value $a_1 + a_2$ at small magnitudes, with parameters a_3 and a_4 controlling the transition. The red curves shown in Figures 2.5.2-275 through 2.5.2-279 show the resulting magnitude-dependent site amplification function compared to the individual analysis results. Magnitude-independent forms of Equation 2.5.2-14 were fit to the amplification values for spectral frequencies of 1 and 0.5 Hz. These models are shown in Figures 2.5.2-280 and 2.5.2-281, respectively. The parameters of the site amplification functions for the GMRS profile are listed in Table 2.5.2-224.

Implementation of Approach 3 from McGuire et al. (Reference 2.5.2-284) also requires specification of the standard error in ln(AF). The variability in the site amplification values presented in Figures 2.5.2-275 through 2.5.2-281 has two sources: the variability in site properties and the variability in the characteristics of the input motions. What is required for Approach 3 is the variability in response due only to the variability in site properties, because the variability in the characteristics of the input motions is already accounted for in the standard error for peak ground-motion amplitude used in calculating the hard rock PSHA developed by EPRI (Reference 2.5.2-282). Therefore, an additional analysis was conducted to estimate the standard error of site amplification. Site response analysis for all possible combinations of site profiles and input motions (1800 combinations) was computed for a range of ground-motion amplitudes. Then, a mixed-effects regression analysis (e.g., Reference 2.5.2-298) was conducted to partition the variance into a record-to-record component and a profile-to-profile component. The resulting values were then fit with Equation 2.5.2-15. The resulting model parameters are listed in Table 2.5.2-224.

2.5.2.6 Ground Motion Response Spectra

This subsection develops the GMRS and FIRS for the RBS site. The first step is the development of soil surface horizontal UHRS for mean annual exceedance frequencies of 10^{-4} and 10^{-5} incorporating the effects of the EPRI CAV model (Reference 2.5.2-299). The GMRS and FIRS are developed from these spectra using the ASCE/SEI performance-based method (Reference 2.5.2-203). Finally, empirical and site-specific vertical/horizontal spectra ratios are used to develop vertical GMRS and FIRS.

2.5.2.6.1 Hazard-Consistent Surface USRS Incorporating CAV

Hazard-consistent surface UHRS are developed using Apprach 3 of McGuire et al. (Reference 2.5.2-284) and the EPRI CAV model (Reference 2.5.2-299). Approach 3 of McGuire et al. (Reference 2.5.2-284) is also developed in Bazzurro and Cornell (Reference 2.5.2-300). The Bazzurro and Cornell (Reference 2.5.2-300) development is employed in this analysis because it provides a convenient way of combining Approach 3 and the CAV model.

In Approach 3, the hazard at the soil surface is computed by integrating the hazard curve for the reference site condition with the probability distribution for the transfer function that defines the ground motion on the site-specific soils relative to those on the reference site condition. For the RBS site, the reference site condition is generic CEUS hard rock. The RBS site-specific amplification relative to this reference site is characterized by a suite of frequency-dependent amplification factors that can account for nonlinearity in soil response (Table 2.5.2-224). The basis for Approach 3 is a modification of the standard hazard formulation to incorporate the additional integration over a probabilistic amplification into the hazard integral. The standard hazard model (e.g., Reference 2.5.2-201) is given by the following equation:

$$\nu(z) = \sum_n \alpha_n(m^0) \int_{m^0}^{m^u} f(m) \left[\int_0^{\infty} f(r|m) \cdot P(Z > z|m,r) \cdot dr \right] \cdot dm \qquad \text{Equation 2.5.2-16}$$

where $\nu(z)$ is the average annual frequency at which the level of ground-motion parameter Z exceeds value z at the site from all earthquakes on all sources in the region; $\alpha_n(m^0)$ is the frequency of earthquakes on source n above a minimum magnitude of engineering significance, m^0; f(m) is the probability density of earthquake size between m^0 and a maximum earthquake that the source can produce, m^u; f(r|m) is the probability density function for distance to an earthquake of magnitude m occurring on source n; and P(Z>z|m,r) is the probability that, given an earthquake of magnitude m at distance r from the site, the peak ground motion will exceed level z. Approach 3 of McGuire et al. (Reference 2.5.2-284) and Bazzurro and Cornell (Reference 2.5.2-300) modify Equation 2.5.2-16 to be:

$$\nu(z) = \sum_n \alpha_n(m^0) \int_0^{\infty} \int_{m^0}^{m^u} P\left(AF > \frac{z}{x} \middle| m,r,x \right) f(m) \left[\int_0^{\infty} f(r|m) \cdot f(x|m,r) \cdot dr \right] dm dx \qquad \text{Equation 2.5.2-17}$$

In Equation 2.5.2-17, x is the ground-motion level on the reference site, and z is the ground-motion level on the site of interest. Parameter AF is the probabilistic amplification factor that transfers amplitudes x on the reference site to amplitudes z on the site of interest, AF = z/x. In theory, it is a function of the amplitude and relative frequency content of the ground motions, and thus, would depend on m, r, and x.

Equation 2.5.2-17 represents full incorporation of all the variables into a single integration such that one does not need to compute the hazard curve $\nu(x)$ for the reference site condition. In practice (e.g., Bazzurro and Cornell; Reference 2.5.2-300; and Entergy Operations, Inc.; Reference 2.5.2-236), Approach 3 is implemented in two steps. The hazard is first computed for the reference site condition using Equation 2.5.2-16. This provides information on the range of m, r, and x of importance for defining the relative amplification AF. The probabilistic AF is then convolved with the reference site hazard results $\nu(x)$ to produce the site-specific hazard $\nu(z)$. As such, Equation 2.5.2-17 is rewritten as follows:

$$\nu(z) = \int_0^\infty \int_{m^0}^{m^u} \int_0^\infty P\left(AF > \frac{z}{x} \middle| m, r, x \right) f(m, r|x) f(x) dm \cdot dr \cdot dx \qquad \text{Equation 2.5.2-18}$$

where f(x) is the absolute value of the derivative of the hazard curve for the reference site, and f(m|x) is the distribution of m for events contributing to the reference site hazard at level x obtained from deaggregation of the hazard curve. The effects of variations in r for a given value of m and x are usually insignificant (Reference 2.5.2-284), which is to be expected, as x and r are highly correlated for a given value of m. This leads to the following form:

$$\nu(z) = \int_0^\infty \int_{m^0}^{m^u} P\left(AF > \frac{z}{x} \middle| m, x \right) f(m|x) f(x) dm \cdot dx \qquad \text{Equation 2.5.2-19}$$

In actual computation, Equation 2.5.2-19 is implemented in discretized form as (e.g., Reference 2.5.2-300):

$$\nu(z) = \sum_{x_j} p(x_j) \times \left[\sum_{m_k} p(m_k|x_j) \times P\left(AF > \frac{z}{x_j} \middle| m_k, x_j \right) \right] \qquad \text{Equation 2.5.2-20}$$

The first term in Equation 2.5.2-20, $p(x_j)$, is obtained by differencing the hazard curve [$p(x_j) = \nu(x-\Delta x) - \nu(x+\Delta x)$] and represents the annual frequency of occurrence of ground-motion level x_j. The term $p(m_k|x_j)$ is the discrete magnitude deaggregation of the hazard at ground-motion level x_j. Depending on the variation of AF with m and the range of magnitudes contributing to the hazard, $p(m_k|x_j)$ may be specified at a few discrete magnitude values. Using a lognormal model for the distribution of AF, given m_k and x_j (e.g., Reference 2.5.2-300), leads to the following expression:

$$P\left(AF > \frac{z}{x_j} \middle| m_k, x_j \right) = 1 - \Phi\left(\frac{\ln\left[\frac{z}{x_j}\right] - \overline{\ln[AF(m_k, x_j)]}}{\sigma_{\ln[AF]}(m_k, x_j)} \right) \qquad \text{Equation 2.5.2-21}$$

where $\overline{\ln[AF(m_k, x_j)}$ and $\sigma_{\ln[AF]}(m_k,x_j)$ are the conditional mean and standard deviation of the natural log of AF at the values m_k and x_j. These values can be obtained using the model presented in Subsection 2.5.2.5.3, with the model coefficients listed in Table 2.5.2-224.

The term in square brackets in Equation 2.5.2-20 defines the probability that reference ground-motion level x_j will produce a surface ground motion in excess of z averaged over the distribution of earthquake magnitudes contributing to the frequency of occurrence of x_j. The total frequency of exceedance of surface motion level z is the sum over all of the contributions from each level of the reference motion x_j.

Equations 2.5.2-16 through 2.5.2-21 described development of surface hazard curves using the standard approach of summing the contributions to the hazard from all earthquakes with magnitudes greater than a fixed lower minimum magnitude m^0. Regulatory Guide 1.208 indicates that an alternative method may be used that is based on the probability that earthquakes of a given magnitude can produce damaging ground motions. These are defined as ground motions with a cumulative absolute velocity (CAV) greater than 0.16 g-second. EPRI (Reference 2.5.2-299) developed an approach for conducting a PSHA incorporating the probability that ground motions produced by an earthquake of magnitude m will have a value of CAV greater than 0.16 g-second. The PSHA formulation incorporating CAV is given by Equations (4-1) through (4-3) of EPRI (Reference 2.5.2-299). Using the notation of Equation 2.5.2-16, these equations are:

$$\begin{aligned}\nu(z,CAV > 0.16) = \sum_{\text{all}\,n} \alpha_n(m^0) \int_{m^0}^{m^u} \int_{0}^{\infty} \int_{-\infty}^{\infty} & f(m) \times f(r|m) \times f(\varepsilon_{PGA}) \times \\ & P\left(CAV > 0.16 | m, PGA(m,r,\varepsilon_{PGA})\right) \times \\ & P(SA > z | m,r,PGA) d\varepsilon_{PGA} dr dm\end{aligned} \qquad \text{Equation 2.5.2-22}$$

with

$$P(SA > z | m,r,PGA) = 1 - \Phi(\varepsilon'_{SA})$$

$$\varepsilon'_{SA} = \frac{\ln(z) - \left[\mu_{\ln SA}(m,r) + b_1 \varepsilon_{PGA} \sigma_{\ln SA\_ref}\right]}{\sqrt{1 - b_1^2}\,\sigma_{\ln SA}} \qquad \text{Equation 2.5.2-23}$$

In Equation 2.5.2-22, $\nu(z,CAV > 0.16)$ is the annual frequency of events with spectral accelerations exceeding level z and with CAV greater than 0.16 g-second. Parameter b_1 in Equation 2.5.2-23 defines the correlation between

PGA and SA for the spectral frequency of interest. This correlation is needed because the CAV model is based on peak acceleration.

The difference between the hazard formulations of Equations 2.5.2-16 and 2.5.2-22 can be explained as follows. In the standard formulation of Equation 2.5.2-16, one defines the frequency of occurrence of earthquakes of each magnitude m_i greater than or equal to m^0 at each distance r_j. The fraction of these events that contribute to the frequency of exceeding ground-motion level z is equal to the probability that an earthquake of magnitude m_i at distance r_j will produce ground motions in excess of z, and is obtained using a ground-motion model for the parameter of interest. In the CAV formulation of Equation 2.5.2-23, one again starts with the frequency of occurrence of earthquakes of each magnitude m_i at each distance r_j. However, now the fraction of these events contributing to the hazard is determined by the joint probability that the event will produce a value of CAV in excess of 0.16 g-second and produce a ground-motion level in excess of z. This joint probability is obtained by integrating over the full range of PGA that may be produced by magnitude m_i at distance r_j. Each PGA level is defined by $\mu_{\ln PGA}(m,r)+\varepsilon_{PGA}\sigma_{\ln PGA}$, where $\mu_{\ln PGA}(m,r)$ and $\sigma_{\ln PGA}$ are the mean and standard deviation of ln(PGA) for magnitude m_i at distance r_j, respectively, and ε_{PGA} is a standard normal variate. The probability that this PGA level will produce a CAV in excess of 0.16 g-second, $P(CAV > 0.16|m, PGA(m,r,\varepsilon_{PGA}))$, is given by the CAV model in EPRI (Reference 2.5.2-299). The probability that the event will also produce a ground motion in excess of z is obtained by multiplying by the conditional probability that the ground-motion parameter will exceed level z given that the PGA is at level $\mu_{\ln PGA}(m,r)+\varepsilon_{PGA}\sigma_{\ln PGA}$. This conditional probability depends on the correlation between the two ground-motion parameters.

The parameters $\mu_{\ln SA}(m,r)$ and $\sigma_{\ln SA}$ in Equation 2.5.2-23 represent the median and standard deviation for peak ground motion or pseudo-spectral acceleration at the ground surface. These are obtained from an appropriate ground-motion model for the site that accounts for the effects of site amplification. Conceptually, if Approach 3 for incorporating site effects is being used, this implies that an additional integration over the probabilistic site amplification function should be incorporated into the formulation. However, Bazzurro and Cornell (Reference 2.5.2-300) show that Approach 3 can be implemented using the standard hazard formulation of Equation 2.5.2-16 with a site-specific ground-motion model developed from the ground-motion model for the reference site and the probabilistic site amplification function AF. In this formulation, $\mu_{\ln SA}(m,r)$ is given by the following expression:

$$\mu_{\ln SA}(m,r) = \mu_{\ln SA\_ref}(m,r) + \overline{\ln[AF(m,x)]}\Big|_{\mu_{\ln SA\_ref}(m,r)} \qquad \text{Equation 2.5.2-24}$$

in which $\mu_{\ln SA\_ref}(m,r)$ is the median ground motion for the reference site condition and the specified values of m and r. The standard error $\sigma_{\ln SA}$ is given by the expression:

$$\sigma_{\ln SA}(m,r) = \sqrt{\left(1+\frac{\partial \ln[AF(m,x)]}{\partial \ln[x]}\right)^2 \times \sigma^2_{\ln SA\_ref} + \sigma^2_{\ln AF}}\Bigg|_{\mu_{\ln SA\_ref}(m,r)} \qquad \text{Equation 2.5.2-25}$$

The EPRI CAV model was implemented in a second set of PSHA calculations for the RBS site. Using Equations 2.5.2-24 and 2.5.2-25, the probabilistic site amplification functions developed in Subsection 2.5.2.5.3 were combined with the EPRI generic CEUS hard rock ground-motion models (References 2.5.2-276 and 2.5.2-282) to produce site-specific ground-motion models for the GMRS profile. The CAV-based hazard calculations included the contributions from all earthquakes above m_b 4.0 weighted by the probability that they can produce a CAV greater than 0.16 g-second. The EPRI CAV model uses moment magnitude (**M**) as the magnitude scale. The model results indicate that earthquakes of magnitude less than **M** 4 have very little probability of producing a CAV greater than 0.16 g-second (Reference 2.5.2-299). The magnitude conversions used in the PSHA convert an m_b magnitude of 4.0 into **M** magnitudes that are less than 4.0.

Two sets of PSHA calculations with site amplification were performed to produce surface hazard curves for the GMRS profile. One set incorporated the CAV filter, and one set was performed without the CAV filter using a fixed lower bound magnitude of m_b 5.0. The purpose of performing the second set was to provide an indication of the effect of the CAV filter on the site hazard. Figures 2.5.2-282 through 2.5.2-288 compare the surface mean hazard curves computed with and without CAV for the seven spectra frequencies of 0.5, 1, 2.5, 5, 10, 25, and 100 Hz, respectively. Also shown in these figures is the corresponding generic CEUS mean rock hazard curve from Subsection 2.5.2.4.4.

The surface mean hazard results shown in Figures 2.5.2-282 through 2.5.2-288 are interpolated to obtain the spectral accelerations corresponding to mean annual frequencies of exceedance of 10^{-4}, 10^{-5}, and 10^{-6}. These are plotted in Figure 2.5.2-289. Smooth UHRS are then constructed through these points. Interpolation between the hazard results for the seven spectral frequencies and extrapolation from 0.5 Hz to 0.1 Hz was guided by multiplying the generic hard rock UHRS and RE spectra (Figures 2.5.2-248 through 2.5.2-250) by the mean site amplification functions.

A similar process was followed to develop UHRS for the FIRS elevations at the foundations of the R/FB, the CB, and the FWSC.

2.5.2.6.2 GMRS

2.5.2.6.2.1 Horizontal GMRS

Regulatory Guide 1.208 defines the GMRS as a risk-consistent design response spectrum computed from the site-specific UHRS at a mean annual frequency of exceedance of 10^{-4} by the relationship:

$$GMRS = DF \times UHRS\ (10^{-4}) \qquad \text{Equation 2.5.2-26}$$

Parameter DF is the design factor specified by the expression:

$$DF = \text{Maximum}\ (1.0,\ 0.6(A_R)^{0.8}) \qquad \text{Equation 2.5.2-27}$$

in which A_R is the ratio of the UHRS ground motions for annual exceedance frequencies of 10^{-4} and 10^{-5}, specifically:

$$A_R = \frac{UHRS(10^{-5})}{UHRS(10^{-4})} \qquad \text{Equation 2.5.2-28}$$

Regulatory Guide 1.208 also specifies that when the value of A_R exceeds 4.2, the value of the GMRS is to be no less than $0.45 \times SA(0.1H_D)$, that is, 45 percent of the 10^{-5} UHRS. Figure 2.5.2-290 shows the horizontal GMRS calculated using the two approaches. The final GMRS is taken as the envelope of the two. These values are listed in Table 2.5.2-225 along with the horizontal mean 10^{-4} and 10^{-5} UHRS. The horizontal GMRS is defined by the minimum value of 0.45 x $SA(0.1H_D)$ for frequencies less than 0.4 Hz.

2.5.2.6.2.2 Vertical GMRS

The vertical GMRS is developed from the horizontal hazard results using vertical-to-horizontal (V/H) response spectral ratios. Approach 3, defined above by Equation 2.5.2-20, is used to convolve the horizontal hazard curves with a probabilistic model for V/H to produce vertical soil hazard curves. These hazard curves are then used to compute the vertical GMRS using the relationships given in Subsection 2.5.2.6.2.1. Two approaches are used to develop V/H ratios for the RBS site. The first approach used empirical ground-motion models for horizontal and vertical response spectral accelerations on soil. The second approach uses site-specific calculations of response for vertical and horizontal motions. There is very little information on vertical ground motions in the CEUS. Therefore, multiple approaches are used to develop the V/H ratios to address the uncertainty in estimating vertical ground motions. The empirical models are included because they are based on strong ground-motion data collected on soil sites. Their potential weakness is that they were developed from data collected in regions of active tectonics (e.g., California). The potential weakness of computation of site-specific V/H ratios is that the numerical modeling of vertical motions for soil sites is less well calibrated than that for horizontal sites (References 2.5.2-292 and 2.5.2-301). The larger uncertainty in estimating vertical motions is addressed by using multiple approaches (Reference 2.5.2-301).

Following the method described in the Grand Gulf COLA (Reference 2.5.2-236), the V/H ratios are developed for specific events representative of the magnitudes and distances of earthquakes contributing to the site hazard. Subsection 2.5.2.4.4.2 presents the magnitude-distance deaggregation of the rock hazard for the RBS site. However, the application of magnitude-dependent site amplification functions and the CAV filter produce a different deaggregation result for the soil surface hazard curves. Therefore, the horizontal soil hazard results were deaggregated to define the magnitudes and distance contributions. The deaggregation was conducted separately for the three source types (EPRI-SOG sources, Saline River source, and the New Madrid source of repeated large earthquakes). These results were used to construct soil hazard DEs following the approach described in Subsection 2.5.2.4.4.2.

Table 2.5.2-226 lists the soil hazard DEs. Three magnitudes are used: **M** 5.5, **M** 6.5, and **M** 7.5. The DEs are defined in terms of moment magnitudes because that is the magnitude scale employed by the ground-motion models and modeling approaches used to develop the V/H ratios. The corresponding ranges in body-wave magnitudes are indicated at the bottom of Table 2.5.2-226.The contribution to the soil surface hazard from the EPRI-SOG sources is from a wide band of magnitudes and distances, and three DEs are used to capture this range. The relative weights and average distances for each vary with the hazard level and spectral period. The contributions to the soil surface hazard from the Saline River and New Madrid sources are confined to narrow ranges in magnitude and distance, allowing the use of a single DE for all ground-motion levels and spectral frequencies for these sources.

Empirical V/H Ratios

Abrahamson and Silva (Reference 2.5.2-302) and Campbell and Bozorgnia (Reference 2.5.2-303) present empirical ground-motion models for both vertical and horizontal spectral accelerations on soil sites. These ground-motion models were used to construct V/H ratios as a function of distance for the three DE magnitudes. The resulting ratios are plotted in Figures 2.5.2-291 and 2.5.2-292. The range of distances was limited to that specified for the individual models. The V/H ratios at the limits of the empirical models were held constant for larger distances.

Site-Specific V/H Ratios

Site-specific V/H ratios were developed by computing the response of the RBS profile to horizontal and vertical motions. For consistency, responses for both horizontal and vertical motions were computed using the same methodology. The horizontal response was computed for vertically propagating, horizontally polarized shear waves (SH) and the vertical response was computed for incident-inclined compression (P) and vertically polarized shear waves (SV). The calculations were performed using the point-source stochastic model for ground-motion estimation described in detail by Silva et al. (Reference 2.5.2-292). The response to horizontal motions is computed using the dynamic properties described in Subsection 2.5.2.5. The response to vertical motions is computed assuming linear behavior (References 2.5.2-292 and 2.5.2-301) using the velocity profile listed in Table 2.5.2-223. Low-strain P-wave damping was set equal to the low-strain shear-wave damping (Reference 2.5.2-304). The total site κ for vertical motions was set at one-half of the horizontal κ (Reference 2.5.2-292). Calculations were performed using both the single-corner source (1C) source model (Reference 2.5.2-292) with a stress parameter of 110 bars and the double-corner (2C) source model (Reference 2.5.2-277). The velocity profile defined in Table 2.5.2-223 was placed upon the mid-continent crustal model developed in EPRI (Reference 2.5.2-219). Calculations were performed for a range of distances.

V/H ratios were developed for two site profiles. The first profile is the GMRS profile, with a surface elevation of 20 ft. This profile is fully saturated with a compression-wave velocity of 5000 fps at the surface layer. The resulting V/H response spectral ratios are shown in Figure 2.5.2-293. The second profile is the finished grade profile, with a surface elevation of 97.5 ft. This profile contains a strong velocity contrast in the compression-wave velocity that represents the transition from saturated to unsaturated conditions in the granular fill. The resulting V/H response spectral ratios are shown in Figure 2.5.2-294. The HF V/H ratios for the finished grade profile are higher than those for the GMRS profile, reflecting the effect of the strong velocity contrast at the water table.

Calculation of Vertical Soil Hazard

Vertical soil hazard curves were computed using Approach 3 as defined by Equation 2.5.2-20. The reference motions consist of the horizontal soil hazard results described in Subsection 2.5.2.6.1. The amplification functions consist of the V/H ratios shown in Figures 2.5.2-291 through 2.5.2-294. The standard deviation in ln(V/H) was set equal to 0.15 for the empirical models and ranged from 0.1 to 0.35 for the site-specific calculations. The minimum V/H ratio was set to 0.4, based on the general minimum observed for empirical data (Reference 2.5.2-236).

Calculations of soil surface hazard curves for vertical motions were performed for the three source types using the DEs listed in Table 2.5.2-226. The process is illustrated on Figure 2.5.2-295. For each source set and spectral frequency, hazard curves were developed for four V/H ratio models, consisting of the two empirical models and the single-corner and double-corner calculations for the site-specific models. The result is four soil hazard curves for each source. The mean hazard curve for the source is then computed by assigning equal weights to the alternative V/H ratios. The empirical and site-specific approaches to V/H are assigned equal weight because there is not a strong preference for either one. Site response for vertical motions is not as well calibrated and shows biases at high and low frequencies compared to empirical data (References 2.5.2-292 and 2.5.2-301). The empirical values are based on strong-motion observations, but from a different tectonic environment.

The above process is repeated for each source and for the seven spectral frequencies used for PSHA calculations. A total mean hazard curve for each spectra frequency is obtained by summing the mean hazard results for each source set. Figures 2.5.2-296 and 2.5.2-297 show the results for 1 Hz and 100 Hz spectral accelerations, respectively. At low spectral frequencies, the New Madrid source of repeated large earthquakes is the principal source of the hazard in the exceedance range of interest. For HF motions, the New Madrid source is the dominant source at an exceedance frequency of 10^{-4}. However, the EPRI-SOG sources (in particular, the local sources) become the largest contributor to hazard for exceedance frequencies of 10^{-5} and lower.

Calculation of the Vertical GMRS

The vertical soil hazard curves for the GMRS profile are interpolated to obtain vertical spectral accelerations for annual exceedance frequencies of 10^{-4} and 10^{-5}. These values are used to obtain GMRS spectral accelerations using Equations 2.5.2-26, 2.5.2-27, and 2.5.2-28. These values are then divided by the horizontal GMRS values to produce GMRS V/H ratios at the seven spectral frequencies 0.5, 1, 2.5, 5, 10, 25, and 100 Hz. The values range from 0.57 at 100 Hz to 0.70 at 45 Hz to 0.42 at 0.5 Hz. Log-log interpolation is then used to obtain V/H ratios at intermediate frequencies. The V/H ratio obtained at 0.5 Hz is assumed to apply for lower frequencies. These interpolated V/H ratios are then used to compute a vertical GMRS from the horizontal GMRS, as shown in Figure 2.5.2-298. The resulting vertical spectrum has a small "sag" at frequencies between 2 and 9 Hz. This "sag" was enveloped to produce a smooth GMRS spectrum, as shown in Figure 2.5.2-298. The resulting vertical GMRS is listed in Table 2.5.2-225 along with the final V/H ratios obtained by dividing the vertical GMRS by the horizontal GMRS. The horizontal and vertical GMRS are compared in Figure 2.5.2-299.

2.5.2.6.3 Foundation Input Response Spectra

Foundation input response spectra (FIRS) are developed for four locations: the foundation level of the Reactor/Fuel Building (R/F FIRS), the foundation level of the Control Building (CB FIRS), the foundation level of the Fire Water Service Center (FWSC FIRS), and the finished grade elevation (FG FIRS). The horizontal

FIRS were developed by scaling the horizontal GMRS by the ratio of the relative horizontal site amplification functions developed for the RBS site. As shown in Figures 2.5.2-273 and 2.5.2-274, there are only small differences in site amplification for the different profile elevations. The vertical FIRS were developed using the process described in Subsection 2.5.2.6.2.2. The GMRS V/H ratios were used to develop the R/FB FIRS and the CB FIRS, as these two elevation levels are also beneath the design groundwater table. The vertical motions computed for the finished grade elevation were used to develop the vertical FG FIRS. The finished grade vertical motions were also used to develop the vertical FWSC FIRS, because the foundation elevation for this structure is near the finished grade elevation. The resulting horizontal and vertical FIRS are listed in Tables 2.5.2-227 through 2.5.2-230. The FG and FWSC vertical FIRS are somewhat higher than the R/FB and CB vertical FIRS because the compression-wave velocity gradient above the water table produces higher vertical response. The R/FB and CB FIRS spectra are compared to the ESBWR certified seismic design response spectra (CSDRS) (Reference 2.5.2-305) in Figures 2.5.2-300 and 2.5.2-301, respectively. The FIRS are enveloped by the CSDRS except at frequencies below about 0.23 Hz for horizontal motions and 0.15 Hz for vertical motions. The FWSC FIRS is compared to 1.35 times the CSDRS in Figure 2.5.2-302. The FWSC FIRS is enveloped by the CSDRS except at frequencies below about 0.18 Hz for horizontal motions and 0.13 Hz for vertical motions. The horizontal and vertical FG FIRS are shown in Figure 2.5.2-303.

The *pga* for the FG ground motions listed in Table 2.5.2-230 is 0.10g. This value is obtained using the CAV filter based on the potential of earthquakes of various magnitudes to damage engineered structures. A FG *pga* is also needed for the assessment of liquefaction potential. The analysis of liquefaction potential has its own process for incorporating the influence of earthquake magnitude. Therefore, an additional calculation was performed to develop the finished grade *pga* without CAV. The resulting value of *pga*, defined using Equations 2.5.2-26 through 2.5.2-28, is 0.10g. Deaggregation of the hazard indicates that most of the hazard contribution for this ground motion is from the New Madrid source of repeating large earthquakes.

2.5.2.6.4 Equivalent Uniform Shear Wave Velocity

RBS DEP 2.0-2 The ESBWR Design Control Document (DCD) (Reference 2.5.2-305) contains a criterion for an equivalent uniform shear wave velocity beneath each of the Seismic Category I structures. The equivalent uniform velocity (V_{eq}) is computed from the site response analysis conducted for the profile that extends to the ground surface. The V_{eq} is obtained by computing the seismic wave velocity travel time from the surface to the specified depth. The depth is then divided by the travel time to obtain the equivalent velocity. The ESBWR DCD (Reference 2.5.2-305) also indicates that the calculations are to be performed for the lower bound properties computed at seismic strains.

The lower bound properties are taken to be the 16th percentile of the randomized dynamic properties developed for the RBS site response analysis. The 16th percentile was based on a nominal "mean-1 sigma" value that represents the actual distribution of the analysis results. In addition to the 16th percentile, the 30th percentile of the dynamic properties was also determined. Calculation of the 30th percentile was based on typical lower bound limits from standard geotechnical practice. The strain compatible shear wave velocities were extracted from each of the site response analysis cases for shaking levels that bracket the 10^{-4} and 10^{-5} GMRS 100 Hz ground motion levels. The approach provides 60 values each for analyses conducted using **M** 5.5, 6.5, and 7.7 input motions. The 180 values were then weighted by the relative contribution of the three magnitudes to the hazard and then ranked from lowest to highest. The 16th, 30th, 50th, and 84th percentile values were then extracted from the distribution of shear wave velocities for each layer. The results for the 10^{-4} and 10^{-5} ground motion levels were then interpolated to obtain the shear wave velocities for the GMRS level of shaking.

The resulting profiles of shear wave velocity were then used to compute the V_{eq} for each of the three Seismic Category I structures. Following the DCD, for each structure, the depth used to determine V_{eq} was taken to be twice the maximum building dimension plus the embedment depth below the ground surface (Reference 2.5.2-305). Table 2.5.2-231 lists the building dimensions, embedment depths, and V_{eq} for the three Seismic Category I structures.

The conditions at the RBS site are such that the lower bound site properties based on the 16th percentile do not satisfy the requirement for a minimum V_{eq} of 1000 fps. It should be noted that the calculated V_{eq} values compared to the DCD criterion are based on several conservative assumptions. As noted in the previous paragraphs, the "lower bound" was based on the 16th percentile or the mean value minus 1 sigma of the V_s values. In standard geotechnical practice, lower bound values for soil properties are typically taken as the 30th percentile. If the 30th percentile values in Table 2.5.2-231 were used, only the V_{eq} for the Reactor/Fuel Building would meet the DCD requirement.

The lower bound values were used to take into account potential variability in the properties of the natural soils. The reduction was applied to all soil layers including the engineered fill that will replace the natural soils in the upper approximately 75 ft. The reduction of velocity in natural soil is a reasonable approach based on the natural variation of soils; however, reducing the velocity of the engineered fill to account for potential variability is very conservative given that the engineered fill will be placed in a controlled manner with minimal expected variation in the dynamic soil properties.

Another important factor that increases the conservatism of the computed V_{eq} values is the effect of the increase in confinement (effective stress) due to the loads from the Seismic Category I structures. Based on the net loading from the structures and the resulting increase in confinement for the soils beneath the structure, the shear wave velocities beneath the structures are expected to increase compared to the velocities of soils outside the stress influence zone. The computation of V_{eq} for the RBS site did not credit any increase in the velocity values due to the increased confinement beneath the Seismic Category I structures.

Based on the 16th percentile lower bound V_{eq} results in Table 2.5.2-231, the RBS site is only 10 to 26 percent less stiff than the "soft" soil conditions (V_{eq} = 1000 fps) used in the DCD Soil Structure Interaction (SSI) analysis (Reference 2.5.2-305). Given the difference in the spectral acceleration between the RBS FIRS and the CSDRS (Figures 2.5.2-300 through 2.5.2-302) and based on a review of the DCD SSI analysis results, as well as discussions with GEH, it is expected that the foundation response for the Seismic Category I structures will be within allowable design criteria. A site-specific SSI analysis will be performed to further support this conclusion.

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Table 2.5.2-201
Parameters of Recent Gulf of Mexico Earthquakes

Date	Source	Original Magnitude	Type	Converted m_b	Distance to RBS Site	Comments
6/30/1994	NEIC	4.2	m_b		208.7 mi. (335.8 km)	
12/9/2000	NEIC	4.3	M_s	5.05	144.5 mi. (232.6 km)	
2/10/2006	ANSS	5.2	M_s	5.54	299.6 mi. (369.4 km)	
	NEIC	5.2	M_s			
4/18/2006		-- (~**M** 4.6)	M_{sw}	NA		Reported by Nettles (References 2.5.2-223 and 2.5.2-224). Not detected or located by USGS (NEIC); therefore, not included in the updated earthquake catalog.
9/10/2006	ANSS	5.8	M	6.08	420.4 mi.	
	NEIC	5.9	m_b		(676.6 km)	

Notes

km = Kilometer
mi. = Mile
M = Moment magnitude
m_b = Body-wave magnitude
M_s = Surface-wave magnitude
M_{sw} = Shear-wave magnitude

Table 2.5.2-202
Bechtel Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Gulf Coast Region (Source BEC-BZ1)	1.0	0	5.4 [0.1], 5.7 [0.4], 6.0 [0.4], 6.6 [0.1]	6.11 [0.1], 6.4 [0.4], 6.6 [0.5]
New Madrid Fault Zone (Source BEC-30)	1.0	533.8	7.4 [0.1], 7.5 [0.9]	6.75 [1.0]

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active

Table 2.5.2-203
Dames & Moore Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Southern Coastal Margin (Source DAM-20)	1.00	0	5.3 [0.80], 7.2 [0.20]	5.52 [0.80], 7.2 [0.20]
New Madrid Compression Zone (Source DAM-21)	1.00	546.9	7.5 [0.75], 7.2 [0.25]	6.75 [1.00]
Ouchita Fold Belt (Source DAM-25)	0.35	197.8	5.5 [0.80], 7.2 [0.20]	
Reelfoot Rift (Source DAM-22)	1.00	402.9	6.9 [0.75], 7.2 [0.25]	

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active

Table 2.5.2-204
Law Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Southern Coastal Block (Source LAW-126)	1.00, P^B = 0.49	0	4.6 [0.9], 4.9 [0.1]	5.52 [0.9], 5.7 [0.1]
Postulated Faults in Reelfoot Rift (Source LAW-18)	1.00	526.5	7.4 [1.0]	6.75 [1.0]

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active
P^B = Background probability

Table 2.5.2-205
Rondout Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Gulf Coast to Bahamas Fracture Zone (Source RND-51)	1.0	0	5.01 [0.20], 5.5 [0.60], 5.8 [0.20]	6.11 [0.30], 6.3 [0.55], 6.5 [0.15]
New Madrid Seismic Zone (Source RND-1)	1.0	536.6	7.1 [0.10], 7.3 [0.80], 7.4 [0.10]	6.75 [1.00]

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active

Table 2.5.2-206
Weston Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Gulf Coast (Source WGC-107)	1.00	0	5.4 [0.71], 6.0 [0.29]	6.6 [0.89], 7.2 [0.11]
New Madrid Fault Zone (Source WGC-31)	0.95	524.4	7.2 [1.00]	6.75 [1.00]

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active

Table 2.5.2-207
Woodward-Clyde Team Seismic Sources

Source	P*	Closest Distance to RBS Site (km)	EPRI (1989) Maximum Magnitude Distribution for RBS Site (m_b)	Maximum Magnitude Distribution Used in PSHA for RBS Site (m_b)
Background (Source WCC-B42)	1.0	0	5.01 [0.17], 5.4 [0.28], 5.8 [0.27], 6.5 [0.28]	5.52 [0.45], 5.8 [0.27], 6.5 [0.28]
Disturbed Zone of Reelfoot Rift (Source WCC-40)	1.0	514.9	7.2 [0.33], 7.5 [0.34], 7.9 [0.33]	6.75 [0.33], 6.75 [0.34], 6.75 [0.33]

Notes

km = Kilometer
m_b = Body-wave magnitude
P* = Probability an EPRI-SOG seismic source is active

Table 2.5.2-208
Magnitude Comparisons for New Madrid 1811-1812 Earthquake Sequence

Study	NM1	NM2	NM3
Johnston	**M** 8.1 ± 0.3	**M** 7.8 ± 0.3	**M** 8.0 ± 0.3
Hough et al.	**M** 7.2 to 7.3	**M** ~7.0[a] (located on the NN)	**M** 7.4 to 7.5
Mueller and Pujol	-	-	**M** 7.2 to 7.4 (preferred **M** 7.2 to 7.3)
Bakun and Hoper	**M** 7.6 (**M** 7.2 to 7.9) (preferred Model 3)	**M** 7.5 (**M** 7.1 to 7.8) (preferred Model 3)	**M** 7.8 (**M** 7.4 to 8.1) (preferred Model 3)
	M 7.2 (**M** 6.8 to 7.9) (Model 1)	**M** 7.2 (**M** 6.8 to 7.8) (Model 1)	**M** 7.4 (**M** 7.0 to 8.1) (Model 1)
Mueller et al.	**M** 7.3	**M** 6.8 (located within the Wabash Valley of southern Illinois/ southern Indiana)	**M** 7.5
Johnston	**M** 7.8 to 7.9	**M** 7.5 to 7.6	**M** 7.7 to 7.8

a) The estimated location and magnitude of this earthquake are revised in Mueller et al.

Notes

M = Moment magnitude
(Weight) = Relative contribution of the source

Source: Reference 2.5.2-253.

Table 2.5.2-209
Magnitude Distributions for Repeating Large-Magnitude New Madrid Earthquakes

	Magnitude for Individual Faults (moment magnitude [M])			
Earthquake Rupture Set	New Madrid South	Reelfoot Thrust	New Madrid North	Weight
1	7.8	7.7	7.5	0.1667
2	7.9	7.8	7.6	0.1667
3	7.6	7.8	7.5	0.25
4	7.2	7.4	7.2	0.0833
5	7.2	7.4	7.0	0.1667
6	7.3	7.5	7.0	0.1667

Source: Reference 2.5.2-253.

Table 2.5.2-210
Earthquake Frequencies for Repeating Large-Magnitude Earthquakes

Recurrence Model	Weight	Mean Repeat Time (years)	Equivalent Annual Frequency
New Madrid Poisson	0.10108	160	6.26E-03
	0.24429	259	3.86E-03
	0.30926	407	2.46E-03
	0.24429	685	1.46E-03
	0.10108	1515	6.60E-04
New Madrid Renewal, α = 0.3	0.10108	325	3.32E-03
	0.24429	401	9.96E-04
	0.30926	475	2.67E-04
	0.24429	562	4.98E-05
	0.10108	695	3.22E-06
New Madrid Renewal, α = 0.5	0.10108	310	4.87E-03
	0.24429	430	2.19E-03
	0.30926	559	8.81E-04
	0.24429	728	2.49E-04
	0.10108	1008	2.72E-05
New Madrid Renewal, α = 0.7	0.10108	318	4.53E-03
	0.24429	494	2.28E-03
	0.30926	701	1.03E-03
	0.24429	986	3.35E-04
	0.10108	1484	4.30E-05

Source: Reference 2.5.2-253.

Table 2.5.2-211
Comparison of EPRI EST Characterizations of Gulf of Mexico Coastal Source Zones and Modifications for STP 3 and 4

EPRI EST	Source	Description	EPRI Model M_{max} (m_b) and Wts.	Updated Model for STP 3 and 4: M_{max} (m_b) and Wts.	Updated Model for STP 3 and 4: Smoothing Options and Wts.
Bechtel Group	BZ1	Gulf Coast	5.4 [0.1], 5.7 [0.4], 6.0 [0.4], 6.6 [0.1]	6.1 [0.10], 6.4 [0.40], 6.6 [0.50]	No update
Dames & Moore	20	South Coastal Margin	5.3 [0.8], 7.2 [0.2]	5.5 [0.80], 7.2 [0.20]	I (0.2), II (0.4), III (0.4)
Law Engineering	126	South Coastal Block	4.6 [0.9], 4.9 [0.1]	5.5 [0.90], 5.7 [0.10]	No update
Rondout Associates	51	Gulf Coast to Bahamas Fracture Zone	4.8 [0.2], 5.5 [0.6], 5.8 [0.2]	6.1 [0.30], 6.3 [0.55], 6.5 [0.15]	No update
Weston Geophysical Corporation	107	Gulf Coast	5.4 [0.71], 6.0 [0.29]	6.6 [0.89], 7.2 [0.11]	No update
Woodward-Clyde Consultants	B42	River Bend Background	4.9 [0.17], 5.4 [0.28], 5.8 [0.27], 6.5 [0.28]	5.5 [0.45],[a] 5.8 [0.27], 6.5 [0.28]	No update

a) Updated in this study.

Notes

I: Constant a, constant b, strong prior on b of 1.04
II: Medium smoothing on a, medium smoothing on b, strong prior on b of 1.04
III: High smoothing on a, high smoothing on b, strong prior on b of 1.04
m_b = Body-wave magnitude
Wts. = Weights

Source: Reference 2.5.2-247.

Table 2.5.2-212
Earthquake Counts and Assessed Catalog Completeness within EPRI Completeness Region 3 within 320 km (200 mi.) of RBS Site

	Assessed Probability of Detection for Time Period[a]								Earthquake Counts for Time Period								
	1625 to 1780	1780 to 1860	1860 to 1910	1910 to 1950	1950 to 1975	1975 to 3/1985	3/1985 to 1/2007										
	Corresponding Time Length (years)							T^E (years)	1625 to 1780	1780 to 1860	1860 to 1910	1910 to 1950	1950 to 1975	1975 to 3/1985	3/1985 to 1/2007	Total Count for T^E	
m_b*	155	80	50	40	25	10.16	21.84										Earthquake Catalog
3.3 to 3.9			0.182	0.489	0.760	1		57.82			0	3	4	2		9	EPRI-SOG
			0.728	0.728	0.760	1	1	116.52			4	3	4	2	2	15	Update
3.9 to 4.5			0.524	1	1	1		101.36			1	1	3	0		5	EPRI-SOG
			1	1	1	1	1	147.00			3	1	3	0	0	7	Update
4.5 to 5.1		0.233	0.721	1	1	1		129.85		0	0	0	0	0		0	EPRI-SOG
		0.233	1	1	1	1	1	165.64		0	1	0	0	0	0	1	Update
5.1 to 5.7		0.233	0.964	1	1	1		142.00		0	0	0	0	0		0	EPRI-SOG
		0.233	1	1	1	1	1	165.64		0	0	0	0	0	0	0	Update
5.7 to 6.3		0.436	0.981	1	1	1		159.09		0	0	0	0	0		0	EPRI-SOG
		0.436	1	1	1	1	1	181.88		0	0	0	0	0	0	0	Update
6.3 to 6.9		0.588	1	1	1	1		172.20		0	0	0	0	0		0	EPRI-SOG
		0.588	1	1	1	1	1	194.04		0	0	0	0	0	0	0	Update

a) Blank cells for time periods before 1985 denote time periods for which EPRI-SOG considered the catalog to be unusable.

Notes

m_b* = Adjusted body-wave magnitude

T^E = Equivalent period of completeness

Table 2.5.2-213
Assessed Probabilities of Detection for the Gulf of Mexico Completeness Region

	Assessed Probability of Detection for Time Period[a]								Earthquake Counts for Time Period								
	1625 to 1780	1780 to 1860	1860 to 1910	1910 to 1950	1950 to 1975	1975 to 3/1985	3/1985 to 1/2007										
	Corresponding Time Length (years)																
m_b*	155	80	50	40	25	10.16	21.84	T^E (years)	1625 to 1780	1780 to 1860	1860 to 1910	1910 to 1950	1950 to 1975	1975 to 3/1985	3/1985 to 1/2007	Total Count for T^E	Earthquake Catalog
Gulf of Mexico Completeness Region																	
3.3 to 3.9						0.04	0.16	3.90						1	9	10	Updated Catalog
3.9 to 4.5						0.04	0.16	3.90						0	1	1	Updated Catalog
4.5 to 5.1					0.31	0.43	0.51	23.26					1	1	1	3	Updated Catalog
5.1 to 5.7					0.88	0.93	0.98	52.85					0	0	1	1	Updated Catalog
5.7 to 6.3					0.99	0.99	1.00	56.65					0	0	1	1	Updated Catalog
6.3 to 6.9					1.00	1.00	1.00	57.00					0	0	0	0	Updated Catalog

a) Blank cells for time periods before 1985 denote time periods for which EPRI-SOG considered the catalog to be unusable.

Notes

m_b* = Adjusted body-wave magnitude
T^E = Equivalent period of completeness

Table 2.5.2-214
PSHA Results for 0.5-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

0.5-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-05	5.55E-02	2.29E-02	3.16E-02	4.90E-02	8.32E-02	1.12E-01
1.00E-04	2.12E-02	5.25E-03	8.51E-03	1.74E-02	3.47E-02	5.25E-02
1.00E-03	4.11E-03	8.13E-04	1.55E-03	3.47E-03	6.61E-03	9.55E-03
2.00E-03	2.73E-03	3.80E-04	9.12E-04	2.40E-03	4.57E-03	6.46E-03
5.00E-03	1.59E-03	1.20E-04	3.24E-04	1.18E-03	2.82E-03	4.37E-03
1.00E-02	8.85E-04	3.09E-05	9.77E-05	4.79E-04	1.74E-03	3.09E-03
2.00E-02	3.83E-04	4.90E-06	1.82E-05	1.07E-04	6.92E-04	1.70E-03
3.00E-02	2.09E-04	1.32E-06	5.62E-06	3.55E-05	3.16E-04	1.00E-03
5.00E-02	8.80E-05	1.91E-07	1.00E-06	7.76E-06	8.32E-05	4.17E-04
1.00E-01	2.28E-05	9.55E-09	5.75E-08	8.13E-07	8.13E-06	6.03E-05
3.00E-01	1.13E-06	9.33E-10	1.51E-09	1.32E-08	2.57E-07	9.77E-07
1.00E+00	9.36E-09	*<1.00E-10*	*<1.00E-10*	1.02E-09	3.24E-09	2.95E-08

Table 2.5.2-215
PSHA Results for 1-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

1-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-04	3.50E-02	1.00E-02	1.62E-02	3.02E-02	5.37E-02	7.59E-02
1.00E-03	7.47E-03	1.78E-03	3.02E-03	6.03E-03	1.18E-02	1.78E-02
3.00E-03	3.38E-03	6.31E-04	1.23E-03	2.88E-03	5.50E-03	7.59E-03
1.00E-02	1.51E-03	1.38E-04	3.39E-04	1.15E-03	2.69E-03	4.07E-03
2.00E-02	7.33E-04	3.72E-05	1.00E-04	3.98E-04	1.41E-03	2.46E-03
3.00E-02	4.10E-04	1.41E-05	4.07E-05	1.70E-04	7.24E-04	1.59E-03
5.00E-02	1.67E-04	3.47E-06	1.10E-05	4.68E-05	2.34E-04	7.41E-04
1.00E-01	3.69E-05	3.47E-07	1.26E-06	7.08E-06	3.31E-05	1.35E-04
2.00E-01	5.68E-06	2.24E-08	8.91E-08	9.33E-07	4.79E-06	1.38E-05
3.00E-01	1.61E-06	4.57E-09	1.62E-08	2.51E-07	1.62E-06	4.07E-06
5.00E-01	3.06E-07	1.59E-09	2.63E-09	3.98E-08	3.98E-07	1.12E-06
1.00E+00	3.43E-08	*<1.00E-10*	1.02E-09	3.16E-09	5.13E-08	1.82E-07

Table 2.5.2-216
PSHA Results for 2.5-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

2.5-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-04	5.05E-02	2.29E-02	3.09E-02	4.57E-02	7.24E-02	1.00E-01
1.00E-03	1.44E-02	4.17E-03	6.31E-03	1.18E-02	2.24E-02	3.39E-02
3.00E-03	5.92E-03	1.59E-03	2.63E-03	5.01E-03	9.12E-03	1.29E-02
1.00E-02	2.53E-03	4.79E-04	9.33E-04	2.24E-03	4.17E-03	5.89E-03
2.00E-02	1.43E-03	1.95E-04	3.89E-04	1.10E-03	2.46E-03	3.80E-03
5.00E-02	3.97E-04	3.39E-05	7.41E-05	2.09E-04	6.61E-04	1.38E-03
1.00E-01	9.81E-05	6.46E-06	1.48E-05	4.27E-05	1.26E-04	3.39E-04
2.00E-01	1.83E-05	9.77E-07	2.19E-06	8.71E-06	2.14E-05	4.57E-05
3.00E-01	6.35E-06	3.02E-07	6.76E-07	3.31E-06	8.91E-06	1.59E-05
5.00E-01	1.66E-06	5.13E-08	1.23E-07	9.12E-07	2.88E-06	5.13E-06
1.00E+00	2.75E-07	3.80E-09	8.91E-09	1.20E-07	5.50E-07	1.05E-06
3.00E+00	1.08E-08	1.02E-09	1.02E-09	2.75E-09	1.91E-08	5.25E-08

Table 2.5.2-217
PSHA Results for 5-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

5-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-03	1.88E-02	6.17E-03	8.91E-03	1.59E-02	2.82E-02	4.17E-02
3.00E-03	7.65E-03	2.29E-03	3.55E-03	6.46E-03	1.15E-02	1.66E-02
1.00E-02	3.13E-03	7.41E-04	1.32E-03	2.75E-03	4.90E-03	6.76E-03
2.00E-02	1.77E-03	3.31E-04	6.17E-04	1.45E-03	2.95E-03	4.37E-03
3.00E-02	1.12E-03	1.78E-04	3.39E-04	8.32E-04	1.95E-03	3.09E-03
5.00E-02	5.32E-04	7.08E-05	1.41E-04	3.39E-04	8.71E-04	1.66E-03
1.00E-01	1.55E-04	1.74E-05	3.55E-05	8.91E-05	2.04E-04	4.57E-04
2.00E-01	3.91E-05	4.17E-06	8.13E-06	2.40E-05	4.90E-05	8.51E-05
3.00E-01	1.67E-05	1.62E-06	3.24E-06	1.12E-05	2.34E-05	3.80E-05
5.00E-01	5.62E-06	4.90E-07	9.77E-07	4.07E-06	9.12E-06	1.48E-05
1.00E+00	1.19E-06	6.31E-08	1.38E-07	7.94E-07	2.24E-06	3.72E-06
3.00E+00	6.21E-08	1.62E-09	3.09E-09	2.40E-08	1.23E-07	2.46E-07

Table 2.5.2-218
PSHA Results for 10-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

10-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-03	1.84E-02	6.46E-03	9.12E-03	1.55E-02	2.75E-02	4.27E-02
3.00E-03	7.82E-03	2.46E-03	3.72E-03	6.46E-03	1.12E-02	1.74E-02
1.00E-02	3.27E-03	8.13E-04	1.41E-03	2.82E-03	5.01E-03	7.08E-03
2.00E-02	1.83E-03	3.47E-04	6.61E-04	1.48E-03	3.02E-03	4.47E-03
5.00E-02	5.76E-04	8.51E-05	1.70E-04	3.89E-04	9.12E-04	1.66E-03
1.00E-01	1.93E-04	2.57E-05	5.01E-05	1.23E-04	2.51E-04	5.13E-04
2.00E-01	6.03E-05	7.76E-06	1.45E-05	4.07E-05	7.76E-05	1.32E-04
3.00E-01	2.94E-05	3.98E-06	7.24E-06	2.19E-05	4.17E-05	6.61E-05
5.00E-01	1.16E-05	1.38E-06	2.69E-06	9.55E-06	1.86E-05	2.82E-05
1.00E+00	3.08E-06	2.46E-07	5.37E-07	2.40E-06	5.50E-06	8.51E-06
2.00E+00	6.55E-07	2.51E-08	7.59E-08	4.17E-07	1.20E-06	2.14E-06
5.00E+00	4.83E-08	1.45E-09	3.16E-09	2.04E-08	8.91E-08	1.95E-07

Table 2.5.2-219
PSHA Results for 25-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

25-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-03	1.54E-02	4.57E-03	6.76E-03	1.18E-02	2.40E-02	3.98E-02
3.00E-03	7.16E-03	1.95E-03	3.09E-03	5.50E-03	1.00E-02	1.66E-02
1.00E-02	3.15E-03	6.46E-04	1.18E-03	2.57E-03	4.79E-03	7.41E-03
3.00E-02	1.14E-03	1.62E-04	3.16E-04	8.13E-04	2.00E-03	3.31E-03
1.00E-01	2.36E-04	2.82E-05	5.62E-05	1.35E-04	3.09E-04	6.92E-04
2.00E-01	9.24E-05	1.12E-05	2.09E-05	5.37E-05	1.10E-04	2.46E-04
3.00E-01	5.02E-05	5.62E-06	1.05E-05	3.16E-05	6.46E-05	1.32E-04
5.00E-01	2.19E-05	2.04E-06	4.68E-06	1.51E-05	3.24E-05	5.75E-05
1.00E+00	6.84E-06	4.47E-07	1.26E-06	4.57E-06	1.18E-05	2.19E-05
2.00E+00	1.99E-06	5.50E-08	1.91E-07	1.00E-06	3.55E-06	7.76E-06
5.00E+00	2.87E-07	2.29E-09	8.71E-09	6.92E-08	4.17E-07	1.35E-06
7.00E+00	1.24E-07	1.23E-09	2.69E-09	2.09E-08	1.55E-07	6.31E-07

Table 2.5.2-220
PSHA Results for 100-Hz Spectral Acceleration on CEUS Generic Hard Rock for the RBS Site

100-Hz Spectral Acceleration (g)	Annual Exceedance Frequency					
	Mean	5th%	16th%	50th%	84th%	95th%
1.00E-03	1.09E-02	3.24E-03	4.68E-03	8.13E-03	1.66E-02	2.95E-02
3.00E-03	4.73E-03	1.23E-03	2.04E-03	3.98E-03	7.08E-03	1.07E-02
1.00E-02	1.81E-03	3.31E-04	6.03E-04	1.45E-03	3.02E-03	4.57E-03
2.00E-02	7.77E-04	1.07E-04	2.14E-04	5.13E-04	1.32E-03	2.40E-03
3.00E-02	4.20E-04	5.50E-05	1.07E-04	2.51E-04	6.61E-04	1.35E-03
5.00E-02	1.84E-04	2.24E-05	4.47E-05	1.10E-04	2.40E-04	5.01E-04
1.00E-01	5.86E-05	8.32E-06	1.48E-05	3.98E-05	7.59E-05	1.26E-04
2.00E-01	1.83E-05	2.14E-06	4.37E-06	1.41E-05	2.88E-05	4.57E-05
3.00E-01	9.46E-06	8.51E-07	2.29E-06	7.08E-06	1.62E-05	2.57E-05
5.00E-01	4.00E-06	2.19E-07	6.92E-07	2.69E-06	7.24E-06	1.26E-05
1.00E+00	1.05E-06	1.95E-08	7.59E-08	4.68E-07	1.86E-06	4.17E-06
3.00E+00	6.00E-08	1.05E-09	1.62E-09	1.00E-08	8.51E-08	3.16E-07

Table 2.5.2-221
Uniform Hazard Response Spectra for the RBS Site for Generic Hard Rock Conditions

Period (sec)	Frequency (Hz)	Spectral Acceleration (g) for Annual Exceedance Frequency of:			
		Mean 10^{-3}	Mean 10^{-4}	Mean 10^{-5}	Mean 10^{-6}
0.01	100	0.0163	0.0723	0.2900	1.0178
0.04	25	0.0331	0.1887	0.7972	2.7706
0.1	10	0.0337	0.1489	0.5424	1.6764
0.2	5	0.0324	0.1253	0.3822	1.0751
0.4	2.5	0.0270	0.0991	0.2525	0.6084
1	1	0.0154	0.0643	0.1645	0.3479
2	0.5	0.0087	0.0464	0.1352	0.3092

Table 2.5.2-222
Rock Hazard Reference and Deaggregation Earthquakes

	Reference (Controlling) Earthquake		Deaggregation Earthquakes		
Hazard	**Magnitude (m_b)**	**Distance (km)**	**Magnitude (m_b)**	**Distance (km)**	**Weight**
Mean 10^{-3} 5 and 10 Hz	6.7	293	5.5 7.2	60 600	0.310 0.690
Mean 10^{-3} 1 and 2.5 Hz	7.0 7.2[(a)]	435 568[(a)]	5.7 7.2	52 600	0.129 0.871
Mean 10^{-4} 5 and 10 Hz	6.4	112	5.6 7.3	23 600	0.516 0.484
Mean 10^{-4} 1 and 2.5 Hz	7.0 7.3[(a)]	336 587[(a)]	5.8 7.3	22 600	0.175 0.825
Mean 10^{-5} 5 and 10 Hz	5.9	22	5.6 7.3	12.4 600	0.852 0.148
Mean 10^{-5} 1 and 2.5 Hz	6.8 7.3[(a)]	166 591[(a)]	5.9 7.3	15.1 600	0.348 0.652
Mean 10^{-6} 5 and 10 Hz	5.8	10.3	5.8 7.4	9.5 600	0.985 0.015
Mean 10^{-6} 1 and 2.5Hz	6.6 7.3	53 591[(a)]	6.1 7.3	12.5 600	0.626 0.374

a) Computed using earthquakes with distances >100 km.

Table 2.5.2-223 (Sheet 1 of 2)
Design Dynamic Properties of the RBS Site

Geologic Unit	Layer	Elevation at Base of Layer (ft.)	Layer Thickness, h (ft.)	delta h (ft.)	Median Shear Wave Velocity, V_S (fps)	Standard Deviation in ln(V_S)	Median Compression Wave Velocity, V_P (fps)	Unit Weight (pcf)	Shear Modulus Reduction and Damping Relationships
Fill	1	95	2.5	0.5	600	0.3	980	121	EPRI (1993) 121-250 ft.
Fill	2	90	5	1	614	0.3	1003	121	EPRI (1993) 121-250 ft.
Fill	3	80	10	1	767	0.3	1253	121	EPRI (1993) 121-250 ft.
Fill	4	65	15	2	973	0.22	1589	121	EPRI (1993) 121-250 ft.
Fill	5a	60	5	0	1141	0.22	1863	121	EPRI (1993) 121-250 ft.
Fill	5b	45	15	2	1141	0.22	5000	121	EPRI (1993) 121-250 ft.
Fill	6	20	25	5	1251	0.22	5000	121	EPRI (1993) 121-250 ft.
Lower Citronelle	7	0	20	5	1085	0.2	5000	121	EPRI (1993) 121-250 ft.
Lower Citronelle	8	-20	20	5	1117	0.2	5000	121	EPRI (1993) 121-250 ft.
Lower Citronelle	9	-45	25	5	1114	0.2	5000	121	EPRI (1993) 121-250 ft.
Pascagoula Above Sand	10	-75	30	12	1245	0.226	5838	125	Vucetic and Dobry (1991) PI 30
	11	-149	74	14	1042	0.1	5497	125	Vucetic and Dobry (1991) PI 30
	12	-281	132	12	1606	0.1	6104	125	Vucetic and Dobry (1991) PI 30
Pascagoula Sand	13	-426	145	15	1400	0.1	5719	125	EPRI (1993) 501-1000 ft
Pascagoula Below Sand	14	-879	453	50	1728	0.1	6194	125	Vucetic and Dobry (1991) PI 50
	15	-1255	376	75	2453	0.1	6605	125	Linear
	16	-1630	375	100	3167	0.1	6972	125	Linear
	17	-5006	3376	600	3900	0.1	7580	125	Linear
	18	-7011	2005	400	4260	0.1	8279	125	Linear

Table 2.5.2-223 (Sheet 2 of 2)
Design Dynamic Properties of the RBS Site

Geologic Unit	Layer	Elevation at Base of Layer (ft.)	Layer Thickness, h (ft.)	delta h (ft.)	Median Shear Wave Velocity, V_S (fps)	Standard Deviation in $\ln(V_S)$	Median Compression Wave Velocity, V_P (fps)	Unit Weight (pcf)	Shear Modulus Reduction and Damping Relationships
Pascagoula Below Sand (Cont.)	19	-7230	219	19	3844	0.1	7471	125	Linear
	20	-7630	400	50	4022	0.1	7817	125	Linear
	21	-7730	100	25	4178	0.1	8121	125	Linear
	22	-8181	451	50	4462	0.1	8672	125	Linear
	23	-8830	649	49	4619	0.1	8978	125	Linear
First Layer of the Wilcox Group	24	-11,030	2200	200	6967	0.1	12,067	125	Linear
	25	-12,460	1430	130	7545	0.1	13,068	130	Linear
	26	-13,650	1190	190	6758	0.1	11,706	130	Linear
	27	-13,875	225	75	6143	0.1	10,640	130	Linear
	28	-15,175	1300	100	8634	0.1	14,954	130	Linear
	29	-15,805	630	30	7121	0.1	12,334	130	Linear
	30	-16,255	450	50	7506	0.1	13,000	130	Linear
	31	-17,155	900	100	7268	0.1	12,589	130	Linear
	32	-17,655	500	100	7656	0.1	13,261	130	Linear

Table 2.5.2-224
GMRS Profile Amplification Function Model

Frequency (Hz)	Parameter *a* of Equation 2.5.2-14				Parameter *b* of Equation 2.5.2-14				Parameter *c* of Equation 2.5.2-14				Standard Error in ln(AF)			
	a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	c_1	c_2	c_3	c_4	σ_1	σ_2	σ_3	σ_4
100	0.7880	-1.0070	1.5764	6.143	-0.2100	-0.2576	0.6803	5.460	0.0404	0.1393	0.8487	4.978	0.1	0.113	0.9113	5.831
25	0.5642	-1.3435	1.2023	6.252	0.2498	-0.6768	0.5645	6.332	0.0229	0.1482	1.6234	6.555	0.1	0.141	1.1403	6.030
10	0.3326	-0.2455	1.6906	6.554	-0.0277	-0.7028	0.8532	5.720	0.0085	0.3448	1.7124	5.694	0.1	0.169	0.8622	5.857
5	0.7104	-0.1185	2.4352	6.192	0.6343	-1.4427	0.5385	6.501	0.0880	0.4523	3.0057	6.129	0.1	0.148	0.6536	6.466
2.5	0.7840	-0.0506	2.5558	5.672	1.0517	-1.5209	0.0145	6.454	0.1416	0.1824	2.6545	6.037	0.1	0.091	0.5152	6.538
1.0	1.0883	0.0	0.0	5.0	-0.8738	0.0	0.0	5.0	1.3797	0.0	0.0	5.0	0.1	0.046	0.0160	6.700
0.5	1.1140	0.0	0.0	5.0	-0.6528	0.0	0.0	5.0	1.4040	0.0	0.0	5.0	0.1	0.099	0.0121	6.700

**Table 2.5.2-225 (Sheet 1 of 4)
GMRS for the RBS Site**

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal GMRS	Vertical/ Horizontal	Vertical GMRS
100.000	0.0755	0.1871	0.0936	0.571	0.0535
60.241	0.0816	0.2181	0.1075	0.640	0.0688
50.000	0.0839	0.2307	0.1131	0.650	0.0735
40.000	0.0868	0.2468	0.1201	0.702	0.0843
33.343	0.0893	0.2607	0.1263	0.702	0.0886
30.303	0.0906	0.2683	0.1296	0.702	0.0910
25.000	0.0933	0.2844	0.1365	0.702	0.0959
23.810	0.0941	0.2860	0.1374	0.702	0.0964
22.727	0.0949	0.2874	0.1382	0.702	0.0969
21.739	0.0957	0.2889	0.1390	0.701	0.0975
20.833	0.0964	0.2902	0.1397	0.701	0.0980
20.000	0.0971	0.2916	0.1404	0.701	0.0984
18.182	0.0988	0.2947	0.1421	0.701	0.0996
16.667	0.1004	0.2976	0.1437	0.700	0.1006
15.385	0.1018	0.3002	0.1451	0.700	0.1016
14.286	0.1032	0.3027	0.1465	0.700	0.1024
13.343	0.1045	0.3051	0.1477	0.699	0.1033
12.500	0.1057	0.3073	0.1489	0.699	0.1041
11.765	0.1068	0.3093	0.1501	0.699	0.1048
11.111	0.1079	0.3113	0.1511	0.698	0.1056
10.526	0.1090	0.3132	0.1522	0.698	0.1062
10.000	0.1100	0.3150	0.1531	0.698	0.1069
9.091	0.1129	0.3209	0.1562	0.678	0.1060
8.343	0.1156	0.3264	0.1591	0.661	0.1052
7.692	0.1182	0.3315	0.1618	0.645	0.1044
7.143	0.1206	0.3364	0.1644	0.631	0.1037

Table 2.5.2-225 (Sheet 2 of 4)
GMRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal GMRS	Vertical/ Horizontal	Vertical GMRS
6.667	0.1229	0.3409	0.1668	0.618	0.1031
6.250	0.1251	0.3452	0.1691	0.606	0.1025
5.882	0.1271	0.3493	0.1712	0.595	0.1020
5.556	0.1291	0.3533	0.1733	0.585	0.1014
5.263	0.1311	0.3570	0.1753	0.576	0.1010
5.000	0.1329	0.3606	0.1772	0.567	0.1005
4.545	0.1346	0.3664	0.1800	0.554	0.0997
4.167	0.1362	0.3718	0.1825	0.542	0.0989
3.846	0.1377	0.3768	0.1849	0.531	0.0982
3.571	0.1391	0.3815	0.1871	0.521	0.0975
3.343	0.1404	0.3860	0.1892	0.512	0.0969
3.125	0.1417	0.3902	0.1912	0.504	0.0964
2.941	0.1428	0.3941	0.1930	0.497	0.0959
2.778	0.1440	0.3979	0.1948	0.490	0.0954
2.632	0.1450	0.4016	0.1965	0.483	0.0949
2.500	0.1460	0.4050	0.1982	0.477	0.0945
2.381	0.1470	0.4084	0.1997	0.471	0.0941
2.273	0.1479	0.4116	0.2012	0.466	0.0937
2.174	0.1488	0.4146	0.2027	0.460	0.0933
2.083	0.1497	0.4176	0.2041	0.456	0.0930
2.000	0.1505	0.4205	0.2054	0.451	0.0926
1.818	0.1525	0.4272	0.2086	0.440	0.0919
1.667	0.1504	0.4300	0.2091	0.436	0.0911
1.538	0.1485	0.4325	0.2095	0.432	0.0905
1.429	0.1468	0.4348	0.2099	0.428	0.0899
1.343	0.1452	0.4370	0.2103	0.425	0.0894
1.250	0.1437	0.4390	0.2107	0.422	0.0888

Table 2.5.2-225 (Sheet 3 of 4)
GMRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal GMRS	Vertical/ Horizontal	Vertical GMRS
1.176	0.1423	0.4410	0.2110	0.419	0.0884
1.111	0.1410	0.4428	0.2113	0.416	0.0879
1.053	0.1398	0.4445	0.2116	0.413	0.0875
1.000	0.1387	0.4462	0.2119	0.411	0.0871
0.909	0.1335	0.4415	0.2086	0.412	0.0860
0.833	0.1290	0.4373	0.2055	0.414	0.0850
0.769	0.1249	0.4334	0.2028	0.415	0.0841
0.714	0.1213	0.4299	0.2003	0.416	0.0833
0.667	0.1180	0.4266	0.1979	0.417	0.0825
0.625	0.1150	0.4235	0.1958	0.418	0.0818
0.588	0.1122	0.4207	0.1938	0.419	0.0811
0.556	0.1097	0.4181	0.1920	0.419	0.0805
0.526	0.1074	0.4156	0.1902	0.420	0.0799
0.500	0.1052	0.4132	0.1886	0.421	0.0794
0.455	0.0996	0.4029	0.1828	0.421	0.0769
0.417	0.0947	0.3937	0.1776	0.421	0.0748
0.385	0.0904	0.3854	0.1734	0.421	0.0730
0.357	0.0866	0.3779	0.1700	0.421	0.0716
0.343	0.0833	0.3710	0.1670	0.421	0.0703
0.313	0.0802	0.3492	0.1572	0.421	0.0662
0.294	0.0755	0.3299	0.1485	0.421	0.0625
0.278	0.0713	0.3127	0.1407	0.421	0.0592
0.263	0.0675	0.2973	0.1338	0.421	0.0563
0.250	0.0642	0.2833	0.1275	0.421	0.0537
0.238	0.0611	0.2706	0.1218	0.421	0.0513
0.227	0.0583	0.2591	0.1166	0.421	0.0491
0.217	0.0558	0.2485	0.1118	0.421	0.0471

Table 2.5.2-225 (Sheet 4 of 4)
GMRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal GMRS	Vertical/ Horizontal	Vertical GMRS
0.208	0.0535	0.2388	0.1075	0.421	0.0452
0.200	0.0513	0.2298	0.1034	0.421	0.0435
0.182	0.0467	0.2102	0.0946	0.421	0.0398
0.167	0.0428	0.1937	0.0872	0.421	0.0367
0.154	0.0395	0.1797	0.0809	0.421	0.0340
0.143	0.0367	0.1677	0.0754	0.421	0.0318
0.133	0.0342	0.1572	0.0707	0.421	0.0298
0.125	0.0321	0.1479	0.0666	0.421	0.0280
0.118	0.0302	0.1398	0.0629	0.421	0.0265
0.111	0.0285	0.1325	0.0596	0.421	0.0251
0.100	0.0257	0.1200	0.0540	0.421	0.0227

Table 2.5.2-226 (Sheet 1 of 2)
Deaggregation Earthquakes for Soil Surface Hazard

Spectral Frequency (Hz)	Exceedance Level	Average Distance (km)			Weight		
		M 5.5[a]	M 6.5[a]	M 7.5[a]	M 5.5[a]	M 6.5[a]	M 7.5[a]
EPRI-SOG Sources							
100	10^{-4}	12.5	35.9	105.3	0.688	0.253	0.059
	10^{-5}	8.5	17.6	55.9	0.771	0.184	0.045
	10^{-6}	7.2	12.1	32.9	0.726	0.196	0.078
	10^{-7}	7.0	10.7	22.7	0.478	0.272	0.250
25	10^{-4}	13.0	37.9	103.9	0.691	0.255	0.054
	10^{-5}	8.3	16.0	50.5	0.765	0.180	0.054
	10^{-6}	7.2	11.7	30.8	0.690	0.186	0.124
	10^{-7}	7.0	10.7	22.8	0.472	0.199	0.330
10	10^{-4}	14.3	45.9	106.4	0.656	0.294	0.050
	10^{-5}	11.1	21.7	50.2	0.796	0.183	0.021
	10^{-6}	8.5	12.3	28.4	0.816	0.147	0.037
	10^{-7}	7.9	10.9	22.9	0.642	0.186	0.172
5	10^{-4}	13.9	43.4	103.7	0.664	0.290	0.047
	10^{-5}	11.4	23.6	46.4	0.766	0.221	0.014
	10^{-6}	9.4	14.4	25.4	0.821	0.175	0.004
	10^{-7}	8.9	12.8	21.9	0.848	0.149	0.003
2.5	10^{-4}	13.3	41.5	107.1	0.640	0.303	0.057
	10^{-5}	11.0	23.8	56.8	0.664	0.299	0.037
	10^{-6}	9.4	15.2	31.2	0.632	0.331	0.037
	10^{-7}	8.5	11.6	22.1	0.589	0.368	0.043
1	10^{-4}	13.3	40.3	108.3	0.557	0.364	0.079
	10^{-5}	11.1	23.0	59.1	0.480	0.434	0.086
	10^{-6}	9.6	16.3	36.8	0.386	0.497	0.117
	10^{-7}	8.7	13.2	27.4	0.293	0.538	0.169

Table 2.5.2-226 (Sheet 2 of 2)
Deaggregation Earthquakes for Soil Surface Hazard

Spectral Frequency (Hz)	Exceedance Level	Average Distance (km)			Weight		
		M 5.5[a]	**M** 6.5[a]	**M** 7.5[a]	**M** 5.5[a]	**M** 6.5[a]	**M** 7.5[a]
0.5	10^{-4}	13.3	40.0	107.2	0.429	0.458	0.112
	10^{-5}	10.3	20.3	53.5	0.273	0.558	0.169
	10^{-6}	8.9	14.7	33.3	0.169	0.585	0.246
	10^{-7}	8.2	12.5	25.9	0.102	0.563	0.335
New Madrid Source of Repeated Large Earthquakes							
All	All			540			1.0
Saline River Source							
All	All			260			1.0

a) **M** 5.5 represents $4.0 \leq m_b \leq 6.2$, **M** 6.5 represents $6.3 \leq m_b \leq 6.9$, **M** 7.5 represents $m_b > 6.9$.

Table 2.5.2-227 (Sheet 1 of 4)
R/FB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
100.000	0.0744	0.1882	0.0938	0.571	0.0536
60.241	0.0803	0.2190	0.1075	0.640	0.0688
50.000	0.0826	0.2316	0.1131	0.650	0.0736
40.000	0.0854	0.2476	0.1201	0.702	0.0843
33.343	0.0878	0.2614	0.1261	0.702	0.0885
30.303	0.0891	0.2690	0.1294	0.702	0.0908
25.000	0.0917	0.2849	0.1363	0.702	0.0957
23.810	0.0925	0.2862	0.1370	0.702	0.0961
22.727	0.0933	0.2873	0.1377	0.702	0.0966
21.739	0.0940	0.2885	0.1383	0.701	0.0970
20.833	0.0947	0.2896	0.1389	0.701	0.0974
20.000	0.0954	0.2906	0.1396	0.701	0.0978
18.182	0.0971	0.2931	0.1410	0.701	0.0988
16.667	0.0986	0.2953	0.1423	0.700	0.0996
15.385	0.1000	0.2974	0.1435	0.700	0.1004
14.286	0.1013	0.2994	0.1446	0.700	0.1012
13.343	0.1026	0.3012	0.1457	0.699	0.1019
12.500	0.1038	0.3030	0.1467	0.699	0.1026
11.765	0.1049	0.3046	0.1477	0.699	0.1032
11.111	0.1060	0.3061	0.1486	0.698	0.1038
10.526	0.1070	0.3076	0.1494	0.698	0.1043
10.000	0.1080	0.3090	0.1502	0.698	0.1049
9.091	0.1108	0.3153	0.1535	0.678	0.1041
8.343	0.1134	0.3211	0.1565	0.660	0.1033
7.692	0.1159	0.3266	0.1593	0.645	0.1027
7.143	0.1182	0.3317	0.1619	0.630	0.1020

Table 2.5.2-227 (Sheet 2 of 4)
R/FB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
6.667	0.1204	0.3366	0.1644	0.617	0.1015
6.250	0.1225	0.3412	0.1668	0.605	0.1009
5.882	0.1245	0.3456	0.1691	0.594	0.1004
5.556	0.1264	0.3498	0.1712	0.584	0.1000
5.263	0.1283	0.3538	0.1733	0.574	0.0995
5.000	0.1300	0.3576	0.1753	0.565	0.0991
4.545	0.1321	0.3639	0.1783	0.552	0.0983
4.167	0.1340	0.3698	0.1811	0.539	0.0977
3.846	0.1358	0.3752	0.1837	0.528	0.0970
3.571	0.1374	0.3803	0.1862	0.518	0.0964
3.343	0.1390	0.3852	0.1885	0.509	0.0959
3.125	0.1405	0.3897	0.1907	0.500	0.0954
2.941	0.1419	0.3941	0.1928	0.492	0.0949
2.778	0.1432	0.3982	0.1947	0.485	0.0945
2.632	0.1445	0.4022	0.1966	0.478	0.0941
2.500	0.1457	0.4059	0.1984	0.472	0.0937
2.381	0.1469	0.4096	0.2002	0.466	0.0933
2.273	0.1481	0.4131	0.2019	0.460	0.0929
2.174	0.1491	0.4164	0.2035	0.455	0.0926
2.083	0.1502	0.4197	0.2050	0.450	0.0923
2.000	0.1512	0.4228	0.2065	0.445	0.0920
1.818	0.1536	0.4303	0.2101	0.434	0.0913
1.667	0.1514	0.4323	0.2103	0.431	0.0906
1.538	0.1494	0.4343	0.2105	0.428	0.0900
1.429	0.1476	0.4360	0.2107	0.425	0.0895
1.343	0.1460	0.4377	0.2108	0.422	0.0890
1.250	0.1444	0.4392	0.2110	0.420	0.0885

Table 2.5.2-227 (Sheet 3 of 4)
R/FB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
1.176	0.1430	0.4407	0.2111	0.417	0.0881
1.111	0.1417	0.4421	0.2113	0.415	0.0877
1.053	0.1404	0.4434	0.2114	0.413	0.0873
1.000	0.1392	0.4447	0.2115	0.411	0.0869
0.909	0.1332	0.4375	0.2069	0.412	0.0853
0.833	0.1279	0.4311	0.2028	0.414	0.0839
0.769	0.1232	0.4252	0.1991	0.415	0.0826
0.714	0.1190	0.4199	0.1958	0.416	0.0814
0.667	0.1152	0.4150	0.1927	0.417	0.0803
0.625	0.1118	0.4105	0.1899	0.418	0.0793
0.588	0.1087	0.4062	0.1872	0.419	0.0784
0.556	0.1058	0.4023	0.1848	0.419	0.0775
0.526	0.1032	0.3986	0.1825	0.420	0.0767
0.500	0.1007	0.3951	0.1804	0.421	0.0759
0.455	0.0962	0.3839	0.1746	0.421	0.0735
0.417	0.0922	0.3740	0.1696	0.421	0.0714
0.385	0.0886	0.3650	0.1650	0.421	0.0695
0.357	0.0855	0.3570	0.1609	0.421	0.0678
0.343	0.0827	0.3496	0.1573	0.421	0.0662
0.313	0.0801	0.3428	0.1543	0.421	0.0650
0.294	0.0754	0.3242	0.1459	0.421	0.0614
0.278	0.0712	0.3076	0.1384	0.421	0.0583
0.263	0.0675	0.2926	0.1317	0.421	0.0554
0.250	0.0641	0.2791	0.1256	0.421	0.0529
0.238	0.0610	0.2669	0.1201	0.421	0.0506
0.227	0.0583	0.2557	0.1151	0.421	0.0484
0.217	0.0557	0.2454	0.1104	0.421	0.0465

Table 2.5.2-227 (Sheet 4 of 4)
R/FB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
0.208	0.0534	0.2360	0.1062	0.421	0.0447
0.200	0.0513	0.2273	0.1023	0.421	0.0431
0.182	0.0466	0.2082	0.0937	0.421	0.0394
0.167	0.0427	0.1921	0.0865	0.421	0.0364
0.154	0.0394	0.1785	0.0803	0.421	0.0338
0.143	0.0366	0.1667	0.0750	0.421	0.0316
0.133	0.0342	0.1564	0.0704	0.421	0.0296
0.125	0.0320	0.1474	0.0663	0.421	0.0279
0.118	0.0302	0.1394	0.0627	0.421	0.0264
0.111	0.0285	0.1322	0.0595	0.421	0.0251
0.100	0.0256	0.1200	0.0540	0.421	0.0227

Table 2.5.2-228 (Sheet 1 of 4)
CB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
100.000	0.0743	0.1811	0.0909	0.571	0.0519
60.241	0.0804	0.2106	0.1042	0.640	0.0667
50.000	0.0828	0.2226	0.1096	0.650	0.0713
40.000	0.0857	0.2379	0.1164	0.702	0.0817
33.343	0.0881	0.2512	0.1222	0.702	0.0858
30.303	0.0894	0.2584	0.1254	0.702	0.0880
25.000	0.0921	0.2736	0.1321	0.702	0.0927
23.810	0.0929	0.2751	0.1329	0.702	0.0932
22.727	0.0937	0.2765	0.1336	0.702	0.0938
21.739	0.0945	0.2779	0.1344	0.701	0.0943
20.833	0.0953	0.2792	0.1351	0.701	0.0947
20.000	0.0960	0.2805	0.1358	0.701	0.0952
18.182	0.0977	0.2835	0.1374	0.701	0.0963
16.667	0.0992	0.2863	0.1390	0.700	0.0973
15.385	0.1007	0.2888	0.1404	0.700	0.0982
14.286	0.1021	0.2912	0.1417	0.700	0.0991
13.343	0.1034	0.2935	0.1429	0.699	0.0999
12.500	0.1046	0.2956	0.1441	0.699	0.1007
11.765	0.1058	0.2976	0.1452	0.699	0.1014
11.111	0.1069	0.2995	0.1462	0.698	0.1021
10.526	0.1080	0.3013	0.1472	0.698	0.1028
10.000	0.1090	0.3030	0.1482	0.698	0.1034
9.091	0.1107	0.3071	0.1502	0.684	0.1028
8.343	0.1122	0.3108	0.1521	0.672	0.1021
7.692	0.1136	0.3143	0.1539	0.660	0.1016
7.143	0.1149	0.3176	0.1555	0.650	0.1011

Table 2.5.2-228 (Sheet 2 of 4)
CB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
6.667	0.1162	0.3206	0.1570	0.641	0.1006
6.250	0.1174	0.3235	0.1585	0.632	0.1002
5.882	0.1185	0.3263	0.1599	0.624	0.0997
5.556	0.1196	0.3289	0.1612	0.616	0.0993
5.263	0.1206	0.3314	0.1624	0.609	0.0990
5.000	0.1216	0.3337	0.1636	0.603	0.0986
4.545	0.1239	0.3400	0.1667	0.588	0.0980
4.167	0.1261	0.3458	0.1696	0.574	0.0974
3.846	0.1281	0.3513	0.1722	0.562	0.0969
3.571	0.1300	0.3564	0.1748	0.552	0.0964
3.343	0.1318	0.3612	0.1771	0.542	0.0959
3.125	0.1334	0.3658	0.1794	0.532	0.0955
2.941	0.1351	0.3701	0.1815	0.524	0.0951
2.778	0.1366	0.3743	0.1836	0.516	0.0947
2.632	0.1381	0.3782	0.1855	0.509	0.0944
2.500	0.1395	0.3820	0.1874	0.502	0.0941
2.381	0.1408	0.3857	0.1892	0.496	0.0937
2.273	0.1421	0.3892	0.1909	0.490	0.0935
2.174	0.1434	0.3926	0.1926	0.484	0.0932
2.083	0.1446	0.3958	0.1942	0.478	0.0929
2.000	0.1457	0.3990	0.1957	0.473	0.0926
1.818	0.1485	0.4065	0.1994	0.462	0.0920
1.667	0.1478	0.4125	0.2016	0.454	0.0915
1.538	0.1472	0.4182	0.2036	0.447	0.0910
1.429	0.1466	0.4235	0.2055	0.440	0.0905
1.343	0.1461	0.4285	0.2073	0.435	0.0901
1.250	0.1456	0.4332	0.2090	0.429	0.0897

Table 2.5.2-228 (Sheet 3 of 4)
CB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
1.176	0.1452	0.4377	0.2106	0.424	0.0893
1.111	0.1447	0.4420	0.2121	0.419	0.0890
1.053	0.1443	0.4461	0.2136	0.415	0.0887
1.000	0.1439	0.4500	0.2149	0.411	0.0883
0.909	0.1375	0.4442	0.2108	0.412	0.0869
0.833	0.1318	0.4389	0.2071	0.414	0.0856
0.769	0.1269	0.4342	0.2037	0.415	0.0845
0.714	0.1224	0.4298	0.2006	0.416	0.0834
0.667	0.1184	0.4258	0.1978	0.417	0.0824
0.625	0.1148	0.4221	0.1952	0.418	0.0815
0.588	0.1115	0.4186	0.1928	0.419	0.0807
0.556	0.1085	0.4154	0.1905	0.419	0.0799
0.526	0.1057	0.4123	0.1884	0.420	0.0792
0.500	0.1032	0.4094	0.1865	0.421	0.0785
0.455	0.0984	0.3970	0.1802	0.421	0.0759
0.417	0.0942	0.3859	0.1746	0.421	0.0735
0.385	0.0905	0.3760	0.1697	0.421	0.0714
0.357	0.0872	0.3671	0.1652	0.421	0.0696
0.343	0.0843	0.3590	0.1615	0.421	0.0680
0.313	0.0816	0.3515	0.1582	0.421	0.0666
0.294	0.0768	0.3320	0.1494	0.421	0.0629
0.278	0.0725	0.3146	0.1415	0.421	0.0596
0.263	0.0687	0.2989	0.1345	0.421	0.0566
0.250	0.0653	0.2848	0.1282	0.421	0.0540
0.238	0.0622	0.2720	0.1224	0.421	0.0515
0.227	0.0593	0.2603	0.1171	0.421	0.0493
0.217	0.0568	0.2496	0.1123	0.421	0.0473

Table 2.5.2-228 (Sheet 4 of 4)
CB FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/ Horizontal	Vertical FIRS
0.208	0.0544	0.2398	0.1079	0.421	0.0454
0.200	0.0522	0.2307	0.1038	0.421	0.0437
0.182	0.0475	0.2109	0.0949	0.421	0.0400
0.167	0.0435	0.1943	0.0874	0.421	0.0368
0.154	0.0402	0.1802	0.0811	0.421	0.0341
0.143	0.0373	0.1680	0.0756	0.421	0.0318
0.133	0.0348	0.1574	0.0708	0.421	0.0298
0.125	0.0326	0.1481	0.0667	0.421	0.0281
0.118	0.0307	0.1399	0.0629	0.421	0.0265
0.111	0.0290	0.1325	0.0596	0.421	0.0251
0.100	0.0261	0.1200	0.0540	0.421	0.0227

Table 2.5.2-229 (Sheet 1 of 4)
FWSC FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
100.000	0.0747	0.1818	0.0913	0.637	0.0582
60.241	0.0810	0.2120	0.1049	0.707	0.0742
50.000	0.0834	0.2243	0.1104	0.717	0.0792
40.000	0.0864	0.2400	0.1174	0.769	0.0903
33.343	0.0890	0.2537	0.1234	0.769	0.0949
30.303	0.0903	0.2611	0.1267	0.769	0.0974
25.000	0.0931	0.2768	0.1336	0.769	0.1027
23.810	0.0940	0.2787	0.1346	0.760	0.1023
22.727	0.0948	0.2806	0.1355	0.752	0.1019
21.739	0.0955	0.2823	0.1364	0.745	0.1016
20.833	0.0963	0.2840	0.1373	0.737	0.1012
20.000	0.0970	0.2857	0.1381	0.731	0.1009
18.182	0.0987	0.2895	0.1401	0.715	0.1001
16.667	0.1002	0.2931	0.1419	0.701	0.0994
15.385	0.1017	0.2964	0.1436	0.688	0.0988
14.286	0.1031	0.2996	0.1452	0.676	0.0982
13.343	0.1044	0.3025	0.1467	0.666	0.0976
12.500	0.1056	0.3052	0.1481	0.656	0.0971
11.765	0.1068	0.3079	0.1495	0.647	0.0967
11.111	0.1079	0.3104	0.1507	0.638	0.0962
10.526	0.1090	0.3127	0.1520	0.630	0.0958
10.000	0.1100	0.3150	0.1531	0.623	0.0954
9.091	0.1119	0.3184	0.1550	0.613	0.0951
8.343	0.1136	0.3216	0.1567	0.605	0.0948
7.692	0.1153	0.3245	0.1583	0.597	0.0945
7.143	0.1168	0.3272	0.1598	0.590	0.0942
6.667	0.1182	0.3298	0.1612	0.583	0.0940

Table 2.5.2-229 (Sheet 2 of 4)
FWSC FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
6.250	0.1196	0.3322	0.1625	0.577	0.0938
5.882	0.1209	0.3345	0.1637	0.571	0.0935
5.556	0.1221	0.3367	0.1649	0.566	0.0933
5.263	0.1233	0.3388	0.1661	0.561	0.0932
5.000	0.1244	0.3407	0.1671	0.556	0.0930
4.545	0.1255	0.3455	0.1693	0.547	0.0927
4.167	0.1264	0.3499	0.1713	0.539	0.0924
3.846	0.1273	0.3540	0.1731	0.532	0.0921
3.571	0.1281	0.3578	0.1748	0.525	0.0918
3.343	0.1289	0.3615	0.1765	0.519	0.0916
3.125	0.1296	0.3649	0.1780	0.513	0.0914
2.941	0.1303	0.3681	0.1795	0.508	0.0912
2.778	0.1310	0.3712	0.1808	0.503	0.0910
2.632	0.1316	0.3741	0.1821	0.498	0.0908
2.500	0.1322	0.3769	0.1834	0.494	0.0906
2.381	0.1328	0.3796	0.1846	0.490	0.0905
2.273	0.1333	0.3822	0.1858	0.486	0.0903
2.174	0.1338	0.3847	0.1869	0.482	0.0902
2.083	0.1343	0.3871	0.1879	0.479	0.0900
2.000	0.1348	0.3894	0.1890	0.476	0.0899
1.818	0.1359	0.3948	0.1914	0.468	0.0896
1.667	0.1366	0.3999	0.1935	0.461	0.0893
1.538	0.1372	0.4046	0.1955	0.455	0.0890
1.429	0.1378	0.4090	0.1974	0.450	0.0888
1.343	0.1383	0.4131	0.1991	0.445	0.0885
1.250	0.1388	0.4170	0.2008	0.440	0.0883
1.176	0.1393	0.4207	0.2023	0.436	0.0881

Table 2.5.2-229 (Sheet 3 of 4)
FWSC FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
1.111	0.1397	0.4242	0.2038	0.431	0.0879
1.053	0.1402	0.4276	0.2052	0.428	0.0878
1.000	0.1406	0.4308	0.2066	0.424	0.0876
0.909	0.1349	0.4270	0.2035	0.425	0.0865
0.833	0.1299	0.4236	0.2006	0.426	0.0855
0.769	0.1254	0.4205	0.1981	0.427	0.0847
0.714	0.1214	0.4177	0.1957	0.428	0.0838
0.667	0.1179	0.4150	0.1936	0.429	0.0831
0.625	0.1146	0.4126	0.1916	0.430	0.0824
0.588	0.1116	0.4103	0.1897	0.431	0.0818
0.556	0.1089	0.4081	0.1880	0.432	0.0812
0.526	0.1064	0.4061	0.1864	0.432	0.0806
0.500	0.1040	0.4042	0.1849	0.433	0.0800
0.455	0.0996	0.3947	0.1798	0.433	0.0778
0.417	0.0957	0.3862	0.1753	0.433	0.0759
0.385	0.0922	0.3785	0.1712	0.433	0.0741
0.357	0.0892	0.3715	0.1676	0.433	0.0726
0.343	0.0864	0.3652	0.1643	0.433	0.0712
0.313	0.0839	0.3593	0.1617	0.433	0.0700
0.294	0.0789	0.3389	0.1525	0.433	0.0660
0.278	0.0745	0.3208	0.1444	0.433	0.0625
0.263	0.0706	0.3045	0.1370	0.433	0.0593
0.250	0.0671	0.2899	0.1304	0.433	0.0565
0.238	0.0639	0.2766	0.1245	0.433	0.0539
0.227	0.0610	0.2645	0.1190	0.433	0.0515
0.217	0.0583	0.2534	0.1140	0.433	0.0494
0.208	0.0559	0.2432	0.1094	0.433	0.0474

Table 2.5.2-229 (Sheet 4 of 4)
FWSC FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
0.200	0.0537	0.2338	0.1052	0.433	0.0456
0.182	0.0488	0.2133	0.0960	0.433	0.0416
0.167	0.0447	0.1962	0.0883	0.433	0.0382
0.154	0.0413	0.1817	0.0817	0.433	0.0354
0.143	0.0383	0.1691	0.0761	0.433	0.0330
0.133	0.0358	0.1583	0.0712	0.433	0.0308
0.125	0.0335	0.1487	0.0669	0.433	0.0290
0.118	0.0316	0.1403	0.0631	0.433	0.0273
0.111	0.0298	0.1328	0.0598	0.433	0.0259
0.100	0.0268	0.1200	0.0540	0.433	0.0234

Table 2.5.2-230 (Sheet 1 of 4)
FG FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
100.000	0.0805	0.2018	0.1007	0.578	0.0582
60.241	0.0872	0.2351	0.1157	0.642	0.0742
50.000	0.0899	0.2487	0.1217	0.651	0.0792
40.000	0.0931	0.2660	0.1294	0.698	0.0903
33.343	0.0959	0.2810	0.1360	0.698	0.0949
30.303	0.0973	0.2892	0.1396	0.698	0.0974
25.000	0.1004	0.3065	0.1471	0.698	0.1027
23.810	0.1009	0.3069	0.1474	0.694	0.1023
22.727	0.1013	0.3074	0.1477	0.690	0.1019
21.739	0.1018	0.3078	0.1480	0.686	0.1015
20.833	0.1022	0.3082	0.1483	0.682	0.1012
20.000	0.1026	0.3085	0.1485	0.679	0.1009
18.182	0.1036	0.3094	0.1492	0.671	0.1001
16.667	0.1045	0.3102	0.1497	0.664	0.0994
15.385	0.1054	0.3110	0.1503	0.657	0.0988
14.286	0.1061	0.3117	0.1508	0.651	0.0982
13.343	0.1069	0.3123	0.1512	0.646	0.0976
12.500	0.1076	0.3129	0.1516	0.640	0.0971
11.765	0.1082	0.3135	0.1520	0.636	0.0967
11.111	0.1088	0.3140	0.1524	0.631	0.0962
10.526	0.1094	0.3145	0.1528	0.627	0.0958
10.000	0.1100	0.3150	0.1531	0.623	0.0954
9.091	0.1147	0.3269	0.1591	0.598	0.0951
8.343	0.1191	0.3382	0.1647	0.575	0.0948
7.692	0.1234	0.3489	0.1700	0.556	0.0945
7.143	0.1275	0.3591	0.1752	0.538	0.0942
6.667	0.1314	0.3689	0.1800	0.522	0.0940

Table 2.5.2-230 (Sheet 2 of 4)
FG FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
6.250	0.1351	0.3783	0.1847	0.507	0.0937
5.882	0.1388	0.3873	0.1893	0.494	0.0935
5.556	0.1423	0.3961	0.1936	0.482	0.0933
5.263	0.1457	0.4045	0.1979	0.471	0.0931
5.000	0.1490	0.4127	0.2020	0.460	0.0930
4.545	0.1478	0.4129	0.2017	0.459	0.0926
4.167	0.1467	0.4131	0.2015	0.458	0.0923
3.846	0.1457	0.4133	0.2013	0.457	0.0920
3.571	0.1448	0.4135	0.2011	0.456	0.0918
3.343	0.1439	0.4137	0.2010	0.456	0.0915
3.125	0.1431	0.4139	0.2008	0.455	0.0913
2.941	0.1424	0.4140	0.2007	0.454	0.0911
2.778	0.1417	0.4142	0.2005	0.453	0.0909
2.632	0.1410	0.4143	0.2004	0.453	0.0907
2.500	0.1404	0.4144	0.2003	0.452	0.0906
2.381	0.1398	0.4145	0.2001	0.452	0.0904
2.273	0.1393	0.4147	0.2000	0.451	0.0902
2.174	0.1388	0.4148	0.1999	0.451	0.0901
2.083	0.1383	0.4149	0.1998	0.450	0.0899
2.000	0.1378	0.4150	0.1997	0.450	0.0898
1.818	0.1367	0.4152	0.1995	0.449	0.0895
1.667	0.1370	0.4154	0.1997	0.447	0.0892
1.538	0.1373	0.4156	0.1998	0.445	0.0889
1.429	0.1375	0.4158	0.2000	0.443	0.0887
1.343	0.1378	0.4160	0.2001	0.442	0.0884
1.250	0.1380	0.4162	0.2002	0.441	0.0882
1.176	0.1382	0.4163	0.2004	0.439	0.0880

Table 2.5.2-230 (Sheet 3 of 4)
FG FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
1.111	0.1384	0.4165	0.2005	0.438	0.0878
1.053	0.1386	0.4166	0.2006	0.437	0.0877
1.000	0.1388	0.4167	0.2007	0.436	0.0875
0.909	0.1329	0.4146	0.1981	0.436	0.0864
0.833	0.1277	0.4126	0.1958	0.437	0.0855
0.769	0.1230	0.4109	0.1937	0.437	0.0846
0.714	0.1189	0.4092	0.1918	0.437	0.0838
0.667	0.1152	0.4077	0.1900	0.437	0.0831
0.625	0.1119	0.4063	0.1883	0.437	0.0824
0.588	0.1088	0.4049	0.1868	0.438	0.0817
0.556	0.1060	0.4037	0.1854	0.438	0.0811
0.526	0.1034	0.4025	0.1840	0.438	0.0806
0.500	0.1010	0.4014	0.1827	0.438	0.0800
0.455	0.0975	0.3933	0.1785	0.438	0.0782
0.417	0.0944	0.3860	0.1747	0.438	0.0765
0.385	0.0916	0.3794	0.1713	0.438	0.0750
0.357	0.0891	0.3735	0.1683	0.438	0.0737
0.343	0.0869	0.3680	0.1656	0.438	0.0725
0.313	0.0848	0.3629	0.1633	0.438	0.0715
0.294	0.0799	0.3422	0.1540	0.438	0.0674
0.278	0.0754	0.3237	0.1457	0.438	0.0638
0.263	0.0714	0.3071	0.1382	0.438	0.0605
0.250	0.0679	0.2922	0.1315	0.438	0.0576
0.238	0.0646	0.2787	0.1254	0.438	0.0549
0.227	0.0617	0.2664	0.1199	0.438	0.0525
0.217	0.0590	0.2551	0.1148	0.438	0.0503
0.208	0.0566	0.2448	0.1102	0.438	0.0482

Table 2.5.2-230 (Sheet 4 of 4)
FG FIRS for the RBS Site

Spectral Frequency (Hz)	5 Percent Damped Spectral Acceleration (g)				
	10^{-4} UHRS	10^{-5} UHRS	Horizontal FIRS	Vertical/Horizontal	Vertical FIRS
0.200	0.0543	0.2353	0.1059	0.438	0.0464
0.182	0.0494	0.2145	0.0965	0.438	0.0423
0.167	0.0452	0.1971	0.0887	0.438	0.0388
0.154	0.0418	0.1823	0.0821	0.438	0.0359
0.143	0.0388	0.1697	0.0764	0.438	0.0334
0.133	0.0362	0.1587	0.0714	0.438	0.0313
0.125	0.0339	0.1490	0.0671	0.438	0.0294
0.118	0.0319	0.1405	0.0632	0.438	0.0277
0.111	0.0302	0.1329	0.0598	0.438	0.0262
0.100	0.0271	0.1200	0.0540	0.438	0.0237

Table 2.5.2-231
Equivalent Uniform Shear Wave Velocity

Building	Building Foundation Dimensions (ft.)	Embedment Depth (ft.)	Depth of Soil Column Considered (ft.)	Equivalent Uniform Shear Wave Velocity (fps)			
				16th Percentile	30th Percentile	50th Percentile	84th Percentile
CB	78 x 99	48.9	246.9	735	825	942	1219
FWSC	66 x 171	7.7	349.7	832	926	1048	1327
RB	161 x 230	65.6	525.6	909	1001	1121	1371

Appendix 2.5.2AA Earthquake Source Catalog

The updated earthquake catalog prepared for the project constitutes this appendix. The development of this catalog is described in Section 2.0.

This catalog was used to select the final catalog of earthquakes occurring within 200 mi. of the RBS Unit 3 site.

The headings for the data in the table are described below:

Year - Year in Coordinated Universal Time (UTC)

Month - Month in Coordinated Universal Time (UTC)

Day - Day in Coordinated Universal Time (UTC)

Hour - Hour in Coordinated Universal Time (UTC)

Minute - Minute in Coordinated Universal Time (UTC)

Second - Second in Coordinated Universal Time (UTC)

Latitude - Latitude (north)

Longitude - Longitude (west negative)

Depth - Hypocentral depth in km

m_b* - m_b adjusted for bias due to uncertainties

Final m_b - m_b

Type - Category for Earthquakes:

- EPRI, from EPRI-SOG (1988).
- Added historical, newly identified earthquakes added to EPRI-SOG catalog (occurring from 1776 to February 1985).
- Post, earthquakes occurring post-EPRI-SOG catalog (May 1985 to April 2008).

EPRI Flag - Earthquake Dependency:

- MAIN, mainshock with dependent events.
- Blank, mainshock with no associated dependent events.
- [number], EPRI UNID of mainshock.

R (km) - Distance from RBS Unit 3 site in km

Table 2.5.2AA-201 (Sheet 1 of 3)
Earthquake Catalog

AI

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	Depth	m_b*	Final m_b	Type	EPRI Flag	Dist. to RB
1842	5	7	15	0	0	30.77	-91.92	0	4.24	3.9	Added	MAIN	56.25
1868	11	28	19	0	0	31.31	-92.46	0	4.14	3.80	Added		123.97
1870	1	9	5	0	0	31.14	-92.29	11	4.54	4.20	Added		100.92
1872	4	16	2	30	0	32.36	-88.7	11	4.20	4.10	Added		306.88
1886	10	23	16	30	0	30.68	-88.09	0	3.84	3.5	Added		310.37
1886	10	23	0	0	0	30.68	-88.09	0	3.84	3.5	Added		310.37
1893	5	21	0	0	0	33.61	-91.21	0	3.84	3.50	Added		317.79
1898	2	13	0	0	0	31.45	-91.3	0	3.12	3.02	Added		77.29
1905	2	3	0	0	0	30.5	-91.1	0	4.04	3.70	EPRI	MAIN	36.12
1909	2	6	0	0	0	30.416	-88.932	0	3.36	3.02	Added		233.04
1927	11	13	16	21	0	32.3	-90.2	0	3.50	3.40	EPRI	MAIN	202.61
1927	12	15	4	30	0	28.9	-89.4	0	3.90	3.80	EPRI	MAIN	278.31
1929	7	28	17	0	0	28.9	-89.4	0	3.90	3.80	EPRI	MAIN	278.31
1930	10	19	12	12	0	30.1	-91	0	4.30	4.20	EPRI	MAIN	79.65
1941	6	28	18	30	0	32.3	-90.8	0	3.34	3.00	EPRI	MAIN	179.07
1947	9	20	21	30	0	31.9	-92.6	0	3.64	3.30	EPRI	MAIN	175.31
1952	10	17	15	48	0	30.1	-93.7	0	3.45	3.11	EPRI	MAIN	238.69
1955	2	1	14	45	0	30.4	-89.1	0	4.40	4.30	EPRI	MAIN	217.51
1956	9	27	14	15	0	31.9	-88.4	0	4.14	3.80	EPRI	MAIN	306.47

Table 2.5.2AA-201 (Sheet 2 of 3)
Earthquake Catalog

AI

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	Depth	m_b*	Final m_b	Type	EPRI Flag	Dist. to RB
1958	11	6	23	8	0	29.9	-90.1	0	3.45	3.11	EPRI	MAIN	151.91
1958	11	19	18	15	0	30.5	-91.2	0	3.30	3.20	EPRI	MAIN	31.16
1959	10	15	15	45	0	29.8	-93.1	0	3.80	3.70	EPRI	MAIN	200.47
1963	11	5	22	45	3.4	27.49	-92.58	15	4.75	4.71	EPRI	MAIN	383.16
1964	4	24	7	33	51.9	31.42	-93.81	5	3.57	3.58	EPRI	MAIN	247.48
1967	6	4	16	14	12	33.55	-90.84	6	4.29	4.30	EPRI	MAIN	314.34
1977	5	4	2	0	24	31.96	-88.44	0	3.29	3.30	EPRI	MAIN	305.8
1978	6	9	23	15	19	32.042	-88.595	2	3.29	3.30	Added		296.81
1978	7	24	8	6	16.9	26.38	-88.72	15	4.87	4.88	EPRI	MAIN	549.89
1978	12	11	2	6	50	31.91	-88.47	3	3.49	3.50	EPRI	MAIN	300.89
1980	1	10	19	16	23.5	24.13	-85.71	15	3.87	3.88	EPRI	MAIN	923.84
1981	2	13	2	15	0	30	-91.8	0	3.09	3.10	Added		95.37
1983	10	16	19	40	50.8	30.24	-93.39	5	3.77	3.78	EPRI	MAIN	205.54
1983	12	9	20	52	10	33.183	-92.704	5	2.99	3.00	Added		299.53
1986	5	12	4	18	2.47	27.7	-88.73	10	3.59	3.60	Post		423.73
1992	3	31	14	59	39.64	26.02	-85.73	5	3.79	3.80	Post		761.31
1992	9	27	17	2	34.31	28.17	-88.44	10	3.79	3.80	Post		401.73
1993	7	16	10	54	32	31.747	-88.341	5	3.69	3.70	Post		305.24
1994	6	10	23	34	2	33.013	-92.671	5	3.19	3.20	Post		281.23

Table 2.5.2AA-201 (Sheet 3 of 3)
Earthquake Catalog

AI

Year	Month	Day	Hour	Minute	Second	Latitude	Longitude	Depth	m_b*	Final m_b	Type	EPRI Flag	Dist. to RB
1994	6	30	1	8	24.22	27.91	-90.18	10	4.19	4.20	Post		335.84
1996	3	25	14	15	50	32.131	-88.671	5	3.29	3.30	Post		295.41
1996	8	11	18	17	49	33.577	-90.874	10	3.39	3.40	Post		316.86
1997	4	18	14	57	35.39	25.78	-86.55	33	3.89	3.90	Post		725.91
1998	7	6	6	54	3.79	25.02	-93.63	10	3.39	3.40	Post		677.2
2000	12	9	6	46	9.12	28.03	-90.17	10	5.04	5.05	Post		323.59
2001	3	3	10	46	13	33.19	-92.66	5	2.99	3.00	Post		298.46
2001	3	16	4	39	7.68	28.36	-89.03	10	3.59	3.60	Post		347.52
2002	5	27	0	28	16.99	27.117	-94.442	10	3.79	3.80	Post		505.8
2002	9	19	14	44	36.15	27.822	-89.135	10	3.69	3.70	Post		389.99
2003	4	13	4	52	53.92	26.09	-86.08	10	3.19	3.20	Post		731.19
2004	6	18	19	20	56.4	27.027	-86.997	10	3.50	3.51	Post		592.41
2005	12	20	0	52	20.51	30.258	-90.708	5	2.99	3.00	Post		81.55
2006	2	10	4	14	17.8	27.597	-90.163	5	5.53	5.54	Post		369.43
2006	9	10	14	56	8.16	26.319	-86.606	14	6.07	6.08	Post		676.62

FSAR 2.5.2 Figures

Due to the large file sizes of the figures for FSAR Section 2.5.2, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.5.3 SURFACE FAULTING

RBS COL 2.0-28-A This subsection describes the evaluation of the potential for surface faulting and related deformation at the RBS site and surrounding site area. The main elements of this analysis, which are discussed in the following subsections, are as follows:

- Geological, Seismological, and Geophysical Investigations (Subsection 2.5.3.1).
- Geologic Evidence, or Absence of Evidence, for Surface Deformation (Subsection 2.5.3.2).
- Correlation of Earthquakes with Capable Tectonic Sources (Subsection 2.5.3.3).
- Ages of Most Recent Deformations (Subsection 2.5.3.4).
- Relationship of Tectonic Structures in the Site Area to Regional Tectonic Structures (Subsection 2.5.3.5).
- Characterization of Capable Tectonic Sources (Subsection 2.5.3.6).
- Designation of Zones of Quaternary Deformation (Subsection 2.5.3.7).
- Potential for Surface Tectonic Deformation at the Site (Subsection 2.5.3.8).

Results of the surface faulting study indicate that there is no evidence for Quaternary tectonic surface faulting or fold deformation at the RBS site. Additionally, there is negligible potential of surface deformation associated with growth faults or nontectonic processes related to salt domes in the site area (within 5-mi. [8-km] radius of the site). No capable tectonic sources have been identified within 5-mi. [8-km] radius of the site. A capable tectonic source, as defined by NRC Regulatory Guide 1.208, is a tectonic structure that can generate both vibratory ground motion and tectonic surface deformation, such as faulting or folding at or near the earth's surface in the present seismotectonic regime. The following subsections provide the data, observations, and reference citations to support these conclusions. The information contained in these subsections was developed in accordance with Appendix C of Regulatory Guide 1.208, "Investigations to Characterize Site Geology, Seismology and Geophysics," and is intended to satisfy 10 CFR 100.23, "Geologic and Seismic Siting Criteria."

2.5.3.1 Geological, Seismological, and Geophysical Investigations

Investigations performed to assess the potential for future surface faulting and related deformation at the RBS site and surrounding site area include the following:

- Compilation and review of available data and literature.

- Lineament analyses.
- Discussions with current researchers in the area.
- Field reconnaissance.
- Geomorphic analyses.
- Review of industry seismicity data.
- Review of excavation mapping report.

2.5.3.1.1 Compilation and Review of Existing Data and Literature

Extensive data, literature, and maps, both published and unpublished, regarding faulting in the RBS site area were compiled and reviewed to evaluate the potential for surface faulting at the site. These include site documents for RBS Units 1 and 2 (References 2.5.3-201 and 2.5.3-202), available published and unpublished literature (Reference 2.5.3-203), and published and unpublished geologic maps (primarily from the Louisiana Geological Survey [LGS]). The review mainly focused on (1) the distribution and ages of the Quaternary terraces, because they provide a useful means for assessing the presence or absence of active faults in the area, and (2) the location and characteristics of growth faults, which are the only active faults that have been identified in the region.

2.5.3.1.1.1 Quaternary Stratigraphy

Information regarding the distribution and ages of the terraces and the associated near-surface deposits is fundamental to the evaluation of the potential for surface-fault rupture at the site. Stratigraphy of the site area is presented in Subsections 2.5.1.1.4 and 2.5.1.2.3.1.

The age and widespread distribution of the Prairie terraces make them useful stratigraphic markers for evaluating surface faulting in the site area. The Prairie Complex is estimated to be between 120 thousand years before present (ka) and 70 ka (References 2.5.3-204 and 2.5.3-205). In the site area, terrace deposits commonly are overlain by a blanket of loess approximately 10 ft. (3 m) thick. The loess generally thickens to the west toward the Mississippi River. Approximately 15 mi. (24 km) north of the site, the loess thickness exceeds 14 ft. (4.3 m). Radiocarbon dates of snail shells and other calcareous materials preserved in this deposit indicate that the loess is 25,000 to 18,000 years old (Reference 2.5.3-202). A younger stream terrace is discontinuously preserved along Thompson Creek, Alexander Creek, and other tributaries of the Mississippi River. It probably correlates to some of the Deweyville terraces recognized on other trunk streams, and is inferred to be mid-Wisconsinan in age (i.e., approximately 35,000 to 18,000 years old) (Reference 2.5.3-202).

2.5.3.1.1.2 Growth Faults

As discussed in Subsection 2.5.1.2.3.2.2, there are several coast-parallel, down-to-the-south growth faults in the site vicinity (Reference 2.5.3-203). Growth faults in the site vicinity that displace or are suspected to displace Quaternary deposits include the Baton Rouge, Denham Springs - Scotlandville, the postulated Baker, and Zachary faults, as well as a postulated fault near Slaughter (Figure 2.5.1-223). None of these faults is located within the site area. The closest of these are the Zachary fault 8 mi. (13 km) southeast of the site and the postulated fault near Slaughter 9 mi. (15 km) east of the site. The westward projections of these features extend to within 5.5 mi. (8.8 km) and 1.5 mi. (2.5 km) of the site, respectively. As discussed in Subsection 2.5.1.2.3.2.2, the Quaternary faulting represents reactivation of older Early Tertiary growth faults.

Historical displacement on the Baton Rouge and Denham Springs - Scotlandville faults has occurred, and is continuing to occur, without any detectable seismicity. Historical displacement includes cracked pavement and buildings (References 2.5.3-206, 2.5.3-207, and 2.5.3-208). Displacement rates on the Baton Rouge fault are discussed in Subsection 2.5.1.1.5.2.1.7. Two small earthquakes occurred in 1905 and 1958 near the trace of the Denham Springs - Scotlandville fault (Figures 2.5.1-210 and 2.5.1-223). None of the faults in the coastal plain have been associated with macroseismic events or with patterns of microseismicity. The large number of growth faults throughout the Gulf Coastal Plain compared to the very low rate of historical seismicity supports the interpretation that the growth faults deform aseismically (refer to Subsection 2.5.1.1.5.2.1.7).

Extensive studies in support of the RBS Unit 1 Updated Safety Analysis Report (USAR) (Reference 2.5.3-202) and more recent mapping indicate no evidence of surface faulting within the site area. The 1982 seismic lines (Figure 2.5.1-243) revealed two deep (Cretaceous) structures (FA and FB) that do not appear to displace the overlying (Tertiary) strata. Figure 2.5.1-229 shows the location of FA at the top of the Cretaceous (depth of 13,500 ft.), and the location of FB at the lower Cretaceous horizon (depth of 18,000 ft.). These possible ancient growth faults exhibit an east-west trend consistent with typical regional growth faulting. They represent the gulfward slumping of sediments that occurred during the early stages of southward buildout of the shelf. As growth faults, they die out upward and are overlain by unfaulted deposits. There is no evidence of movement along either fault within the past 60 million years, as concluded in the USAR based on an interpretation of the1982 seismic lines (Reference 2.5.3-202). Evidence for the absence of surface faulting on these structures is discussed in Subsection 2.5.3.2.

2.5.3.1.2 Lineament Analyses

In the RBS USAR (Reference 2.5.3-202), previous geological studies in this area have demonstrated that structural features associated with salt domes and the east-west growth faults commonly exhibit discernible surface evidence. Faults and fractures are evidenced at the surface in a variety of ways, including regional lineaments, linear drainage lines, abrupt or anomalous changes in stream direction, vegetation changes, soil changes, changes in drainage density, abrupt topographic changes or scarps, and changes in land use (Reference 2.5.3-202). Lineaments can also be caused by differential erosion, beach ridge formation, deltaic distributary growth, and cultural features.

Based primarily on an analysis of drainage networks, Fisk (Reference 2.5.3-209) and McCulloh (Reference 2.5.3-210) describe a rectilinear pattern consisting of nearly orthogonal lineament sets that are oriented northeast and northwest in the Mississippi embayment and southeastern United States. Fisk (Reference 2.5.3-209) referred to his interpreted lineaments as fault zones, or collectively as a regional fracture pattern (Figure 2.5.1-218). The northeast- and northwest-trends of these lineaments are inconsistent with the generally east-west trend of the well-documented, deep-seated, down-to-the-coast, normal growth faults (Reference 2.5.3-204), which clearly have been active during the Late Quaternary.

As part of the site investigations for RBS Unit 1, lineament studies were conducted that included photogeologic interpretation of high-altitude imagery, index mosaics, and Landsat multispectral scanner (MSS) imagery (Table 2.5.1-205) (Reference 2.5.3-202). Numerous north- and northwest-trending lineaments were identified in the site area; however, geophysical data and detailed examination of the site excavation revealed no faulting (Reference 2.5.3-211). The only faults in the area that have been confirmed by subsurface evidence (both shallow and deep seismic reflection and refraction surveys) are the east-west-trending growth faults, which do not follow the regional pattern identified by Fisk (Reference 2.5.3-209). (Reference 2.5.3-202)

LiDAR (light detection and ranging) data collected in 2001 by Louisiana State University (LSU) (Reference 2.5.3-212) provide more detailed topographic information than was available during the previous study for the RBS Unit 1 USAR. LiDAR data are available for the state of Louisiana by quarter quadrangle with a grid spacing of 16.4 ft. (5 m) and vertical accuracy of less than 3.3 ft. (1 m). The LiDAR data are useful for delineating linear features as well as distinct terrace surfaces. Shaded relief models created using the LiDAR digital elevation model (DEM) were analyzed visually in both two dimensions (2-D) and three dimensions (3-D) to identify linear features. Most of the identified lineaments are defined by linear alignment of drainages, and in a few cases, by possible steps in the top of terrace surfaces (Figure 2.5.3-201). Although northwest- (e.g., Alligator Bayou) and northeast-trending (e.g., Thompson Creek) lineaments are evident, only lineaments that parallel the trend of Gulf Coast growth faults (generally east-west trending) are shown on Figure 2.5.3-201. Topographic irregularities in the terrace surfaces are subdued by, or can be obscured by, the loess mantle. High scarps (3.3 to 6.6 ft. [1 to 2 m]) that displace the Lower Prairie terrace in Baton Rouge are clearly visible (Figures 2.5.3-202 and 2.5.3-203). Smaller scarps of 1 ft. or less would be difficult to detect.

A lineament analysis based on LiDAR data was performed independently by the LGS as part of its STATEMAP mapping program. Four lineaments were mapped by the LGS within 10 mi. (16 km) of the site, but none within the site area. Two of the lineaments coincide with the surface traces of the Zachary fault, and the other two are located north of the Zachary fault near the town of Slaughter (Figure 2.5.3-204); one is on private property and has not yet been field-checked. These lineaments are hypothesized to be the surface expression of growth faults, because they have similar topographic expression to the Zachary and Baton Rouge faults (Reference 2.5.3-213).

Observations based on the lineament and topographic profile analyses are included in Subsection 2.5.3.2.

2.5.3.1.3 Discussions with Current Researchers in the Area

Local experts were contacted to obtain the latest available information relevant to the site geology and tectonics of the region. Representatives of the LGS participated in two meetings and two field reconnaissance trips, both in the site vicinity and at the site. They have conducted numerous studies of growth faults in the site region and are currently responsible for the preparation of new geologic quadrangle maps that cover the site area. A search of GEOMAP Company's files and a search by SeiSearch indicated no new surveys or deep wells in the site area.

2.5.3.1.4 Field Reconnaissance

Field investigations were conducted during March and April of 2007 and involved consultations and field trips with local experts, examination of known faults in the site vicinity, examination of well-documented exposures of stratigraphic units as described in previous publications, geologic mapping of the site location and surrounding area, and field-checking of lineaments in the site area identified from LiDAR data. Key sites visited near the RBS site location were located, typically to within 20 ft. (6 m), and were recorded as waypoints with a hand-held Garmin 60CSx Global Positioning System (GPS).

The Baton Rouge, Denham Springs - Scotlandville, Baker, and Zachary faults lie within the site vicinity (Figure 2.5.1-223) and have been documented in previous studies (refer to Subsection 2.5.1.2.3.2.2.1). Several mapped traces of these faults were reviewed with the LGS representatives. The vertical separation of the sloping terrace surfaces deformed across the faults is generally less than 10 ft. (3 m). The scarps typically appear as gently sloping (less than 1 to 2 degrees), broad (approximately 650-ft. [200-m] wide) inflections in the relatively flat terrace surfaces. The low scarp profiles suggest the scarps are either degraded or buried by loess, or the deformation is distributed across a broad zone. Zones of cracks in pavement and buildings along the Baton Rouge and Denham Springs - Scotlandville faults are evidence of ongoing movement.

The more prominent LiDAR lineaments in the site area, which are described in Subsection 2.5.3.2.1 (Figure 2.5.3-201), were field-checked. Geologic mapping in the site location was focused in Grants Bayou and Alligator Bayou, where terrace deposits are exposed in the stream banks, and on the terrace surfaces to the east and west of the site to examine surface morphology where lineaments closest to the site were identified (Figure 2.5.3-205).

2.5.3.1.5 Geomorphic Analyses

Digital elevation models based on LiDAR data were used to construct topographic profiles along the interfluves between drainages and along the fluvial terraces that parallel the larger drainages (Figure 2.5.3-204). The profiles were located to assess whether there are any topographic anomalies (e.g., scarps or abrupt changes in slope) associated with LiDAR lineaments, and to evaluate the elevations of the different terrace surfaces. Profiles were constructed across known growth faults for calibration (Figures 2.5.3-202 and 2.5.3-203). Figure 2.5.3-204 shows the locations of the topographic profiles relative to the LiDAR lineaments. The topographic profiles are discussed in Subsection 2.5.3.2.1.

2.5.3.1.6 Industry Seismic Data

Subsurface seismic data that were used to evaluate faulting in the RBS Unit 1 site area included the following:

- A deep reflection seismic profile made in 1970 that images the Cenozoic strata down to a depth of approximately 9000 ft. (2743 m).
- Proprietary industry seismic reflection survey data that provided images down to a depth of approximately 13,500 ft. (4100 m) (Reference 2.5.3-202).

The location of the deep reflection seismic profile is shown in Figure 2.5.1-223. The deep seismic reflection profile is shown in Figure 2.5.1-238. A map showing the location of test holes and seismic survey lines for petroleum exploration that were reviewed for the RBS Unit 1 study is shown in Figure 2.5.1-243. A cross-section based on these data is shown in Figure 2.5.1-229.

A search was conducted through SeiSearch in March 2007 (Reference 2.5.3-214) to determine if there were any newer seismic data available for the site area. The review of available seismic lines indicated that there are no more recent seismic surveys for the area within an approximately 10-mi. (16-km) radius of the site.

2.5.3.1.7 Review of Excavation Mapping Report

Detailed geologic mapping of an excavation for Category I structures and pipelines associated with RBS Units 1 and 2 was completed during 1976 and 1977 by Stone & Webster Engineering Company (Reference 2.5.3-201). The excavation was approximately 75 ft. (23 m) deep, covered approximately 3 ac. (1.2 ha), and exposed the area below the current structures and much of the area below the proposed structures (Figure 2.5.3-206). The excavation consisted of four levels separated by narrow benches (Reference 2.5.3-201). The walls were cleaned along shallow channels, cut a few inches into the slopes, and spaced at least every 100 ft. (30 m) apart. The shallow trenches were logged in detail and were used to create maps of the excavation walls (Reference 2.5.3-201) (Figures 2.5.3-207 and 2.5.3-208). The following four geologic units were mapped in the excavation, in increasing order of age:

- Loess.
- Top-stratum silts and clays of the Port Hickey terrace (equivalent to the Prairie Terrace).
- Silty sands of the Port Hickey terrace (equivalent to the Prairie terrace).
- Fine- to coarse-grained Citronelle Formation deposits (Reference 2.5.3-201).

The excavation was located on a generally northwest-trending remnant of the Port Hickey terrace, near its contact with the Citronelle Formation (Reference 2.5.3-201). Based on the detailed geologic mapping, there was no evidence of faulting, folding, or other geologic hazards in the main excavation. The exposed geometric features were determined to be erosional and/or depositional in origin (Reference 2.5.3-201). The NRC concurred that no structural abnormalities were visible in the mapped areas and in the areas exposed at the time of its visit in 1976 (Reference 2.5.3-211).

2.5.3.2 Geological Evidence, or Absence of Evidence, for Surface Deformation

The RBS USAR (Reference 2.5.3-202) concluded that there were "no faults at or near the ground surface in the sedimentary sequence within 5 mi. (8 km) of the site," and the NRC agreed that "there is no known evidence either at the River Bend site or within 5 mi. to indicate surface faulting or the potential for new surface faulting" (Reference 2.5.3-211).

As outlined in Subsection 2.5.3.1.1.2, growth faults that exhibit evidence for Quaternary surface deformation are present within the site vicinity (i.e., 25-mi. [40-km] radius). These include the Baton Rouge, Denham Springs - Scotlandville, and Zachary faults. The Zachary fault (Figure 2.5.1-223) is located 8 mi. (13 km) south of the site and would project to within 5.5 mi. (8.8 km) of the site. Additionally, two lineaments north of the Zachary fault and approximately 9 mi. (14 km) southeast of the site are postulated to be indicative of growth faulting. The westward projection of these lineaments is approximately 1.3 mi. (2 km) south of the site.

Two faults (designated FA and FB), which are interpreted to be ancient growth faults, were identified in the subsurface within the site area (5-mi. [8-km] radius) based on borehole and seismic data (Figure 2.5.1-229) (Reference 2.5.3-202). These possible ancient growth faults exhibit an east-west trend consistent with typical regional growth faulting (Figure 2.5.1-243). They were interpreted to represent the coastward slumping of sediments that occurred during the early stages of southward buildout of the shelf in the site area during Cretaceous time (Reference 2.5.3-202).

As discussed in Subsection 2.5.1.2.3.2.2.2, the location and timing of the most recent activity for Faults FA and FB were based on interpretations of proprietary seismic profile and borehole data that were reviewed during the RBS Unit 1 site characterization investigations. The locations of Faults FA and FB, as shown in Figure 2.5.3-205, represent the locations of the faults at the top of the Cretaceous sediments at depths of 13,000 to 18,000 ft. (3960 to 5500 m) projected vertically to the ground surface (Reference 2.5.3-202). Based on the projected dip of the faults to the surface, these faults would project to at least 2 mi. (3.2 km) north of the site (Reference 2.5.3-211).

Stratigraphic and structural relationships across the site area, as interpreted from the industry seismic and well data for the RBS Unit 1 site characterization, are shown in Figure 2.5.1-229. The top of the Lower Cretaceous in a depth bracket of 18,000 to 22,000 ft. (5500 to 6700 m) was readily identifiable in the 1982 seismic profiles. As reported in the RBS USAR, the Lower Cretaceous appears to have an indication of a fault downthrown to the south (FB), with a possible fault strike of N80 degrees E at the Lower Cretaceous horizon approximately 3000 ft. (900 m) north of the site at a depth of approximately 20,000 ft.(6100 m). It was observed that the evidence for faulting dies out upward, and Upper Cretaceous reflectors did not appear to be displaced. A slight indication of a possible down-to-the-south growth fault (FA) that strikes N80 degrees W at the top of the Upper Cretaceous in a depth bracket of 13,500 to 15,000 ft. (4110 to 4500 m) was also observed. This indication was not seen in the shallow Tertiary reflector nor the deeper Lower Cretaceous layer (Reference 2.5.3-202).

However, based on an interpretation of the Amoco 1982 seismic data, the faults do not offset sediments above a depth of approximately 13,500 ft. (4100 m) (i.e., above the top of the Upper Cretaceous Selma Group), and it was concluded that the timing of most recent movement along either structure was on the order of 60 million years ago (Reference 2.5.3-202). The regional geologic cross-section of Bebout and Gutierrez (Reference 2.5.3-215) shows growth faults to the west of the site area extending into the Eocene Wilcox Formation, but not into younger sediments (Figure 2.5.1-205).

Available electric logs from boreholes within 5 or more mi. (8 or more km) of the site, which are shown in Figure 2.5.1-243, were also evaluated for evidence of faulting (Reference 2.5.1-202). Insofar as upward and lateral extensions of Faults FA and FB identified on the Amoco seismic line (Figure 2.5.1-243) are concerned, the only well propitiously located to test such occurrence is Well No. 6 (South Louisiana Production Witter), which would encounter the eastward extension of Fault FA at a depth of approximately 13,000 ft. (3960 m). However, no fault has been identified on this well for the entire log depths from 4500 to

17,800 ft. (1370 to 5400 m), a vertical distance of 13,300 ft. (4050 m) (Reference 2.5.3-202).

A deep reflection seismic profile acquired in 1970 shows that reflections interpreted to be the mid-Tertiary Tatum limestone, Wilcox Group, have no displacements from 3.5 mi. (5.6 km) south of the site to 5 mi. (8 km) north of the site (Figure 2.5.1-238).

Industry seismic and well data were also reviewed by the NRC's consultants, who identified several small, shallow anomalies on some more weakly defined reflector horizons. The following lines of evidence were cited in the Unit 1 FSER (Reference 2.5.3-211) to indicate that these anomalies are not faults:

- Some of the shallow anomalies show decreasing displacement with depth, whereas faults typically show increasing displacement with depth.
- If the small features were faults, they would have dips of approximately 35 degrees, and most faults should have dips of 55 to 70 degrees.
- Some of the small features would require reverse displacement, and regional structures display normal displacement.
- Key stratigraphic horizons in nearby boreholes show no indication of missing stratigraphic sections indicative of faulting.
- Reflectors above and below the small shallow anomalies are smooth and show no evidence of faulting.
- The anomalies may be related to processing errors.

The NRC consultants concurred that there is no evidence of surface faulting within the site area.

2.5.3.2.1 Results of Lineament Analyses

LiDAR data make it possible to more accurately image the topography in heavily vegetated areas than was previously possible using conventional aerial photography and topographic maps. LiDAR data provide a useful tool for geomorphic analyses to identify and assess the potential for surface deformation. Shaded relief maps created from LiDAR-based digital elevation models were used to identify lineaments in the site area (i.e., a 5-mi. [8-km] radius) (Figure 2.5.3-201). Lineaments that were clearly associated with cultural features were excluded. Only lineaments that parallel the trend of Gulf Coast growth faults (generally east-west-trending) were identified in this study. The mapped lineaments were classified as either prominent or poorly expressed, based on their relative degree of expression on the shaded relief maps. Three prominent, approximately east-west-trending lineaments and one poorly expressed lineament were identified in the 0.6-mi. (1-km) area surrounding the site (Figure 2.5.3-205).

The lineaments that were identified both in 2-D and 3-D shaded relief maps of the site area were examined in the field to evaluate if there was any evidence of surface faulting associated with the lineaments. Topographic profiles were constructed along the interfluves between drainages to examine whether there were any geomorphic anomalies (e.g., possible vertical steps in the terrace surfaces) coincident with the lineaments.

All of the previously mapped Quaternary faults in the site region are expressed in the LiDAR data. As illustrated in Figures 2.5.3-202 and 2.5.3-203, the Baton Rouge, Denham Springs - Scotlandville, and Zachary faults, which are known to displace Quaternary deposits, are well expressed in the profiles. They displace the Prairie terrace 10 to 33 ft. (3 to 10 m) down to the south over horizontal distances of more than 330 ft. (100 m).

Based on an analysis of LiDAR data, McCulloh and Heinrich (Reference 2.5.3-213) map a lineament near Slaughter as a possible growth fault, which had not been identified previously and has not been named. This postulated fault is not as well expressed topographically as the mapped Quaternary faults described above; however, as shown in Figures 2.5.3-209 and 2.5.3-210, there are approximately 3 to 6 ft. (1 to 2 m) high south-facing scarps where it crosses the Lower Prairie and Intermediate terraces. There are no subsurface data for this inferred fault. Based on the 1984 *Geologic Map of Louisiana* (Reference 2.5.3-216), the eastern trace of this lineament roughly coincides with the contact between a Pleistocene terrace and the Plio-Pleistocene Citronelle Formation, which suggests that the scarp may be erosional. However, more recent mapping shows the postulated fault-cutting Lower Prairie and Intermediate terraces (Figure 2.5.3-209). Unlike the mapped Quaternary faults described above, the postulated unnamed fault does not correspond to any of the identified deep-seated growth faults in the region that were identified from interpretation of industry seismic data reviewed as part of the RBS Unit 1 licensing investigations, and it is not apparent in the deep seismic reflection line (Figure 2.5.3-211), which crosses the western projection of this lineament.

The inferred Baker fault does not appear to be associated with surface displacement. Three profiles across the Baker fault (Figures 2.5.3-202 and 2.5.3-212) show no systematic offsets where the fault traverses Intermediate- and Prairie-age terraces. The older Intermediate terrace is moderately dissected (Figure 2.5.3-212), and small displacements (approximately 1-1/2 ft. [0.5 m]) cannot be precluded. The Prairie terrace is not displaced where it crosses the inferred Baker fault (Figure 2.5.3-212).

Parsons (Reference 2.5.3-217) postulated a fault that he called the Jackson fault, to explain the lower elevations of the base of the Citronelle Formation on an east-west trend through the town of Jackson, Louisiana, located approximately 6 mi. (10 km) north of the site (Figure 2.5.3-204). As described in the RBS USAR for Units 1 and 2 (Reference 2.5.3-202), the seismic reflection survey data and the terrace profiles show no evidence for such a fault, and it was concluded that what Parsons observed is simply an erosional feature. This interpretation is corroborated by the LiDAR data, which show no evidence of surface displacement where the postulated fault trace traverses the Prairie terrace or the Citronelle surface (Figures 2.5.3-213 and 2.5.3-214).

Lineaments that intersect the RBS site area that do not coincide with previously mapped faults are discussed below, from south to north, starting with the lineaments closest to previously identified growth faults.

Lineaments L22, L23, L24, L25, and L26 trend approximately east-west and are located approximately 1.2 mi. (2 km) south of the site (Figure 2.5.3-213). A possible 3 to 6 ft. (1 to 2 m) down-to-the-south step in the surface of the Lower Prairie terrace across the area of L26 and in the Upper Prairie terrace across the area of L25 can be seen in the profiles across these lineaments (Figure 2.5.3-215). The Prairie terrace remnants along these profiles are narrow and highly dissected, suggesting that the apparent relief may be erosional.

Lineament L16 projects through the southwestern corner of the 1976 - 1977 excavation for RBS Units 1 and 2, intersecting both the south and west walls (Figure 2.5.3-206). The surface projection of this lineament crosses the west wall between MT1-3 and 1-4 (Figure 2.5.3-207) and the south wall between MT1-46 and 1-47 (Figure 2.5.3-208). As mapped, both of these locations coincide with channel margins in the Citronelle Formation, with the base of the coarse-grained facies dropping down to the south, and in both cases, there is a smaller channel margin in the Port Hickey top stratum (i.e., Prairie terrace deposit). On the west wall of the excavation, there is 10 to 15 ft. (3 to 4.5 m) of relief on the bases of channels in the Citronelle between "trenches" (Figures 2.5.3-207 and 2.5.3-208). These channel margins were identified by comparing the elevation of the base of the channel at adjacent "trenches" that are approximately 100 ft. (30 m) apart. On the west wall, the projection of the lineament corresponds to the apparent northern margins of two channels (Figure 2.5.3-207). However, interpretation of deeper stratigraphic units shown on cross-sections developed from borehole data show that there is no down-to-the-south step where the lineament would cross; rather, a channel margin contact at the base of the Citronelle and top of Pascagoula slopes down to the north between boreholes (Figure 2.5.3-216), supporting the conclusion that the changes in elevation exposed in the excavation are due to channel incision rather than fault displacement.

One set of lineaments (L11 through L15) (Figures 2.5.3-201 and 2.5.3-217) identified on the LiDAR shaded relief model appears to coincide with the vertical projection of a deep fault (Fault FA) (Reference 2.5.3-202). However, the updip projection of these faults to the surface would put them at least 2 mi. (3 km) from the site (Reference 2.5.3-211). Therefore, Lineaments L11 through L15 are not the surface expression of Fault FA. Topographic profiles created from LiDAR data were constructed across this set of lineaments to the east and west of the site on the Lower Prairie terrace surface and the Citronelle surface (Figure 2.5.3-217). To the west of the site on the top of the Lower Prairie terrace, there is no surface expression of the lineaments (Figure 2.5.3-218). To the east of the site on the Citronelle surface, just east of Highway 965, there is also no surface expression of lineaments (Figure 2.5.3-218). In a stream cut along the west fork of Grants Bayou near Lineament L13, there is an exposure of highly deformed red and gray clay of the Citronelle Formation overlying white to brown cross-bedded sand of the Prairie terrace (Figure 2.5.3-205). Bedding orientations within the clay varied from N30°E, dipping 20 to 40 degrees east to N85°E, and vertical over a horizontal distance of less than 3 ft. (1 m). The juxtaposition of Citronelle over Prairie terrace deposits cannot be explained by normal faulting. Because the deformation is entirely within the Citronelle clay, the deformed clay appears to be a slump block of Citronelle into a Lower Prairie stream channel that formed when the Lower Prairie channel was incised into the Citronelle uplands.

Lineament L9 is defined by an alignment of linear stream segments (Figure 2.5.3-205). No evidence of surface faulting was observed in the stream cuts along the west fork of Grants Bayou or along Highway 965 in the vicinity of this lineament. The stratigraphic units appear to be continuous, and there are no steps on the surfaces of the mapped terrace units. No surface expression of Lineament L10, directly east of L9 (Figure 2.5.3-217) was seen; however, there is an apparent step in the Citronelle surface that was observed from the adjacent property approximately 328 ft. (100 m) south of Lineament L10 (Figure 2.5.3-218).

Other identified lineaments not discussed above are largely defined by alignment of drainages and show lack of consistent steps on the terrace surfaces and/or undeformed sediments in the stream cuts on the Citronelle or Prairie terrace surfaces.

Topographic profiles by Parsons (Reference 2.5.3-217) on the interfluves between Thompson Creek and the Comite River on the Citronelle surface showed anomalies that Parsons suggests could be indicative of faulting in the site vicinity. One profile was created on Prairie terrace surfaces along Thompson Creek, and two were created in the Citronelle Formation, to evaluate this area. There are no steps in terrace surfaces along the trend of the postulated fault that would suggest the existence of Quaternary faulting at this location (Figures 2.5.3-213 and 2.5.3-214).

The LiDAR lineaments mapped for this study intersect with the deep seismic reflection profile shown in Figure 2.5.3-211. No obvious through-going disruptions indicative of faulting were observed in the seismic data. Continuous reflectors were observed at depth across all the lineaments or projected trends of lineaments, indicating the absence of faulting within the resolution of the seismic data.

The known faults in the site vicinity are all coincident with lineaments identified on the shaded relief maps developed from the LIDAR digital elevation models. The detailed analysis of other east-west-trending lineaments did not reveal any indication of surface faulting in the site area.

2.5.3.3 Correlation of Earthquakes with Capable Tectonic Sources

Based on an assessment of the earthquake catalog, only two events are reported to have occurred within 25 mi. (40 km) of the RBS site (Figure 2.5.1-210): the November 19, 1958, m_b 3.2 earthquake was 19 mi. (31 km) from the site; and the February 3, 1905, m_b 3.7 earthquake was 22 mi. (36 km) from the site. These earthquakes occurred close to the Denham Springs - Scotlandville fault, which is part of the larger Tepetate - Baton Rouge fault system. No macroseismic events or patterns of microseismicity have been associated with any of the mapped traces along this system of growth faults. The nearest areas of known faulting associated with high historical seismic activity are the New Madrid fault zone, located more than 300 mi. (480 km) north of the site, and the Saline River source zone, located approximately 200 mi. (320 km) north of the site.

2.5.3.4 Ages of Most Recent Deformations

As noted in Subsections 2.5.3.1.6 and 2.5.3.2, interpretation of industry seismic data by both Entergy and NRC reviewers for RBS Unit 1 indicated the possible presence of two growth faults at depth within the RBS site area (Faults FA and FB in Figure 2.5.3-205). The most recent movement along either structure is interpreted to predate deposition of the Wilcox Group, indicating that the most recent displacement is on the order of 60 million years old (Reference 2.5.3-202).

Topographic profiles were constructed along Prairie terrace surfaces to the east and west of the site that trend roughly north-south perpendicular to the LiDAR lineaments (Figures 2.5.3-217 and 2.5.3-218). The Prairie terraces are moderately dissected and are mantled by younger loess deposits, which make it difficult to preclude small displacements (i.e., less than approximately 3 ft. [1 m]). No evidence was observed that suggests the 70 ka to 140 ka Prairie deposits are displaced across any of the LiDAR lineaments.

Growth faults that are recognized as Quaternary active structures (i.e., the Baton Rouge, Denham Springs - Scotlandville, and Zachary faults) (Figure 2.5.3-202) are readily apparent on the shaded-relief model generated from the LiDAR data, and they exhibit well-defined topographic steps in the profiles generated from the LiDAR DEM (Figure 2.5.3-203). The Baton Rouge and Denham Springs - Scotlandville faults have had historical displacement, as evidenced by cracks in pavement and buildings (Reference 2.5.3-208).

2.5.3.5 Relationship of Tectonic Structures in the Site Area to Regional Tectonic Structures

Growth faults and salt diapirs identified within the site vicinity and the site area are described in detail in Subsection 2.5.1.2.3.2. The east-west-trending growth faults in the site vicinity are part of a regional system of Quaternary faults, the Gulf-margin normal faults. As noted in the RBS Unit 1 USAR (Reference 2.5.3-202), the only recognized faults in the site area are possible growth faults that are imaged in seismic records below a depth of 13,500 ft. (4116 m). Based on interpretation of industry seismic profile and well data, the most recent movement along these structures was interpreted to be on the order of 60 million years old (Reference 2.5.3-202).

2.5.3.6 Characterization of Capable Tectonic Sources

There are no capable tectonic sources within 5 mi. (8 km) of the RBS site. As described in Subsection 2.5.1.2.3.2.2.2, seismic lines reveal two deep (Cretaceous) structures that do not appear to displace the overlying (Tertiary) strata. Faults FA and FB are shown in Figures 2.5.1-229 and 2.5.1-243. The shallow Tertiary horizons, such as the Miocene reflector in a depth bracket of 7000 to 9000 ft. (2100 to 2700 m), are excellent reflectors that show no evidence of disruption or faulting (Figure 2.5.3-211). Active growth faults have been mapped in the site vicinity that have had Quaternary and historical displacement. They are part of a regional system of Quaternary faults, the Gulf-margin normal faults, that are deforming aseismically. The faulting is contained entirely in the sedimentary sequence and does not extend into the basement (Reference 2.5.3-202). Because the faults are located in poorly lithified rocks and sediments, they may not be able to support the stresses required for the propagation of significant seismic ruptures that could cause damaging ground motions (References 2.5.3-203 and 2.5.3-205). These faults neither reach the basement nor arise from basement tectonic movement. The key factors involved in their formation include overloading in areas of voluminous sedimentation, differential compaction of the deposited sediments, high fluid pressures, and gravity sliding on (and salt flow within) a layer of plastic salt. (Reference 2.5.3-202; refer to Subsection 2.5.1.1.5.2.1.7.)

2.5.3.7 Designation of Zones of Quaternary Deformation

The recognized zones of Quaternary deformation in the site vicinity and their closest distance to the RBS site are the Zachary fault (8 mi. [13 km]); the Denham Springs - Scotlandville fault (19 mi. [13 km]); and the Baton Rouge fault (24 mi. [38 km]). In addition to these well-documented Quaternary growth faults, the inferred Baker fault 13 mi. (21 km) from the site and an unnamed postulated growth fault near Slaughter 9 mi. (14 km) from the site have been considered. The inferred Baker fault does not appear to be associated with surface displacement. The postulated fault scarp near Slaughter may be an erosional feature, and this feature is not associated with a growth fault at depth.

2.5.3.8 Potential for Surface Tectonic Deformation at the Site

The potential for tectonic deformation at the RBS site is assessed to be negligible. This conclusion is based on the following:

- The results of comprehensive investigations for RBS Units 1 and 2 have demonstrated that there are no surface faults in the study area, and that deep subsurface faults that displace Cretaceous and older strata beneath the site have not been active during the past 60 million years (Reference 2.5.3-202).

- Geologic mapping in the site vicinity (References 2.5.3-213, 2.5.3-216, 2.5.3-218, 2.5.3-219, 2.5.3-220, 2.5.3-221, and 2.5.3-222) and site location identified no evidence for surface faulting or deformation that would indicate there are capable faults in the RBS site area.

- Mapping of Plio-Pleistocene and Pleistocene deposits exposed in the excavation for RBS Units 1 and 2 provides direct evidence for the absence of surface faulting beneath the footprint of the excavation.

2.5.3.9 References

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FSAR 2.5.3 Figures

Due to the large file sizes of the figures for FSAR Section 2.5.3, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.5.4 STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS

RBS COL 2.0-29-A

This subsection presents information on the properties and stability of soils that may affect the River Bend Station (RBS) Unit 3 facilities, under both static and dynamic conditions, including vibratory ground motions associated with the Ground Motion Response Spectra (GMRS). The discussion focuses on the stability of the materials as they influence the safety of Seismic Category I structures and presents an evaluation of the site conditions, ground water (groundwater), and geologic features that might affect nuclear power plant structures or their foundations.

This subsection is organized into the following subsections, as presented in Regulatory Guide 1.206:

- Geologic Features (2.5.4.1).
- Properties of Subsurface Materials (2.5.4.2).
- Foundation Interfaces (2.5.4.3).
- Geophysical Surveys (2.5.4.4).
- Excavations and Backfill (2.5.4.5).
- Groundwater Conditions (2.5.4.6).
- Response of Soil and Rock to Dynamic Loading (2.5.4.7).
- Liquefaction Potential (2.5.4.8).
- Earthquake Site Characteristics (2.5.4.9).
- Static Stability (2.5.4.10).
- Design Criteria (2.5.4.1.1).
- Techniques to Improve Subsurface Conditions (2.5.4.1.2).

2.5.4.1 Geologic Features

Subsection 2.5.1.1 addresses the regional geologic setting, including regional physiography and geomorphology, regional geologic history, regional stratigraphy, regional tectonic history and features and neotectonic conditions, and potential regional geologic hazards; it also includes related maps, figures, cross sections, and references.

Subsection 2.5.1.2 addresses geologic conditions specific to the site, including site structural geology, site physiography and geomorphology, site geologic history, site stratigraphy and lithology, and site seismic conditions; it also includes related maps, figures, cross sections, and references. Potential site geologic hazards are presented in Subsection 2.5.1.2.4. Geologic hazards due to natural features, human activities, and regional warping are included in Subsections 2.5.4.1.1 and 2.5.4.1.2.

As noted above, both Subsections 2.5.1.1 and 2.5.1.2 address potential geologic hazards, both regional and site-specific, including bedrock solutioning/karst, zones of irregular weathering, zones of structural weakness, and unrelieved residual stresses. Refer to those subsections for additional details.

Preloading (overconsolidation) influences on soil deposits, including estimates of consolidation properties, overconsolidation ratios, preconsolidation pressures, and methods used for their estimation are addressed in Subsection 2.5.4.2. Related maps and subsurface profiles specific to the site are also presented in Subsection 2.5.4.2.

The stability of site soils and their response to dynamic loading is addressed in Subsection 2.5.4.7. The stability of site soils and their response to static (foundation) loading, including the stability of major foundations, is addressed in Subsection 2.5.4.10.

2.5.4.1.1 Natural Features

There are no natural geologic hazards, such as tectonic depressions and cavernous or karstic terrain, at this site. Refer to Subsection 2.5.1.2 for more details.

2.5.4.1.2 Human Induced Geologic Features

Potential sources of human induced geologic issues that could affect the RBS Unit 3 site include local and regional petroleum production, groundwater withdrawal and related decline of groundwater levels, and changes in slope stability caused by earthwork. Local and regional petroleum production and its possible effects at the site are discussed in Subsection 2.5.1.2.5.6.

During construction of the RBS, the site was excavated to allow for the construction of RBS Unit 1 and RBS Unit 2. The site was excavated to Elevation 20 ft. msl. After the excavation was completed, it was decided that RBS Unit 2 would not be built. The unused portion of the excavated site was partially backfilled to Elevation 65 ft. msl. The soil properties of the fills are presented in Subsection 2.5.4.2.2.1.1. The stability of the excavation slopes is discussed in the RBS Unit 1 Updated Safety Analysis Report (USAR) (Reference 2.5.4-234). The stability of construction slopes is presented in Subsection 2.5.4.5.2, and the stability of permanent slopes is presented in Subsection 2.5.5.

2.5.4.1.2.1 Groundwater Withdrawal

Groundwater withdrawals in the area surrounding the site are described in Subsection 2.4.12. Subsidence of ground levels resulting from groundwater withdrawals in the Baton Rouge area has been observed since 1934 (Reference 2.5.4-201). This subsidence was measured by the releveling of existing benchmarks in the Baton Rouge area by the National Geodetic Survey (NGS). Maximum ground-level subsidence attributed to groundwater withdrawal has been measured to be on the order of 2.3 ft. (0.7 m) at the center of the withdrawal. Similar releveling of benchmarks in the RBS site area (within a radius of 5 mi. [8 km]) for similar periods by the NGS was not possible because such benchmarks were not available. Nearby data from the New Roads area (approximately 7 mi. west-southwest of the RBS) characterized it as one of the most stable in the Baton Rouge area study, averaging less than 0.08 in. (2 mm) of subsidence per year for the period between 1964 and 1976. During the same period, the Industrial Park area of Baton Rouge averaged more than 0.39 in. (10 mm) of subsidence per year.

During the Pleistocene stages of glacial maxima, when sea levels were as much as 300 ft. (90 m) below present sea level, the Mississippi River downcut its course to correspondingly low levels. Groundwater in the existing terraces was lower, corresponding to the river stage. As a result, the consolidation of clays, particularly the Pascagoula Formation, resulted in ground-level subsidence. This lowering caused a preconsolidation of existing deposits, which is directly related to the extent of groundwater withdrawal during the Pleistocene stages. Present drawdowns in the vicinity of the site (Figure 2.5.4-201) are far less than the earlier withdrawals. Therefore, it was concluded that no significant subsidence would occur in the RBS site area until local drawdowns exceed those earlier Pleistocene levels, as in the Baton Rouge area, where drawdowns have exceeded 400 ft. (122 m) in some aquifers (Reference 2.5.4-202).

The 1978 Capital Area Water Conservation Commission study by Smith and Kazmann (Reference 2.5.4-201) examined releveling surveys performed annually since the 1930s. The study made a generalized estimate of subsidence of 0.2 ft. (61 mm) for the 42-year period between 1934 and 1976 in the St. Francisville area.

The mechanism for ground-level subsidence is the consolidation of clay layers between the aquifers caused by desaturation (Reference 2.5.4-202). Effective stresses within the clay increase, causing consolidation of the clay layers and subsequent subsidence of the overlying ground surface.

To provide some measure of possible subsidence due to groundwater withdrawals in the vicinity of the RBS site, a means of comparison has been made using correlations between drawdown and corresponding subsidence, as proposed in Reference 2.5.4-202. Nunn used known drawdowns and corresponding subsidence measurements to develop a linear relationship for the area around Baton Rouge. Nunn theorized that the ratio of land surface subsidence to groundwater drawdown is very low, 0.0067 ft/ft (Reference 2.5.4-202). Water level readings from Piezometers P-1A and P-1B (located within the RBS site and placed within the Zone 3 aquifer) for the 20-year period between 1985 and 2005 (Figure 2.5.4-201) reflect a general downward trend of approximately 25 ft. (7.6 m) of drawdown. Water levels shown between the fourth quarter of 1985 through the first quarter of 1998 are the average of water levels measured on both piezometers; water levels measured after the second quarter of 1998 represent levels measured on Piezometer P-1B. Using the Nunn correlation, the 25 ft. (7.6 m) drawdown corresponds to a potential subsidence of 2 in. (50 mm) or approximately 0.1 in. (2.5 mm) per year, which correlates well with the prediction presented by Smith and Kazmann (Reference 2.5.4-201) of 0.08 in. (2 mm) per year.

It should be noted that any subsidence resulting from groundwater withdrawal would be generally uniform over a large area, particularly in the zones relatively distant from the source of the withdrawal. Therefore, any subsidence at the RBS site location (within a radius of 0.6 mi. [1 km]) would be small and generally uniform across the entire site. Based on a rate of subsidence of 0.08 in. per year, the total subsidence at the site after a 60-year period should be less than 6 in. (150 mm). Differential settlement between structures would not be caused by regional groundwater withdrawal.

2.5.4.2 Properties of Subsurface Materials

This subsection presents a summary of the site investigation and subsurface material properties at the RBS site. Subsection 2.5.4.2.1 provides a description of laboratory testing and sample control procedures and Subsection 2.5.4.2.2 provides a summary of static and dynamic engineering properties of site materials. Site stratigraphy at the site location (within a radius of 0.6 mi. [1 km]) is presented in Subsection 2.5.1. Refer to Subsection 2.5.4.3.1 for a discussion of RBS site exploration activities and sampling techniques.

Field and laboratory investigations were specifically developed to comply fully with the requirements in the following guides:

- NRC Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Rev. 2, October 2003.
- NRC Regulatory Guide 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants," Rev. 2, December 2003.
- NRC Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," Rev. 0, March 2007.

Specifically, the following items presented in Regulatory Guide 1.132 have been addressed:

- The scope of the exploration program, including borings and geophysical measurement locations, was planned using the guidelines presented in Appendix A of Regulatory Guide 1.132 and provided coverage in the power block area, including the nuclear island and the adjacent nonsafety-related structures. The information obtained from the exploration program was used to characterize the subsurface conditions in the power block areas and allows for the construction of detailed cross sections through the areas of the nuclear island and adjacent structures, as discussed and illustrated in Subsection 2.5.4.2.2.

- Field operations were conducted under the provisions of approved quality assurance plans and procedures. Field operations were conducted by experienced and qualified personnel. The borings were grouted upon completion, protective covers were installed in monitoring wells and piezometers, and exploration locations were located by surveying methods following completion. Borehole deviation surveys were performed on borings greater than 100 ft. deep. The boring logs included in Appendix 2AA contain coordinates, elevations, and completion notes.

- The field investigation and sampling methods were conducted in accordance with established procedures and applicable industry standards.

- Geophysical testing, consisting of P-S suspension and downhole logging, sonic logging, and deviation surveys, were performed. Refer to Subsection 2.5.4.4 for details of these investigations.

- Groundwater investigations were conducted by observing water levels in borings during and after completion, installing monitoring wells and piezometers to different depths and measuring the water levels periodically for a period of time after completion, and by pump test results from previous investigations. Refer to Subsection 2.4.12 for details.

- Sample storage and retention was performed in accordance with appropriate quality procedures.

- Soil samples were photographed in the field before they were transported to the on-site storage area for further disposition.

Specifically, the following items discussed in Regulatory Guide 1.138 have been addressed:

- The laboratories met the guidelines for space configuration, establishing controlled access storage areas, and adequate ventilation. The facilities also used calibrated equipment.

- Approved sample handling and storage protocol was followed prior to testing. Chain of custody was used for sample shipment as discussed in Subsection 2.5.4.2.1.2.

- Samples to be tested were initially identified on the basis of visual description, in accordance with ASTM D2488-06 (Reference 2.5.4-208) and were selected to be representative of various soil types found across the site. Damaged or otherwise inadequate samples were not used for testing and were replaced with suitable samples chosen to represent the same area, soil type, and strata as the original sample.

- Bulk samples were tested to determine existing moisture content and compaction characteristics.

- Classification tests were performed on samples to define the various soil types present across the site. Boring logs were verified with laboratory data.

- Both static and dynamic laboratory testing were performed in accordance with standard test procedures using calibrated equipment. Minor deviations, if any, from standard test procedures are noted on individual test reports. The procedures used are discussed in Subsection 2.5.4.2.1.

2.5.4.2.1 Laboratory Testing

2.5.4.2.1.1 Purpose and Scope

A total of 44 borings (excluding borings performed specifically for seismic testing) were completed during the RBS Unit 3 site investigation. A total of 1295 samples were retrieved during this investigation: 1036 disturbed samples and 258 undisturbed samples. Two hundred ninety-one (291) samples recovered during the site investigation were submitted for static laboratory analysis (Table 2.5.4-201). Locations of the sampled borings are presented in Subsection 2.5.1 and in Figure 2.5.4-202. Samples were selected and submitted to obtain data on the following basis:

- Representative samples for each stratigraphic unit of engineering interest.

- Coarse-grained samples with relatively low blow counts for liquefaction analysis.

- Samples used to evaluate slope stability and settlement characteristics.

- Even spatial distribution of samples across the investigation area.

The scope of the static laboratory testing program included the following analyses, with applicable ASTM standards, U.S. Army Corps of Engineers (USACE) procedures, or U.S. Environmental Protection Agency (EPA) methods in parentheses:

- 221 natural moisture tests (ASTM D2216-05 [Reference 2.5.4-209]).
- 45 unit weight tests (ASTM D653-07f [Reference 2.5.4-210]).
- 7 specific gravity tests (ASTM D854-06 [Reference 2.5.4-211]).
- 149 Atterberg index tests (ASTM D4318-05 [Reference 2.5.4-212]).
- 128 mechanical sieve tests (ASTM D422-63e1 [Reference 2.5.4-213]).
- 41 hydrometer tests (ASTM D422-63e1 [Reference 2.5.4-213]).
- 14 consolidated-undrained triaxial compression tests with pore pressure measurement (ASTM D4767-04 [Reference 2.5.4-214]).
- 35 unconsolidated-undrained triaxial compression tests (ASTM D2850-03a [Reference 2.5.4-215]).
- 22 one-dimensional consolidation tests using incremental loading (ASTM D2435-04 [Reference 2.5.4-216]).
- 2 one-dimensional consolidation tests using controlled-strain loading (ASTM D4186-06 [Reference 2.5.4-217]).
- 3 direct shear tests (ASTM D3080-04 [Reference 2.5.4-218]).
- 1 moisture-density standard Proctor test (ASTM D698-07 [Reference 2.5.4-219]).
- 2 chemical analysis of soils, including pH (ASTM G51-95 [Reference 2.5.4-203]), soluble chloride (ASTM D512-04 [Reference 2.5.4-204]), soluble sulfate (ASTM D516-07 [Reference 2.5.4-205]), sulfide (EPA 9031 [Reference 2.5.4-220]), and oxidation and reduction potential (REDOX) (ASTM D1498-07 [Reference 2.5.4-206]).

Dynamic laboratory testing included 12 resonant column and torsional shear (RCTS) analyses conducted in accordance with ASTM D4015-07 (Reference 2.5.4-221) using RCTS equipment developed by the Geotechnical Engineering Center at the University of Texas at Austin (Reference 2.5.4-222). To supplement these results, three resonant column tests (ASTM D4015-07 [Reference 2.5.4-221) and six cyclic simple shear tests (ASTM D3999-92 and ASTM D6528-07 [References 2.5.4-223 and 2.5.4-224]) were performed. Information from resonant column tests performed during the RBS Unit 1 investigation was also used for analysis. The dynamic laboratory data set is shown in Table 2.5.4-202. Static and dynamic laboratory test results are discussed in Subsections 2.5.4.2.2.1 and 2.5.4.2.2.2, respectively.

2.5.4.2.1.2 Sample Control

Samples were obtained from split-spoon, ring-lined split-spoon, undisturbed thin-walled tubes, or soil cores taken under the direct observation of field geotechnical engineers or geologists as part of the site investigation process. Split-spoon samples were photographed, placed in glass jars, and sealed using a moisture-tight lid. Ring-lined samples were photographed and sealed in the field using plastic caps and duct tape. The exposed bottom of undisturbed tube samples were photographed, and the tubes were sealed in the field using soil packers, and if needed, waxed, as presented in accordance with ASTM D4220-95 (Reference 2.5.4-225). Soil cores were photographed, placed in Lexan tubes, and sealed. All sample jars, tubes, rings, and Lexan tubes were labeled with identifying information, transferred to the climate controlled lockable temporary site storage area, and entered into the sample inventory records. Chain of custody (COC) forms were completed for samples for each boring drilled and placed with the project documents. Only field engineers and geologists had access to the lockable temporary site storage area. The custody of the samples was transferred to the laboratory contractor and the samples taken to a storage area in its laboratory facilities.

Samples were handled and transported to the laboratory facilities following handling methods in ASTM D4220-95 (Reference 2.5.4-225). Samples for index testing were handled as Group B samples and undisturbed tube samples were handled as Group C samples. The undisturbed samples were transported in padded wooden crates by the laboratory personnel in passenger vehicles or small pickup trucks. COC forms were filled out by project personnel at the site and accompanied samples to the laboratories. COC forms were then completed by the receiving lab and returned for inclusion in the project file. A signed copy of the COC form was kept in the laboratory facilities. All parties involved in sample transportation completed and signed COC forms to completely document the handling process. If samples were sent to other laboratory facilities, the copies of the COC form were signed as the custody of the samples was transferred. Samples were stored in the controlled laboratory environment in a secure location. Laboratory assignment sheets were prepared by project engineers and provided to the testing laboratories.

Appropriate portions of jar and undisturbed tube samples were taken to complete the assigned tests. In many cases, the entire sample was used for testing. Any unused portion of the jar or undisturbed sample was properly re-sealed and stored in the controlled laboratory environment.

2.5.4.2.1.3 Testing Procedures

All testing was performed in accordance with the ASTM standards, EPA methods, and USACE procedures listed in Subsection 2.5.4.2.1.1. Methodology descriptions of critical tests are provided below.

2.5.4.2.1.3.1 Consolidated-Undrained Triaxial Compression

Consolidated-undrained with pore pressure measurement (CU bar) testing was performed pursuant to ASTM D4767-04 (Reference 2.5.4-214) on undisturbed test specimens extruded from sampling tubes and trimmed to appropriate dimensions. The specimens were encased in rubber membranes and saturated by backpressure prior to shearing. Specimen saturation was determined as prescribed in Subsection 8.2.3.1 of ASTM Standard D4767-04 (Reference 2.5.4-214). The specimen was permitted to drain during the consolidation phase, allowing equilibrium under the confining stress but no drainage was allowed during the loading phase. Failure was assumed to have occurred when the specimens had reached the maximum deviator stress or an axial strain of 15 percent, whichever occurred first.

Vertical load, vertical displacement, chamber pressure, and pore pressures generated during the loading phase were measured and recorded. The test is termed consolidated-undrained; total stresses result if no pore pressure corrections are included. When the pore pressures generated during the loading phase are subtracted from the total stresses, effective stresses result.

2.5.4.2.1.3.2 Unconsolidated-Undrained Triaxial Compression

Unconsolidated-undrained (UU) triaxial compression testing was performed in a manner similar to the CU bar test described above, except that no drainage was allowed under the confining pressure or the loading. Testing was performed pursuant to ASTM D2850-03a (Reference 2.5.4-215).

2.5.4.2.1.3.3 One-Dimensional Consolidation

One-dimensional consolidation testing was performed pursuant to ASTM D2435-04 (Reference 2.5.4-216) or ASTM D4186-06 (Reference 2.5.4-217) on undisturbed test specimens extruded from sampling tubes. Specimens were trimmed to appropriate dimensions. The specimen was confined in a stainless steel ring, placed between porous stones, and subjected to incrementally increasing vertical loads. Resulting changes in specimen height with respect to time were measured with a linear variable differential transformer and recorded on the data collector. The load increments were doubled with each loading phase until the sample was loaded at least two loading increments beyond the estimated preconsolidation pressure. Consolidation under each load increment was considered complete when log-time plots of deformation indicated that each sample had achieved at least 90 percent primary consolidation.

During the first phase of testing, 26 specimens were tested in a one-dimensional odeometer, in accordance with ASTM D2435-04 (Reference 2.5.4-216). Sample disturbance was quantified by determining the sample quality designation (SQD), a measurement of the change in volume (volumetric strain ε_v) necessary to bring the specimen back to its in situ stress condition (Reference 2.5.4-226). Results for all tests indicated high to very high disturbance SQDs, ranging between D and E.

A second phase of testing was started on specimens from the same undisturbed samples or specimens from samples gathered at short distances from the original sample locations. An engineer was present at the laboratory to observe specimen trimming and preparation for the start of the second phase of testing. Sample quality was improved by revising the sample preparation and trimming procedures. Results of 22 tests from the second phase of testing were used to estimate the coefficient of consolidation (C_c), the coefficient of recompression (C_r), and preconsolidation stress (P_c) (Table 2.5.4-201).

2.5.4.2.1.3.4 Direct Shear

Direct shear testing was performed pursuant to ASTM D3080-04 (Reference 2.5.4-218) on undisturbed and reconstituted specimens of cohesionless soils and cohesionless soils within a cohesive soil matrix. Undisturbed specimens were extruded from sampling tubes; reconstituted specimens were compacted to approximately 95 percent of the maximum relative density. The test is performed by deforming a specimen at a controlled strain rate on a close to horizontal failure plane. Typically, three different normal stresses are applied to the specimen and the specimen sheared. Deformation and shear strain measured during shearing for each normal stress applied are plotted to determine the strength envelope of the tested soil. Test results were used to estimate drained strength parameters of cohesionless soils (Table 2.5.4-201).

2.5.4.2.1.3.5 Resonant Column and Torsional Shear (RCTS)

Regulatory Guide 1.138 discusses the use of cyclic triaxial and torsional shear testing along with resonant column testing to determine both the change in shear modulus and damping ratio of soils with change in strain. Based on this methodology, two samples are used to determine the complete shear modulus and damping curves for the soil (Reference 2.5.4-227). The resonant column torsional shear test equipment allows performing both a resonant column and torsional shear tests on a single specimen; therefore, variability due to preparing identical samples is avoided (Reference 2.5.4-222).

Published damping ratio and modulus reduction curves (References 2.5.4-228 and 2.5.4-229) for the site soil column to be used for ground motion site-response analysis were verified using damping and modulus information from specimens tested on RCTS testing equipment. Specimens from seven undisturbed samples, two disturbed samples, and three reconstituted samples were tested using the RCTS equipment. Testing was performed in accordance with ASTM D4015-07 (Reference 2.5.4-221) and with the University of Texas at Austin Procedure RCTS

GR06 (Reference 2.5.4-222). Each test specimen was consolidated to the in situ effective mean stress and, if possible, to four times the in situ stress. The in situ effective mean stress was calculated assuming a coefficient of earth pressure at rest (K_o) of 0.5 for cohesionless soils and 0.7 for cohesive soils. Each test specimen was then subjected to a suite of tests of varying confining pressures and cyclic strain levels. Table 2.5.4-202 shows the mean effective in situ stress (and corresponding K_o used) for each test specimen.

The ratio of the shear wave velocity measured in the laboratory at small strains and measured in the field at the sample depth are shown in Table 2.5.4-202 for laboratory test specimens consolidated to the estimated mean effective in situ stress. Ideally, this ratio should approach unity.

2.5.4.2.1.3.6 Resonant Column and Cyclic Simple Shear Dynamic Testing

To supplement the shear modulus behavior and damping characteristics determined from the RCTS test results, three resonant column (RC) tests (ASTM D4015-07 [Reference 2.5.4-221]) and six cyclic simple shear (CSS) tests (ASTM D3999-92 and ASTM D6528-07 [References 2.5.4-223 and 2.5.4-224]) were performed on selected samples (Table 2.5.4-202). Cyclic triaxial tests were not performed for the following reasons:

- Samples cyclically loaded during the cyclic triaxial test are loaded in a direction parallel to the longitudinal axis of the specimen, whereas during an earthquake, typical shear loads tend to be perpendicular to the longitudinal axis of the specimen.
- Cyclic simple shear tests allow for the determination of liquefaction behavior of the tests performed under loading conditions very similar to a seismic event.

The RCTS test results were compared with the published damping ratio and modulus reduction curves.

2.5.4.2.2 Material Engineering Properties

Three hundred and twelve (312) samples were tested to determine the static and dynamic properties of the materials found at the proposed RBS Unit 3 site. Visual descriptions from boring logs were studied in combination with laboratory test results, cone penetration soundings, and geologic cross sections to determine the soil stratigraphy at the site. The location of the borings drilled for the RBS Unit 3 site investigation and selected borings drilled during the RBS Unit 1 site investigation are shown in Figure 2.5.4-202. Cross sections showing the stratigraphy at the power block are presented in Figures 2.5.4-203, 2.5.4-204, 2.5.4-205, and 2.5.4-206. A summary of the boring and cone penetration testing stratigraphic data is presented in Table 2.5.4-203. The locations and depths of borings drilled for the site investigation were determined based on the guidance provided in Regulatory Guide 1.132 and the ESBWR DCD.

2.5.4.2.2.1 Static Material Properties

Results from laboratory tests performed on specimens from samples gathered during the site investigation were reviewed to determine the properties of the soils encountered at the site. As stated in Subsection 2.5.4.2.1.1, index properties and classification laboratory tests included moisture content, unit weight, specific gravity, Atterberg limits, grain size, and hydrometers. Strength and compressibility testing included consolidated undrained triaxial tests, unconsolidated undrained triaxial tests, direct shear tests, and consolidation tests.

Standard penetration tests (SPTs) in accordance with ASTM D1586-99 (Reference 2.5.4-230) were performed on both cohesive and cohesionless soils. SPTs were performed to determine the number of blows required to penetrate a standard split-spoon sampler (without liner and with plastic catchers) 18 in. (450 mm) into the ground using a 140-lb. (63.5-kg) automatic hammer with a 30-in. (760-mm) drop. The blows needed for the sampler to penetrate each of the three 6-in. (150-mm) intervals into the ground are recorded. The field N-value is calculated by adding the amount of blows necessary for the sampler to penetrate the last 12-in. (300-mm) increment into the ground. N-values are used to approximate the consistency of cohesive soils and for determining the relative density of cohesionless soils. If gravel alluvium was expected, the blows per 0.1 ft. (30 mm) of penetration were documented. The values were later analyzed to determine if the presence of gravel affected the SPT. If the SPT was affected, it was corrected in accordance with ASTM D6066-96 (Reference 2.5.4-231).

As shown in Figures 2.5.4-202 and 2.5.4-206, the borings drilled for the site investigation were drilled both inside and outside the existing excavation at the site. The ground surface elevation outside the excavation is approximately 95 ft. msl, and the ground surface elevation inside the excavation is approximately 65 ft. msl. The final site grade will vary from 94.4 ft. msl to 97.9 ft. msl (will be referenced as 97.5 ft. msl hereafter). Because of the difference in elevation of the ground surface and subsequent change in confining stress at the same depths between borings inside and outside the excavation, field N-values corrected for the presence of gravel are presented in Figure 2.5.4-207 for borings drilled outside the excavation and Figure 2.5.4-208 for borings drilled inside the excavation. Furthermore, both native soils and fill soils are encountered within the existing excavation.

Moisture content and Atterberg limit results for all the cohesive soils encountered below the Seismic Category I structures and other nonsafety-related structures at the site during the site investigation are shown in Figure 2.5.4-209. Fines content of all soils encountered during the site investigation are presented in Figure 2.5.4-210.

Nine cone penetration test (CPT) soundings were also performed during the site investigation. Measured cone tip resistance, side friction, static pore pressures, friction ratios and correlated soil behavior types, and SPT N_{60} (blow counts corrected for 60 percent energy transfer) values (References 2.5.4-232 and 2.5.4-233) are presented in Figure 2.5.4-211.

2.5.4.2.2.1.1 General, Engineered, and Structural Fill

As mentioned in Subsection 2.5.1.2.3.2, the construction of RBS Unit 1 significantly changed the surface of the RBS Unit 3 location. Two general types of fill have been identified within the RBS Unit 3 site location: general fill and engineered fill.

According to the RBS Unit 1 USAR, general fill includes excavated Loess and Port Hickey Top Stratum soils that were used for site development. The general fill also includes fill known as Class III fill, which classifies as clayey sand with an angle of internal friction of 32 degrees. Samples were gathered from the general fill material. Four static laboratory indices tests and seven grain size distributions were performed for the general fill (Table 2.5.4-201). Soils encountered as fill include lean clays, poorly graded sands, and clayey sands, with natural moisture contents ranging from 7 to 37 percent. The lean clay portions of the soil have plasticity indices ranging from 8 to 12 percent and an undrained shear strength of 640 lb. per sq. ft. (psf) (30.6 kPa), based on one unconfined compression test.

Engineered fill was used to backfill the majority of the RBS Unit 2 excavation from Elevation 20 ft. msl to the current surface of approximately Elevation 65 ft. msl. The engineered fill displays distinctly different characteristics than the general fill used at other locations within the RBS Unit 2 excavation and immediate RBS Unit 1 area. One hundred two (102) SPTs were performed on the engineered fill, with a mean gravel corrected N_{60} value of 73 blows per foot and a coefficient of variation (cov)[a] of 0.46, representing a very dense material. N_{60} values of 50 were assigned to tests that reached refusal. Refusal was reached if a total of 50 blows had been applied during any of the three 6-in. drive increments, if a total of 100 blows had been applied in successive intervals, or there was no observed advance of the sampler during application of 10 successive hammer blows.

Based on five grain size distributions (Table 2.5.4-201), the engineered fill has a mean of 5 percent gravel and 5 percent of material passing the No. 200 sieve. These values correspond well with the RBS Unit 1 engineered fill gradation specification, which required the material to have no more than 5 percent gravel and no more than 5 percent fines (Reference 2.5.4-234).

The existing RBS Unit 2 excavation is to be excavated down to Elevation 20 ft. msl (Subsection 2.5.4.5), and backfilled with structural fill. It is expected that the structural fill to be used for construction of RBS Unit 3 would have similar engineering properties as the engineered fill used for construction of RBS Unit 1.

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a. Coefficient of variation is the ratio of the standard deviation to the mean value; it represents a measure of dispersion of values from the mean value. The higher the coefficient of variation, the higher the variability of the parameter described.

2.5.4.2.2.1.2 Loess

Because of the limited amount of loess encountered throughout the site, static laboratory indices were determined for only one loess sample (Table 2.5.4-201). The sample was recovered from Boring CT-47, which was advanced into the formation just south and west of the RBS Unit 3 power block (Figure 2.5.4-202). Together with RBS Unit 1 data (Reference 2.5.4-234), a total of five static laboratory indices are available for the loess (Table 2.5.4-201). Figure 2.5.4-212 shows a representative photograph of the loess from a recovered split-spoon sample. A summary of engineering properties of the loess is presented in Table 2.5.4-204.

Samples are generally classified as lean clay (CL) or fat clay (CH) (Figure 2.5.4-213). Plasticity indices ranged between 12 and 31; corresponding liquid limits are 29 to 52 (Figure 2.5.4-209). Moisture contents ranged from 22 to 23 percent (Table 2.5.4-201). The fines content (silt and clay) of the loess samples (based on results from the RBS Unit 1 site investigation) ranged from 93 to 98 percent (Table 2.5.4-201, Figure 2.5.4-210).

One unconfined compression test performed on a sample from the RBS Unit 3 site investigation indicates an undrained shear strength of 4130 psf (197.7 kPa). The mean undrained shear strength calculated from CPT data is 5836 psf (280 kPa) (Table 2.5.4-205), with a cov of 0.56. The mean gravel corrected N_{60} value of the loess is 21 blows per foot, with a cov of 0.54.

2.5.4.2.2.1.3 Port Hickey Top Stratum

During construction of RBS Unit 1, the Port Hickey Top Stratum, consisting of silts and clays, was removed from beneath all of the Seismic Category I and safety-related structures of the power plant, and used as general fill in the RBS site (Subsection 2.5.4.2.2.1.1) (Reference 2.5.4-234). Port Hickey Top Stratum soils are typically yellow, brown, or gray fine sandy silts to silty clays of low-to-medium plasticity (Reference 2.5.4-234). A photograph of a representative sample of the Port Hickey top stratum soils from a recovered split-spoon sample is presented in Figure 2.5.4-214.A summary of engineering properties for the Port Hickey Top Stratum soils is presented in Table 2.5.4-204.

Cohesive soils in the Port Hickey deposits in their native condition were grouped to determine the soil properties of the Port Hickey Top Stratum. Fifteen SPT samples and seven undisturbed tube samples were gathered from locations surrounding the proposed power block area. Gravel corrected N_{60} values ranged from 10 to 69 blows per foot (Figure 2.5.4-207), averaging 23 blows per foot with a cov of 0.70 . The liquid limit and plasticity indices averaged 41 and 24, respectively (Figure 2.5.4-209), and fines content averaged 61 percent (Figure 2.5.4-210).

Undrained shear strength was determined from three specimens of cohesive soils in the Port Hickey Top Stratum and Port Hickey. The undrained shear strength ranged from 1160 to 4100 psf (28 to 197 kPa), the higher value for a sample below the general fill. Cone penetration sounding data indicated a mean undrained shear strength of 2900 psf (134 kPa), with a cov of 0.44. Based on the mean plasticity index, the angle of internal friction can be approximated to be 30 degrees, with a moist unit weight of 135 pounds per cubic foot (pcf) (2170 kg/m^3).

2.5.4.2.2.1.4 Port Hickey

A total of 42 samples (37 disturbed samples, 5 undisturbed samples) were gathered from Port Hickey materials. The Port Hickey materials can be described as yellow, brown, or gray clayey, silty, and stratified fine-to-medium grained sands (Reference 2.5.4-234). The fines contents ranged from 15 to 48 percent (Table 2.5.4-201) with a mean fines content of 25 percent (Table 2.5.4-204). Gravel corrected N_{60} values ranged between 3 and 48, averaging 17 blows per foot. No laboratory strength testing was performed on the Port Hickey materials, but cone penetration data indicate an angle of internal friction that range between 31 and 50 degrees. Correlations with gravel corrected N_{60} values indicate an angle of internal friction of 33 degrees.

A photograph of a representative split-spoon recovered sample of the Port Hickey material is presented in Figure 2.5.4-215. A summary of engineering properties for the Port Hickey material is presented in Table 2.5.4-204.

2.5.4.2.2.1.5 Upper Citronelle

The Upper Citronelle stratum is composed of orange, brown, or reddish-brown clayey and stratified fine-to-medium grained sands, with some clay and silt lenses. Unit 3 site investigation gravel contents ranged from 0 to 53 percent; the highest gravel content encountered was for a small gravelly layer at an elevation of 65 ft. msl (Figure 2.5.4-216). Fines content for the cohesionless portion of the soils ranged from 1 to 49 percent, with a mean value of 14 percent (Figure 2.5.4-210 and Table 2.5.4-204). Atterberg limits were determined for the fines portion of the sands encountered; they were classified as low plasticity (Figure 2.5.4-217).

One hundred ninety-six (196) SPTs were performed on the Upper Citronelle materials. Gravel corrected N_{60} values ranged from 5 blows per foot to refusal, with a mean value of 35 blows per foot and a cov of 0.60. N_{60} values of 50 or greater blows per foot were used to describe tests that reached refusal. Based on information from direct shear test results, cone penetration soundings, and SPT results, an angle of internal friction of 35 degrees was determined for the Upper Citronelle materials. A photograph of a representative sample of the Upper Citronelle soils from a recovered split-spoon sample is presented in Figure 2.5.4-218. A summary of the engineering properties of the Upper Citronelle material is presented in Table 2.5.4-204.

2.5.4.2.2.1.6 Lower Citronelle

The Lower Citronelle soils can be described as orange, brown, or reddish-brown fine-to-medium grained sands with varying amounts of gravel. During the RBS Unit 3 site investigation, it was noted that these soils tend to be light brown at the location of the power block. This material displays an erosional surface with the Pascagoula Formation; therefore, layers and discrete lenses of cohesive materials are encountered just above the Pascagoula Formation within the cohesionless materials of the Lower Citronelle. Gravels can also be encountered as discontinuous layers throughout the site (Figure 2.5.4-216).

Three hundred twenty-eight (328) SPTs were performed in the Lower Citronelle cohesionless materials. Gravel corrected N_{60} values ranged between 17 per foot to refusal, with a mean of 75 blows per foot and a cov of 0.41, with higher values representing soils tested in borings outside of the existing excavation area where there is a difference of approximately 30 ft. (9 m) of overburden with the bottom of the existing excavation (Figures 2.5.4-207 and 2.5.4-208). Fines content ranged from 0 to 21 percent (Figure 2.5.4-210) with a mean of 7 percent and a cov of 0.73 and ranged from non-plastic to a plasticity index of 10. Forty-nine (49) grain size distributions were determined for the cohesionless Lower Citronelle materials (Figure 2.5.4-219); gravel contents averaged 14 percent with a cov of 1.30; sand contents averaged 79 percent with a cov of 0.24.

Triaxial and direct shear tests were not performed on samples from the Lower Citronelle. Internal friction angles determined from CPT data are presented in Figure 2.5.4-220. Solid data points represent angles of internal friction determined from cone penetration soundings performed in areas where the ground surface is at Elevation 95 ft. msl, while hollow points represent data from CPTs performed in areas where the ground surface is at Elevation 65 ft. msl. Five cone penetration soundings reached the Lower Citronelle. The angles of internal friction determined from cone penetration data ranged from 28 to 43 degrees (Figure 2.5.4-220), with a mean value of 37 degrees. The lowest values represent the materials just above the surface of the Pascagoula Formation, where higher water contents and higher fines content are expected because of the alluvial deposition of materials and the slight erosion of the Pascagoula Formation during the alluvial deposition.

For soils between Elevation -15 ft. msl to the top of the Pascagoula clay and where most of the cohesive soils in the Lower Citronelle layer occur, an angle of internal friction of 30 was determined. Gravel corrected N_{60} values for the cohesive soils ranged between 17 and 77 blows per foot, with a mean of 31 and a cov of 0.47. The liquid limit and plasticity index for these soils have a mean of 42 and 23, with covs of 0.21 and 0.30, respectively. A summary of the engineering properties of the Lower Citronelle materials are presented in Table 2.5.4-204. A photograph of a representative sample of the Lower Citronelle soils recovered from a split-spoon sample is presented in Figure 2.5.4-221.

2.5.4.2.2.1.7 Pascagoula Formation

The Pascagoula Formation soils can be described as hard, greenish-gray lean and fat clays with discountinous sand partings and pockets, with some coarse sand to gravel-size calcareous nodules at lower elevations. Under the Reactor Building, and at Elevation -276 ft. msl, the first substantial sand zone of the Pascagoula Formation was encountered. This zone is approximately 100 ft. thick, and consists of fine-grained, poorly graded sands and silty sands. This zone represents the Zone 1 aquifer, as described in Subsection 2.4.12. Because of the depth to this layer, limited sampling was performed.

One hundred sixty-one (161) SPTs were performed on the Pascagoula Formation. The gravel-corrected N_{60} values have a mean value of 55 blows per foot, with a cov of 0.31. Index properties for the clay are presented in Table 2.5.4-204. Moisture content ranged between 15 and 47 percent, averaging 27 percent with a cov of 0.22 (Figure 2.5.4-209). Liquid limits and plasticity indices ranged from 25 to 87 and from 7 to 53, respectively, with coefficients of variation of 0.25 and 0.35, respectively. Both lean and fat clays were encountered in this layer, as shown in Figure 2.5.4-222. Based on hydrometer tests, the minus 2 micron fraction clay content ranged between 6 to 60 percent, with a mean of 24 percent and a cov of 0.58.

Thirty-five (35) unconsolidated undrained tests were performed on Pascagoula Formation materials. The mean measured shear strength is 8200 psf (392 kPa), with a cov of 0.54. A trend of increasing undrained shear strength with increasing effective overburden stress was observed; this can be described using a linear function as shown in Figure 2.5.4-223.

Fourteen consolidated-undrained triaxial compression tests with pore pressure measurements were performed on Pascagoula Formation materials. The shear strength envelope created from these tests is presented in Figure 2.5.4-224. The shear strength envelope describes the effective stress strength of a soil with a cohesion value of zero and an angle of internal friction of 25 degrees.

Consolidation tests were performed on undisturbed samples from three borings during the RBS Unit 1 site investigation (Figure 2.5.4-225). For each test, a probable range for the preconsolidation pressure was reported (Reference 2.5.4-234). The estimated range of preconsolidation pressures, the computed in situ effective vertical stress, and the estimated overconsolidation ratio are shown in Figure 2.5.4-225. Overconsolidation ratios (OCR) ranged from 1.2 to 2.2. Compression and recompression ratios ranged from 0.160 to 0.379 and 0.017 to 0.042, respectively. Initial void ratios ranged from 0.616 to 0.901.

During the first phase of the RBS Unit 3 site investigation, as noted in Subsection 2.5.4.2.1.3.3, 26 consolidation tests were performed on materials gathered from the Pascagoula Formation. Results from the testing showed significant sample disturbance (Subsection 2.5.4.2.1.3.3). For the second phase of testing, sample preparation procedures were revised and 22 samples were tested. Specimens used for the second phase of testing were prepared using portions of the same samples tested during Phase 1, or different samples from equivalent depths and with similar soil properties as the samples used for the Phase 1 testing.

For the first phase of testing, SQD for each sample ranged from D to E, with an average change in volume of 8.7 percent (SQE of E), which shows significant sample disturbance. For the second phase of testing, the SQD determined for each sample ranged from A to D, with an average change in volume of 3.7 percent (SQD of C), which shows less sample disturbance than previous test results.

The preconsolidation pressures (P_c'), based on samples obtained during the Unit 3 investigation, were determined using the Casagrande construction method from the typical void ratio versus log pressure laboratory curve (Reference 2.5.4-235). The overconsolidation ratio (OCR) was defined as the ratio of the preconsolidation stress to the in situ vertical effective overburden stress. The compression index (C_c) was determined from the slope of the virgin compression curve. The recompression index (C_r) was determined from the slope of the recompression part of the curve (Reference 2.5.4-235). Compression ratio (CR) is defined as $CR = \frac{C_c}{1+e_0}$ and the recompression ratio (RR) is defined as $RR = \frac{C_r}{1+e_0}$.

The laboratory data was corrected for disturbance effects by applying the Schmertmann graphical procedure (Reference 2.5.4-235) to determine the field-corrected compression ratios. Void ratios ranged from 0.618 to 0.936, with an mean value of 0.744. Preconsolidation pressures ranged between 5.4 tsf to 22.0 tsf, with an average value of 11.4 tsf. Recompression and compression ratios ranged between 0.009 to 0.026 and 0.072 to 0.207, respectively, with average values of 0.016 and 0.152, respectively.

No hydraulic conductivity tests were performed on samples from the Unit 3 investigation. The hydraulic conductivity of the Pascagoula Formation was determined from selected consolidation tests based on the following equations:

$$k = \frac{C_v a_v \gamma_w}{1 + e_{50}} \qquad a_v = \frac{\Delta e}{\Delta p}$$

$$k = C_v m_v \gamma_w \qquad m_v = \frac{\Delta \varepsilon}{\Delta p}$$

Hydraulic conductivity values ranged between 5 x 10^{-8} to 4 x 10^{-10} cm/sec (2 x 10^{-9} to 1 x 10^{-11} ft/sec). These values are comparable to published hydraulic conductivities for lean and fat clays.

Consolidation properties were compared with the results from consolidation tests performed for the Unit 1 investigation. It is unknown if the compression and recompression ratios were determined from field-corrected data; therefore, uncorrected values from the Unit 3 investigation were compared to the Unit 1 values. The recompression and compression ratios determined from samples of the Unit 3 investigation are lower than the ratios determined from the Unit 1 investigation. Overconsolidation ratios determined from the Unit 3 investigation are higher than those determined based on the Unit 1 investigation, which was expected because of the lower in situ overburden stress of the samples gathered during the Unit 3 investigation. Most of the samples obtained during the Unit 1 investigation were from borings located at ground surface elevations between approximately 90 and 110 ft. msl (Reference 2.5.4-234), while the samples obtained during the Unit 3 investigation were obtained from borings located inside the existing excavation, where the ground surface is at Elevation 65 ft. msl.

Settlement parameters were also determined from movement measurements at RBS Unit 1, recorded in extensiometers throughout the plant between 1985 and 1997 (Reference 2.5.4-234). Using this information, recompression ratios were back-calculated based on observed movements. Recompression ratios ranged between 0.003 and 0.010, values lower than those determined based on laboratory data from both the Unit 3 and Unit 1 investigations.

During the Unit 1 construction, movements caused by excavation, construction, and filling were monitored with extensiometers placed around the construction site. Data from these extensiomenters indicated the following:

- About three-quarters of the movement observed occurred in the upper portion of the Pascagoula Formation.
- Observed movements during excavation, construction, and fill were smaller than those predicted.

Because of these considerations, the recompression and compression ratios based on the Unit 1 monitoring data were used for the settlement analyses.

2.5.4.2.2.2 Dynamic Material Properties

The results of the RCTS testing are shown in Figures 2.5.4-226, 2.5.4-227, 2.5.4-228, and 2.5.4-229 as a function of the cyclic strain and are described by the damping ratio and the modulus reduction ratio (G/Gmax), that is, the shear modulus at strain levels greater than the cyclic threshold shear strain divided by the maximum shear strain modulus. Data from five RC tests performed during the RBS Unit 1 investigation (Reference 2.5.4-234) are also included in these figures (Table 2.5.4-202). The data for cohesionless soils are plotted on depth-dependent modulus reduction and damping ratios developed by the Electric Power Research Institute (EPRI) (Reference 2.5.4-236). Data for cohesive soils are plotted on plasticity index-dependent modulus reduction and damping ratios developed by Vucetic and Dobry (Reference 2.5.4-229). Dynamic testing also included RC and CSS tests.

Dynamic test results were evaluated for analysis by geologic origin and index properties to identify logical groupings for the purpose of assigning dynamic modulus reduction curve and damping values for ground motion site-response analysis. As a result of this analysis, RCTS testing data were partitioned onto the following:

- Lower Citronelle.
- Pascagoula Formation (cohesive).
- Pascagoula Formation (cohesionless).

Table 2.5.4-202 summarizes laboratory and field measured shear wave velocity. The methodology used to determine which samples to test is presented in Subsection 2.5.4.2.2.2.1.

2.5.4.2.2.2.1 Sample Selection for Dynamic Testing

Dynamic testing included RCTS tests as well as RC and CSS tests. The RC and CSS tests augmented the information gathered from the RCTS tests.

As a first step in determining the specimens to be tested, preliminary soil profiles and cross sections (based on field soil descriptions) were drawn to describe the soil stratigraphy underneath the Seismic Category I structures and the Turbine Building. After the amount of samples for each soil type was determined, a statistical analysis was performed to determine if the samples chosen cover the variability that might be encountered at the site.

The existing soils at the proposed locations of the Seismic Category I structures will be excavated to Elevation 20 ft. msl (Subsection 2.5.4.5), and structural fill will be placed to the bottom of the foundations. Therefore, samples for dynamic testing were chosen below Elevation 20 ft. msl, from the lower portion of the Lower Citronelle and from the Pascagoula Formation, which are the native soils beneath the Seismic Category I structures (Figures 2.5.4-203, 2.5.4-204, 2.5.4-205, and 2.5.4-206).

Numerous dynamic tests were performed on the engineered fill used to backfill the RBS Units 1 and 2 excavation to Elevation 65 ft. msl. Entergy expects to obtain the structural fill material from the same source that was used for RBS Unit 1 construction. Therefore, Entergy expects that the proposed structural fill will have a similar gradation to the engineered fill placed during the construction of RBS Unit 1 and will be placed under similar conditions to those used for placement of the engineered fill. Also, extensive information on the dynamic behavior of the engineered fill is presented in Reference 2.5.4-234; therefore, no samples of the engineered fill were tested as part of the RBS Unit 3 site investigation. The need for further dynamic testing of the structural fill material will be determined when the source and gradation of the materials to be used for structural fill is known and compared with the source and gradation of the existing engineered fill.

One sample from the Lower Citronelle materials had to be eliminated because of the high amount of gravel encountered in the sample. The index properties of the sample, field classified as silt, indicated a lean clay classification. This sample was replaced by a sample gathered below the sand layer encountered at Elevation -285 ft. msl at the Pascagoula Formation.

Samples of cohesionless materials were selected for testing that represented the range of gravel corrected N-values for the formation studied. Figure 2.5.4-230 represents a histogram of the energy corrected N-values of the cohesionless Lower Citronelle materials. Hatched bars represent ranges of N-values represented by a sample to be tested. As shown in Figure 2.5.4-230, one sample with an N-value below the mode was chosen for testing, as well as two samples with higher N-values than the mode value.

For cohesive soils, both the liquid and plastic limits were used as indicators of the soil variability at the site. Figure 2.5.4-231 represents a histogram of the liquid limit values of the cohesive soils encountered in the Pascagoula Formation. Hatched bars represent ranges of liquid limits represented by a sample to be tested. Liquid limits were determined from samples tested from the same borings and same layers as represented by visual descriptions. As shown in Figure 2.5.4-231, two samples with liquid limits below the mode of 46 were chosen for testing, as well as two samples with liquid limits close to the mode and one sample above the mode.

The same analysis was performed on the basis of the plasticity indices measured from other samples from the same soil layer (based on field descriptions) represented by the samples to be tested, as shown in Figure 2.5.4-232. Three samples represent soils with plasticity indices lower than the mode of 24, two samples represent soils with plasticity indices close to the mode, and one sample represents soils with a higher than the mode.

Based on the statistical analysis, and the revised soil descriptions, the samples that were tested are presented in Table 2.5.4-202.

2.5.4.3 Foundation Interfaces

This subsection presents a summary of foundation interface conditions at the RBS site. Subsection 2.5.4.3.1 provides a description of RBS Unit 3 investigation activities and sampling techniques. Subsection 2.5.4.3.2 summarizes the relationships of subsurface stratigraphy to RBS Unit 3 power block Seismic Category I and safety related structures.

2.5.4.3.1 Site Exploration

2.5.4.3.1.1 Purpose and Scope

An engineering geological and geotechnical site investigation (herein referred to as site investigation) was performed at the RBS site to accomplish the following:

- Characterize site conditions and develop site-specific seismic design criteria.
- Evaluate potential for seismically induced ground failure and hazards.
- Obtain information to use for foundation design and site grading.

Investigation activities involved the following modes of data collection:

- Exploratory boring drilling and sampling.
- Pressuremeter testing.
- Monitoring wells and piezometer installation.
- CPT soundings.

The methodology and extent of each investigation activity is discussed below.

2.5.4.3.1.2 Exploratory Borings

During RBS Unit 3 site investigation activities, a total of 44 exploratory borings (excluding borings performed specifically for seismic testing) were advanced to depths of between 30 and 565 ft. (9 and 172 m) to characterize subsurface geologic conditions, perform in situ testing, and obtain laboratory test samples (Figure 2.5.4-202 and Table 2.5.4-206). Twenty borings were advanced specifically to investigate the subsurface conditions beneath the RBS Unit 3 safety-related structures, and 24 borings were advanced to investigate RBS Unit 3 nonsafety-related facility footprints (i.e., Turbine Building, Radwaste Building, cooling towers, and general site coverage).

Originally, a total of 42 exploratory borings were to be drilled at the site. As a result of initial findings, it was noted that N-values from SPTs performed on Borings CB-22 and RB-29 were (in general) much lower than the N-values from the rest of the borings, especially between Elevations 19.7 and -45.3 ft. msl, and 23.3 and -41.7 ft. msl, respectively. Borings CB-22A and RB-29A were added to the site investigation program to supplement information gathered on Borings CB-22 and RB-29. Logs of all borings conducted for the RBS Unit 3 site investigation are shown in Appendix 2AA.

Soil boring locations and depths were located based on the following:

- GE site investigation recommendations for the ESBWR unit.
- GE ESBWR DCD, Tier 2, Rev. 4.
- NRC Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants," Rev. 2, October 2003.
- NUREG/CR-5738, *Field Investigations for Foundations of Nuclear Power Facilities* (Reference 2.5.4-237).

During the layout of the site investigation, the existing conditions of the area were studied, including existing boring locations, and underground utility and existing grade drawings. Existing geotechnical borings were utilized as much as possible in laying out the geotechnical site investigation. The investigation locations were adjusted to avoid affecting any existing facilities or underground utilities indicated on the drawings. If any of the site investigation locations were unacceptable, the borings were moved as needed. Spacing of borings was carefully planned to correspond to the structure footprints as well as to thoroughly and efficiently document the site stratigraphy geometry of engineering significance (Figure 2.5.4-202).

Most borings were advanced into the Pascagoula Formation. Borings drilled at the proposed location of the safety-related structures were advanced at least to the top of the Pascagoula Formation. Two borings within the site were drilled to a total depth of 550 ft. (168 m) (approximately Elevation -490 ft. msl, or 450 ft. [137 m] into the Pascagoula Formation) for in situ seismic testing. One boring within the site was drilled outside the safety-related structure to a total depth of 565 ft. (172.2 m) (approximately Elevation -505 ft. msl, or 465 ft. [141.7 m] into the Pascagoula Formation) for in situ seismic testing. Borings intended to characterize the subsurface beneath nonsafety-related structures were advanced between 35 to 310 ft. (10.7 to 94.5 m) below the ground surface (Table 2.5.4-206, Appendix 2AA).

All borings were advanced and sampled using one or more of the following techniques (Table 2.5.4-206):

- Mud rotary wash with SPT unlined split-spoon drive and thin-walled tube sampling.
- Wire-line HQ rock core drilling and sampling system that produces a 2.5 in. (63.5 mm) core, used for stiff clays at depths below approximately -295 ft. msl (360 ft. [110 m] deep).

Mud rotary wash boring equipment was used to advance borings and collect disturbed samples pursuant to EM 1110-2-1907 (Reference 2.5.4-238), ASTM D1586-99 (Reference 2.5.4-230), and ASTM D6066-96 (Reference 2.5.4-231).

Borehole diameters ranged from 3.8 to 6.9 in. (96 to 175 mm), depending on the conditions encountered (e.g., 4 in. [102 mm] outside diameter casing was necessary in two borings to stabilize the borehole in gravelly sand strata, 6.9 in. [175 mm] outside diameter casing was necessary in the borings drilled for geophysical testing). Drive sampling by SPT method was conducted with automatic trip hammers, at 2.5-ft. (0.75-m) intervals for the first 10 ft., and 5-ft. (1.5-m) intervals below the first 10 ft. (3 m) of drilling. Continuously sampled borings or portions thereof were sampled at 2.5-ft. (0.75-m) intervals.

Disturbed samples were collected using a standard SPT unlined split-spoon sampler with plastic catchers or 3-in. (76-mm) diameter brass ring lined split-spoon sampler. All samplers were of standard manufacture and were in good condition. After recovery, the field engineer/geologist photographed the sample and selected representative portions of each SPT sample to place in one or more labeled glass jars with sealed caps, pursuant to ASTM Standard D4220-95 (Reference 2.5.4-225). Ring-lined samples were photographed, capped with plastic caps, and preserved. All samples were immediately assigned alphanumeric sample identifications, described pursuant to ASTM D2488-06 (Reference 2.5.4-208) and recorded on boring logs.

Wire-line HQ rock coring equipment was used to advance portions of two borings between depths of 360 ft. to 550 ft. (109 m to 167 m) to collect and describe soil samples. Samples were gathered with 4-in. (102-mm) outside diameter, 5-ft. (1.5-m) long core sample barrels. After recovery, soil core samples were photographed and placed in Lexan tubes. All samples were immediately assigned alphanumeric sample identifications, described pursuant to ASTM D2488-06 (Reference 2.5.4-208), and recorded on field logs.

Undisturbed samples were collected in targeted intervals using 30-in. (762-mm) long, 3-in. (76-mm) inside diameter thin-walled Shelby tubes, pursuant to ASTM D1587-00 (Reference 2.5.4-239). Shelby tubes were attached to the drill rod string with a fixed head sample holder with a check valve and were advanced with steady hydraulic push on the drill head. After recovery, Shelby tubes were carefully purged of excess drilling fluid and drill cuttings, and sample recovery recorded. All samples were immediately photographed, assigned alphanumeric sample identifications, described pursuant to ASTM D2488-06 (Reference 2.5.4-208), and recorded on boring logs. Pocket penetrometer and torvane field tests were performed on undisturbed samples, and the results were recorded on the field log.

Soil packers were placed at the top and the bottom of the tubes to preserve moisture and stabilize the sample, and plastic caps were placed over each end. Adhesive tape was used to further secure the plastic end caps. If the tubes were bent during pushing, not allowing the use of a soil packer, 1 to 2 in. of melted wax was poured into the bent end of the tube, plastic caps placed, and adhesive tape used to secure the caps. Tube condition was recorded on the field logs and shown in sample photographs. The use of samples from bent tubes was avoided by reviewing the tube condition on the boring logs and the sample photographs.

Shelby tube samples were stored upright in a climate-controlled temporary site storage area, secured from accidental disturbance. The samples transported off-site were secured upright in padded wooden crates in passenger vehicles or pickup trucks and hand-delivered by the drilling crew personnel. Sample preparation and preservation methods conformed to ASTM D4220-95 (Reference 2.5.4-225).

As mentioned above, SPTs were conducted at regular intervals during boring advancement to provide estimates of the in situ density/consistency of cohesionless soils, to obtain disturbed samples for index testing, and to be used as a screening tool to evaluate potential liquefaction susceptibility and foundation properties. To achieve each SPT, a 140-lb. (63.5-kg) automatic trip hammer with a 30-in. (762-mm) hammer drop was used to impact a steel anvil screwed onto the top of drill rods. Pursuant to ASTM 6066-96 (Reference 2.5.4-231), cleanout and tip of sampler depths were recorded for SPTs in gravelly soils. Cleanout depths were determined to the nearest 0.1 ft. (30 mm) using the following methodology: after the removal of cuttings, the drill bit and rods were slightly raised and fluid circulation cut off. After approximately 3 minutes, the drill bit and rods were lowered to check the cleanout depth. If the thickness of the cuttings, cave, or heave was more than 0.4 ft. (122 mm), circulation was continued to remove this material and the boring depth rechecked. When the correct depth was reached, the drill bit was removed, the sampler inserted in the hole, and the depth of the tip of the sampler checked. If the tip of the sampler was not within 0.4 ft. (122 mm) of the intended sampling depth, the bottom of the hole was redrilled or the sample interval moved 2.5 ft. (762 mm) below the originally intended sampling depth.

Blow counts were measured for each 6-in. (152-mm) driving interval drawn on the anvil. Driving was terminated at a count of 50 blows in any 6-in. (152-mm) interval and the actual penetration distance recorded. Blow counts were recorded independently by field engineers/geologists and drillers and immediately noted on the field logs. If gravelly soils were expected, 0.1-ft. (30-mm) marks were drawn on the rods to determine blows necessary to drive the sampler 0.1 ft. (30 mm). Blow counts necessary for the sampler to penetrate each 0.1-ft. (30-mm) increment were recorded and were used to determine if the presence of gravel was a factor on measured N-values. Typical hammer impact frequencies ranged between 40 and 50 blows per minute.

Energy measurements were made on drill rig equipment performing SPTs. Two drill rigs were used to perform all of the SPTs at the site: a truck-mounted SIMCO 2800 and an all-terrain vehicle (ATV) mounted SIMCO 2800 rig. Energy measurements were recorded during sampling at several different depth intervals; these were performed pursuant to ASTM D4633-05 (Reference 2.5.4-240). The ratio of average measured energy of the theoretical potential energy or the SPT system is the energy transfer ratio (ETR). The ETR range of automatic hammers used at the RBS site was 77 to 89 percent for the truck-mounted SIMCO 2800 and 75 to 85 percent for the ATV mounted SIMCO 2800, with overall ETR averages of 86 and 80 percent, respectively. These ETR values are within the range of typical values for automatic hammers.

Measured N-values were later corrected for equipment energy and the presence of gravel, and corrected for overburden for liquefaction potential analyses. Ranges and means of gravel corrected N_{60} values for each geologic layer are summarized in Subsection 2.5.4.2.2.1. The liquefaction potential analysis is presented in Subsection 2.5.4.8.

2.5.4.3.1.3 Pressuremeter Testing

Pressuremeter testing was performed in two borings (Table 2.5.4-206). Twenty-two (22) pressuremeter tests were attempted at the site in Borings RB-28A and TB-06A; however, because of the sands and gravels encountered at the site, only eight tests provided enough information to determine the pressuremeter modulus, limit pressure, and unload and reload modulus. The summarized results are shown in Table 2.5.4-207.

The pressuremeter boreholes were prepared by drilling a boring with a bottom discharge drill bit; care was taken to minimize disturbance to the boring wall at the test depth. The drilling was performed using wet rotary drilling with viscous drill mud, using slow rotation defined as 60 revolutions per minute (rpm) or less and low fluid flow defined as less than 4 gallons per minute (gpm) (0.015 m^3/min).

The pressuremeter tests were performed according to ASTM D4719-00 (Reference 2.5.4-241), with a Model TEXAM pressuremeter. Each test began by lowering a 2.75-in. (70-mm) diameter monocellular hydraulically inflated probe into the predrilled borehole and inflating the cell membrane to deform adjacent materials at prescribed intervals. A mechanical actuator was used to displace a piston to pressurize the inflation fluid.

The pressuremeter operator inflated the probe with 20 steps of equal volume increments (80 cubic centimeters [cm^3] each) until the limit of the equipment (1600 cm^3) was reached. To pressurize the probe, a crank handle was rotated clockwise at a uniform rate of 12 rpm to inject water, stopping to record the pressure 30 seconds after each step of volume. When the maximum volume for the probe was injected, the piston was returned to its initial position at a rate not exceeding 20 rpm. One load-unload cycle was performed during the test. To determine the start of the unloading cycle, pressure measurements were recorded and the difference in pressure between steps noted. If the change in pressure was constant, it was assumed that the soil was behaving elastically, and the unloading pressure was determined to be 50 percent of the highest pressure applied before the unloading cycle was started. The soil was then reloaded to the pressure applied before the unloading cycle was started, and the test continued until the equipment limit. The resulting unload-reload loop was used to evaluate the elastic behavior of tested materials (materials with linear elastic characteristics exhibit weak hysteretic behavior in that the plot of the reloading path closely follows the unloading path).

2.5.4.3.1.4 Monitoring Wells and Piezometer Installation

During site investigation activities and as part of the hydrogeology investigation, 21 monitoring wells were installed within the site vicinity (Subsection 2.4.12). Two of these monitoring wells (MW-02 and MW-04) were installed in and around the RBS Unit 3 power block. The remaining 19 monitoring wells were installed to investigate groundwater movement at the site vicinity. During the geotechnical site investigation, three piezometers (PZ-01, PZ-02, and PZ-03) were also installed at the RBS Unit 3 power block (Figure 2.5.4-202 and Table 2.5.4-208). Figures 2.5.4-203 to 2.5.4-206 show cross sections constructed from boring logs and design groundwater levels related to RBS Unit 3 power block embedment depths. Table 2.5.4-208 presents summaries of the monitoring well and piezometer depths and aquifers monitored. Water levels measured in the three piezometers are shown in Figure 2.5.4-233.

2.5.4.3.1.5 Cone Penetration Test (CPT) Soundings

Nine CPT soundings were advanced to depths between 17.3 and 133.0 ft. (5.3 to 40.5 m) to characterize subsurface geologic conditions pursuant to ASTM D5778-95 (Reference 2.5.4-242). Figure 2.5.4-202 shows the CPT locations, and Figure 2.5.4-211 shows measured cone tip resistance, sleeve friction, and static pore pressures, along with correlated friction ratio, soil type behavior, and N_{60} values. Table 2.5.4-209 contains a summary of the CPT soundings. Three CPT soundings were advanced specifically to investigate the subsurface conditions beneath the RBS Unit 3 Seismic Category I structures, and five CPT soundings were advanced to investigate additional structures and general site coverage.

Correlation of CPT data to the stratigraphy of the site (Figure 2.5.4-211) was achieved by correlating the layer model from each CPT sounding to the stratigraphy in adjacent borings and to specific lithologic units within the site stratigraphic framework.

Stratigraphic models for CPT soundings were initially developed qualitatively by evaluating the variance of key data values with depth below surface. Data parameters used to build stratigraphic models include static pore pressure (u_2), and friction ratio (R_f), where R_f is described by the equation.

$$R_f = \frac{100fs}{qc}$$

Thus, R_f is a function of sleeve friction (fs) and cone tip resistance (qc). Generally speaking, cohesionless soils commonly return low R_f and low u_2 values, and clayey, cohesive soils commonly return high R_f and high u_2 values.

After developing stratigraphic models for each CPT sounding, individual layers were correlated to stratigraphy in adjacent borings and assigned to specific lithologic units. Table 2.5.4-205 was developed as a result of this process and summarizes the CPT properties for each geologic unit encountered. Representative CPT-boring comparisons with data from sampled borings are included as Figure 2.5.4-234.

Shear wave velocities were also determined based on cone penetration soundings. After the intended depth for testing was reached with the cone penetrations, a seismic pulse was generated at the ground surface. The elapsed time between the impact and the arrival of the wave at the probe was determined and based on the distance between the probe and the source, a shear wave velocity was determined.

2.5.4.3.2 Foundation Interfaces

Figures 2.5.4-203 to 2.5.4-206 show cross sections constructed from boring logs and CPT soundings and demonstrate the position of subsurface stratigraphy relative to RBS Unit 3 Seismic Category I structures. Figure 2.5.4-202 and Tables 2.5.4-206, 2.5.4-207, 2.5.4-208, and 2.5.4-209 show locations for all borings, piezometers, CPT soundings, pressuremeter tests, and seismic tests performed during the course of the RBS Unit 3 geotechnical site investigation.

The three RBS Unit 3 power block Seismic Category I structures are as follows:

- Reactor Building/Fuel Building (RB/FB).
- Control Building (CB).
- Fire Water Service Complex (FWSC).

Key dimensions of the RB/FB, CB, and the FWSC foundations are shown in DCD Table 3.8-13. Using the embedment depths from this table and the elevations in DCD Table 3.4-1, the elevation that is the basis for the required embedments is the finished ground-level grade (referred to hereafter as "site grade").

The RB/FB embedment depth is 65.6 ft. (20 m) below site grade. As shown in Figures 2.5.4-203, 2.5.4-204, and 2.5.4-205, the base of the RB/FB foundation would lie on the engineered fill that was placed during RBS Unit 1 construction and on Upper Citronelle material. Overexcavation of the Upper Citronelle material to the Lower Citronelle material and filling with structural fill provides a firmer and more consistent bearing surface for the RB/FB.

The CB embedment depth is 48.9 ft. (14.9 m) below final site grade. The base of the CB foundation at this depth would lie on Upper Citronelle soils. Overexcavation of the Upper Citronelle material to the Lower Citronelle material and filling with structural fill provides a firmer and less variable bearing surface for the CB.

The top of the FWSC foundation is at 0.5 ft. (0.15 m) above final site grade. The foundation mat is 8.2 ft. (2.5 m) thick, resulting in a bearing level at approximately Elevation 89.8 ft., where Port Hickey soils are present. An overexcavation of roughly 70 ft. (21.3 m) would completely remove the general fill, the underlying Port Hickey, and Upper Citronelle material. The FWSC foundation would, therefore, be supported by 70 ft. of structural fill.

2.5.4.4 Geophysical Surveys

This subsection presents a summary of geophysical data collected at the RBS site. Subsection 2.5.4.4.1 provides a description of borehole suspension velocity logging procedures, Subsection 2.5.4.4.2 provides a description of downhole seismic testing procedures, and Subsection 2.5.4.4.3 provides a description of other geophysical downhole testing procedures, including boring deviation surveys and full waveform sonic logging. Refer to Subsection 2.5.4.7 for a description of data set analysis and a discussion of the response of site materials to dynamic loading.

2.5.4.4.1 Suspension Compression and Shear Wave Velocity Logging

In situ surveys of seismic wave velocity were performed in three locations (Reactor Building, Turbine Building, and Radwaste Building). The surveys were performed with an OYO Model 170 suspension logging system that measures both compression (V_p) and shear (V_s) wave velocity in subsurface materials that form borehole walls (Reference 2.5.4-243). The measured velocities are used to create a vertical velocity profile of the borehole walls using both V_p and V_s. Results of the surveys are presented as velocity-depths plots in Figure 2.5.4-235. Locations of suspension velocity logging are shown in Figure 2.5.4-202. The borings were used solely for geophysical surveys and were advanced adjacent to existing exploration borings to obtain an understanding of the soil stratigraphy at the testing location.

The OYO suspension logging system consists of a 23-ft. (7-m) long probe, containing a source and two receivers spaced 3.3 ft. (1 m) apart, suspended by a cable. The receiver separation permits determination of local average wave velocity by inversion of the wave travel time between receivers. The probe was lowered into the borehole within a flexible sleeve by a power winch. Velocity measurements were obtained at 1.6-ft. (0.5-m) intervals. Comparisons of source-to-receiver and receiver-to-receiver travel time data sets provided a quality check of acquired data and confirmed the survey results. Although higher quality data are obtained in uncased holes, suspension velocity measurements were performed on a cased hole at TB-10A because of the instability of the upper 100 ft. in the boring.

At the beginning of each survey, the instrument string was placed at the top of the borehole, and lowered incrementally, recording data points every 1.6 ft. (0.5 m). All geophysical field surveys were observed and documented by geotechnical staff. A column of water was kept inside the borehole or casing to maintain the equipment under water during all testing.

Suspension velocity logging is a relatively new technique and an ASTM standard for this procedure has not been developed. GEOVision Inc. developed the technical procedure used for the suspension velocity logging (Reference 2.5.4-244) and the site investigation team approved the procedure.

Recorded velocity data was processed upon completion of the surveys to develop the velocity-depth plots presented in Figure 2.5.4-235. Analysis of layer velocities is presented in Subsection 2.5.4.7.1.2.

2.5.4.4.2 Compression and Shear Wave Downhole Seismic Testing

The compression (P) and shear (S) wave downhole seismic test is one of several industry-accepted borehole geophysical methods performed to assess the in situ dynamic rock and soil properties by measuring V_p and V_s at regular depth intervals. The downhole method for obtaining V_p and V_s consists of transmitting seismic waves vertically through soils or rock material (generated by a surface seismic wave energy source) and measuring the travel time of direct arrival seismic signals detected by a three-component geophone receiver placed in the borehole. Forward and reverse-polarized shear wave energy is generated by alternately striking opposite sides of a semicircular baseplate assembly. With post-acquisition data reduction and processing, V_p and V_s velocities are then calculated using first arrival time picks, corrected for vertical travel-times (slant time correction) and known distances between the receiver and source location. Results of the downhole seismic tests performed in Borings RB-31B, RB-31C, RW-36, and TB-10A are presented in Figure 2.5.4-235.

2.5.4.4.3 Other Geophysical Testing

Full waveform sonic logging is similar to Suspension P-S Velocity Logging in terms of equipment and instrument components and field operations. The Full Wave Sonic tooling contains a single transmitter and dual receiver to record formation travel times. Full waveform data are also recorded simultaneously, along with near and far travel times, borehole-compensated delta time, calculated sonic porosity, receiver gains, near/far amplitudes, and natural gamma. Sonic logs are widely used to provide formation porosity, permeability, and mechanical properties in uncased holes. In cased boreholes, Full waveform sonic logging is used primarily for the detection of poor contact or missing grout behind the casing wall. Full waveform sonic logging was performed in Borings RB-31A and TB-10A. The results indicated that the casing/grout/soil bonding was not of sufficient quality to render the results of the suspension P-S velocity logging for TB-10A. Therefore, the suspension P-S velocity logging data from these borings were not used in the creation of the shear wave velocity profile for the site.

Other geophysical testing performed at various locations at the site included borehole deviation logging, borehole diameter using a caliper, electromagnetic induction to determine soil conductivity, soil resistivity, and natural gamma. Deviation logging, borehole diameter, electromagnetic induction, resistivity, and natural gamma testing were performed on Borings RB-31B, RB-31C, and RW-36.

Deviation logging was performed to determine the verticality of uncased sampled borings with depth below ground surface of more than 100 ft. (30.5 m) and cased test boring. Measurements were performed to determine borehole inclination and deviation from vertical to determine the need to correct soil and geophysical log depth to true vertical depths. The probe contains a magnetometer to monitor magnetic north, and a three-axis accelerometer to provide boring dip data, which when processed with orientation data, allows boring deviation data to be obtained.

A caliper and natural gamma probe were used to measure the borehole diameter and volume; determine the location of hard and soft formations; determine the location of fissures, caving, pinching and casing damage (if any) for bed boundary identification; and determine strata correlation between borings. The caliper consisted of three arms within a rack attached to a probe. The probe is placed at the bottom of the borehole, the arms opened, and the probe pulled to the surface. The rack is coupled to a potentiometer which, in turn, converts movement of the arms into a voltage sensed by the probe's microprocessor.

Natural gamma measurements rely upon small quantities of radioactive material contained in all rocks to emit gamma radiation as they decay. This radiation can be detected by scintillation (production of a flash of light when gamma rays strike a crystal of sodium iodide). Different soils emit different amounts of gamma radiation; therefore, natural gamma can be used to determine the major soil types encountered in the formations sampled.

Soil conductivity was measured using an induction probe that consisted of a transmitter and receiving coils. The transmitter coils emit an alternating current, which creates an electromagnetic field. This field gives rise to a secondary electromagnetic field from the induced current in the subsurface materials and is measured in the receiving coil. The measured current is proportional to the formation conductivity which provides an indication of lithology at the borehole.

Soil resistivity was determined using a probe that measured Single Point Resistance (SPR), short normal resistivity, long normal resistivity, and spontaneous potential. This probe is useful for identifying bed boundaries and determining the strata geometry and type at the borehole. The resistivity portion of the probe operates by driving an alternating current into the formation and measuring the returning current between electrodes spaced at known intervals within the probe and the ground surface.

2.5.4.5 Excavations and Backfill

This subsection discusses the excavation, backfill, and earthwork requirements for the Seismic Category I structures. The following items are addressed in this subsection:

- The horizontal and vertical limits of excavation.
- Construction excavation and dewatering.

- Backfill type, source, specifications, and quality control testing.
- Foundation excavation monitoring.

2.5.4.5.1 Plans and Sections

As presented in Subsection 2.5.5, the overall final grading for the site would not produce cut or fill slopes that would affect the Seismic Category I structures. The Seismic Category I structure excavation slopes would cut into native soils, and both general and engineered fill. The foundation excavation would use structural fill to create a working area for the foundations of the Seismic Category I structures and general structures. The excavation would be filled with structural fill after construction to the Seismic Category I foundation subgrade levels. After foundation construction, structural fill would be placed, as structure construction proceeds, to Elevation 97.5 ft. The vertical and horizontal extents of the proposed excavation are presented in Subsections 2.5.4.5.1.1 and 2.5.4.5.1.2. The horizontal and vertical extents of the foundation excavation for the RB/FB, CB, and FWSC were determined based on dimensions in DCD Figures 3G.1-1, 3G.1-6, 3G.2-1, and DCD Table 3.8-13. The stability of the slopes to be open during construction is discussed in Subsection 2.5.4.5.2.1.

2.5.4.5.1.1 Lateral Limits of Excavation

The plan lateral limits and cross sections of the excavation for the Seismic Category I structures are presented in Figures 2.5.4-236, 2.5.4-237, and 2.5.4-238. Because of the close proximity of the Seismic Category I structures and the depth of excavation required to reach the embedment required in DCD Table 3.8-13, a single, combined excavation would be made to accommodate the RB/FB, CB and FWSC. Because of the proximity of the Radwaste Building (RW) to these structures, the excavation would also accommodate this structure.

As discussed in Subsection 2.5.4.5.2.1, an open excavation with overall side slopes of 2.5 horizontal to 1 vertical (2.5H:1V) would be made. The minimum lateral limits of the excavation were established by projecting a 0.5H:1V line from the edge of the bottom of the Seismic Category I structure foundations to the proposed depth of the excavation. Other lateral limits were based on maintaining a reasonable geometry for construction access.

In addition, the RW embedment depth and proximity to the RB/FB indicate that the excavation for the RW would proceed in parallel with that for the RB/FB, only to a shallower depth. This results in a rectangular shaped excavation.

Because of the proposed location of the Turbine Building (TB) and the location of the west wall of the existing excavation, it would be necessary to excavate the footprint of the TB to existing grade inside the RBS Unit 2 excavation. The need to replace the existing founding soils with structural fill underneath the proposed TB footprint would be determined during detailed design.

The maximum overall lateral limits for the excavation shown in Figure 2.5.4-236 are approximately 500 ft. (152 m) north-south and 700 ft. (213 m) east-west. These limits would be adjusted to accommodate detailed construction plans as required; however, large dimensional changes are not expected for the excavation for the Seismic Category I structures.

2.5.4.5.1.2 Vertical Limits of Excavation

DCD Figure 3G.1-6 shows the relationship of the RB/FB to a reference "Grade" elevation of 4500 mm. For RBS Unit 3, this corresponds to a site grade of 97.5 ft. msl (Subsection 2.4.1). DCD Table 3.8-13 provides a depth to top of the RB/FB foundation 52.5 ft. (16 m) below plant grade and the mat thickness of 13.1 ft. (4 m); these numbers provide a depth to the bottom of the foundation relative to the DCD plant grade of 65.6 ft. (20 m) and a bottom of foundation elevation of 31.9 ft. msl. Similarly, using the information on DCD Table 3.8-13 and Figure 3G.2-17, the bottom of foundation elevation for the CB is 48.6 ft.

During construction of RBS Unit 1, the proposed site for the Unit 2 nuclear island was excavated to Elevation 20 ft. msl, as shown in Figure 2.5.1-227. As discussed in Reference 2.5.4-234, lower SPT blow counts were encountered between the RBS Unit 2 proposed bottom of foundation grades and Elevation 20 ft. msl. Because of concerns about possible liquefaction under the safe shutdown earthquake (SSE), these soils were excavated to Elevation 20 ft. msl (Reference 2.5.4-234).

The proposed location of the RBS Unit 2 TB and other buildings was excavated to Elevation 65 ft. msl. Unit 2 was never built and the deeper portion of the excavation was backfilled with engineered and general fill to Elevation 65 ft. msl. The soil properties of the general and engineered fill are presented in Subsection 2.5.4.2.2.1.1.

The current elevations within the proposed RB/FB and CB footprints within and outside the existing excavation are approximately Elevation 65 ft. and Elevation 95 ft., respectively. If the vertical extent of the excavation for the Seismic Category I structures is limited to the bottom of the foundation, part of the footprint would bear on native materials and the other part on engineered fill. To ensure uniform bearing conditions for these foundations, the native soils, as well as the existing engineered fill, would be removed to Elevation 20 ft. (Figures 2.5.4-237 and 2.5.4-238). Based on the existing grades, the excavation depth would range between 45 ft. and 75 ft. (13.7 m and 23 m). Structural fill from a borrow source described in Subsection 2.5.4.5.3 would be used to raise the RB/FB and CB foundation soils to the required elevations of 31.9 and 48.6 ft., respectively.

2.5.4.5.2 Construction Excavation and Dewatering

The foundation excavation would involve an open cut slope. As presented in Subsection 2.5.4.6, the design groundwater level at the site is at Elevation 60 ft. msl, in the RB/FB, CB, and FWSC areas. Based on the hydrogeological investigation performed for this COLA, groundwater does not occur as localized, perched conditions in the site vicinity. Because of the vertical extent of the excavation for the RB/FB, CB, and FWSC, dewatering by predrainage would be required during construction.

2.5.4.5.2.1 Stability of Construction Slopes

As presented in Subsection 2.5.5, site construction and grading activities would not produce permanent cut or fill slopes within a distance of 500 ft. from the Seismic Category I structures. It is anticipated that temporary excavations for the construction of the mat foundations would be performed as open cuts with overall side slopes of 2.5H:1.0V, with intermediate benches. Prior to start of excavation in any area, the dewatering system would be installed and operated to draw the groundwater level down below the base of the excavation as described in Subsection 2.5.4.5.2.2. Dewatering would ultimately lower the groundwater level to Elevation 18 ft. msl during excavation, but at no point would the excavation be permitted to reach a depth great enough to intersect the groundwater level. As stated in Subsection 2.5.4.5.1.1, a single, combined excavation would be made to accommodate the construction of the RB/FB, CB, and FWSC foundations. The lowest portion of the excavation would be Elevation 20 ft. msl, which is a maximum of 45 to 75 ft. below surrounding grade, as described in Subsection 2.5.4.5.1.2. The top and bottom of the excavation would be at least 87 and 157 ft., respectively, away from any existing Unit 1 structure, as indicated in Figures 2.5.4-236, 2.5.4-237, and 2.5.4-238. The top and bottom of the excavation would be at least 71 and 121 ft., respectively, away from the bottom of the existing Independent Spent Fuel Storage Installation (ISFSI) pad.

A stability analysis of the temporary construction excavation slopes was performed using the computer software program Slope/W. The analysis included cases for areas of excavation within native soils and engineered fill (placed during RBS Unit 1 construction). Engineering properties of the soil layers used in the slope stability analysis were selected from Table 2.5.4-204. The analyses were performed using a variety of limit equilibrium methods including Bishop's Simplified Method and the Morgenstern and Price Method. Both short-term (undrained) and long-term (drained) cases were analyzed to determine the stability of the excavation slopes.

A factor of safety (FOS) for static conditions of 1.8 or greater was calculated for each of the slope configurations and shear strength combinations described, which is adequate as it is greater than the minimum required FOS of 1.5 (DCD Table 2.0-1). The FOS was computed for a variety of trial circular shear surfaces. Wedged shape trial shear surfaces were not considered to be realistic shear surfaces for the slopes analyzed. These analyses did not include any surcharge loading at the top of the slope or any seismic loading. Such special cases, if any, should be considered during detailed design analysis.

Surface water runoff into the excavation would be prevented with perimeter berms. The slope surface would be protected to prevent erosion. Water would be removed from inside the excavation using sump pumps to maintain dry conditions.

2.5.4.5.2.2 Dewatering

Adequate dewatering equipment would be required to predrain the groundwater from excavations and remove and dispose of all surface water entering excavations and other parts of the work. Control of groundwater would be accomplished by predrainage in a manner that would preserve the strength of the foundation soils, would not cause instability of the excavation slopes, and would not result in damage to existing structures. The plans for construction dewatering for the Seismic Category I structures are discussed in Subsection 2.5.4.6.3. A system of deep wells would be installed around the perimeter of the excavation, approximately 4 to 5 ft. (1.2 to 1.5 m) away from the slope edge on the unexcavated side of the excavation. The dewatering system installation would start before excavation starts, or would start after a preliminary excavation has been made to a level just above groundwater. The conceptual locations of the dewatering wells are shown in Figure 2.5.4-239. The conceptual dewatering system layout serves to lower the groundwater level within the excavation of the Seismic Category I structures footprint to a target depth 2 ft. (0.6 m) below the bottom of the excavation level (or at a target elevation of 18 ft. msl). Because the pumped wells would create a conical drawdown pattern away from each well, the dewatering system would lower groundwater levels to elevations ranging from approximately 15 ft. msl to about 18 ft. over most of the excavation area.

Effluent from dewatering wells at the perimeter of the construction area would be discharged to the stormwater drainage system at an estimated mean rate of 10,000 gpm during the 9-month construction excavation phase. Entergy plans to discharge the dewatering effluent under Louisiana's General Permit Number LAR10000-AI 83363 for Storm Water from Construction Activities. This permit includes authorization of discharge of "uncontaminated excavation dewatering." Entergy plans to apply for coverage under this permit prior to the beginning of construction at the site. Entergy expects the construction dewatering system radius of influence to be approximately 2 mi. in the surficial aquifer.

Maintaining the water level below the excavation bottom level by pumping would create a stable work area for preparing the foundations and placing concrete. The pumping creates a gradient toward the wells that precludes upward gradients into the base of the excavation. Entergy will provide dewatering system backup, 24 hr. inspection, and 24 hr. maintenance to ensure that foundation degradation or instability due to upward water seepage or piping would not occur. The stability of the excavation slopes during construction is addressed in Subsection 2.5.4.5.2.1. The construction dewatering system would remain in operation until the fill within the excavation has been raised above the groundwater level and until there is no longer a chance of structure flotation. To avoid undermining of the bearing soils during construction due to the failure of the dewatering system, a secondary system would be installed to serve as backup of the primary system. If the primary system fails, the secondary system would keep the water levels below the excavation bottom. No permanent dewatering system would be required because the static groundwater level at the site is more than 2 ft. below the final plant grade.

2.5.4.5.3 Backfill

2.5.4.5.3.1 Materials and Sources

Structural fill would be required underneath the Seismic Category I structures and between the building walls and the adjacent excavation sides. Structural fill would also be required to replace unsuitable soils removed as part of foundation preparations and to fill in the area between the RB/FB and the CB. The required volume of structural backfill is estimated at 960,000 yd^3. The structural fill would be obtained from off-site borrow sources.

A representative for the quarry that supplied the engineered fill for the RBS Unit 1 and 2 construction was contacted. Based on the approximate volume of material required, the representative confirmed that the quarry can supply sufficient material from the same source used for the RBS Unit 1 construction.

To verify that the material to be used as structural fill is similar to the material used as engineered fill for the RBS Unit 1 construction, samples of the borrow pit materials would be collected and tested in the laboratory. The laboratory testing would include the following:

- Modified proctor compaction testing.
- Grain size distribution testing.
- Maximum and minimum density testing.
- Strength testing on remolded samples.
- Dynamic testing on remolded samples.
- Organic content.
- Chemical testing.

Results from laboratory tests would be compared with laboratory results of the material used during the RBS Unit 1 construction (Reference 2.5.4-234). If the material from the borrow source has similar properties as the material used for RBS Unit 1, and shows similar type of compaction behavior based on laboratory tests, the quarry material would be used for RBS Unit 3 construction.

2.5.4.5.3.2 Backfill Properties

The fill to be used beneath and around the Seismic Category I structures would be an inorganic, nonplastic, clean, fine-to-medium grained sand (mostly fine), with similar characteristics to the Class I engineered fill used during the construction of RBS Unit 1 (Reference 2.5.4-234). The main soil properties of the engineered fill are presented in Figure 2.5.4-240. The existing engineered fill is very dense, with a mean relative density of 94 percent and a mean relative compaction of 99 percent. The angle of internal friction of the compacted engineered fill is 40 degrees, as determined by consolidated drained triaxial tests (Figure 2.5.4-240). The minimum angle of internal friction acceptable for bearing soils is 30 degrees, as presented in the DCD. The angle of internal friction of the compacted engineered fill is higher than the minimum value presented in the DCD.

2.5.4.5.3.3 Compaction Specifications

As discussed in Subsection 2.5.4.5.3.2, it is expected that the structural fill material to be placed during construction would be similar to that used as engineered fill for the RBS Unit 1 and 2 excavation; therefore, similar density requirements as those used for the engineered fill should be followed. The engineered backfill for the RBS Unit 1 and the excavation of RBS Unit 2 was placed moist (5 to 10 percent moisture based on field testing), in lifts not exceeding 10 in. (250 mm) uncompacted thickness, and compacted by not less than four passes of heavy vibratory rollers ranging in weight between 8 and 11 tons. In confined areas, or where lightweight compaction equipment was used, the loose lift layer thickness was reduced to 6 in. (150 mm). At the time of in-place density testing, the moisture content of fill ranged between approximately 5 and 10 percent (Reference 2.5.4-234).

The structural fill would be compacted to a minimum dry density equal to 95 percent of the maximum dry density determined by the modified Proctor procedure, ASTM D1557-07 (Reference 2.5.4-245). The material should be moist (between 5 and 10 percent moisture content) during placement. These values are consistent with the compaction specification used for backfilling of RBS Unit 1, and are also consistent with state-of-the-art engineering practice.

2.5.4.5.3.4 Quality Control Testing

2.5.4.5.3.4.1 Structural Fill

Structural fill to be used during backfilling underneath and around Seismic Category I structures would be transported from a local quarry approximately 5 mi. from the site. The quarry would provide quality control testing results during construction of grain size distributions, organic content, and chemical analyses to ensure that the material fulfills the specified requirements. The number and frequency of testing would be determined once the rate of production of the fill is known.

During fill operations, in-place field density tests would be performed in the structural fill using current versions of one or more of the following ASTM procedures: ASTM D1556-07 (Reference 2.5.4-246), ASTM D2937-04 (Reference 2.5.4-247), ASTM D4564-02 (Reference 2.5.4-248), or ASTM D6938-07 (Reference 2.5.4-249). The field density tests would be performed at a frequency of at least one test per 250 yd^3 of compacted structural backfill placed and at least one per lift.

2.5.4.5.4 Foundation Excavation Monitoring

Observations and monitoring of excavations during construction would be performed by appropriately qualified and trained geotechnical personnel working under the supervision of a geotechnical engineer. Monitoring would be performed during general excavation to achieve bottom of excavation elevations and any additional excavation below the design foundation bearing elevations. Qualified and trained personnel would observe and document the RB/FB and CB mat foundation excavation to the desired bottom of excavation elevation of 20 ft. msl to confirm that the soil conditions conform to those encountered during the site investigation, as depicted on the boring logs (Appendix 2AA). Documentation would include the following:

- Classification of soil penetrated.
- Thicknesses of materials.
- Presence and depth to groundwater table.
- Equipment used for excavation.
- Excavation geologic maps.

Proofrolling techniques would be used to identify any isolated zones of unsuitable materials at the base of the excavation. Unsuitable materials are defined as soft or loose materials that are observed to pump or rut under the weight of the compaction equipment as documented by the geotechnical engineer. Any unsuitable material would be removed to competent materials in preparation for the structural fill placement.

2.5.4.5.4.1 Fill Placement Inspection

Structural fill would be placed to bring the bottom of the excavation to the design foundation depth. The placement of the fill and quality control procedures are presented in Subsection 2.5.4.5.3.4.1.

Once the base of the excavation has been inspected, the structural fill would be placed to reach the design mat bearing elevations. Geotechnical personnel would observe and document placement of the structural fill. Quality control testing on the placement of the fill is discussed in Subsection 2.5.4.5.3.4.1. The construction sequence is to place the structural fill in horizontal layers of uniform thickness until the entire mat foundation subgrade is covered, followed by the placement of the next, underlying layer; however, construction sequences may modify that approach as approved by the geotechnical engineer.

2.5.4.5.4.2 Geotechnical Instrumentation

Rebound would be monitored within the excavation for Seismic Category I structures. Geotechnical instrumentation consisting of soil movement monitoring system would be installed prior to excavation at predetermined locations within the footprint of the Seismic Category I structures excavation. Figure 2.5.4-236 shows the general plan for instrumentation. Seven movement monitoring devices would be installed within the excavation including four within the RB/FB, one within the CB, and two within the FWSC footprints.

Because of the proximity of the proposed excavation to RBS Unit 1, inclinometers would be placed along the perimeter of the RBS Unit 3 excavation slope adjacent to RBS Unit 1 and the ISFSI to monitor the excavation slope, as shown in Figure 2.5.4-236. Settlement monitoring points within the RBS Unit 1 area would be surveyed during dewatering and excavation. Entergy will survey the existing Unit 1 settlement markers prior to start of construction activities.

Each soil movement system would monitor four points as follows:

- Base of the excavation.
- Interface between Lower Citronelle and Pascagoula Formation.
- 50-ft. (15-m) depth below top of Pascagoula Formation.
- 100-ft. (30-m) depth below top of Pascagoula Formation.

The frequency of measurements would be related to the construction schedule and rates of material removal. A typical frequency would be at least weekly during dewatering and excavation and after completion of the excavation until construction of the foundations.

Using data gathered from the movement monitoring systems, the elastic modulus of the Lower Citronelle materials and the recompression modulus of the Pascagoula Formation would be calculated and compared to the predicted values used for the foundation settlement analysis discussed in Subsection 2.5.4.10.

2.5.4.6 Groundwater Conditions

This subsection includes information on the groundwater conditions at the site relative to the foundation stability for the Seismic Category I structures. The occurrence of groundwater and the history of groundwater fluctuations as presented in Subsection 2.4.12 are reviewed. The results of field and laboratory hydraulic conductivity tests and the analysis and interpretation of seepage and potential piping conditions during construction are discussed in the following subsections.

2.5.4.6.1 Groundwater Occurrence

Extensive geological and hydrogeological data are available from the groundwater investigations for RBS Unit 1 (Reference 2.5.4-234). For the Unit 3 site investigation, 44 borings and 9 CPT soundings were advanced to characterize the geologic and geotechnical conditions at the site (Table 2.5.4-206), and 21 monitoring wells and 3 piezometers were installed to characterize groundwater conditions at the site and its vicinity (Table 2.5.4-208). The data from the monitoring wells and piezometers are presented and discussed in detail in Subsection 2.4.12.

Historical groundwater elevations are presented in Subsection 2.4.12. Groundwater levels within the site vicinity were monitored for at least 9 months during the site investigation. Levels measured in September 2007 (highest water levels measured during the monitoring period) indicate a groundwater elevation in the Upper Citronelle (outside of the existing excavation) and within the engineered fill (within the existing excavation) of approximately 58 ft. msl. It is important to note that during heavy rain periods, the existing excavation becomes a drainage basin within the plant due to this location and depth. During prolonged and heavy precipitation episodes, the water level inside the excavation can be up to 2 ft. (0.6 m) higher than the existing excavation bottom (Elevation 67 ft.) at some locations within the excavation. Water is then pumped out of the excavation at a location between Borings TB-10 and TB-10A (Figure 2.5.4-202). Because of the possible historical groundwater fluctuation, as well as to account for delayed periods of aquifer release, the design groundwater level has been set at Elevation 60 ft. msl.

The existing site grade in the area of the RB/FB, CB, and FWSC, as noted in Subsection 2.5.4.5.1.2, is between 95 ft. (outside of the existing excavation) and 65 ft. (inside the existing excavation). Thus, the expected depth to groundwater in the vicinity of the RB/FB, CB, and FWSC is approximately 35 ft. (10.7 m) outside of the excavation and 5 ft. (1.5 m) inside the excavation (refer to previous paragraph), based on the groundwater elevations measured in September 2007.

Historical groundwater data as shown in Subsection 2.4.12 indicate limited groundwater elevation fluctuation, both within the Upper Citronelle and the engineered fill, generally within the range of 1 to 2 ft. (0.3 to 0.6 m). DCD Table 2.0-1 requires that the maximum groundwater elevation be 2 ft. (0.6 m) below the final plant grade. Final plant grade is defined as the finished grade adjacent to the RB, which is Elevation 97.5 ft., as discussed in Subsection 2.5.4.5.1.2. The historical groundwater elevation data from existing monitoring wells in the immediate vicinity of RBS Unit 3 indicate that the groundwater surface remains well below the DCD Table 2.0-1 requirement. Therefore, post-construction permanent dewatering is not required.

2.5.4.6.2 Determination of Field and Laboratory Hydraulic Conductivity

Determination of hydraulic conductivity and other aquifer parameters is discussed in detail in Subsection 2.4.12. Determination of these parameters included long-term constant discharge (pumping) aquifer tests performed during the RBS Unit 1 site investigation and slug tests conducted for the site investigation. Table 2.5.4-210 summarizes the results of the hydraulic conductivity testing from the RBS Unit 1 site investigation (Reference 2.5.4-234) and the site investigation (Subsection 2.4.12).

For the Upper Citronelle granular soils, hydraulic conductivity coefficients (k) were also determined empirically on the basis of laboratory grain size distribution measurements conducted on samples obtained during the well installation for the site investigation (Table 2.5.4-210). Consolidation tests were conducted on undisturbed samples obtained from the cohesive soils of the Lower Citronelle materials and the upper portion of the Pascagoula Formation. A range of k values of 1 x 10^{-6} to 1 x 10^{-4} ft. per day was obtained, with a median value of 4 x 10^{-5} ft. per day. Such values indicate low permeability, as would be expected for a predominantly clayey material.

2.5.4.6.3 Construction Dewatering

Construction dewatering is necessary for the RB/FB, CB, FWSC, TB, and RW foundation excavations. An analysis was made to evaluate the layout of a conceptual dewatering system and the groundwater withdrawal rates needed to facilitate the excavation of the foundations and to maintain the water level a minimum of 2 ft. (0.6 m) below the excavation during construction.

The dewatering analysis was based on a projected lowering of the groundwater surface to a minimum of 2 ft. (0.6 m) below the base of the construction excavation. As discussed in Subsection 2.5.4.5.1.2, the deepest point of the excavation is Elevation 20 ft. The dewatering analysis was based on a projected maximum groundwater surface elevation of 18 ft. as the target to be maintained while the excavation is at final depth. At this elevation, the minimum required drawdown of the piezometric surface is approximately 42 ft. (12.8 m), based on the design groundwater elevation of 60 ft. msl.

The dewatering analysis was based on a series of simulated wells installed around the perimeter of the excavation, as shown in Figure 2.5.4-239. Each well would be screened in the sands of the Lower Citronelle which comprise the Upland Terrace Aquifer (UTA). The proposed dewatering was modeled using MODFLOW. Parameters for the model were derived from information discussed in Subsection 2.4.12 and a review of the boring logs (Appendix 2AA) and laboratory test data discussed in Subsection 2.5.4.2. For the MODFLOW model, the basic model input parameters were as follows:

- Hydraulic Conductivity--250 ft/day (0.09 cm/sec).

- Specific Yield--0.24.
- Storage Coefficient--0.08.
- Bottom of Aquifer--Elevation -30 ft. msl.

The results of the model indicate that a network of 18 wells surrounding the excavation area (Figure 2.5.4-239), with each pumping at approximately 470 gpm, could lower the groundwater elevation to below Elevation 20 ft. within 6 months of the start of pumping. The same set of wells could maintain the groundwater table at that level over the following year by each pumping 415 gpm.

2.5.4.6.4 Groundwater Impacts on Foundation Stability

Groundwater elevation measurements from piezometers and monitoring wells installed during the site investigation in close proximity to the RB/FB and CB (Subsection 2.5.4.6.1) show that groundwater elevation is approximately Elevation 60 ft. msl (Figure 2.5.4-233). The top of the RB/FB foundation, the lowest building level, is at Elevation 45 ft., as derived from DCD Figure 3G.1-6 (Subsection 2.5.4.5.1.2). Thus, the natural groundwater levels are above the lowest building level. The maximum groundwater level, in accordance with DCD Table 2.0-1, is more than 2 ft. (0.6 m) below plant grade; therefore, no permanent dewatering system is required. Temporary dewatering by predrainage is required for groundwater control during the construction stage. Water that may enter the backfill soil adjacent to the RB foundation is collected and routed to a local sump pump for removal.

Based on the analyses, the groundwater drawdown predicted during construction dewatering ranges from 22 ft. (6.7 m) to 35 ft. (10.7 m) across the RBS Unit 1 area. Total dewatering induced settlement less than 2.2 in. (55.9 mm) and differential settlement less than 0.4 in. (10.2 mm) due to excavation dewatering is expected at the RBS Unit 1 Reactor Building. Excavation monitoring instrumentation for the existing structures is presented in Subsection 2.5.4.5.4.2. Additional discussion about the impacts of dewatering is provided in Subsection 2.4.12. A final construction stage dewatering design and specification will be developed during project detailed design stage.

2.5.4.7 Response of Soil and Rock to Dynamic Loading

Dynamic parameters for evaluation of seismic ground motion site response were developed from extensive borehole measurements.

These data were compiled and statistically analyzed to develop a dynamic profile for general classification of the site for comparison to DCD generic site classification and certified seismic design response spectra (CSDRS), development of the site GMRS (Subsection 2.5.2.6), and development of foundation input response spectra (FIRS) (Subsection 2.5.2.6.3).

Stratigraphy in the RBS Unit 3 power block area is generally horizontal and of consistent thickness, as described in Figures 2.5.4-203 through 2.5.4-206). The geometry and character of the subsurface stratigraphy was confirmed by a network of borings (Figure 2.5.4-202) and can be predictably traced between borings throughout the power block area. Boring summary sheets show simplified borings logs with data from suspension P-S velocity logging and P-S downhole velocity logging (Figure 2.5.4-235).

As discussed in Subsection 2.5.1, no evidence of historic or prehistoric seismic ground failure, including liquefaction and lateral spreading, was found during the site investigation. No features indicative of liquefaction, such as sand dikes, were observed during the site investigation. No features indicative of liquefaction were encountered during the RBS Units 1 and 2 excavation. Loess and terrace deposits are Pleistocene in age, suggesting that liquefaction is not likely to develop. Subsection 2.5.4.8 discusses liquefaction potential of the Loess, Port Hickey Top Stratum, Port Hickey, Upper Citronelle, and Lower Citronelle.

2.5.4.7.1 Calculation of Dynamic Soil Property Profiles

Compilation and analyses of the seismic velocity data described in this subsection were performed using suspension P-S, downhole P-S, and seismic CPT velocity test data collected during the site investigation. As discussed in Subsection 2.5.4.4, the maximum depth of velocity testing during the site investigation was 550 ft. (approximate Elevation -485 ft. msl). To supplement the velocity testing, deep seismic velocity data were obtained from three oil/gas wells near the site. Seismic velocity data from previous site investigations at the RBS site were also used in the analysis. Only Vs are presented in this discussion because compression wave velocities measured during the site investigations are not considered representative of the soil structure skeleton, because the materials are saturated at shallow depth.

As discussed in Subsection 2.5.4.3.2, the footprint for the RBS Unit 3 foundation lies partially within an area that was overexcavated to Elevation 20 ft. msl, then backfilled to approximately Elevation 65 ft. msl. At the time of the site investigation, two significantly different site conditions (in terms of ground conditions) existed within the RBS Unit 3 footprint: one where the native soils had been excavated to Elevation 20 ft. msl and then backfilled with approximately 45 ft. of engineered fill to approximately Elevation 65 ft. msl, and one where the native soils were still present to approximately Elevation 95 ft. msl. The two different site conditions represent differences in both stratigraphy and in situ stress. Upon completion of RBS Unit 3, a third site condition will exist, one where the entire footprint of the Seismic Category I structures is overexcavated to Elevation 20 ft. msl, then backfilled with more than 75 ft. of structural fill to a final grade of approximately Elevation 97.5 ft.

The site response analysis for the RBS Unit 3 is based on the conditions that will exist once the unit is constructed and operating. At the time of the RBS site investigation, the post-construction conditions did not exist within the Unit 3 footprint; therefore, assumptions were required to generate the conditions that would be at the site after construction. These assumptions included the following:

- The structural fill to be used for backfilling during the Unit 3 construction will have the same soil properties as the engineered fill used to backfill the Unit 1 excavation to Elevation 65 ft. msl.
- Because of changes in stress conditions after construction, correlations were used to determine the post-construction Vs profile for the structural fill and for the Lower Citronelle soils. It was assumed that the testing at the stress state during the RBS Unit 3 site investigation could be used to calculate the post-construction seismic velocities. These site-specific correlations were based on the measured Vs values from the Unit 3 site investigation.

2.5.4.7.1.1 Shear Wave Velocity Analysis - Engineered/Structural Fill

Seismic velocities for the fill were obtained from testing above Elevation 20 ft. msl (45 ft. depth) at the four boring test locations within the previously over-excavated area, as well as three seismic CPT soundings that penetrated as least partially into the fill. As discussed in the previous subsection, the thickness of the fill and the stress conditions that the fill is under will increase compared to the stress state that existed at the time of the site investigation. In order to account for this change in stress conditions, a correlation of Vs with mean effective confining stress (σ'_m) was obtained. This site-specific correlation was based on published correlations (Reference 2.5.4-250) in the general form of Vs = $C(\sigma'_m)^m$, where C and m are site-specific constants determined from the Vs values as measured by the suspension P-S velocity testing performed at the site. The site-specific correlation was compared to the published correlation, as well to other measured data including the downhole and the CPT Vs measurements from the fill, and found to be in good agreement. The site-specific correlation was then extrapolated to estimate the post-construction Vs values corresponding to the increased stress that would occur post-construction. The Vs values estimated for the post-construction conditions are presented in Figure 2.5.4-241.

2.5.4.7.1.2 Shear Wave Velocity Analysis for the Native Soils Below the Fill (below Elevation 20 ft.)

The shear wave velocity analysis of soils below the fill to the maximum depth of testing (550 ft.) (Elevation -485 ft. msl) was completed using the testing results from the four boring locations within the previously overexcavated area. The seismic CPT test results were not used because most CPT soundings did not penetrate to the planned depth as indicated in Table 2.5.4-209. The shear wave velocity results were used to create a mean velocity profile (Figure 2.5.4-241). The mean velocity profile was determined based on the natural log-average for the velocity layers.

Layer velocities for each borehole were determined by GEOVision Geophysical Services (GEOVision). Layer velocities for the P-S suspension testing were determined by first calculating the velocities of the test interval, then generating artificial travel time measurements by summing the travel times for previous test intervals. Velocity layers were determined by plotting the travel time against distance (depth) and identifying changes in the slope of the resulting line (Figure 2.5.4-242). The velocity of the layer was determined using the following equation:

$$b = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2}$$

to calculate the slope (b) of the least-squares regression line through depth and travel time data for each layer, where x is travel time (seconds), y is depth (ft.), $\bar{x}$ is mean travel time (seconds), and $\bar{y}$ is mean depth (ft.).

Layer velocities from the downhole data were determined in a similar manner using the measured travel times from the source to the receiver.

For each boring, the velocity layer models prepared by GEOVision were reviewed by Black & Veatch against the stratigraphy observed in the boring (Figure 2.5.4-243). As the figure shows, the velocity layer models agree well with the stratigraphy changes observed in the borings. By comparing the stratigraphic changes with the velocity layer models, the following seven velocity layers were identified:

1. Engineered Fill (defined previously).
2. Lower Citronelle (defined based on stratigraphy).
3. Pascagoula 1 (defined based on stratigraphy and velocity change).
4. Pascagoula 2 (defined based on velocity change).
5. Pascagoula 3 (defined based on velocity change).
6. Pascagoula 4 (defined based on stratigraphy and velocity change).
7. Pascagoula 5 (defined based on velocity change).

This mean velocity profile was then compared to previous testing performed at the RBS site. The comparison indicated that the Vs values within the Lower Citronelle, as measured during the Unit 3 site investigation, were 100 to 200 ft/sec lower than the previous measurements. This discrepancy was attributed to the stress difference between the Unit 3 testing (ground surface elevation approximately 65 ft. msl) and the previous testing (ground surface elevation approximately 110 ft. msl). This discrepancy was generally not observed in the clays below the Lower Citronelle. As was done for the fill, to account for the post-construction stress conditions, another site-specific correlation was developed using the suspension P-S results for the Lower Citronelle soils. In addition to the Unit 3 suspension P-S test results, the previous Vs test results for the Lower Citronelle were also used to develop the site-specific correlation. By using the previous testing (which was at a stress higher than the post-construction condition), the correlation was used to interpolate, rather than extrapolate as was done for the fill, the Vs values for the Lower Citronelle. By using the site-specific correlation, the Vs values for the Lower Citronelle were increased by approximately 200 ft/sec (Figure 2.5.4-241).

2.5.4.7.1.3 Shear Wave Velocity Analysis for Native Soils Below Elevation -485 Ft.

In accordance with Regulatory Guide 1.208, the subsurface model should extend to a sufficient depth to reach the generic rock conditions as defined by the attenuation relationships used in the probabilistic seismic hazard analysis. The regulatory guide also indicates that the existing attenuation relationships for the central and eastern United States typically define generic rock conditions as materials with a shear wave velocity of 2.8 km/s (9200 ft/sec). The deepest Vs values determined during the Unit 3 site investigation indicated that at approximately 550 ft. deep, the Vs values were less than 2000 ft/sec. In order to extend the profile, seismic velocity data were obtained from three deep oil/gas wells located within the site vicinity [5 mi. (98 km)] radius.

Seismic velocity data (sonic logs) from three deep oil and gas wells were obtained from Petrophysics, Inc. The sonic logs were interpreted by Black & Veatch, and Vp layer models were developed for each well. Based on the stratigraphic information presented in the RBS Unit 1 USAR (Reference 2.5.4-234), the Vp layer models were compared to the deep stratigraphy beneath the RBS site location (Figure 2.5.1-228). Because the stratigraphy beneath the RBS Unit 3 site is dipping to the south (Figure 2.5.1-229), the Vp layer models were normalized to the top of the Wilcox Group because it was clearly visible in all three wells.

A mean Vp layer model was calculated by using a log-average as was done for the Vp values above a depth of 550 ft. (Figure 2.5.4-244). Once the mean Vp layer model was determined, the Vs profile was calculated using the following equation (Reference 2.5.4-253):

$$\frac{Vp}{Vs} = \left[\frac{2(1-\nu)}{(1-2\nu)}\right]^{\frac{1}{2}}$$

Poisson's ratios (ν) were estimated as 0.32 for unconsolidated sediments and 0.25 for consolidated sediments. The Wilcox Group was considered to be the boundary between unconsolidated sediments and consolidated sediments, based on Vp values above 12,000 ft/sec.

Since the groundwater is shallow at the RBS site, the entire stratigraphic column was considered to be saturated; therefore, using the measured Vp values to calculate Vs values was approached with considerable caution. The concern was that saturated materials generally do not exhibit the compression wave velocity of the soil skeleton, but instead the compression wave velocity of water (approximately 5000 ft/sec). Compression wave velocities in shallow saturated soils are typically that of water because the compression wave velocity travels through the pore fluid faster than the soil skeleton and, therefore, does not reflect the compression wave velocity of the soil skeleton. Once the compression wave velocity of the soil skeleton becomes greater than the compression wave velocity of water, the compression wave velocity of the soil skeleton becomes apparent.

To ensure that the Vp values were not Vp values for water, only Vp values below Elevation 1630 ft. were used. This elevation was used because the Vp is greater than 7000 ft/sec, and this is the first significant increase in the Vp layer model. Based on Figure 2.5.4-228, this elevation incidentally corresponds to the top of the Hattiesburg Formation in the Grand Gulf Sequence. Another significant increase in the Vp values occurs at the top of the Wilcox Group. Compression wave velocities increase significantly to more than 12,000 ft/sec at the top of the Wilcox Group. This significant increase in Vp was assumed to indicate the first occurrence of sediments that are consolidated enough to be considered rock. In order for the calculated Vs data below Elevation 1630 ft. to meet up with the measured data above Elevation -485 ft, a transition was calculated assuming two uniform increments to complete the profile. The design Vs profile for the RBS Unit 3 site is presented in Figure 2.5.4-245. Based on the design Vs profile, rock (Vs > 9200 ft/sec) is encountered at a depth of approximately 17,500 ft. deep.

As a final review of the Vs profile developed for the RBS Unit 3, a review of Vs profiles previously used for the RBS Unit 1 was completed. The most recent seismic hazard analysis for the RBS Unit 1 site was found in the 2005 EPRI Technical Report, *Program on Technology Innovation: Assessment of a Performance-Based Approach for Determining Seismic Ground Motions for New Plant Sites* (Reference 2.5.4-207). In this report, the seismic hazard analysis was performed based on base case (M1P1), low deep velocity (M1P2), and high deep gradient (M1P3) Vs profiles generated for a generic Vs profile developed for the Mississippi Embayment by Dr. Glenn Rix of the Georgia Institute of Technology. EPRI's use of this generic Vs profile was consistent with what was also done for the nearby Grand Gulf Nuclear Station as well as the South Texas Project. Personal communications with Dr. Rix indicated that the generic Mississippi Embayment Vs profile was developed for the Memphis area stratigraphy where Paleozoic basement rocks are approximately 1 km deep (Reference 2.5.4-252). Review of the deep stratigraphy at the RBS Unit 3 site indicates a much deeper profile, with the depth to basement rocks estimated at 27,000 ft. (Figure 2.5.1-228). Looking specifically at common stratigraphic units such as the top of the Wilcox Group, the profile from Dr. Rix shows the top of the Wilcox Group at a depth of 300 m (~900 ft.) (Reference 2.5.4-252); at the RBS site, the top of the Wilcox Group is more than 9000 ft. (~3000 m) deep (Figure 2.5.1-228), a difference of nearly a factor of 10. The great difference in the depth of stratigraphy is consistent with the generally south dipping geologic layering of the Mississippi Embayment and the Gulf Coastal Plain (Subsection 2.5.1). Relative to Memphis, the RBS site is in a much deeper portion of the Mississippi Embayment. The M1P1, M1P2, and M1P3, as used by EPRI, are shown together with the Unit 3 Vs profile on Figure 2.5.4-245. As the figure illustrates, profiles show a different Vs profile compared to the RBS Unit 3 profile. This is expected given the relative position of the RBS Unit 3 site within the embayment; therefore, the Vs profile determined from the RBS Unit 3 site investigation and the deep oil/gas well was recommended for use in the response analysis.

2.5.4.7.2 Evaluation of Modulus Reduction and Damping Values from RCTS, RC, and CSS Data

Testing of 12 RCTS samples from the RBS Unit 3 power block site was conducted as described in Subsection 2.5.4.2.1.3.5. Dynamic laboratory testing results are grouped by geologic origin and material properties in Table 2.5.4-202. A discussion of data analysis methods and conclusions is located in Subsection 2.5.4.2.2.2. Two sets of damping ratio and modulus reduction curves (Figures 2.5.4-226, 2.5.4-227, 2.5.4-228, and 2.5.4-229) were considered in the analysis to develop the GMRS and FIRS. These curves are used because they span the range in regular nonlinear dynamic properties.

For the engineered fill, the data from RCTS tests plot around the EPRI 120-250 ft. curve. Therefore, the EPRI 120-250 ft. curve was chosen for the engineered fill.

RCTS test results were plotted with the EPRI curves to select the appropriate EPRI design curve for the Lower Citronelle layer. Most of the test results were grouped along the EPRI 120-250 ft. curve for modulus reduction and damping ratio plots. While there was some data scatter, the selection of the EPRI 120-250 ft. curve is considered to be appropriate as it best represents the median distribution of the test data. CSS test results were also added to the data plots for comparison. These test results plotted were below the EPRI curves and were considered to be beyond the range of reasonable results. Therefore, the CSS results were not used for the selection of the design curves for modulus reduction and damping ratios.

For the Pascagoula Formation, clay samples, RCTS, RC, and CSS test results were plotted with Vucetic and Dobry published curves for modulus reduction and damping ratio plots. The PI=30 curve was selected as it best represents the median distribution of the test data. The CSS data results were included in the selection of the curve for modulus reduction and damping ratios as they were generally bounded within the range of RCTS test results.

RCTS and RC data from the sands of the Pascagoula Formation (Zone 1 aquifer) plot around the EPRI 500-1000 ft. curve. Therefore, the EPRI 500-1000 ft. curve was chosen for the sands of Pascagoula Formation.

One sample from the Pascagoula clay below the Pascagoula sand was tested. While there is scatter in the data, the PI=50 curve was considered to best represent the test data when considering both modulus reduction and damping curves. Therefore, the Vucetic and Dobry PI=50 curve was selected for the clays below the Pascagoula sands.

2.5.4.7.3 Development of Ground Motion Response Spectra

The GMRS, used for comparison against the safety-related nuclear island basemat CSDRS, is derived at the top of uppermost competent in situ material (base of excavation) at the RB embedment depth. Therefore, dynamic properties of Loess, Port Hickey Top Stratum, Port Hickey, and Upper Citronelle materials are not relevant for evaluation of the Seismic Category I structure seismic response. However, the velocity model described in Subsection 2.5.4.7.1 allows for calculation of site response to Elevation 97.5 ft. for development of FIRS. The design seismic velocity profile is shown in Figure 2.5.4-245. Derivation of the GMRS based on this velocity profile is described in Subsection 2.5.2.6.

2.5.4.8 Liquefaction Potential

2.5.4.8.1 Overview

In meeting the requirements of 10 CFR 50 and 10 CFR 100, if the foundation materials at the site adjacent to and under Seismic Category I structures are saturated soils and the groundwater is above bedrock, then an analysis of the liquefaction potential at the site is required. The need for a detailed analysis is determined by a study on a case-by-case basis of the site stratigraphy, critical soil parameters, and the location of Seismic Category I and safety-related foundations.

Geologic and groundwater conditions for the Seismic Category I RBS Unit 3 structures conform to the 10 CFR 100, Appendix A criteria that requires analysis of liquefaction potential, including possible detailed liquefaction analysis. A geologically based liquefaction assessment was performed to determine if the soils encountered at the site have significant liquefaction susceptibility. Also, cyclic simple shear tests on selected samples gathered during the RBS Unit 3 site investigation were performed to evaluate the potential for liquefaction. Geologically based screening and SPT based liquefaction analyses were performed in accordance with Regulatory Guide 1.198.

Liquefaction potential was determined with the simplified method (Reference 2.5.4-255) using field measured SPT N-values, corrected for the presence of gravel (Reference 2.5.4-254), energy, overburden stress, and amount of fines. Cyclic Stress Ratio (CSR) values were plotted on the Cyclic Resistance Ratio (CRR) versus SPT clean sand blow count plot, to determine if any sample at the site has the potential for liquefaction. The simplified method was developed with data collected from sites on level to gently sloping terrain; therefore, the analysis was performed to account for the effects of the proximity of the excavation slope.

Plots were prepared for two boring conditions: borings farther than 50 ft. (15.2 m) from the existing excavation slope and for borings within 50 ft. (15.2 m) of the excavation slope crest. The FOS against liquefaction was determined for every SPT sample depth; a FOS equal to or less than 1 represents soils that might be liquefiable during a seismic event with the assumed magnitude and ground acceleration.

2.5.4.8.2 Geologically Based Liquefaction Assessment

As discussed in Subsection 2.5.3, no active or potentially active faults or seismic deformation zones occur within the RBS site location. Subsections 2.5.1 and 2.5.4.1 describe geologic mapping and extensive subsurface explorations performed at the site that confirm that the geologic deposits underlying and around the RBS Unit 3 have not experienced seismically induced ground failure (e.g., slope failure, liquefaction, lurching, lateral spreading, and subsidence) from historic or paleo earthquakes. These deposits range in age from Pliocene to Pleistocene and, therefore, provide a long geologic record documenting the absence of deformation. Based on the geologic setting and the lack of liquefaction indicators, liquefaction is not expected to occur within the natural deposits beneath the Seismic Category I structures based on the geologic assessment.

Furthermore, the RBS Unit 3 area would be filled to a final elevation of approximately 97.5 ft. msl, the approximate grade elevation at the RBS Unit 1 area. The plant yard area would be a level surface extending hundreds of feet away from the plant footprint, except for an existing slope north of the proposed Seismic Category I structures and an existing slope south of the Seismic Category I structures. The stability of these slopes is discussed in Subsection 2.5.5. Based on the final grading, no potential ground conditions exist that could result in lateral spreading failure.

The geologic screening process (described in Regulatory Guide 1.198) was applied to the deposits that include Loess, Port Hickey Top Stratum, Port Hickey, and Upper and Lower Citronelle materials. These deposits extend from the existing grade outside the excavation to the top of the Pascagoula Formation.

The geologic screening process is based largely on Reference 2.5.4-256, which shows that most liquefaction risk is associated with saturated, recent Holocene deposits of loose sand and silt, and uncompacted fills (typically hydraulically placed sandy fill). Geologic deposits in the RBS Unit 3 power block area do not fall within the categories of deposits susceptible to liquefaction (Figures 2.5.4-246 and 2.5.4-247), because no hydraulically placed fill or Holocene deposits were encountered or are expected to be encountered beneath the RBS Unit 3 footprint or surrounding site location. The Pascagoula Formation is generally not susceptible to liquefaction based on a combination of Pliocene age, deep occurrence (generally deeper than approximately 140 ft. (42.7 m) below existing grade), and predominantly clayey composition. This provides an initial screening showing that the deposits are not susceptible to liquefaction.

2.5.4.8.3 SPT-Based Liquefaction Assessment

A detailed liquefaction analysis using a simplified SPT-based empirical procedure was performed for the engineered fill, Loess, Port Hickey Top Stratum, Port Hickey, Upper and Lower Citronelle, and Pascagoula Formations. The simplified procedure was implemented through spreadsheet calculation, and represents the current industry state of practice and various updates from those described in Reference 2.5.4-255. These updates include magnitude scaling factor (MSF) (Reference 2.5.4-257), stress reduction coefficient (r_d) (Reference 2.5.4-257), SPT hammer energy correction factor (C_E), SPT overburden correction factor (C_N) (Reference 2.5.4-258), fines content (References 2.5.4-257 and 2.5.4-258), CRR (Reference 2.5.4-259), and overburden stress factor for CRR (as noted by $K\sigma$) (Reference 2.5.4-259). The earthquake moment magnitude of Mw = 7.91; maximum horizontal ground acceleration of a_{max} = 0.1 g, corresponding to peak ground acceleration (PGA); and design groundwater elevation of +60.0 ft. msl were used in these analyses.

An initial screening based on grain size distribution, plasticity, and depth was not performed. SPT data from a total of 40 boreholes drilled between January and May 2007 were used. Depending on the ground surface elevation at the time of subsurface investigation, these borings were divided into two groups. The first group includes the boreholes whose ground surface elevation at the time of investigation had been close to the final grade elevation (approximately +95.0 ft. msl). This group of boreholes includes a total of 18 borings, with 342 valid SPT samples. The second group are the boreholes whose ground surface elevation at the time of subsurface investigation had been at elevation of approximately +65.0 ft. msl (i.e., at the bottom of the existing excavation). This group includes a total of 22 boreholes, with 650 valid SPT samples. Because the final grade elevation is greater than the grade elevation for this group of borings, necessary corrections have been made to take into account the effect of placement of fill (to the final grade) at these locations, when assessing liquefaction potential for the lifetime of the project. These two groups of borings result in a total of 987 valid SPT samples for liquefaction analysis. Figure 2.5.4-248 shows a flow chart for the analysis process.

The factor of safety (FOS) against liquefaction was calculated for each SPT sample by comparing CRR values against corresponding calculated CSR values. Figures 2.5.4-249 and 2.5.4-250 show FOS for these two groups of SPT samples (note that the FOS for many samples exceeds the range of FOS in these two figures). Tables 2.5.4-211 and 2.5.4-212 include details about samples with FOS in certain ranges of interest (from smaller than 1.0 to 1.4) as recommended by Regulatory Guide 1.198.

Of the 987 analyzed samples, 985 (99.80 percent) show an FOS greater than 1.0, and only three samples (0.20 percent) have a calculated FOS smaller or equal to 1.0. As remarked in Table 2.5.4-211, one of these samples is at a location and depth that will be removed and replaced by engineered fill, and the second sample represents a very small thickness and lateral extent and is from a depth that is beyond the range of application of the simplified procedure. Therefore, based on the shear fraction of competent SPT samples (99.80 percent), it is concluded that liquefaction susceptibility is very low.

Tables 2.5.4-211 and 2.5.4-212 also include information about the SPT samples with FOS smaller of equal to 1.1 and smaller or equal to 1.4. Based on Regulatory Guide 1.198, these ranges of FOS may be an indication of past liquefaction, and thus, may necessitate the use of more conservative shear strength parameters, based on residual shear strength, for the analysis of stability and deformability. These tables indicate that a total as 12 SPT samples (1.22 percent of the total) fall in this range (these include the two samples discussed above with FOS smaller than or equal to 1.0). As remarked in these tables, some of these samples relate to the locations and depths that will be removed and replaced by engineered fill. The remaining samples all represent very small thickness and lateral extent, or relate to depths that are beyond the range of application of the simplified procedure. Accordingly, it is concluded that the use of residual shear strength parameters for stability and deformability analyses based on liquefaction potential will be overly conservative.

2.5.4.9 Earthquake Site Characteristics

The dynamic properties of soil at the site were determined through a program of field exploration, laboratory testing, and analysis. The seismic wave transmission characteristics of this soil are described in Subsections 2.5.2.5 and 2.5.4.7. Rock was encountered more than 9000 ft. (2743 m) below the site. A site response analysis was performed to develop the final GMRS for the site, as described in Subsection 2.5.2.6. The equivalent uniform shear wave velocity is described in Subsection 2.5.2.6.4.

2.5.4.10 Static Stability

In this subsection, the analyses performed to evaluate the stability of the safety-related structures under static loading conditions are presented. This subsection includes analyses of foundation bearing capacity and settlement, excavation rebound, lateral earth pressures, and hydrostatic pressures.

DCD Figure 3G.1-6 and DCD Tables 3.8-8, 3.8-13, and 2.0-1 provide information on plan dimensions, embedment depths, and loads. The RB/FB mat foundation has plan dimensions of 161 ft. by 230 ft. (49 m by 70 m) and is embedded 65.6 ft. (20 m) below the DCD reference grade (4500 mm). The base of the RB/FB foundation is at Elevation 31.9 ft. msl. The 13.1-ft. (4-m) thick foundation is designed for soil pressures of 14,600 psf (700 kPa) (static) and 56,400 psf (2700 kPa) (dynamic).

The CB mat foundation has plan dimensions of 78 ft. by 99 ft. (23.8 m by 30.3 m) and is embedded 48.9 ft. (14.9 m) below the final site elevation. The base of the CB foundation is at Elevation 48.6 ft. msl. The 9.8-ft. (3-m) thick CB mat is designed for allowable soil bearing pressures of 6100 psf (292 kPa) (static) and 58,500 psf (2801 kPa) (dynamic).

The FWSC mat foundation has plan dimensions of 66 ft. by 171 ft. (20 m by 52 m) and is embedded 7.7 ft. (2.4 m) below the final site elevation. The base of the FWSC foundation is at Elevation 89.8 ft. msl. The 8.2-ft. (5.2-m) thick FWSC mat is designed for allowable soil bearing pressures of 3450 psf (165 kPa) (static) and 9200 psf (440.5 kPa) (dynamic).

The stability of the RB/FB, CB, and FWSC foundations were evaluated for the various design conditions, which included DCD reference grade, maximum design groundwater elevation, and the total static and dynamic loads. Soil bearing capacity and foundation settlement potential were evaluated for the foundations using accepted current methods and practices. Lateral earth pressures were calculated for the situation where compacted sand backfill is placed against buried concrete walls (RB/FB and CB only), based on at-rest lateral earth pressure condition.

2.5.4.10.1 Soil Property Determination

Engineering properties of the native soils were determined from field test data and laboratory test results obtained in the COL study, from published sources, and from field measured data from the RBS Unit 1 site investigation, as documented in Reference 2.5.4-234. In particular, back-calculated elastic modulus and recompression ratio values of the Pascagoula Formation were obtained from the RBS Unit 1 excavation rebound measurements. The elastic modulus of the reinforced concrete foundation was obtained from DCD Table 3G.1-12. A groundwater elevation of 60 ft. msl was used for the analyses.

Engineering properties of the structural fill were taken from Reference 2.5.4-234. A total unit weight of 125 pounds per cubic foot (pcf) (2005 kg/m^3), friction angle of 36 degrees, and elastic modulus of 1800 kips per square foot (ksf) (12,410 MPa) were used.

2.5.4.10.2 Bearing Capacity

Bearing capacity at the design embedment depths was evaluated using conventional bearing capacity theory for shallow foundations (References 2.5.4-260 and 2.5.4-261). Meyerhof's shape, size, and depth factors were applied on the basis of the size and shape of the foundation. The ultimate bearing capacity was then calculated using these parameters and factors. Calculated bearing capacity for the RB/FB, CB, and FWSC foundations was compared to the allowable soil pressure values presented for both static and dynamic loading requirements shown in DCD Table 2.0-1.

The design bearing elevation for the RB/FB mat foundation is approximately 72 ft. (21.9 m) above the Pascagoula Formation and in approximately 12 ft. (3.7 m) of structural fill overlying the Lower Citronelle stratum. The design bearing elevation for the CB foundation is approximately 89 ft. (27.1 m) above the Pascagoula Formation and in approximately 29 ft. (8.8 m) of structural fill. The design bearing elevation for the FWSC foundation is approximately 7 ft. (2.1 m) below ground surface and in approximately 70 ft. (21.3 m) of structural fill.

Bearing capacity calculations performed using the conventional methods estimated an ultimate bearing capacity of 217,000 psf (10,400 kPa) for the RB/FB, 364,500 psf (17,500 kPa) for the CB, and 146,500 psf (7000 kPa) for the FWSC. For the RB/FB, the calculated values are 15 and 4 times greater than the minimum bearing pressure under static and dynamic conditions, respectively. For the CB, the calculated vales are 60 and 6 times greater than the minimum bearing pressure for the static and dynamic condition, respectively. For the FWSC complex, the calculated values are 43 and 16 times greater than the minimum bearing pressure for the static and dynamic cases, respectively.

Allowable bearing capacities were calculated using an FOS of 3.0, and are as follows:

- RB/FB is 72,000 psf (3500 kPa).
- CB is 121,500 psf (5800 kPa).
- FWSC is 48,800 psf (2300 kPa).

2.5.4.10.3 Sliding and Static Lateral Earth Pressures

The foundations for the Seismic Category I structures will be founded upon and backfilled with structural fill. The structural fill would have an angle of internal friction greater than 30 degrees, which meets the internal friction angle requirements of Table 2.0-1 of the DCD. Based on Appendix 3G of the DCD, the angle of internal friction that is greater than or equal to 30 degrees envelops the sliding evaluation and static lateral earth pressure design basis presented in the DCD.

According to Appendix 3G of the DCD, the gap between the buildings and the excavated soil was modeled by backfilling with concrete up to the top level of the basemat. It should be noted that the slope of the construction excavation was modeled as vertical in the DCD. Based on discussions with GE Nuclear, the purpose of this concrete backfill was to ensure that the lateral load is transferred to the in situ soil and passive lateral earth pressures of the in situ soil would be mobilized for the foundation sliding evaluation. RBS Unit 3 would be constructed using an open cut excavation with the entire footprint of the Seismic Category I structures excavated to Elevation 20 ft. msl (Figure 2.5.4-236); therefore, at the top of the basemat level, the gap between the buildings and the excavated soils would be a minimum of 62.5 ft. (19 m) (north, east, and south edges of the RB/FB). Because of the large temporary gap between the structures and the excavated soils, the passive resistance of the basemat would be developed entirely within the structural fill; therefore, installing concrete backfill to transfer the loads to the native soils is not needed. Rather than use concrete as backfill, RBS Unit 3 would use structural fill to backfill the gap between the basemat and the excavated soil.

No sliding evaluation of the safety-related structures were required, because the friction angle of the structural fill beneath the safety-related structures (36 degrees) meets the DCD criterion of 30 degrees.

Structural fill is placed against completed concrete structures below grade. The lateral earth pressure for the backfill was calculated using conventional earth pressure theory, and assuming that the buried concrete walls are sufficiently thick and rigid so that lateral deflection does not occur, and the at-rest lateral earth pressure state is applicable. Lateral earth pressures due to a level soil backfill condition, a 250 psf surcharge pressure from construction equipment (Reference 2.5.4-262) and hydrostatic pressures were computed and compared to the values presented in the DCD Figure 3G.2-12. Lateral earth pressures are not applicable to the FWSC because it does not have any below grade walls. The calculation used an excavation bottom at Elevation 20 ft. msl for both structures, along with a design groundwater elevation of 60 ft. msl.

The backfill used for RBS Unit 1 excavation and the backfill to be used for the RBS Unit 3 construction is clean sand obtained from borrow areas, as discussed in Subsection 2.5.4.5.3.1. Use of similar material is assumed for the lateral earth pressure analysis for RBS Unit 3. Material properties and compaction requirements are discussed in Subsection 2.5.4.5.3. A coefficient of lateral earth pressure at rest value of 0.41 is applicable to a well-compacted sand with the stated friction angle.

Calculated lateral earth pressures are shown in Figure 2.5.4-251 for compacted clean sand backfill placed against buried concrete walls, in addition to lateral surcharge pressures, and hydrostatic pressure. The calculated maximum total lateral earth pressure for the RB/FB and CB are approximately 4470 lb/ft^2 (0.219 MPa) and 2970 lb/ft^2 (0.142 MPa) at the base of the foundation, respectively. This total lateral earth pressure is less than the design total lateral earth pressures of 6787 to 10,213 lb/ft^2 (0.325 to 0.489 MPa), presented in DCD Figures 3G.1-19 and 3G.2-12.

2.5.4.10.4 Settlement

RBS DEP 2.5-1 The settlement of the RB/FB, CB, and FWSC foundations was calculated using a combination of elastic theory to compute strains for the materials above and below the Pascagoula Formation clays and consolidation theory to compute strains for the Pascagoula Formation clays. This method of analysis was used because of the predominantly granular nature of the alluvial layers and the structural fill, and the overconsolidated state of the Pascagoula Formation clay. Soil input parameters were developed from field and laboratory test data (SPT, CPT, undrained shear strength, and consolidation test results) obtained during the

RBS Unit 1 and RBS Unit 3 site investigations. These input parameters were adjusted to correlate with back-calculated values obtained from field measurements of rebound during foundation excavation and settlement during construction of RBS Unit 1.

The following two computation methods were used:

- Finite Element (FE) analysis using Plaxis 3D (Reference 2.5.4-263).
- Hand calculation using the Elasticity Theory (Reference 2.5.4-251).

The FE analysis program was the primary method used for calculating settlement of the RB/FB, CB, and FWSC because of the ability to model buildings bearing at different elevations, and for the ability to account for the mat stiffness and soil structure interaction effects. Soft soil creep or hardening soil stiffness models were used for the Pascagoula Formation. Linear elastic or Mohr-Coulomb stiffness models were used to model strata above and below the Pascagoula Formation clay.

The elastic settlement method, discussed in Reference 2.5.4-251, was used to check the FE results. This method allows for calculation of elastic settlement of a rigid shallow foundation constructed over an elastic half-space, which has a uniform elastic modulus.

Settlement potential of the Pascagoula Formation was evaluated using conventional consolidation theory. Because the clays are preconsolidated to an effective stress greater than the stresses imposed following building construction, settlements were along the recompression curve. Because of the degree of overconsolidation of the Pascagoula Formation, secondary consolidation was assumed not to occur.

As indicated in Tables 2.0-201 and 2.5.4-213, the settlement values for the RB/FB, CB, and FWSC are within the DCD limits except for the average settlement at four corners of the CB basemat. To address this departure, the CB structural design adequacy is evaluated for site-specific settlements under dead loads. Structural evaluation is performed using two approaches, termed Type 1 and Type 2 herein.

The Type 1 analysis utilizes the DCD building finite element model (refer to DCD Appendix 3G) from which the DCD settlement limits were determined through a variation of gradient distributions of soil spring stiffness for generic sites. In the site-specific analysis, the DCD soil springs are adjusted in stiffness values so that the resulting basemat displacements under the building dead loads, as shown in Figure 2.5.4-252, envelop the site-specific maximum and average settlements summarized in Table 2.5.4-213. The induced basemat bending moments in two principal directions are compared with the DCD moments in Figures 2.5.4-253 and 2.5.4-254. As shown in these figures, the site-specific settlement induced bending moments exceed the DCD design moments by a maximum of 16 percent.

This increase of bending moments does not affect the basemat design because there are sufficient stress margins, in accordance with DCD Tables 3G.2-17, 3G.2-19, 3G.2-21, and 3G.2-23. Note that the maximum corner and average corner settlement values in this analysis are 0.88 inch and 0.72 in., respectively, which are more conservative than the actual value of 0.7 in. for both in Table 2.5.4-213.

The Type 2 analysis also utilizes the DCD building finite element model, except that the soil springs are excluded. The applied loads are in the form of imposed displacements at basemat nodes, and they are the site-specific settlement values across the entire basemat as shown in Figure 2.5.4-255. The resulting bending moments in two principal directions are compared with the DCD moments in Figures 2.5.4-256 and 2.5.4-257. As shown in these figures, the site-specific settlement induced bending moments are smaller than the DCD design moments.

From the results of the two analyses presented above, it can be concluded that the CB design is adequate to accommodate site-specific foundation settlement.

For the RBS Unit 1 Reactor Building, 4.6 in. (11.7 mm) of average mat foundation settlement was predicted in Reference 2.5.4-234, based on an allowable soil bearing pressure of 8 ksf (383 kPa). Settlement monitoring results reported in Table 2.5.19 of Reference 2.5.4-234 show measured mean settlements (mean of three settlement markers) of 2.6 in. (66 mm) for the Reactor Building. Only 0.5 in. of this settlement occurred after completion of the Reactor Building roof. The predicted settlements for RBS Unit 3 and the foundation bearing pressures are compatible with the measured settlements in RBS Unit 1, when factors such as applied bearing pressure, type of bearing stratum, and magnitude of stress relief caused by excavation are taken into consideration.

An instrumentation monitoring program would be used during excavation for RBS Unit 3. Rebound measurements would be used to confirm the elastic properties used in the settlement analysis.

2.5.4.10.5 Excavation Rebound

In addition to foundation settlement, estimates of excavation bottom heave (rebound) were made. Heave or expansion of the soils below the excavation occurs due to stress reduction as a result of excavation. It is estimated that a stress reduction of about 3 ksf (144 kPa) would occur because of construction excavation. Based on the FE analysis, an excavation bottom heave of 5.5 in. (14 cm) is predicted at the center of the RB/FB and CB excavations. Any rebound that would occur for the excavation to remove undocumented fill and loess at the FWSC is of no consequence, because the replacement fill would be brought to the appropriate subgrade level, negating the effects of any rebound.

Geotechnical instrumentation, installed in the RB/FB and CB foundation areas, would be used to measure heave during construction and to compare the measured heave to predicted values. The monitoring program is discussed in

Subsection 2.5.4.5.3.2. Direct measurement of heave with borehole settlement devices would allow for estimation of soil layer elastic modulus values, which can then be compared to those estimated from the P-S logging results, as presented in Subsection 2.5.4.7.

Excavation rebound data obtained during RBS Unit 1 construction (Reference 2.5.4-234) was reviewed. Borehole extensometers were installed in the mat foundation areas to measure rebound, with a maximum heave of 7.4 in. (18.8 cm) recorded, as listed in Reference 2.5.4-234. However, rebound amounts would be expected to be less at RBS Unit 3 because of the lesser thickness of material to be removed as compared to that removed at RBS Unit 1.

2.5.4.11 Design Criteria

The design of the safety-related foundations for the RB/FB, CB, and FWSC are based on the foundation mats supported on controlled structural fill. Removal of in-place engineered fill and/or unsuitable soils is expected. In-place fill would be removed from below the base of the RB/FB mat, both fill and unsuitable materials removed from beneath the CB mat foundation, and unsuitable materials removed from beneath the FWSC mat foundation.

The design criteria used for static stability analysis are identified in Subsection 2.5.4.10. FOS estimates are applicable to the calculation of bearing capacity and are discussed in Subsection 2.5.4.10.2. Discussion of assumptions and conservatism in static stability analyses are included in Subsection 2.5.4.10.

Refer to Subsection 2.5.5 for slope stability design criteria. Computer analysis and methods of verification are discussed in the subsections in which they are used.

2.5.4.12 Techniques to Improve Subsurface Conditions

This subsection discusses techniques for soil improvement in the foundation areas of the RB/FB, CB, and FWSC.

Based on the static stability analysis discussed in Subsection 2.5.4.10, deep soil improvement of foundation bearing soils (such as vibro-compaction, vibro-replacement, vibro concrete columns, soil mix columns, and/or grouting) would not be necessary. Shallow soil improvement techniques, including over-excavation and replacement and bearing surface compaction, would apply to preparation of the foundation bearing surfaces. These techniques are described briefly in this subsection and are discussed in detail in Subsection 2.5.4.5.

2.5.4.12.1 RB/FB Mat Bearing Surface Preparation

As discussed in Subsection 2.5.4.10, the existing soils at the design embedment depth consist of granular materials placed as engineered fill during the construction of RBS Units 1 and 2. To ensure a competent material for embedment of the RB/FB foundation, the engineered fill would be removed to approximately 10 ft. (3 m) below the embedment elevation and backfilled with structural fill to meet the requirements in Subsection 2.5.4.5.3. A program of inspection, shallow improvement, and verification would be conducted as discussed in Subsection 2.5.4.5.4.

2.5.4.12.2 CB Mat Bearing Surface Preparation

At the design embedment depth given in DCD Table 3.8-8, approximately 45 ft. (13.7 m) of general fill, Loess, Port Hickey, and Upper Citronelle materials would have to be removed to reach the embedment depth on one side of the structure. On the opposite side of the structure, only 16 ft. (4.9 m) of the in-place engineered fill would have to be removed to reach the embedment depth. To ensure that competent material is used to bear the CB foundation, the native soils and engineered fill would be removed to approximately 28 ft. (8.5 m) below the embedment elevation and backfilled with structural fill to meet the requirements in Subsection 2.5.4.5.3. A program of inspection, shallow improvement, and verification would be conducted, as discussed in Subsection 2.5.4.5.4.

2.5.4.12.3 FWSC Mat Bearing Surface Preparation

Because of the proximity of the FWSC to the CB and the design embedment depth given in DCD Table 3.8-8, approximately 70 ft. (21.3 m) of general fill, Loess, Port Hickey, and Upper Citronelle materials would have to be removed to reach the bottom of the proposed excavation. To ensure a competent material for embedment of the FWSC foundation, the native soils would be removed to approximately 70 ft. (21.3 m) below the embedment elevation and backfilled with structural fill to meet the requirements in Subsection 2.5.4.5.3. A program of inspection, shallow improvement, and verification would be conducted as discussed in Subsection 2.5.4.5.4.

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Table 2.5.4-201 (Sheet 1 of 6)
Summary of Static Laboratory Analyses

RBS COL 2.0-29-A

Sample ID				Depth (ft. bgs)			USCS Class					Atterberg Index[c]			Mechanical Sieve Analysis			Hydrometer Analysis		Total Stress		Effective Stress		Maximum							Consolidation Testing		
Boring	Sample No.	Geologic Unit[a]	Source	From	To	Sample Method[b]	Lab	Field	Natural Moisture (%)	Dry Unit Weight (pcf)	Gs	LL	PL	PI	% Gravel	% Sand	% Fines	% Silt	% Clay	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Dry Density (pcf)	Optimum Moisture %	pH	Soluble Chloride mg/kg	Soluble Sulfate mg/kg	Sulfide mg/kg	REDOX mV	p_c (psf)	C_c	C_r
CT-43	2	Fill	FSAR	2.5	4	SPT	CL	CL	13	--	--	28	16	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	3	Fill	FSAR	5	6.5	SPT	--	CL	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-03	1	Fill	FSAR	0.5	2	SPT	SP	SP-SM	7	--	--	--	--	--	29.3	50.8	19.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-04	3	Fill	FSAR	5	7	TW	--	CL	37	90	--	23	15	8	5.1	70.2	24.7	--	--	640	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-05	1	Fill	FSAR	1	2.5	SPT	SC	SP	17	--	--	--	--	--	0	62.9	37.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26	4	Fill	FSAR	7.5	9	SPT	SC	SC	--	--	--	20	11	9	11.2	76.4	12.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-11	5	Fill	FSAR	10	11.5	SPT	SM	SC	10	--	--	NP	NP	NP	11.5	70.4	18.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-11	7	Fill	FSAR	20	21.5	SPT	SW	SW	11	--	--	--	--	--	2.7	91.7	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WT-41	5	Fill	FSAR	10	11.5	SPT	--	SC	14	--	--	--	--	--	0	80	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	12	E. Fill	FSAR	45	46.5	SPT	SP	SW	13	--	2.656	--	--	--	4.1	91.8	4.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FPWST-56	10	E. Fill	FSAR	35	36.5	SPT	SP	SP	--	--	--	--	--	--	5.1	86.2	8.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-33	2	E. Fill	FSAR	0.5	2	BAG	SP	SP	--	--	--	--	--	--	--	--	--	--	--	--	--	0	32.6	--	--	--	--	--	--	--	--	--	--
RW-33	9	E. Fill	FSAR	25	26.5	SPT	SP	SW	--	--	--	--	--	--	3	92.7	4.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-34	8	E. Fill	FSAR	35	36.5	SPT	SP	SW	--	--	--	--	--	--	6.7	88.9	4.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-35	11	E. Fill	FSAR	40	41.5	SPT	SP	SP	--	--	--	--	--	--	3.5	92	4.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-36	BAG 1	E. Fill	FSAR	--	--	BAG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.8	< 100	< 100	14.0	29.5	--	--	--
CT-47	1	Loess	FSAR	0.5	2	SPT	--	CL	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-47	3	Loess	FSAR	5	7	TW	CH	CL	23	105	--	52	21	31	--	--	--	--	--	4130	--	--	--	--	--	--	--	--	--	--	--	--	--
112	1	Loess	Unit 1 USAR	--	--	--	--	--	--	--	--	29	17	12	0	7	93	24	19		--	--	--	--	--	--	--	--	--	--	--	--	--
114	1	Loess	Unit 1 USAR	--	--	--	--	--	--	--	--	35	19	16	0	2	98	81	17		--	--	--	--	--	--	--	--	--	--	--	--	--
115	1	Loess	Unit 1 USAR	--	--	--	--	--	--	--	--	43	21	22	0	7	93	75	18		--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	3	PHTS	FSAR	5	7	TW	CL	CH	14	117.2	--	38	15	23	--	--	--	--	--	4100	--	--	--	--	--	--	--	--	--	--	--	--	--
112	2	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	36	15	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
112	2A	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	--	--	--	0	9	91	66	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
112	3A	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	--	--	--	0	38	62	52	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
112	3C	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	--	--	--	0	62	38	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
114	2	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	46	17	29	0	4	96	71	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
114	3	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	37	13	24	0	9	91	62	29	--	--	--	--	--	--	--	--	--	--	--	--	--	--
115	2	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	38	14	24	0	7	93	69	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--
115	3	PHTS	Unit 1 USAR	--	--	--	--	--	--	--	--	25	10	15	0	20	80	56	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	5	PH	FSAR	10	11.5	SPT	CL	CL	12	--	--	28	16	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	6	PH	FSAR	15	16.5	SPT	--	SM	--	--	--	--	--	--	0	72.2	27.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-01	4	PH	FSAR	7.5	9	SPT	--	SP-SC	13	--	--	--	--	--	0	84.5	15.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-03	3	PH	FSAR	5	6.5	SPT	SC	SP-SC	8	--	2.67	--	--	--	0	84.8	15.2	8.2	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-04	5	PH	FSAR	10	11.5	SPT	SC	SP	12	--	--	--	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-05	4	PH	FSAR	10	11.5	SPT	SM	SP	24	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FO-42	5	PH	FSAR	15	17	TW	SC	CL	30	--	--	48	16	32	--	--	47	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FO-42	6	PH	FSAR	20	21.5	SPT	CH	CH	35	--	--	67	23	44	--	--	75	--	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FWS-19	5	PH	FSAR	10	11.5	SPT	CL	CL	27	--	--	44	19	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	2	PH	FSAR	2	4	TW	CH	CH	26	106.1	--	54	29	25	--	--	--	--	30	1160	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	5	PH	FSAR	10	11.5	SPT	CL	CL	24	--	--	36	18	18	--	--	--	--	--	1250	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	5	PH	FSAR	10	12	TW	CL	CL	21	105.7	--	30	17	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	6	PH	FSAR	15	16.5	SPT	--	SC	14	--	--	--	--	--	7.5	71.9	20.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-53	6	PH	FSAR	15	16.5	SPT	SC	SP	34	--	--	--	--	--	3.8	48.4	47.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BFT-57	10	UC	FSAR	35	36.5	SPT	SP-SC	SP-SC	22	--	--	--	--	--	0	85	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BFT-57	12	UC	FSAR	40	41.5	SPT	--	SP-SC	18	--	--	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BFT-57	15	UC	FSAR	55	56.5	SPT	--	SP w/ ML	37	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	12	UC	FSAR	45	46.5	SPT	--	SP-SM	--	--	--	--	--	--	1.3	88.8	9.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	13	UC	FSAR	50	51.5	SPT	SM	SM	--	--	--	--	--	--	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	14	UC	FSAR	55	56.5	SPT	SM	SM	--	--	--	--	--	--	0	67.5	32.5	25.5	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	15	UC	FSAR	60	61.5	SPT	--	SP	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	6	UC	FSAR	20	21.5	SPT	SC	SM	21	--	--	20	11	9	0.7	81.8	17.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	7	UC	FSAR	25	26.5	SPT	--	SM	19	--	--	--	--	--	0.4	86.2	13.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-52	8	UC	FSAR	25	26.5	SPT	SC	SM	19	--	--	18	11	7	1.7	82	16.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CS-51	5	UC	FSAR	10	11.5	SPT	SC	SC	12	--	--	22	10	12	15.6	68.8	15.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2.5.4-201 (Sheet 2 of 6)
Summary of Static Laboratory Analyses

Sample ID				Depth (ft. bgs)			USCS Class					Atterberg Index[c]			Mechanical Sieve Analysis			Hydrometer Analysis		Total Stress		Effective Stress		Maximum							Consolidation Testing		
Boring	Sample No.	Geologic Unit[a]	Source	From	To	Sample Method[b]	Lab	Field	Natural Moisture (%)	Dry Unit Weight (pcf)	Gs	LL	PL	PI	% Gravel	% Sand	% Fines	% Silt	% Clay	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Dry Density (pcf)	Optimum Moisture %	pH	Soluble Chloride mg/kg	Soluble Sulfate mg/kg	Sulfide mg/kg	REDOX mV	p_c (psf)	C_c	C_r
CS-51	6	UC	FSAR	15	16.5	SPT	CH	CH	40	--	--	53	24	29	--	--	--	--	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CS-51	7	UC	FSAR	20	21.5	SPT	CH	CH	35	--	--	60	19	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CS-51	8	UC	FSAR	25	26.5	SPT	SP-SM	SP-SM	17	--	--	--	--	--	8.1	83.8	8.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	8	UC	FSAR	25	26.5	SPT	--	SC	--	--	--	--	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	12	UC	FSAR	45	46.5	SPT	SC	--	--	--	--	--	--	--	16.3	63.1	20.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	14	UC	FSAR	55	56.5	SPT	CH	--	45	--	--	71	27	44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-47	8	UC	FSAR	25	26.5	SPT	--	SC	--	--	--	--	--	--	3.3	79.5	17.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-47	14	UC	FSAR	55	56.5	SPT	SP	SC	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-01	6	UC	FSAR	15	16.5	SPT	SC	SC	17	--	--	18	11	7	--	--	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-01	9	UC	FSAR	30	31.5	SPT	--	SW-SC	10	--	--	--	--	--	18.4	70.8	10.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-03	8	UC	FSAR	25	26.5	SPT	SP-SM	SC	11	--	--	NP	NP	NP	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-04	9	UC	FSAR	30	31.5	SPT	GW-GC	GC	--	--	--	--	--	--	53.4	41.6	11.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EB/TSC-05	7	UC	FSAR	25	27	TW	--	SP-SC	13	--	--	--	--	--	17	69	14	--	--	--	--	0	29	--	--	--	--	--	--	--	--	--	--
FB-39	8	UC	FSAR	20	21.5	SPT	SP	SW-SC	12	--	--	--	--	--	5.9	87.6	6.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	10	UC	FSAR	30	31.5	SPT	--	SM	22	--	--	--	--	--	0	88.3	11.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	12	UC	FSAR	40	41.5	SPT	SP	SW	15	--	--	--	--	--	1.8	93.5	4.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	13	UC	FSAR	45	46.5	SPT	GP-GC	GC	12	--	--	22	10	12	42.2	33.4	8.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	14	UC	FSAR	50	51.5	SPT	SP	SP	21	--	--	--	--	--	0	98.8	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FO-42	7	UC	FSAR	25	26.5	SPT	--	SP	44	--	--	--	--	--	0.2	67.6	32.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FO-42	9	UC	FSAR	35	36.5	SPT	--	SP	21	--	--	--	--	--	--	81.8	18.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FO-42	10	UC	FSAR	40	41.5	SPT	--	SP	18	--	--	--	--	--	3.9	81.3	14.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FWS-19	12	UC	FSAR	45	46.5	SPT	CH	CL	41	--	--	61	37	30	--	--	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	7	UC	FSAR	20	21.5	SPT	--	SW	14	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	8	UC	FSAR	25	26.5	SPT	--	SP	17	--	--	--	--	--	0	85	15	--	--	--	--	0	21	--	--	--	--	--	--	--	--	--	--
RB-24	12	UC	FSAR	45	46.5	SPT	--	SP	10	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	7	UC	FSAR	20	21.5	SPT	SC	SM	18	--	--	20	13	7	3	83.5	13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	8	UC	FSAR	25	26.5	SPT	SC	SM	22	--	--	20	10	10	0	85.3	14.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	10	UC	FSAR	35	36.5	SPT	--	SW	13	--	2.885	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	11	UC	FSAR	40	41.5	SPT	SP	SW	13	--	--	--	--	--	6	90.1	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	10	UC	FSAR	22.5	24	SPT	--	SC	18	--	--	--	--	--	--	--	13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	14	UC	FSAR	32.5	34	SPT	SP	SP	--	--	--	--	--	--	16.5	78.2	5.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	8	UC	FSAR	25	26.5	SPT	SM	SC	23	--	--	NP	NP	NP	0	88.4	11.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	11	UC	FSAR	35	36.5	SPT	--	SP	20	--	--	--	--	--	20	47.1	32.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	12	UC	FSAR	40	41.5	SPT	--	SP	24	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	14	UC	FSAR	50	51.5	SPT	--	SW	20	--	--	--	--	--	29.4	64.8	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	15	UC	FSAR	55	56.5	SPT	--	SP	21	--	--	--	--	--	38.8	82.5	7.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	6	UC	FSAR	15	16.5	SPT	--	SP	15	--	--	--	--	--	0	80.2	19.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	8	UC	FSAR	25	26.5	SPT	--	SP	16	--	--	--	--	--	0.2	82.2	17.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	11	UC	FSAR	40	41.5	SPT	SC	SM	17	--	--	22	10	12	0.7	73.3	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	12	UC	FSAR	45	46.5	SPT	--	SP	16	--	--	NP	NP	NP	0	90.1	9.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SF-40	13	UC	FSAR	50	51.5	SPT	SM	SP	14	--	--	NP	NP	NP	3.7	86.2	10.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	10	UC	FSAR	35	36.5	SPT	--	CL	18	--	--	--	--	--	11.3	71.1	17.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	13	UC	FSAR	50	51.5	SPT	--	SM	--	--	--	--	--	--	0.7	90.7	8.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	15	UC	FSAR	60	61.5	SPT	--	SM	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	16	UC	FSAR	65	66.5	SPT	--	SM	13	--	--	--	--	--	8.8	84.7	6.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	10	UC	FSAR	35	36.5	SPT	SC	SC	16	--	--	20	10	10	8.4	81.3	10.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	13	UC	FSAR	50	51.5	SPT	CL	CL	31	--	--	23	12	11	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	13	UC	FSAR	50	51.5	SPT	--	SP	--	--	--	--	--	--	5.9	76.3	17.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-09	5	UC	FSAR	10	11.5	SPT	--	SC	15	--	--	--	--	--	32	55.1	12.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-09	8	UC	FSAR	25	26.5	SPT	--	SM	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	6	UC	FSAR	15	16.5	SPT	SM	CL	17	--	--	NP	NP	NP	17	66.2	16.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-53	10	UC	FSAR	35	36.5	SPT	SC	SM	27	--	--	31	16	15	0	69.4	30.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-53	11	UC	FSAR	40	41.5	SPT	--	SM	--	--	--	--	--	--	--	--	--	--	--	--	--	0	42.9	--	--	--	--	--	--	--	--	--	--
TB-53	13	UC	FSAR	50	51.5	SPT	--	CH	--	--	--	--	--	--	--	--	90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WT-41	7	UC	FSAR	20	21.5	SPT	CH	CH	38	--	--	53	19	34	0	51.2	48.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WT-41	11	UC	FSAR	40	41.5	SPT	--	SP-SM	19	--	--	--	--	--	0	90.7	9.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2.5.4-201 (Sheet 3 of 6)
Summary of Static Laboratory Analyses

Sample ID				Depth (ft. bgs)			USCS Class					Atterberg Index[c]			Mechanical Sieve Analysis			Hydrometer Analysis		Total Stress		Effective Stress									Consolidation Testing		
Boring	Sample No.	Geologic Unit[a]	Source	From	To	Sample Method[b]	Lab	Field	Natural Moisture (%)	Dry Unit Weight (pcf)	Gs	LL	PL	PI	% Gravel	% Sand	% Fines	% Silt	% Clay	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Maximum Dry Density (pcf)	Optimum Moisture %	pH	Soluble Chloride mg/kg	Soluble Sulfate mg/kg	Sulfide mg/kg	REDOX mV	p_c (psf)	C_c	C_r
WT-41	13	UC	FSAR	50	51.5	SPT	--	SP-SM	16	--	--	--	--	--	2.1	89.2	8.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-509	BAG-1	UC	FSAR	1	5	BAG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.0	< 100	< 100	< 8.0	91.7	--	--	--
CB-22	19	LC	FSAR	80	81.5	SPT	--	GW	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	24	LC	FSAR	105	106.5	SPT	--	SP	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	28	LC	FSAR	125.5	127	SPT	--	SM	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22A	3	LC	FSAR	85	86.5	SPT	SP	SW	--	--	--	--	--	--	14.2	81.6	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22A	5	LC	FSAR	95	96.5	SPT	SP	SW	--	--	--	--	--	--	6.4	89	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22A	10	LC	FSAR	112.5	114	SPT	CH	CH	31	--	--	50	18	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22A	16	LC	FSAR	127.5	129	SPT	SM	SM	--	--	--	NP	NP	NP	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	9	LC	FSAR	35	36.5	SPT	SP	SW-SM	11	--	--	--	--	--	6.3	89.4	4.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	16	LC	FSAR	70	71.5	SPT	SP	SP	15	--	--	--	--	--	1.5	94.6	3.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	18	LC	FSAR	80	81.5	SPT	CL	CH	27	--	--	49	22	27	--	--	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	19	LC	FSAR	85	86.5	SPT	CL	CL	29	--	--	41	17	24	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-23	20	LC	FSAR	90	92	TW	CL	CL	29	105	--	42	18	24	--	--	--	--	--	440	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-52	22	LC	FSAR	82.5	84	SPT	--	GW-GC	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-52	31	LC	FSAR	105	106.5	SPT	--	GC	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	18	LC	FSAR	75	76.5	SPT	SW	SW-SC	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-47	19	LC	FSAR	80	81.5	SPT	--	SP-SC	--	--	--	--	--	--	0	88.7	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-47	30	LC	FSAR	135	136.5	SPT	--	SC	--	--	--	--	--	--	--	--	16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	13	LC	FSAR	50	51.5	SPT	SP	SW	18	--	--	--	--	--	6.5	91.2	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	14	LC	FSAR	52.5	54	SPT	SP	SP	16	--	--	--	--	--	4.5	91.9	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	16	LC	FSAR	60	61.5	SPT	SP	SP	5	--	--	--	--	--	1.1	92.2	6.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	21	LC	FSAR	85	86.5	SPT	CL	CL	24	--	--	30	16	14	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	22	LC	FSAR	90	92	TW	CL	CL	11	108.1	--	45	21	24	--	--	--	--	--	2580	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	15	LC	FSAR	52.5	54	SPT	SP	SW-SC	130	--	--	--	--	--	2.6	93.8	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	17	LC	FSAR	60	61.5	SPT	SP	SP-SC	20	--	--	--	--	--	0	94.2	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	18	LC	FSAR	65	66.5	SPT	SP	SW	12	--	--	--	--	--	14.1	82.8	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	21	LC	FSAR	80	81.5	SPT	CL	CL	25	--	--	40	18	22	--	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	23	LC	FSAR	90	91.5	SPT	SP-SC	SC	20	--	--	21	13	8	0	87.6	12.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	25	LC	FSAR	100	101.5	SPT	--	SP-SC	21	--	--	--	--	--	0	88.9	11.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	23	LC	FSAR	100	101.5	SPT	--	SP	22	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	14	LC	FSAR	55	56.5	SPT	SP	SP	18	--	--	--	--	--	1.9	92.2	5.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	18	LC	FSAR	75	76.5	SPT	SP	SP	17	--	--	--	--	--	3.3	94.3	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	20	LC	FSAR	85	86.5	SPT	GC	GC	13	--	--	21	12	9	45.7	38.5	7.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	22	LC	FSAR	95	96.5	SPT	--	SM	24	--	--	--	--	--	0	83.5	16.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26	13	LC	FSAR	50	51.5	SPT	SP	SW	16	--	--	--	--	--	3.8	94.5	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26	15	LC	FSAR	60	61.5	SPT	SP	SP	--	--	--	--	--	--	0	95.1	4.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26	19	LC	FSAR	80	81.5	SPT	SP	SW	--	--	--	--	--	--	31.4	66.4	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26A	2	LC	FSAR	85	86.5	SPT	SP	GW	--	--	--	--	--	--	33	61	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	22	LC	FSAR	52.5	54	SPT	SP	SW	15	--	--	--	--	--	11.9	86.7	1.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	33	LC	FSAR	80	81.5	SPT	--	GC	--	--	--	--	--	--	48.7	39.7	11.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	40	LC	FSAR	97.5	99	SPT	--	SP-SC	--	--	--	--	--	--	0	91	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	16	LC	FSAR	65	66.5	SPT	SP	SW	--	--	--	--	--	--	5.5	90.9	3.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	20	LC	FSAR	85	86.5	SPT	CL	CL	29	--	--	49	20	29	--	--	85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	21	LC	FSAR	90	92	TW	CL	CL	25	97.2	--	40	20	20	--	--	--	--	--	3500	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	22	LC	FSAR	95	96.5	SPT	SM	SC	24	--	--	NP	NP	NP	1.9	88.2	9.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	15	LC	FSAR	60	61.5	SPT	SP	SP	17	--	--	--	--	--	6	91.1	2.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	20	LC	FSAR	85	86.5	SPT	--	SW-SM	9	--	--	--	--	--	45.2	43.1	2.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	22	LC	FSAR	95	96.5	SPT	SP	GW	--	--	--	--	--	--	28.6	69.6	1.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	23	LC	FSAR	100	101.5	SPT	CL	CH	18	--	--	41	16	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	24	LC	FSAR	105	106.5	SPT	--	SP-SM	23	--	--	--	--	--	1.7	86.6	11.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29A	4	LC	FSAR	60	61.5	SPT	SP	SW	14	--	--	--	--	--	1.4	93.5	5.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29A	8	LC	FSAR	72.5	74	SPT	SP	SW-SM	--	--	--	--	--	--	1.6	93	5.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29A	13	LC	FSAR	85	86.5	SPT	SP	GW-GC	8	--	--	NP	NP	NP	39.8	56	4.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29A	16	LC	FSAR	100	101.5	SPT	--	SP-SM	--	--	--	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	19	LC	FSAR	80	81.5	SPT	CH	CH	26	--	--	51	26	25	--	--	--	--	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2.5.4-201 (Sheet 4 of 6)
Summary of Static Laboratory Analyses

Sample ID: Boring	Sample ID: Sample No.	Geologic Unit[a]	Source	Depth (ft. bgs): From	Depth (ft. bgs): To	Sample Method[b]	USCS Class: Lab	USCS Class: Field	Natural Moisture (%)	Dry Unit Weight (pcf)	Gs	Atterberg Index[c]: LL	Atterberg Index[c]: PL	Atterberg Index[c]: PI	Mechanical Sieve Analysis: % Gravel	Mechanical Sieve Analysis: % Sand	Mechanical Sieve Analysis: % Fines	Hydrometer Analysis: % Silt	Hydrometer Analysis: % Clay	Total Stress: Cohesion (psf)	Total Stress: Friction Angle (degrees)	Effective Stress: Cohesion (psf)	Effective Stress: Friction Angle (degrees)	Maximum Dry Density (pcf)	Optimum Moisture %	pH	Soluble Chloride mg/kg	Soluble Sulfate mg/kg	Sulfide mg/kg	REDOX mV	Consolidation Testing: p_c (psf)	Consolidation Testing: C_c	Consolidation Testing: C_r
RB-30	20	LC	FSAR	85	87	TW	CL	CH	28	97	--	32	18	14	--	--	--	--	--	4200	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	20A	LC	FSAR	85	86.5	SPT	CL	CL	--	--	--	44	22	22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	20B	LC	FSAR	85.9	87.4	SPT	CH	CH	--	--	--	39	21	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	22	LC	FSAR	95	96.5	SPT	CL	ML	--	--	--	22	12	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-33	18	LC	FSAR	70	71.5	SPT	SP	SW	--	--	--	--	--	--	2	94.2	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-34	12	LC	FSAR	55	56.5	SPT	--	SP	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RW-35	15	LC	FSAR	60	61.5	SPT	--	SP-SC	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	29	LC	FSAR	125	126.5	SPT	--	SP	23	--	--	--	--	--	0	79.2	20.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	21	LC	FSAR	90	91.5	SPT	SP	SM	--	--	--	--	--	--	8.7	85.7	5.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	23	LC	FSAR	100	101.5	SPT	SP	SP	--	--	--	--	--	--	46.2	41	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	24	LC	FSAR	105	106.5	SPT	GP	GC	10	--	--	--	--	--	68.8	24.3	6.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	29	LC	FSAR	130	132	TW	CL	CH	20	98.6	--	35	12	23	--	--	--	--	--	3000	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	15	LC	FSAR	60	61.5	SPT	SP	SC	12	--	--	NP	NP	NP	0	93.8	6.2	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	17	LC	FSAR	70	71.5	SPT	SP	GW-GC	8	--	--	--	--	--	43.5	50.6	5.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	20	LC	FSAR	85	86.5	SPT	SP	SW	12	--	--	--	--	--	4.9	89.3	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-07	22	LC	FSAR	95	96.5	SPT	SP	GP	--	--	--	--	--	--	21.9	74.3	3.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	17	LC	FSAR	70	71.5	SPT	SW	SW	12	--	--	--	--	--	17.4	78	4.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	28	LC	FSAR	125	126.5	SPT	--	SC	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	14	LC	FSAR	55	56.5	SPT	--	GC	--	--	--	--	--	--	15.7	67.2	17.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	24	LC	FSAR	100	101.5	SPT	--	GC	--	--	--	--	--	--	48.5	37.5	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	25	LC	FSAR	105	106.5	SPT	CH	CH	21	--	--	55	16	39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-11	11	LC	FSAR	40	41.5	SPT	SW	SW-SC	15	--	--	--	--	--	4.2	94.1	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-11	12	LC	FSAR	45	46.5	SPT	--	SC	20	--	--	21	11	10	1.8	88.7	9.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-11	15	LC	FSAR	55	56.5	SPT	SW	SP	20	--	--	--	--	--	0	98.1	1.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-53	18	LC	FSAR	75	76.5	SPT	--	SW	--	--	--	--	--	--	22.4	71.8	5.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	33	PF	FSAR	150	152	TW	CH	CL	24	102.9	--	55	26	29	--	--	--	--	--	8460	--	--	--	--	--	--	--	--	--	--	--	--	--
CB-22	37	PF	FSAR	170	172	TW	CL	ML	24	103.6	--	34	19	15	--	--	--	--	--	1300	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	25	PF	FSAR	120	122	TW	CL	CL	32	91.7	--	42	21	21	--	--	--	--	--	1980	--	--	--	--	--	--	--	--	--	--	--	--	--
CT-43	30	PF	FSAR	170	171.5	SPT	--	SP-SC	--	--	--	--	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	26	PF	FSAR	110	111.5	SPT	CL	CL	29	--	--	42	21	21	--	--	--	--	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	28	PF	FSAR	120	121.5	SPT	CL	MH	27	--	--	32	16	16	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	31	PF	FSAR	135	137	TW	CL	CH	25	102.3	--	32	19	13	--	--	--	--	--	3400	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	32	PF	FSAR	140	141.5	SPT	CL	CL	37	--	--	31	16	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	33	PF	FSAR	145	146.5	SPT	CL	MH	26	--	--	41	21	20	--	--	--	--	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	36	PF	FSAR	160	161.5	SPT	CH	CL	45	--	--	52	23	29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-38	37	PF	FSAR	165	167	TW	CH	CL	30	89.8	--	60	27	33	--	--	68	--	--	2400	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	30	PF	FSAR	122	123.5	SPT	CH	CL	32	--	--	60	25	35	--	--	--	--	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	31	PF	FSAR	125	126.5	SPT	CL	ML	29	--	--	33	17	16	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	32	PF	FSAR	130	131.5	SPT	CL	CL	23	102	--	32	18	14	--	--	--	--	--	5400	--	--	--	--	--	--	--	--	--	--	--	--	--
FB-39	33	PF	FSAR	135	137	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10,800	0.1985	0.0331
FB-39	39	PF	FSAR	165	166.5	SPT	CH	CH	37	--	--	52	26	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	25	PF	FSAR	110	111.5	SPT	--	SP	24	--	--	--	--	--	--	--	84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	28	PF	FSAR	125	127	TW	CL	CL	18	108	--	31	16	15	--	--	--	--	--	7600	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	30	PF	FSAR	135	137	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14,600	0.3093	0.0242
RB-24	39	PF	FSAR	180	181.5	SPT	CH	ML	31	--	--	62	27	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	42	PF	FSAR	195	197	TW	CH	CL	30	--	--	57	23	34	--	--	--	--	--	--	--	--	33.4	--	--	--	--	--	--	--	--	--	--
RB-24	50	PF	FSAR	235	237	TW	CH	CL	33	92.7	--	65	29	36	--	--	--	--	--	6800	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-24	56	PF	FSAR	265	267	TW	CL	CL	22	104.6	--	44	20	24	--	--	--	--	--	14,200	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	25	PF	FSAR	110	111.5	SPT	CL	CL	26	--	2.684	40	20	20	--	--	--	--	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	27	PF	FSAR	120	122	TW	CL	CL	24	103	--	47	26	21	--	--	--	--	--	5000	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	31	PF	FSAR	140	141.5	SPT	CL	CL	30	--	--	38	18	20	--	--	--	--	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	34	PF	FSAR	155	156.5	SPT	SP	SP	21	--	2.672	--	--	--	0	92.3	7.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	38	PF	FSAR	175	176.5	SPT	CH	CL	28	--	2.709	54	28	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-25	43	PF	FSAR	200	202	TW	CL	CH	21	108.4	--	46	23	23	--	--	--	--	--	8200	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26	45	PF	FSAR	210	212	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32,000	0.3654	0.0282
RB-25	47	PF	FSAR	220	222	TW	CL	CL	32	98.2	--	40	20	20	--	--	--	--	--	12,000	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2.5.4-201 (Sheet 5 of 6)
Summary of Static Laboratory Analyses

Sample ID		Geologic		Depth (ft. bgs)		Sample	USCS Class		Natural	Dry Unit		Atterberg Index[c]			Mechanical Sieve Analysis			Hydrometer Analysis		Total Stress		Effective Stress		Maximum			Soluble	Soluble			Consolidation Testing		
Boring	Sample No.	Unit[a]	Source	From	To	Method[b]	Lab	Field	Moisture (%)	Weight (pcf)	Gs	LL	PL	PI	% Gravel	% Sand	% Fines	% Silt	% Clay	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Dry Density (pcf)	Optimum Moisture %	pH	Chloride mg/kg	Sulfate mg/kg	Sulfide mg/kg	REDOX mV	P_c (psf)	C_c	C_r
RB-26	56	PF	FSAR	260	262	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	38,000	0.3089	0.0374
RB-25	58	PF	FSAR	270	272	TW	CL	CL	18	111	--	39	18	21	--	--	--	--	--	8800	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26A	10	PF	FSAR	125	127	TW	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20,000	0.2512	0.0318
RB-26A	12	PF	FSAR	135	137	TW	CL	MH	27	95.6	--	42	21	21	--	--	--	--	--	7800	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26A	14	PF	FSAR	145	147	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20,000	0.3621	0.0161
RB-26A	15	PF	FSAR	150	151.5	SPT	CL	ML	27	--	--	42	22	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-26A	32	PF	FSAR	235	236.5	SPT	CH	CH	28	--	--	66	24	42	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	36	PF	FSAR	87.5	89.5	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14,200	0.2757	0.0368
RB-27	45	PF	FSAR	110	111.5	SPT	CL	CH	21	--	--	49	23	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	46	PF	FSAR	112.5	114.5	TW	CH	CL	22	--	--	68	31	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	47	PF	FSAR	115	117	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24,000	0.1693	0.028
RB-27	50	PF	FSAR	120	121.5	SPT	CL	CL	25	--	--	49	24	25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	59	PF	FSAR	142.5	144.5	TW	CL	ML	25	--	--	40	22	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	66	PF	FSAR	160	161.5	SPT	--	SP	--	--	--	--	--	--	0.7	89.1	10.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	70	PF	FSAR	170	172	TW	CH	CH	28	--	--	68	29	39	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	75	PF	FSAR	182.5	184.5	TW	CL	ML	36	--	--	46	28	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-27	87	PF	FSAR	212.5	214.5	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	41,000	0.2957	0.0227
RB-27	98	PF	FSAR	237.5	239.5	TW	CL	CL	24	--	--	36	18	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	26	PF	FSAR	115	116.5	SPT	CL	CL	28	--	--	46	24	22	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	28	PF	FSAR	125	127	TW	CL	CL	26	103.8	--	44	22	22	--	--	--	--	--	7000	--	--	--	--	--	--	--	--	--	--	24,000	0.2597	0.0399
RB-28	30	PF	FSAR	135	137	TW	CL	CL	25	--	--	47	27	20	--	--	--	--	--	--	--	--	27	--	--	--	--	--	--	--	--	--	--
RB-28	34	PF	FSAR	155	157	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14,000	0.3089	0.0225
RB-28	35	PF	FSAR	160	161.5	SPT	CL	MH	24	--	--	35	19	16	--	--	--	--	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	36	PF	FSAR	165	167	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	26,000	0.299	0.0183
RB-28	39	PF	FSAR	180	181.5	SPT	CH	CL	47	--	--	87	34	53	--	--	--	--	60	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	40	PF	FSAR	185	186.5	SPT	CL	MH	40	--	--	43	26	17	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	42	PF	FSAR	195	196.5	SPT	CH	CL	40	--	--	64	31	33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	45	PF	FSAR	210	212	TW	CH	CL	26	98.4	--	61	29	32	--	--	--	--	--	19,080	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	50	PF	FSAR	235	236.5	SPT	CH	CH	26	--	--	59	26	33	--	--	--	--	53	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	51	PF	FSAR	240	242	TW	CH	CL	23	102	--	37	20	17	--	--	--	--	--	7940	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-28	53	PF	FSAR	250	252	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	44,000	0.3089	0.0177
RB-29	26	PF	FSAR	115	116.5	SPT	CL	CL	27	--	--	43	17	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	28	PF	FSAR	125	126.5	SPT	CL	ML	27	--	--	34	19	15	--	--	--	--	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	29	PF	FSAR	130	132	TW	CL	CH	18	113.4	--	25	18	7	--	--	--	--	--	10,800	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	30	PF	FSAR	135	136.5	SPT	CL	MH	26	--	--	36	19	17	--	--	--	--	14	--	--	5500	35.6	--	--	--	--	--	--	--	--	--	--
RB-29	32	PF	FSAR	145	146.5	SPT	CL	MH	27	--	--	36	21	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	36	PF	FSAR	165.5	167	SPT	CL	MH	26	--	--	31	19	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	38	PF	FSAR	175.3	177.3	TW	CL	MH	24	97	--	32	21	11	--	--	--	--	--	5100	--	--	--	--	--	--	--	--	--	--	20,000	0.3039	0.0303
RB-29	43	PF	FSAR	200	201.5	SPT	--	SM	31	--	--	--	--	--	0	35.2	64.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	47	PF	FSAR	220	221.5	SPT	CL	CH	21	--	--	47	25	22	--	--	--	--	37	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	50	PF	FSAR	235	237	TW	CH	CH	32	--	--	63	30	33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-29	55	PF	FSAR	260	261.5	SPT	CL	CH	22	--	--	43	22	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	25	PF	FSAR	110	112	TW	CL	CH	27	95	--	18	18	20	--	--	--	--	13	3300	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	26	PF	FSAR	115	116.5	SPT	SC	SM	--	--	--	--	--	--	0	75.9	24.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	27	PF	FSAR	120	121.5	SPT	CL	CH	23	--	--	49	23	26	--	--	--	--	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	28	PF	FSAR	125	127	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20,000	0.1169	0.0145
RB-30	29	PF	FSAR	130	131.5	SPT	CL	CL	22	--	--	38	17	21	--	--	--	--	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	36	PF	FSAR	161.5	163.5	TW	CL	CL	26	--	--	44	26	18	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	37	PF	FSAR	165	167	TW	CL	CL	28	96.5	--	40	22	18	--	--	--	--	--	7600	--	--	--	--	--	--	--	--	--	--	20,000	0.3081	0.0437
RB-30	38	PF	FSAR	170	171.5	SPT	CH	CH	37	--	--	73	33	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	40	PF	FSAR	180	181.5	SPT	CL	CL	35	--	--	42	25	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	43	PF	FSAR	195	197	TW	CL	CH	23	104.7	--	43	17	26	--	--	--	--	--	7200	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	45	PF	FSAR	205	207	TW	CH	CH	27	97.37	--	56	25	31	--	--	--	--	--	4290	6	4500	8.2	--	--	--	--	--	--	--	--	--	--
RB-30	48	PF	FSAR	220	221.5	SPT	CL	ML	23	--	--	30	20	10	0	34.7	65.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	52	PF	FSAR	240	241.5	SPT	CL	CH	18	--	--	45	15	30	--	--	--	--	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-30	56	PF	FSAR	260	261.5	SPT	CH	CL	22	--	--	54	22	32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 2.5.4-201 (Sheet 6 of 6)
Summary of Static Laboratory Analyses

Sample ID		Geologic	Source	Depth (ft. bgs)		Sample	USCS Class		Natural	Dry Unit		Atterberg Index[c]			Mechanical Sieve Analysis			Hydrometer Analysis		Total Stress		Effective Stress		Maximum	Optimum		Soluble	Soluble			Consolidation Testing		
Boring	Sample No.	Unit[a]		From	To	Method[b]	Lab	Field	Moisture (%)	Weight (pcf)	Gs	LL	PL	PI	% Gravel	% Sand	% Fines	% Silt	% Clay	Cohesion (psf)	Friction Angle (degrees)	Cohesion (psf)	Friction Angle (degrees)	Dry Density (pcf)	Moisture %	pH	Chloride mg/kg	Sulfate mg/kg	Sulfide mg/kg	REDOX mV	P_c (psf)	C_c	C_r
RB-31	21	PF	FSAR	90	92	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20,000	0.2864	0.0322
RB-31	26	PF	FSAR	115	116.5	SPT	CL	MH	29	--	--	42	22	20	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	30	PF	FSAR	135	137	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20,000	0.2183	0.0271
RB-31	32	PF	FSAR	145	147	TW	CH	CH	19	--	--	57	21	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	36	PF	FSAR	165	167	TW	CH	CH	21	--	--	60	26	34	--	--	--	--	--	1650	15.6	1300	27.4	--	--	--	--	--	--	--	--	--	--
RB-31	41	PF	FSAR	190	191.5	SPT	CH	CH	34	--	--	67	27	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	51	PF	FSAR	240	241.5	SPT	CL	CL	26	--	--	50	23	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	56	PF	FSAR	265	267	TW	CL	CL	30	96.5	--	50	21	29	--	--	77	--	--	4800	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	58	PF	FSAR	275	277	TW	CL	CH	18	112.6	--	41	17	24	--	--	99	--	--	9600	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	69	PF	FSAR	330	331.5	SPT	CL	CL	29	--	--	46	25	21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
RB-31	73	PF	FSAR	350	351.5	SPT	SC	SM	--	--	--	23	13	10	--	65.5	34.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SB-54	32	PF	FSAR	140	141.5	SPT	CL	CH	21	--	--	49	22	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-06	34	PF	FSAR	155	157	TW	CL	CL	19	107.2	--	31	16	15	--	--	--	--	--	15,300	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	31	PF	FSAR	140	142	TW	CL	CH	20	102.1	--	48	20	28	--	--	--	--	--	3540	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	32	PF	FSAR	145	146.5	SPT	CL	CL	24	--	--	47	21	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	33	PF	FSAR	150	152	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24,000	0.1711	0.0219
TB-08	35	PF	FSAR	160	162	TW	CL	ML	27	93.3	--	49	27	22	--	--	--	--	--	6600	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	37	PF	FSAR	170	172	TW	CL	CH	27	95.1	--	42	24	18	--	--	--	--	--	7400	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	44	PF	FSAR	205	206.5	SPT	CL	MH	31	--	--	49	26	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-08	45	PF	FSAR	210	212	TW	CL	CH	15	--	--	49	23	26	--	--	--	--	--	3330	11	3200	13.5	--	--	--	--	--	--	--	--	--	--
TB-08	50	PF	FSAR	235	236.5	SPT	CH	CL	26	--	--	51	24	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	31	PF	FSAR	125	127	TW	CL	ML	23	--	--	34	15	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	35	PF	FSAR	145	147	TW	CL	MH	22	97.7	--	40	23	17	--	--	--	--	--	6200	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	40	PF	FSAR	170	172	TW	CL	ML	22	96.2	--	26	16	10	--	--	--	--	--	22,000	--	--	--	--	--	--	--	--	--	--	24,000	0.1727	0.0188
TB-10	49	PF	FSAR	215	217	TW	CH	CH	23	104.4	--	55	21	34	--	--	--	--	--	8400	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10	52	PF	FSAR	230	231.5	SPT	CL	MH	24	--	--	30	16	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10A	3	PF	FSAR	440	442	TW	--	SP	24	103	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-10A	5	PF	FSAR	550	552	TW	CL	CL	35	95	--	36	18	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TB-53	31	PF	FSAR	140	142	TW	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13,000	0.1654	0.0312
TB-53	35	PF	FSAR	160	162	TW	CL	MH	25	94.2	--	43	24	19	--	--	--	--	--	8200	--	--	--	--	--	--	--	--	--	--	18,000	0.3986	0.0299

a) Fill = Fill; E. Fill = Engineered Fill; Loess = Loess; PHTS = Port Hickey Top Stratum; PH = Port Hickey; UC = Upper Citronelle; LC = Lower Citronelle; PF = Pascagoula Formation.

b) SPT = Standard Penetration Test; TW = Shelby Tube; RNG = Ring-Lined Split Spoon Sampler.

c) LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index.

RBS COL 2.0-29-A

Table 2.5.4-202
Compilation of Dynamic Sample Data

Sample Identification					Confining Pressure (σ_o)				Laboratory Measured Shear Wave Velocity Vs					
Boring	Sample	Formation	Test Performed[c]	Sample Depth (ft)	In-situ (psi)	4x (psi)	Assumed K_o	G_{max} 1x In-situ σ_o (ksf)	In-situ (ft/sec)	4x (ft/sec)	In-situ Vs[a] (ft/sec)	Lab to Field Vs Ratio In-situ σ_o	Soil Type USCS	Correction Factors[b]
RB24	TW26	Pascagoula	RCTS	115.9	43	173	0.7	2515	797	1049	1210	0.66	CL	1.52
RB25	RNG15	Lower Citronelle	RCTS	61.5	20	80	0.5	3068	913	1277	880	1.04	SP	0.96
RB27	TW-80	Pascagoula	RCTS/CSS	196.4	71	NA	0.7	2330	773	NA	970	0.80	CH	1.25
FB39	TW22	Pascagoula	RCTS/CSS	86.4	27	108	0.7	1326	591	860	820	0.72	CL	1.39
FB39	SPT16	Lower Citronelle	RCTS/CSS	56.5	18	73	0.5	2639	828	1159	950	0.87	SP-SC	1.15
RB26A	TW14	Pascagoula	RCTS/CSS	146.2	55	219	0.7	4946	1152	1393	1220	0.94	CL	1.06
RB26A	TW14	Pascagoula	RC	145.9	55	---	0.7	3191	917	---	1220	0.75	CL	1.33
RB28	TW36	Pascagoula	RCTS/CSS	166.2	61	NT	0.7	2435	796	NT	845	0.94	CL	1.06
RB28	TW36	Pascagoula	RC	165.7	61	---	0.7	2564	825	---	845	0.98	CL	1.02
RB31	TW62	Pascagoula	RCTS	297	106	NT	0.7	N/A	N/A	NT	1740	N/A	CH	N/A
RB24	TW40	Pascagoula	RCTS	185.4	68	270	0.7	N/A	N/A	N/A	905	N/A	CH	N/A
RB31A	CS04	Pascagoula	RCTS	381	113	226[d]	0.7	5139	1162	1437[d]	1360	0.85	SP	1.17
RB31A	CS05	Pascagoula	RC	390.5	113	---	0.7	5094	1128	---	1350	0.84	SP	1.20
RB31A	CS14	Pascagoula	RCTS	517.6	181	363[d]	0.7	5857	1259	1408[d]	1820	0.69	CH	1.45
TB-10	SPT20&21	Lower Citronelle	RCTS/CSS	80-86.5	23	93	0.5	3240	910	1323	1040	0.88	SW-SM/ SP-SC	1.14

a) In-situ Vs determined from suspension logging data from Borings RB-31B and RB-31C.

b) Correction values were only applied if lab to field Vs ratio was below 0.80 or more than 1.20.

c) RCTS = Resonant column torsional shear test; CSS = Cyclic simple shear test; RC = Resonant column test.

d) Values represent data from tests performed at 2x in-situ confining stress.

NT = Not Tested.

N/A = Not Available.

RBS COL 2.0-29-A

Table 2.5.4-203 (Sheet 1 of 3)
Summary of Boring and CPT Stratigraphic Data

Boring/ Sounding ID	Top of Hole Elevation (ft. msl)	Base of Hole Depth (ft. bgs)	Top of Loess/Fill (ft. bgs)	Top of Port Hickey TS (ft. bgs)	Top of Port Hickey (ft. bgs)	Top of Engineered Fill (ft. bgs)	Top of Upper Citronelle (ft. bgs)	Top of Lower Citronelle (ft. bgs)	Top of Pascagoula (ft. bgs)
EB/TSC-01	93.8	36.5	0	--	4.5	--	12.5	--	--
EB/TSC-03	94.1	36.5	0	--	4.5	--	15	--	--
EB-TSC-04	94.3	36.5	0	--	7.5	--	18	--	--
EB-TSC-05	93.8	36.5	0	--	10	--	20.3		
TB-06	94.4	171.5	0 - 5	--	7.5	--	30.5	76	141.4
TB-07	93.6	96.5	0	--	7.5	--	30	60	--
TB-08	94.2	236.5	0	--	8.4	--	30	65	135
TB-09	66.9	66.5	0	--	--	--	2.7	41.1	--
TB-10	67.2	310	0	--	--	--	2.5	40	117
TB-11	65.9	66.5	0	--	--	--	25	40	--
FWS-19	93.6	51.5	0	--	8	--	20	--	--
CB-22	94.7	211.5	0	2.3	7.5		33	68	133
CB-22A	94.5	141.5	--	--	--	--	--	75	135
CB-23	64.2	101.5	0	--	--	--	4.5	28	--
RB-24	66	271.5	--	--	--	0	9.5	48	108.5
RB-25	66.6	271.8	--	--	--	0	1.5	43	108
RB-26	68.8	128	0	--	--	16	--	46.1	--
RB-26A	69.3	271.5	--	--	--	--	--	80	112.5

Table 2.5.4-203 (Sheet 2 of 3)
Summary of Boring and CPT Stratigraphic Data

RBS COL 2.0-29-A

Boring/ Sounding ID	Top of Hole Elevation (ft. msl)	Base of Hole Depth (ft. bgs)	Top of Loess/Fill (ft. bgs)	Top of Port Hickey TS (ft. bgs)	Top of Port Hickey (ft. bgs)	Top of Engineered Fill (ft. bgs)	Top of Upper Citronelle (ft. bgs)	Top of Lower Citronelle (ft. bgs)	Top of Pascagoula (ft. bgs)
RB-27	64.5	271.4	--	--	--	--	0	40.8	109.5
RB-28	68.2	271.6	0	--	--	17.5	--	48.3	113
RB-29	68.3	271.5	--	--	--	0	--	50.9	113
RB-29A	69.9	111.5	--	--	--	--	--	45	--
RB-30	64.9	271.5	--	--	--	0	7.5	53	107
RB-31	67.8	356.5	0	--	--	2.5	--	47.5	112.5
RW-33	64.6	71.5	--	--	--	0	--	45.7	--
RW-34	64.4	71.5	--	--	--	0	--	44.6	--
RW-35	67.1	76.5	--	--	--	0	--	51.2	--
FB-38	68.4	171.5	--	--	--	0	--	48.6	107.5
FB-39	65.2	171.5	0	--	--	--	15	52.5	117.5
SF-40	92.7	51.5	0	--	2	--	13	--	--
WT-41	93.4	51.5	0	--	10.7	--	13	--	--
FO-42	95.6	51.5	0	--	5		23.5	--	--
CT-43	95.1	176.5	0	--	7	--	17.5	57.9	117
CT-47	104.3	177	0	12.5	17.5	--	25	75	150.5
CS-51	63.3	31.5	0	--	--	--	1.5	--	--
CB-52	66.3	132	0	--	--	--	2.5	32.5	112.9
TB-53	94.3	171.8	0	--	8.5	--	32.5	60	135

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Table 2.5.4-203 (Sheet 3 of 3) Summary of Boring and CPT Stratigraphic Data

Boring/ Sounding ID	Top of Hole Elevation (ft. msl)	Base of Hole Depth (ft. bgs)	Top of Loess/Fill (ft. bgs)	Top of Port Hickey TS (ft. bgs)	Top of Port Hickey (ft. bgs)	Top of Engineered Fill (ft. bgs)	Top of Upper Citronelle (ft. bgs)	Top of Lower Citronelle (ft. bgs)	Top of Pascagoula (ft. bgs)
SB-54	93.8	151.5	0	--	5.8	--	27	52.5	133
FPWST-56	68.7	76.5	--	--	--	0	--	48.7	--
BFT-57	93.9	101.5	0	--	5	--	15	70	--
CPT-01	93.9	51.5	0	--	5	--	15.7		--
CPT-02	94.3	98.2	0 - 5	--	7.5	--	31.3	76.4	--
CPT-03	64	36	--	--	--	0	--	--	--
CPT-04	65.9	70.2	--	--	--	--	1.7	45.2	--
CPT-05	94.4	98	0	2.5	7.5	--	35.4	70.6	--
CPT-06	68.2	31.6	0	--	--	2.5	--	--	--
CPT-08	104.2	107	0	12.4	18.1	--	25.5	75.5	--
CPT-09	69	18	0	--	--	16.5	--	--	--
CPT-10	65.3	133	0	--	--	--	5	52.6	118.2

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**Table 2.5.4-204 (Sheet 1 of 2)
Summary of Engineering Properties**

	Wc (%)	LL (%)	PL (%)	PI (%)	γ_{total} (pcf)	% Fines
Engineered Fill	13	NP	NP	NP	120	5
Loess	23	40	20	20	120	95
Port Hickey (Top Stratum)	24	41	17	24	135	61
Port Hickey	18	N/A	N/A	N/A	120	25
Upper Citronelle (Cohesionless)	18	24	12	12	125	14
Upper Citronelle (Cohesive)	40	61	25	36	125	67
Lower Citronelle (Cohesionless)	16	21	12	9	125	7
Lower Citronelle (Cohesive)	25	42	18	23	125	48
Pascagoula (Cohesive)	27	46	22	24	125	24[a]
Pascagoula (Cohesionless)	27	31	16	15	125	25

a) Represents percent clay (material smaller than 0.002 mm).

NP represents non-plastic materials.

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Table 2.5.4-204 (Sheet 2 of 2) Summary of Engineering Properties

	Undrained Strength Parameters		Drained Strength Parameters	
	ϕ	c (tsf)	ϕ'	c' (tsf)
Engineered Fill	36	0	36	0
Loess	0	1.5	31	0
Port Hickey (Top Stratum).	0	1.4	30	0
Port Hickey	N/A	N/A	33	0
Upper Citronelle (Cohesionless)	N/A	N/A	35	0
Upper Citronelle (Cohesive)	N/D	N/D	N/D	N/D
Lower Citronelle (-15 > Elev > -30)	0 0	0 1.7	37 30	0 0
Pascagoula	0	$Su = 0.3*\sigma'_V + 2.6$ $2 \leq Su \leq 7$	25	0

N/D represents values not determined.

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Table 2.5.4-205
Summary of CPT Properties

Interpreted Parameter	Fill		Engineered Fill		Loess		Port Hickey TS		Port Hickey		Upper Citronelle		Lower Citronelle		Pascagoula	
	Mean	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**	**Mean**	**St Dev**
$q_{c\ (tsf)}$	1.54	0.64	3.18	0.68	3.09	1.77	0.99	0.45	1.84	0.77	1.34	0.79	1.32	0.70	1.49	0.87
q_t (tsf)	147.3	66.9	454.2	76.0	122.0	78.8	40.6	17.7	135.6	69.8	184.9	110.5	252.0	127.3	83.7	49.1
R_f (%)	1.50	1.87	0.70	0.13	2.74	0.93	2.51	0.73	1.63	0.91	-0.12	0.45	0.59	0.31	1.95	0.82
u (psi)	-0.9	0.7	-0.1	2.0	-1.7	1.5	-5.4	3.8	-3.9	1.4	0.8	4.6	16.0	12.2	4.6	4.9
N_{60} (blows/ft)	47	27	75	21	21	12	41	32	18	16	31	23	43	21	19	8
Phi (Φ)	50	0	49.64	0.98	48	1.73	48.43	2.07	41.03	3.5	38.69	5.55	37.3	4.49	29.43	1.79
S_u (psf)	3619	1878	NA	NA	5836	3292	2951	1301	2645	1310	1708	2414	2748	1958	4506	1139
OCR	111.4	65.1	NA	NA	124.6	80.7	57.4	37.2	17.6	15.1	5.6	12.2	1.3	1.0	1.9	0.6

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Table 2.5.4-206 (Sheet 1 of 3)
Summary of Borehole Locations, Depths, Drilling Methods, and In Situ Testing

		Location		Borehole Method		Depth (ft.)		In Situ Testing	
Facility or Zone	Borehole ID	Northing	Easting	Rotary Wash	Soil	Proposed	Actual	Seismic Velocity	Pressuremeter
Power Block Primary Boreholes	CB-22	17166.0	16783.1	x	n/a	210	211.5		
	CB-22A	17175.9	16787.7	x	n/a	140	141.5		
	CB-23	17196.9	16919.8	x	n/a	100	101.5		
	RB-24	17096.2	16973.0	x	n/a	270	271.5		
	RB-25	17075.6	16999.7	x	n/a	270	271.8		
	RB-26	17080.0	17082.3	x	n/a	270	128.0		
	RB-26A	17090.5	17082.4	x	n/a	270	271.5		
	RB-27	17154.5	16931.7	x	n/a	270	271.4		
	RB-28	17158.0	16998.8	x	n/a	270	271.6		
	RB-28A	17164.2	17001.1	x	n/a	150	150.0		x
	RB-29	17128.7	17079.7	x	n/a	270	271.5		
	RB-29A	17128.4	17074.5	x	n/a	110	111.5		
	RB-30	17236.7	16920.3	x	n/a	270	271.5		
	RB-31	17235.0	16988.2	x	n/a	430	356.5		
	RB-31A	17232.3	16978.0	x	x	550	555.0	x	
	RB-31B[(a)]	17214.4	16989.0	x	x	550	565.0		
	RB-31C[(a)]	17254.2	16984.7	x	n/a	200	76.2		
	FB-38	17308.1	16990.3	x	n/a	170	171.5		
	FB-39	17311.6	16924.7	x	n/a	170	171.5		
	CB-52	17026.8	17060.1	x	n/a	130	132.0		

Table 2.5.4-206 (Sheet 2 of 3)
Summary of Borehole Locations, Depths, Drilling Methods, and In Situ Testing

Facility or Zone	Borehole ID	Location		Borehole Method		Depth (ft.)		In Situ Testing	
		Northing	Easting	Rotary Wash	Soil	Proposed	Actual	Seismic Velocity	Pressuremeter
	RB-31B	17214.4	16989.0	x	n/a	565	565	x	
	RB-31C[b]	17254.2	16984.7	x	n/a	175	176.2	x	
Power Block Secondary Boreholes	EB/TSC-01	16691.9	16707.9	x	n/a	35	36.5		
	EB/TSC-03	16820.4	16706.8	x	n/a	35	36.5		
	EB/TSC-04	16943.5	16707.8	x	n/a	35	36.5		
	EB/TSC-05	16965.7	16768.5	x	n/a	35	36.5		
	TB-06	16685.4	16927.5	x	n/a	170	171.5		
	TB-06A	16681.4	16925.6	x	n/a	150	150.0		x
	TB-07	16838.7	16926.8	x	n/a	95	96.5		
	TB-08	17010.5	16882.2	x	n/a	235	236.5		
	TB-09	16703.8	17040.3	x	n/a	65	66.5		
	TB-10	16793.0	17040.5	x	n/a	230	310.0		
	TB-10A	16816.7	17121.7	x	x	550	552.0	x	
	TB-10B[a]	16836.7	17128.7	x	x	550	75		
	RW-33A[a]	16931.4	17191.3	x	n/a	230	55		
	TB-11	16947.8	17082.5	x	n/a	65	66.5		
	RW-33	16945.5	17205.4	x	n/a	70	71.5		
	RW-34	16955.8	17324.8	x	n/a	70	71.5		
	RW-35	17054.9	17205.3	x	n/a	75	76.5		
	RW-36	17007.2	17269.4	x	n/a	265	252.3	x	
	TB-53[b]	16913.5	16921.8	x	n/a	170	171.8		

Table 2.5.4-206 (Sheet 3 of 3)
Summary of Borehole Locations, Depths, Drilling Methods, and In Situ Testing

		Location		Borehole Method		Depth (ft.)		In Situ Testing	
Facility or Zone	Borehole ID	Northing	Easting	Rotary Wash	Soil	Proposed	Actual	Seismic Velocity	Pressuremeter
Cooling Tower	CT-43	17420.2	16561.9	x	n/a	175	176.5		
	CT-47	15575.6	15700.5	x	n/a	175	177.0		
General Site Coverage and Facilites	SF-40	16417.9	16528.6	x	n/a	50	51.5		
	WT-41	16531.1	16525.9	x	n/a	50	51.5		
	FO-42	16783.2	16528.6	x	n/a	50	51.5		
	FPWST-56(b)	17117.6	17194.7	x	n/a	75	76.5		
	BFT-57(b)	16818.0	16769.2	x	n/a	100	101.5		
	SB-54(b)	17024.3	16809.5	x	n/a	150	151.5		
	CS-51	16741.8	17118.9	x	n/a	30	31.5		
	FWS-19	17155.7	16743.1	x	n/a	50	51.5		

a) Seismic test boreholes without sampling.

b) Borings performed for alternate reactor technology.

RBS COL 2.0-29-A

Table 2.5.4-207
Summary of Pressuremeter Test Reports

Borehole ID	Test Location[a] Depth (ft. bgs)	Test Location[a] Elevation (ft. msl)	Geologic Unit[b]	Limit Pressure (ksf)	Pressuremeter Modulus (E_{PMT}) (ksf)	Unload-Reload Modulus (E_{ur}) (ksf)	Menard's Correction Factor α[c]	Corrected Young's Modulus (E_{adjust})[d] (ksf)
TB-06A	51.0	43.6	UC	40	254	2500	0.33	770
TB-06A	61.0	33.6	UC	22	234	1572	0.50	469
TB-06A	64.5	30.1	UC	68	375	3276	0.33	1136
RB-28A	75.0	-6.7	LC (Cohesionless)	88	405	----	0.25	1622
RB-28A	105.0	-36.7	LC (Cohesive)	----	556	3008	----	----
RB-28A	115.0	-46.7	PC	47	291	1090	0.50	581
RB-28A	125.0	-56.7	PC	63	1313	1799	1.00	1313
RB-28A	135.0	-66.7	PC	79	1495	2839	1.00	1495

a) Ground surface elevations at TB-06A and RB-28A are 68.3 ft. msl and 94.6 ft. msl, respectively.

b) UC = Upper Citronelle, LC = Lower Citronelle, PC = Pascagoula Clay.

c) α represents correction factor to account for stress history and soil type.

d) $E_{adjust} = E_{PMT} / \alpha$.

RBS COL 2.0-29-A

Table 2.5.4-208
Summary of Monitoring Wells and Piezometers

Monitoring Well/ Piezometer ID	Location[a]		Ground Surface Elevation (ft. msl)	Top of Casing Elevation (ft. msl)	Depth of Screened Interval		
	Northing	Easting			Base (ft.)	Top (ft.)	Aquifer[b]
MW-01	18277.9	14632.8	126.4	129.30	108	98	UT
MW-02	17667.5	16195.9	96.2	99.58	84	74	UT
MW-03	15876.6	12902.3	135.9	139.04	115	105	UT
MW-04	16333.0	16401.4	93.6	96.89	88	78	UT
MW-05	16206.7	14546.1	130.7	133.79	98	88	UT
MW-06	16040.7	17991.0	93.0	96.27	87	77	UT
MW-07	15709.0	18426.8	88.8	91.98	96	86	UT
MW-08	15203.3	14960.3	138.8	142.38	119	109	UT
MW-09	14737.2	17805.0	102.4	105.11	60	50	UT
MW-10	14869.9	17037.7	107.4	110.65	112	107	UT
MW-11	13650.8	13154.9	135.7	139.33	115	105	UT
MW-12	13076.3	15047.2	124.9	128.44	106	96	UT
MW-13	13786.6	17241.8	103.0	106.29	115	105	UT
MW-14	14426.4	15283.6	136.2	139.13	110	100	UT
MW-15	12760.2	14299.4	134.7	138.00	109	99	UT
MW-16	12839.6	11119.8	99.4	103.01	90	80	UT
MW-17	12520.6	12941.8	124.0	127.46	105	95	UT
MW-18	11831.0	14403.1	113.2	116.42	97	87	UT
MW-19	11496.3	11167.7	112.2	115.31	90	80	UT
MW-20	11979.8	8383.7	46.5	49.53	70	60	MRAA
MW-21	10958.7	12204.0	104.9	108.07	90	80	UT
PZ-01	16696.9	16925.3	94.4	97.00	65	55	UT
PZ-02	17161.0	16785.4	94.7	96.98	78	68	UT
PZ-03	16952.7	17324.5	64.4	67.30	69	59	UT

a) Location coordinates represent plant coordinates.

b) UT = Upland Terrace Aquifer, MRAA = Mississippi River Alluvial Aquifer.

Table 2.5.4-209
Summary of CPT Soundings

Facility or Zone	Sounding ID	Coordinates		Ground Surface Elevation (ft. msl)	Depth (ft.)	
		Northing	Easting		Prop.	Actual
Safety Related Structures	CPT-05	17171.6	16779.0	94.4	100.0	98.0
	CPT-06	17237.6	16986.0	68.2	270.0	31.6
	CPT-09	17082.5	17078.8	69.0	100.0	18.0
	CPT-10	17306.9	16921.8	65.3	135.0	133.0
Non-Safety Related Structures	CPT-01	16818.0	16704.9	93.9	100.0	51.5
	CPT-02	16687.6	16925.3	94.3	100.0	98.2
	CPT-03	16947.9	17316.6	64.0	100.0	36.0
	CPT-04	17016.0	17031.4	65.9	100.0	70.2
	CPT-08	15582.0	15699.3	104.2	100.0	107.0

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Table 2.5.4-210
Summary of Field Measured and Estimated Aquifer Hydraulic Properties

Monitoring Well No.	Aquifer	Approximate Screen Elevation (ft. msl)	Field Hydraulic Conductivity (ft./day)	Type of Test	Empirical Hydraulic Conductivity (ft./day)[a]	Coefficient of Transmissivity (gpd/ft.)	Storage Coefficient
T1	UT[b]	50 to -30	2.93E+02	Pump	N/A	184,400	0.08
T-13	Z-3[c]	-1690	5.85E+01	Pump	N/A	35,000	0.0001
MW-1	UT	20	3.98E-01	Slug	6.38E-01	N/A	N/A
MW-2	UT	10	3.81E+00	Slug	6.29E+01	N/A	N/A
MW-4	UT	3	1.50E+01	Slug	2.55E+00	N/A	N/A
MW-7	UT	-2	1.34E+00	Slug	1.81E+03	N/A	N/A
MW-18	UT	13	3.77E-01	Slug	2.30E+01	N/A	N/A
MW-5	UT	31	4.50E-02	Slug	9.18E+01	N/A	N/A
MW-11	UT	18	1.58E-02	Slug	2.30E+01	N/A	N/A
MW-14	UT	33	7.54E-03	Slug	1.55E+01	N/A	N/A
N/A	MRAA[d]	N/A	N/A	Pump	N/A	139,000	0.001

a) Empirical hydraulic conductivity values based on the Hazen Equation.

(b) UT = Upland Terrace Aquifer.

(c) Z-3 = Zone 3 Aquifer.

(d) MRAA = Mississippi River Alluvial Aquifer.

N/A = Not available.

Table 2.5.4-211
Samples with FOS < 1.4 from Borings with Their Initial Ground Surface at Approximately Elevation +95 ft. msl or Higher
(Total Number of Samples: 344)

Range of FS	Boring	Sample Elevation (ft. msl)	Sample Depth (ft.)	FS	Remark
FS $\leq$ 1.0	CB-22	+34.7	60.0	1.0	Will be removed and backfilled
	TB-06	-75.6	170.0	0.95	Limited thickness and lateral extent; deep
1.0 < FS $\leq$ 1.1	CB-22	+29.7	65.0	1.10	Will be removed and backfilled
	TB-06	+34.4	60.0	1.01	Limited thickness and lateral extent
1.1 < FS < 1.4	BTF-57	+88.9	5.0	1.20	Limited thickness and lateral extent
	CB-22	+76.2	18.5	1.35	Will be removed and backfilled
	CB-22	+44.7	50.0	1.35	Will be removed and backfilled
	FWS-19	+88.6	5.0	1.27	Will be removed and backfilled
	TB-06	+44.4	5.0	1.17	Limited thickness and lateral extent
	TB-06	-10.6	105.0	1.23	Limited thickness and lateral extent

Table 2.5.4-212
Samples with FOS < 1.4 from Borings with Their Initial Ground Surface at Approximately Elevation +65 ft. msl to Be Backfilled to Approximately +95.0 ft. msl
(Total Number of Samples: 650)

Range of FS	Boring	Sample Elevation (ft. msl)	Sample Depth[a] (ft.)	FS	Remark
FS $\leq$ 1.0					None
1.0 < FS $\leq$ 1.1					None
1.1 < FS < 1.4	RB-28	-27.2	122.2	1.36	Limited thickness
	RB-29A	-25.1	120.1	1.20	Very limited thickness (approximately 1.0 ft. only)

a) Depth estimated from final grade (Elevation +95.0 ft. msl).

Table 2.5.4-213
Computed Settlement Versus DCD Critiera

	Acceptance Settlement in the ESBWR DCD/ Calculated Settlement from FEM/Hand-Method[a]			
Building	**Maximum Settlement at any Corner of Basemat[b] (in.)**	**Average Settlement at Four Corners of Basemat[b] (in.)**	**Maximum Differential Settlement along the Longest Mat Foundation Dimension[c] (in.)**	**Maximum Differential Displacement between Reactor/ Fuel Building and Control Building (in.)**
Reactor/Fuel Building	4.0/0.7	2.6/0.6	3.0/0.6	3.3/0.8
Control Building	0.7/0.7	0.5/0.7	0.6/0.3	3.3/0.8
Fire Water Service Complex	0.7/0.4	0.4/0.4	0.5/0.2	N/A

a) The calculated FEM settlements are rounded to the nearest 0.1 in.

b) Maximum corner settlements are computed for the post-construction case in accordance with the DCD.

c) Computed values for differential settlements were selected as the maximum values calculated between corner points on the foundation between the FEM loading stages.

FSAR 2.5.4 Figures

Due to the large file sizes of the figures for FSAR Section 2.5.4, they are collected in a single .pdf file, which you can navigate via the figure numbers in the Bookmark pane. When cited in the text, the links for these figures will launch the .pdf file.

2.5.5 STABILITY OF SLOPES

RBS COL 2.0-30-A

This subsection provides an evaluation of the stability of all earth slopes, both natural and man-made, the failure of which could adversely affect the safety of Seismic Category I structures. Potential dam failures are discussed in Subsection 2.4.4. No safety-related retaining walls, bulkheads, or jetties are required for RBS Unit 3. The plant is centrally sited on a broad, relatively level cut pad that was excavated during the construction of RBS Unit 1. With the exception of the excavation for the previous Unit 2, the site is relatively level and is bordered by existing cut slopes on the north, south, and west (Figure 2.5.5-201). Existing cut slopes range in height from 20 to 33 ft. and are separated from the Seismic Category I or safety-related structures by distances between 400 and 1000 ft. The minimum slope height-to-distance ratio for the structures is at least 10. No natural or man-made slopes exist in proximity to the safety-related nuclear islands that could pose a potential slope stability hazard to the safe operation of the plant. Additionally, no natural descending slopes, such as riverbanks or ridge slopes, exist near the perimeter of the RBS Unit 3 power block area that could pose a potential encroachment or undermining hazard. Therefore, a potential slope stability hazard does not exist under static or dynamic conditions that could adversely affect the Seismic Category I or safety-related structures.

Temporary cuts below the existing ground surface are required for construction of the nuclear island basemat foundations. These cuts are to be backfilled up to level plant grade and would not pose a potential post-construction or operational slope stability hazard. This FSAR section, therefore, presents a brief discussion of the permanent slopes, natural or man-made; Subsection 2.5.4.5 briefly discusses the temporary slope stability of the construction cut slopes under static conditions.

2.5.5.1 Slope Characteristics

2.5.5.1.1 General Discussion

The existing ground surface within the RBS Unit 3 area is approximately Elevation 95 ft. with the exception of the previous Unit 2 excavation, which is to be backfilled upon construction of RBS Unit 3. As discussed in Subsection 2.5.1, the soils at the RBS site are generally granular, cohesionless sands overlying stiff clay. As shown in Figure 2.5.5-201, the site grading for RBS Unit 3 involves filling the Unit 2 excavation to final plant grade, relocating the canal for West Creek approximately 200 ft. west, and cutting soils to the west to make room for construction areas and the cooling towers (Figure 2.5.5-201). With the exception of the western portion of the site, construction of RBS Unit 3 does not require any significant changes to the site topography (Figure 2.5.5-201).

2.5.5.1.2 Existing Slope Characteristics

As noted in the RBS Safety Evaluation Report, there are no permanent slopes near the existing Unit 1 whose failure could damage Seismic Category I structures (Reference 2.5.5-201).

The existing east-west trending cut slope to the north of the RBS Unit 3 nuclear island is limited in height to approximately 33 ft., is cut into granular materials, and is inclined at a grade of approximately 3 horizontal to 1 vertical (Reference 2.5.5-202). The toe of this cut slope is approximately 450 ft. from the fuel building (Figure 2.5.5-202). The distance from the Unit 1 Seismic Category I structure to the same slope is slightly more, 480 ft. according to the Updated Final Safety Analysis Report (UFSAR) (Reference 2.5.5-203). The minimum separation distance between the RBS Unit 3 Seismic Category I structures and the north cut slope toe is more than 10 times the slope height, providing a substantial safety buffer zone against possible slope failure under dynamic or static loading conditions encroaching on the Seismic Category I structures.

Even though the separation between the north cut slope toe and Unit 1 is approximately 450 ft., the stability of this slope was analyzed during the design of RBS Unit 1 (Figure 2.5.5-201). The results of the Unit 1 static stability analysis indicated factors of safety of greater than 5 for the static case (Reference 2.5.5-203). Dynamic slope stability analysis was also completed for the slope based on a horizontal acceleration of 0.10g and a vertical acceleration of 0.067g, corresponding to the Unit 1 safe shutdown earthquake (SSE) (Figure 2.5.5-203). The dynamic analysis also assumed that a liquefiable soil layer existed between Elevations +20 and +40 ft. msl. As discussed in Subsection 2.5.4.8, the RBS Unit 3 COL investigation did not observe the potential for extensive liquefaction in this zone. This layer was very conservatively analyzed using zero strength and analyzing the failure surface as a sliding block. The results of the analysis indicated a minimum factor of safety of 1.3 for the dynamic case (Reference 2.5.5-203). According to Table 2.0-2 of the ESBWR DCD, required factors of safety for slopes are 1.5 for static (non-seismic) loading and 1.1 for dynamic (seismic) loading due to site-specific SSE. The calculated factors of safety are greater than these requirements.

Additional analysis of the north slope was completed as part of the evaluation of the temporary excavation for RBS Unit 3. The results of this analysis were presented in Subsection 2.5.4. Based on the significant buffer zone and previous analysis, this permanent cut slope does not pose a potential safety hazard to the RBS Unit 3 Seismic Category I structures.

The existing slope to the south of RBS Unit 3 is limited to a maximum height of approximately less than 20 ft., is in cohesionless materials, and is also inclined at a grade of approximately 3 horizontal to 1 vertical (Reference 2.5.5-202). The minimum distance from the toe of the south slope to the nearest RBS Unit 3 Seismic Category I structure (reactor building) is more than 1000 ft. and more than 600 ft. from the RBS Unit 3 turbine building (Figure 2.5.5-202). The minimum separation between the RBS Unit 3 Seismic Category I structures and the south cut slope toe is more than 50 times the maximum slope height, providing a substantial safety buffer zone against possible slope failure under dynamic or static loading conditions. Therefore, the south cut slope does not pose a potential safety hazard to the RBS Unit 3 Seismic Category I structures.

The cut slopes to the west require modification for the construction of RBS Unit 3 and are described in the following subsection.

2.5.5.1.3 New Slope Characteristics

The existing slopes to the northwest and west of the nuclear island are to be regraded as part of the RBS Unit 3 construction. The cut slope to the northwest is limited to a maximum height of less than 15 ft. and is to be graded to a grade of at least 3 horizontal to 1 vertical (Figure 2.5.5-202). The minimum distance from the toe of the slope to the nearest Seismic Category I structure is more than 300 ft. (Figure 2.5.5-202). The minimum separation between RBS Unit 3 and the cut slope toe is more than 12 times the maximum slope height, providing a substantial safety buffer zone against possible west slope failure under dynamic or static loading conditions. Therefore, this cut slope does not pose a potential safety hazard to the RBS Unit 3 Seismic Category I structures.

The existing cut slope to the west of the RBS Unit 3 area is to be extended further west. The existing cut slope is currently approximately 25 ft. high and 500 ft. west of the nearest Seismic Category I structure (fire water service complex). Stability analysis of any required cut slopes will be completed as part of detailed design, and safety factors are to be calculated in accordance with Reference 2.5.5-204. The buffer between the toe of the slope and the nearest Seismic Category I structure is more than 20 times the slope height, providing a substantial safety buffer zone. The distance between the relocated cut slope and the RBS Unit 3 Seismic Category I structures would be the same or greater than for the existing cut slope and nearest Seismic Category I structure; therefore, this cut slope does not pose a potential safety hazard to the RBS Unit 3 Seismic Category I structures.

The cooling tower to the southwest of the RBS Unit 3 nuclear island also requires significant earthwork for construction. Stability analysis of any required cut slopes will be completed as part of detailed design, and safety factors are to be calculated in accordance with Reference 2.5.5-204. Based on the separation of the cooling tower from the RBS Unit 3 nuclear island (more than 1500 ft.), any cut slopes for this structure do not pose a potential safety hazard to the RBS Unit 3 Seismic Category I structures.

2.5.5.1.4 Exploration Program

Site investigation and subsurface geotechnical characterization are presented in Subsection 2.5.4; however, since the existing permanent slopes in the granular materials were previously analyzed and found to have adequate safety factors, no investigation was completed for the permanent slopes during the RBS Unit 3 investigation.

2.5.5.1.5 Groundwater and Seepage

A detailed discussion of the groundwater conditions is included in Subsection 2.4.12 and 2.5.4.6. In the Unit 1 analysis, the groundwater was modeled at Elevation 70 ft. msl (Figure 2.5.5-203), which is conservative based on the observations during the RBS Unit 3 investigation.

2.5.5.1.6 Slope Materials and Properties

Because the permanent slopes would not affect the Seismic Category I structures and a stability analysis was not performed, the selection of materials and properties for the cohesionless materials was not necessary. The soil properties used for the Unit 1 analysis are indicated in Figure 2.5.5-203. Subsection 2.5.4 discusses the soil parameters used in the slope stability analysis of the temporary construction slopes.

2.5.5.2 Design Criteria and Analysis

Because the permanent slopes do not affect the safety of the Seismic Category I structures, design/performance criteria and the most severe natural phenomena were not identified, and stability analyses were not performed.

2.5.5.3 Boring Logs

The boring logs are provided in Appendix 2AA. The exploration program and the drilling and sampling procedures are discussed in Subsection 2.5.4.

2.5.5.4 Compacted Fill

As discussed in Subsections 2.5.4.5 and 2.5.4.10, backfill is to be placed beneath the safety-related structures following removal of the existing material to Elevation 20 ft. msl. There are no safety-related fill embankments or fill slopes necessary. Compaction requirements for compacted fill or backfill placement are discussed in Subsection 2.5.4.5. Subsection 2.5.4.2.1 provides a description of the laboratory testing and sampling control procedures, and Subsection 2.5.4.2.2 provides a summary of static and dynamic engineering properties of the site materials. Refer to Subsection 2.5.4.3.1 for a discussion of RBS site exploration activities and sampling techniques.

There are no earth, rock, or earth and rock fill embankments used for plant flood protection or for impounding cooling water that could affect the safety of RBS Unit 3. Furthermore, there are no impoundment structures within the site that could pose a hazard to the proposed RBS Unit 3. Therefore, the hazard to embankment failure and surface water inundation of the proposed location of RBS Unit 3 is negligible.

2.5.5.5 References

2.5.5-201 U.S. Nuclear Regulatory Commission, *Safety Evaluation Report Related to the Operation of the River Bend Station*, Docket No. 50-458, NUREG-0989, dated May 1984; Supplement 1, dated October, 1984; Supplement 2, dated August 1985; Supplement 3, dated August 1985; Supplement 4, dated September 1985; Supplement 5, dated November 1985.

2.5.5-202 Entergy Operations, "Plant Excavation," Drawing No., EY-3A-4, Issue 4, June 3, 1996.

2.5.5-203 Entergy Operations, Inc., "River Bend Station Updated Final Safety Analysis Report," Section 2.5.5 through Revision 19, July 2006.

2.5.5-204 U.S. Army Corps of Engineers, "Slope Stability," Manual EM 1110-2-1902, 2003, Office of the Chief of Engineers, Department of the Army.

Figure 2.5.5-201. Site Grading Plan

RBS COL
TABLE 2.0-2
(2.5.5)

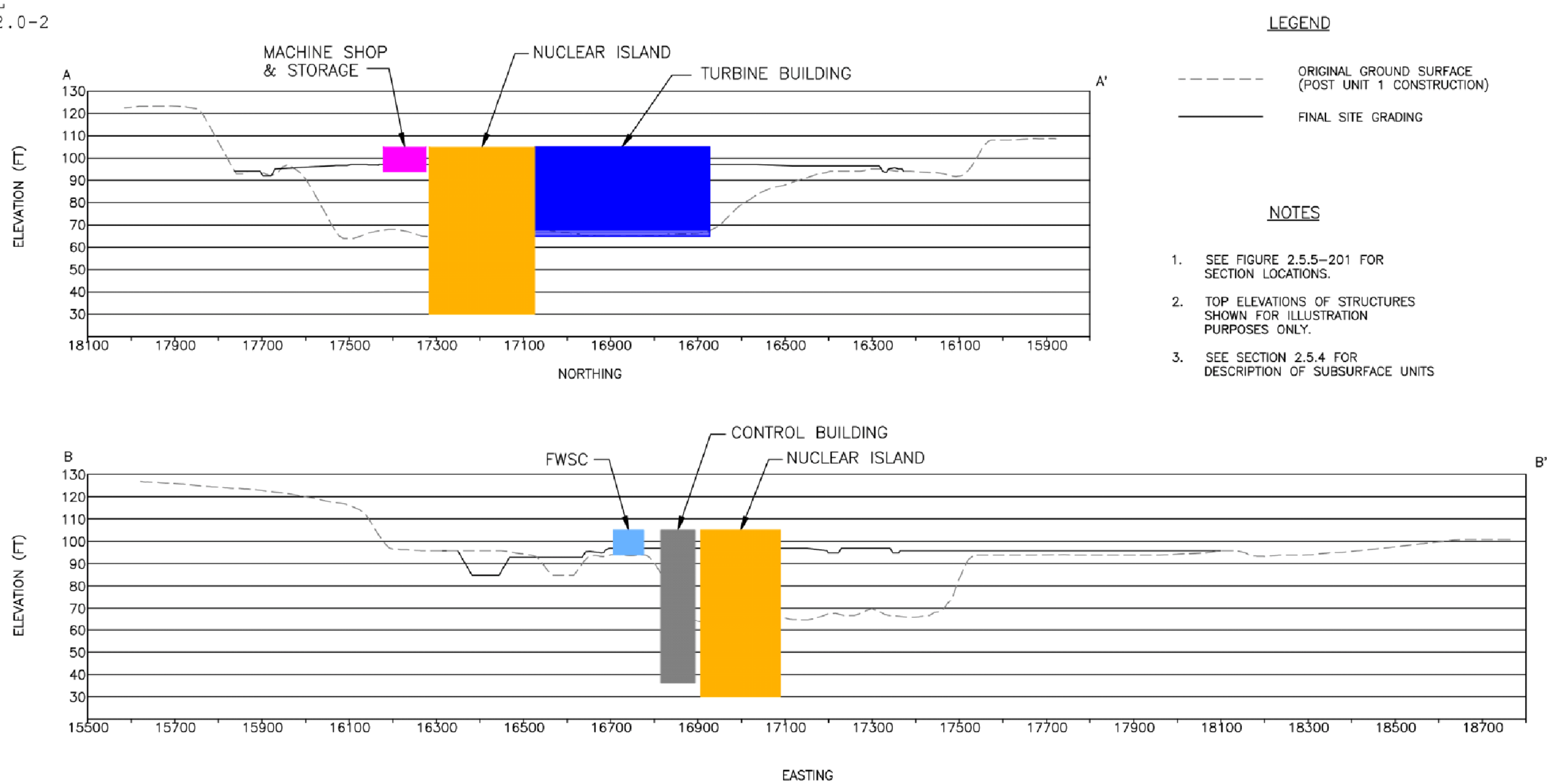

Figure 2.5.5-202. Profiles of Existing and New Slopes Within the Site Location

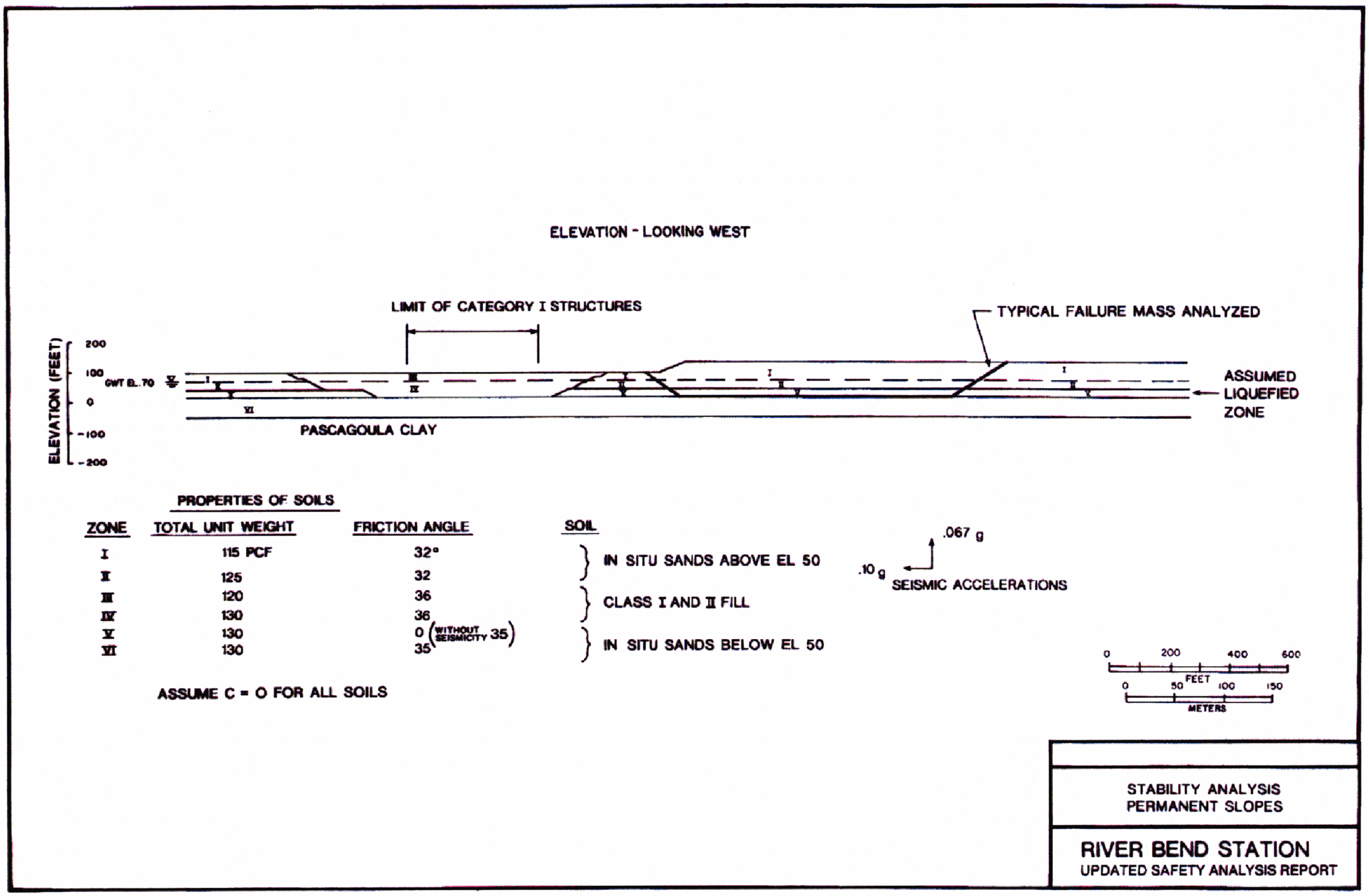

Figure 2.5.5-203. Stability Analysis Permanent Slopes
(Copy of Figure 2.5-94 from RBS Unit 1 Updated Safety Analysis Report)

APPENDIX 2AA LOGS OF BORINGS

RBS COL 2.0-30-A This appendix contains the entire set of geotechnical boring logs and a legend with Boring Log Terminology and Symbols for the RBS Unit 3 site investigations conducted between November 14, 2006 and December 13, 2006; between January 12, 2007 and June 13, 2007; and between February 21, 2008 and March 25, 2008.

CHAPTER 3 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT, AND SYSTEMS

3.1 CONFORMANCE WITH NRC GENERAL DESIGN CRITERIA

This section of the referenced DCD is incorporated by reference with no departures or supplements.

3.2 CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Table 3.2-1 Classification Summary

Replace the note for System P73 with the following.

STD CDI The site-specific plant design includes the Hydrogen Water Chemistry System (HWCS). See Section 9.3.9 for further details.

Replace the note for System P74 with the following.

STD CDI The site-specific plant design does not include the Zinc Injection System.

3.3 WIND AND TORNADO LOADINGS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

3.4 WATER LEVEL (FLOOD) DESIGN

This section of the referenced DCD is incorporated by reference with no departures or supplements.

3.5 MISSILE PROTECTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.5.1.5 Site Proximity Missiles (Except Aircraft)

Add the following sentence after the first sentence in the first paragraph.

STD SUP 3.5-1 Site-specific missile sources are addressed in Section 2.2.

3.5.1.6 Aircraft Hazards

Add the following at the end of the first paragraph.

STD SUP 3.5-2 Site-specific aircraft hazard analysis and the site-specific critical areas are addressed in Section 2.2.

3.6 PROTECTION AGAINST DYNAMIC EFFECTS ASSOCIATED WITH THE POSTULATED RUPTURE OF PIPING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.6.2.5 Pipe Break Analysis Results and Protection Methods

Replace the first sentence in this section with the following.

STD COL 3.6.5-1-A

The pipe break evaluation report will be completed in conjunction with closure of ITAAC 3.1-1, Item 3. This information will be included in the FSAR as part of a subsequent FSAR update. The pipe break evaluation report includes the following.

3.6.5 COL INFORMATION

3.6.5.1-1-A Pipe Break Analysis Results and Protection Methods

STD COL 3.6.5-1-A

This COL item is addressed in Section 3.6.2.5.

3.7 SEISMIC DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.7.1.1 Design Ground Motion

Add the following sections.

RBS SUP 3.7-1

3.7.1.1.4 Site-Specific Design Ground Motion Response Spectra

RBS DEP 2.0-1

The site-specific design Ground Motion Response Spectra (GMRS) and associated Foundation Input Response Spectra (FIRS) for Seismic Category I structures are described in Subsection 2.5.2. The site-specific GMRS/FIRS are compared with Certified Seismic Design Response Spectra (CSDRS) in Table 2.0-201. The GMRS/FIRS are enveloped by the CSDRS except for exceedance below 0.23 Hz for the horizontal motion and below 0.15 Hz for the vertical motion. This exceedance does not have an adverse impact on the seismic design of the ESBWR Standard Plant because:

a. There are no structural frequencies below 0.23 Hz in the frequency range of interest to structural response. For frequencies greater than 0.23 Hz, the CSDRS are higher.

b. Although pools in Reactor Building/Fuel Building (RBFB) have sloshing frequencies less than 0.23 Hz, sloshing response is only a small portion of overall seismic-induced hydrodynamic loads on the pool structure and does not govern. The majority of hydrodynamic loads are due to the impulsive response of the water. Impulsive response is a function of the pool structure response at structural frequencies. The FIRS are enveloped by the CSDRS in the frequency range of interest to structural response, frequencies greater than 0.23 Hz. The impulsive response inherent in the CSDRS-based design is typically an order of magnitude higher than the sloshing response at lower accelerations of the FIRS.

c. The CSDRS for the Fire Water Service Complex (FWSC) is 1.35 times the RBFB/Control Building (CB) CSDRS. The FWSC sloshing frequency is 0.24 Hz and is enveloped by the CSDRS.

d. The higher FIRS below 0.23 Hz is irrelevant to the CB because the CB does not contain water pools.

e. The vertical exceedance at frequencies below 0.15 Hz is inconsequential because vertical earthquake components do not induce sloshing.

Therefore, the adequacy of CSDRS is confirmed for Unit 3 application.

RBS SUP 3.7-2 3.7.1.1.5 Site-Specific Design Ground Motion Time History

The site-specific earthquake ground motion time history is not developed to match the GMRS/FIRS because the CSDRS are confirmed adequate (Section 3.7.1.1.4). Also Approach 3 of NUREG/CR-6728 was used to develop FIRS at the various foundation levels.

3.7.1.3 Supporting Media for Seismic Category I Structures

Add the following at the end of the first paragraph.

RBS SUP 3.7-3 Subsection 2.5.4 describes the site-specific properties of subsurface materials.

3.7.2.4 Soil/Structure Interaction

Add the following at the end of the first paragraph.

RBS SUP 3.7-4 Subsection 2.5.4 describes the site-specific properties of subsurface materials.

3.7.2.8 Interaction of Non-Category I Structures with Seismic Category I Structures

---

Add the following second paragraph.

RBS SUP 3.7-5 The locations of structures are provided in Figure 1.1-201.

3.7.4 SEISMIC INSTRUMENTATION

Add the following at the end of the first paragraph.

RBS SUP 3.7-6 The seismic monitoring program described in this subsection, including the necessary test and operating procedures, will be implemented prior to receipt of fuel on site.

3.8 SEISMIC CATEGORY I STRUCTURES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

3.9 MECHANICAL SYSTEMS AND COMPONENTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.9.2.4 Initial Startup Flow-Induced Vibration Testing of Reactor Internals

---

Replace the last two paragraphs in this section with the following.

RBS COL 3.9.9-1-H

A vibration assessment program, as specified in Regulatory Guide 1.20, will be completed no later than 6 months after the lead plant has completed its vibration assessment program.

3.9.3.1 Loading Combinations, Design Transients and Stress Limits

---

Replace the last sentence in this section with the following.

STD COL 3.9.9-2-H

The piping stress reports identified in this DCD section will be completed within six months of completion of ITAAC Table 3.1-1. The FSAR will be revised as necessary in a subsequent update to address the results of this analysis.

3.9.3.7.1(3)e Snubber Pre-service and In-service Examination Testing

---

Replace the last two sentences at the end of this section with the following.

STD COL 3.9.9-4-A

The inservice testing program for snubbers will be completed in accordance with milestones described in Section 13.4.

3.9.3.7.1(3)f Snubber Audit Support Data

Replace the first sentence of this section with the following:

STD COL 3.9.9-4-A

A plant specific table will be prepared in conjunction with closure of ITAAC Table 3.1-1 and include the following specific snubber information:

Add the following at the end of this section.

STD COL 3.9.9-4-A This information will be included in the FSAR as part of a subsequent FSAR update.

3.9.6 IN-SERVICE TESTING OF PUMPS AND VALVES

Replace the last sentence of this section with the following.

STD COL 3.9.9-3-A Milestones for implementation of the ASME OM Code preservice and inservice testing programs and the motor operated valve testing program are defined in Section 13.4.

3.9.6.6 10 CFR 50.55a Relief Requests and Code Cases

Add the following to the end of the first paragraph.

STD SUP 3.9-1 No relief from or alternative to the ASME OM Code is being requested beyond what is identified in the DCD.

3.9.7 RISK-INFORMED INSERVICE TESTING

Replace the text in this section with the following.

STD SUP 3.9-2 Risk informed inservice testing is not being utilized.

3.9.8 RISK-INFORMED INSERVICE INSPECTION OF PIPING

Replace the text in this section with the following.

STD SUP 3.9-3 Risk informed inservice inspection of piping is not being utilized.

3.9.9 COL INFORMATION

3.9.9-1-H Reactor Internals Vibration Analysis, Measurement and Inspection Program

RBS COL 3.9.9-1-H

This COL item is addressed in Subsection 3.9.2.4.

3.9.9-2-H ASME Class 2 or 3 or Quality Group D Components with 60 Year Design Life

STD COL 3.9.9-2-H

This COL item is addressed in Section 3.9.3.1.

3.9.9.3-A Inservice Testing Programs

STD COL 3.9.9-3-A

This COL item is addressed in Section 3.9.6.

3.9.9.4-A Snubber Inspection and Test Program

STD COL 3.9.9-4-A

This COL item is addressed in Section 3.9.3.7.1(3)e and Section 3.9.3.7.1(3)f.

3.10 SEISMIC AND DYNAMIC QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.10.1.4 Dynamic Qualification Report

Replace the last sentence in this section with the following:

STD COL 3.10.4-1-A

The Dynamic Qualification Report will be completed prior to fuel load. FSAR information will be revised, as necessary, as part of a subsequent FSAR update.

STD SUP 3.10-1

Section 17.5 defines the Quality Assurance Program requirements that are applied to equipment qualification files, including requirements for handling safety-related quality records, control of purchased material, equipment and services, test control, and other quality related processes.

3.10.4 COL INFORMATION

3.10.4-1-A Dynamic Qualification Report

STD COL 3.10.4-1-A

This COL item is addressed in Section 3.10.1.4.

3.11 ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3.11.2.2 Qualification Program, Methods and Documentation

Add the following paragraphs at the end of this section:

STD COL 3.11-1-A

Implementation of the environmental qualification program, including development of the plant specific Equipment Qualification Document (EQD), will be in accordance with the milestone defined in Section 13.4.

Following program implementation, DCD Table 3.11-1 will be supplemented, as necessary, in a subsequent FSAR update to include additional equipment covered by the program but not identified in the table.

3.11.5 COL INFORMATION

3.11-1-A Equipment Qualification Document

STD COL 3.11-1-A

This COL item is addressed in Section 3.11.2.2.

3.12 PIPING DESIGN REVIEW

STD SUP 3.12-1 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.

STD SUP 3.12-2 The location and distance between piping systems will be established as part of the completion of ITAAC Table 3.1-1. The FSAR will be revised as necessary, in a subsequent update to include this information.

3.13 THREADED FASTENERS - ASME CODE CLASS 1, 2, AND 3

STD SUP 3.13-1 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.

APPENDIX 3A SEISMIC SOIL-STRUCTURE INTERACTION ANALYSIS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

3A.1 INTRODUCTION

Replace the last sentence in the second paragraph with the following.

RBS CDI Site-specific geotechnical data is described and compatibility with site enveloping parameters is discussed in Chapter 2.

3A.2 ESBWR STANDARD PLANT SITE PLAN

Replace the first two sentences for the first paragraph with the following.

RBS CDI The site plan is shown in Figure 1.1-201. The plan orientation is denoted on the figure.

APPENDIX 3B CONTAINMENT HYDRODYNAMIC LOAD DEFINITIONS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3C COMPUTER PROGRAMS USED IN THE DESIGN AND ANALYSIS OF SEISMIC CATEGORY I STRUCTURES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3D COMPUTER PROGRAMS USED IN THE DESIGN OF COMPONENTS, EQUIPMENT AND STRUCTURES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3E (DELETED)

This section of the reference DCD is incorporated by reference with no departures or supplements.

APPENDIX 3F RESPONSE OF STRUCTURES TO CONTAINMENT LOADS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3G DESIGN DETAILS AND EVALUATION RESULTS OF SEISMIC CATEGORY I STRUCTURES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3H EQUIPMENT QUALIFICATION DESIGN ENVIRONMENTAL CONDITIONS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3I DESIGNATED NEDE-24326-1-P MATERIAL THAT MAY NOT CHANGE WITHOUT PRIOR NRC APPROVAL

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3J EVALUATION OF POSTULATED RUPTURES IN HIGH ENERGY PIPES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3K RESOLUTION OF INTERSYSTEM LOSS OF COOLANT ACCIDENT

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 3L REACTOR INTERNALS FLOW INDUCED VIBRATION PROGRAM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

CHAPTER 4 REACTOR

4.1 SUMMARY DESCRIPTION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

4.2 FUEL SYSTEM DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following paragraph after the third paragraph:

STD COL 4.2.6 There are no changes to the design of the fuel assembly or control rods from that presented in the certified design.

4.2.6 COL INFORMATION

STD COL 4.2.6 This COL item is addressed in Section 4.2.

4.3 NUCLEAR DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following sentence after the first paragraph:

STD COL 4.3-1-A There are no changes to the fuel or core design from that described in the referenced certified design.

4.3.5 COL INFORMATION

4.3-1-A Variances from Certified Design

STD COL 4.3-1-A This COL Item is addressed in Section 4.3.

4.4 THERMAL AND HYDRAULIC DESIGN

This section of the referenced DCD is incorporated by reference with no departures or supplements.

4.5 REACTOR MATERIALS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

4.6 FUNCTIONAL DESIGN OF REACTIVITY CONTROL SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 4A TYPICAL CONTROL ROD PATTERNS AND ASSOCIATED POWER DISTRIBUTION FOR ESBWR

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

4A.1 INTRODUCTION

Add the following at the end of the first paragraph.

STD COL 4A-1-A There are no changes to the fuel or core design from that described in the referenced certified design.

4A.3 COL INFORMATION

4A-1-A Variances from Certified Design

STD COL 4A-1-A This COL item is addressed in Appendix 4A.

APPENDIX 4B FUEL LICENSING ACCEPTANCE CRITERIA

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 4C CONTROL ROD LICENSING ACCEPTANCE CRITERIA

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 4D STABILITY EVALUATION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

CHAPTER 5 REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

5.1 SUMMARY DESCRIPTION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

5.2 INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

5.2.4 PRESERVICE AND INSERVICE INSPECTION AND TESTING OF REACTOR COOLANT PRESSURE BOUNDARY

Replace the last two sentences in the third paragraph with the following.

STD COL 5.2-1-H The initial inservice inspection program incorporates the latest edition and addenda of the ASME Boiler and Pressure Vessel Code approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load.

5.2.4.6 System Leakage and Hydrostatic Pressure Tests

Add the following paragraph at the end of this section.

STD SUP 5.2-1 System pressure tests and correlated technical specification requirements are provided in the plant Technical Specifications 3.4.4, "RCS Pressure and Temperature (P/T) Limits," and 3.10.1, "Inservice Leak and Hydrostatic Testing Operation."

5.2.4.11 COL Information for Preservice and Inservice Inspection and Testing Program of Reactor Coolant Pressure Boundary

---

Replace the first sentence of the first paragraph of this section with the following.

STD COL 5.2-1-H DCD Section 5.2.4 fully describes the Preservice and Inservice Inspection and Testing Programs for the RCPB. The implementation milestones for the Preservice and Inservice Inspection and Testing Programs are provided in Section 13.4.

Replace DCD Section 5.2.5.9 with the following.

5.2.5.9 Leak Detection Monitoring

STD COL 5.2-2-H Operators are provided with procedures to determine the identified and unidentified leakage in order to establish whether the leakage rates are within the limits in the Technical Specifications. These procedures assist operators in monitoring, recording, trending, determining the source of leakage, and evaluating potential corrective action. These procedures address the conversion of different parameter indications for identified and unidentified leakage (e.g., sump pump run time, sump level, condensate transfer rate) into common leak rate equivalents (e.g., volumetric or mass flow) and leak rate rate-of-change values. A description of the plant procedures program and implementation milestones are provided in Section 13.5.

5.2.6 COL INFORMATION

5.2-1-H Preservice and Inservice Inspection Program Plan

STD COL 5.2-1-H This COL Item is addressed in Section 5.2.4 and Section 5.2.4.11.

5.2-2-H Leak Detection Monitoring

STD COL 5.2-2-H This COL Item is addressed in Section 5.2.5.9.

5.3 REACTOR VESSEL

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

5.3.1.8 COL Information for Reactor Vessel Material Surveillance Program

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Replace this section with the following.

STD COL 5.3-2-A The description of the reactor vessel material surveillance program is provided in DCD Section 5.3.1.6. This program description addresses the following areas:

- Basis for selection of material in the program (DCD Section 5.3.1.6.1)
- Number and type of specimens in each capsule (DCD Section 5.3.1.6.1)
- Number of capsules and proposed withdrawal schedule (DCD Section 5.3.1.6.1)
- The method for calculating neutron flux and fluence calculations for vessel wall and surveillance specimens and conformance with guidance of RG 1.190 (DCD Section 5.3.1.6.2)
- Expected effects of radiation on vessel wall materials and basis for estimation (DCD Section 5.3.1.6.3)
- Location of capsules, method of attachment, and provisions to ensure that capsules are retained in position throughout the vessel lifetime (DCD Section 5.3.1.6.4)

A complete reactor vessel material surveillance program will be developed as described above in accordance with the implementation schedule provided in Section 13.4.

Report of Test Results

A summary technical report, including test results, is submitted as specified in 10 CFR 50.4, for the contents of each capsule withdrawn, within one year of the date of capsule withdrawal unless an extension is granted by the Director, Office of Nuclear Reactor Regulation. The report includes the data required by ASTM E185-82, as specified in Paragraph III.B.1 of 10 CFR 50, Appendix H, and includes the results of the fracture toughness tests conducted on the beltline materials in the irradiated and unirradiated conditions. If the test results indicate a change in the Technical Specifications is required, the expected date for submittal of the revised Technical Specification will be provided with the report.

5.3.3.6 Operating Conditions

Add the following after the first sentence.

STD SUP 5.3-1 Development of plant operating procedures is addressed in Section 13.5. These procedures require compliance with the Technical Specifications. The Technical Specifications (which are developed by the methodology also identified in the Technical Specifications) 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.

5.3.4 COL INFORMATION

5.3-2-A Materials and Surveillance Capsule

STD COL 5.3-2-A This COL Item is addressed in Section 5.3.1.8.

5.4 COMPONENT AND SUBSYSTEM DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

5.4.8 REACTOR WATER CLEANUP/SHUTDOWN COOLING SYSTEM

Add the following paragraph at the end of this section.

STD SUP 5.4-1 Operating procedures provide guidance to prevent severe water hammer caused by mechanisms such as voided lines.

5.4.12 REACTOR COOLANT SYSTEM HIGH POINT VENTS

Add the following paragraph at the end of this section.

STD SUP 5.4-2 A 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. This analysis considers:

- The use of this information by an operator during both normal and abnormal plant conditions;
- Integration into emergency procedures;
- Integration into operator training; and
- Other alarms during an emergency and the need for prioritization of alarms.

5.4.12.1 Operation of RPV Head Vent System

Add the following paragraph at the end of this section.

STD SUP 5.4-3 Operating procedures for the reactor vent system address considerations regarding when venting is needed and when it is not needed, including a variety of initial conditions for which venting may be required. The development of operating procedures is addressed in Section 13.5.

CHAPTER 6 ENGINEERED SAFETY FEATURES

6.0 GENERAL

This section of the referenced DCD is incorporated by reference with no departures or supplements.

6.1 ENGINEERED SAFETY FEATURE MATERIALS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

6.1.2.3 Evaluation

Delete the parenthetical statement at the end of the second paragraph, and insert a new third paragraph as follows.

STD COL 6.1.3-1-A

For protective coatings and organic materials used inside the containment that do not meet the requirements of ASTM D 5144 and RG 1.54 as per above, an evaluation is performed to determine the generation rate, as a function of time, of combustible gases that can be formed from these unqualified organic materials under DBA conditions. Surveys of the containment are used to identify this material. The technical basis and assumptions used for this evaluation are documented and retained as quality records. These evaluations will be completed before fuel load, and the FSAR will be revised, as necessary, in a subsequent update to incorporate the results of these evaluations.

6.1.3 COL INFORMATION

6.1.3-1-A Protective Coatings and Organic Materials

STD COL 6.1.3-1-A

This COL item is addressed in Section 6.1.2.3.

6.2 CONTAINMENT SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

6.2.1.6 Test and Inspection

Add the following at the end of this section.

Inspections to Limit Debris

STD SUP 6.2-1

Procedures describe the activities necessary to prevent debris from affecting the emergency core cooling and long-term cooling safety functions in accordance with RG 1.82, including: 1) inspection of the cleanliness of pools within containment, 2) a visual examination for evidence of structural degradation or corrosion of debris screens, 3) an inspection of the wetwell and the drywell, including the vents, downcomers, and deflectors, for the identification and removal of debris or trash that could contribute to the blockage of debris screens for the ECC and long-term cooling safety functions, 4) containment cleanliness programs to clean the pools within containment on a regular basis, and 5) plant procedures for control and removal of foreign materials from the containment and abatement procedures to avoid latent debris generation during removal and/or replacement of insulation within containment.

6.2.4.2 System Design

Replace the parenthetical after the third sentence in the first paragraph with the following.

STD COL 6.2-1-H

DCD Tables 6.2-16 through 6.2-42 require an entry for the length of pipe from the containment to the inboard and outboard isolation valves. Pipe lengths will be determined as part of completion of the piping design ITAAC identified in DCD Tier 1, Table 3.1-1. The FSAR will be revised to reflect the pipe length information in a subsequent update.

6.2.5.2 Containment Inerting System

RBS CDI

In DCD Figure 6.2-29, remove the Utility Scope designation.

6.2.8 COL INFORMATION

STD COL 6.2-1-H

6.2-1-H This COL item is addressed in Section 6.2.4.2.

6.3 EMERGENCY CORE COOLING SYSTEMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

6.4 CONTROL ROOM HABITABILITY SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

6.4.4 SYSTEM OPERATION PROCEDURES

Replace the second paragraph with the following.

RBS COL 6.4-1-A

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 83. Training and procedures are developed and implemented in accordance with Sections 13.2 and 13.5, respectively. The implementation milestones for training and procedures are provided in Sections 13.4 and 13.5, respectively.

6.4.5 DESIGN EVALUATIONS

System Safety Evaluation

Add the following after the second paragraph.

RBS SUP 6.4-1

The impact of a postulated design basis accident (DBA) in Unit 1 on the Unit 3 control room was evaluated. The evaluation was performed as follows:

- Atmospheric dispersion factors, χ/Qs, at the Unit 3 main control room (MCR) intakes, were conservatively calculated based on the Turbine Building and plant stack release points modeled in the Unit 1 dose analysis. The distance to the Unit 3 control room intakes from the release points was determined to be 276 m and 306 m, respectively, with nominal "receptor to source" directions (with respect to "true north") of 60 and 68 degrees, respectively. An intake height of 1 m was assumed with release heights at 59 and 27 m, respectively. Meteorological data used for cross-unit impact are consistent with those used for the χ/Q values presented in Section 2.3. The χ/Q values are presented in Table 2.3-302.

- The Unit 1 accident analysis, as described in Reference 6.4-201, was reviewed and the bounding event was determined to be the design basis loss-of-coolant accident (LOCA). The resultant dose at the Unit 3 MCR intake was evaluated with the RADTRAD-NAI computer code, based on the Unit 1 source term releases and the control room assumptions on breathing rates and occupancy factors endorsed in NRC Regulatory Guide 1.183. Credit was taken for control room isolation and intake air filtration at values consistent with the Unit 3 LOCA analysis described in

DCD Subsection 15.4.4. The resultant dose was determined to be less than GDC 19 limits.

- Unit 3 Technical Specifications require the Control Room Habitability Area Ventilation System to be maintained OPERABLE except in Modes 5 and 6. The probability of Unit 3 operator doses exceeding the GDC 19 limits in these off-normal conditions was determined to be below the regulatory threshold for establishing mitigation requirements.

RBS COL 6.4-2-A

Delete DCD Table 6.4-2. Replace the third paragraph with the following.

Potential toxic gas sources were evaluated to confirm that an external release of hazardous chemicals would not affect control room habitability. These sources include (1) off-site industrial facilities and transportation routes, (2) Unit 1, and (3) Unit 3.

Evaluation of potentially hazardous off-site chemicals within 5 mi. (8 km) of the control room is addressed in Section 2.2. This includes potential accidental release of toxic chemicals transported on U.S. Highway 61 and materials transported near the site moving on the Mississippi River. Also evaluated in Section 2.2 are nearby manufacturing plants, chemical plants, storage facilities, and oil pipelines or gas pipelines within 5 mi. (8 km) of the control room. There are also no significant control room habitability impacts due to chemicals being transported along off-site routes within 5 mi. (8 km) of the plant or from nearby industrial facilities.

Toxic gas analysis for potentially hazardous chemicals stored on-site was performed in accordance with the guidelines of Regulatory Guide 1.78 and on the basis of no action being taken by the control room operator. The results of the analysis, when compared to the toxicity limits given in Regulatory Guide 1.78 and the National Air Quality Standards, show that hazardous concentrations of toxic gas in the control room are not reached.

On-site locations with potentially toxic chemicals are identified in Tables 2.2-203 and 2.2-204. Evaluation of these chemicals is provided in Tables 2.2-208 and 2.2-209.

Unit 1 hydrogen and oxygen supplies are used for Unit 3. These supplies are in excess of 1350 ft. from the Unit 3 Control Building. This distance is acceptable for toxic gas concerns according to Regulatory Guide 1.78, based on the hazards of postulated instantaneous release followed by vapor cloud explosion or intake of a flammable vapor concentration into a safety-related intake. The hazard for the oxygen supply was a postulated release with an increased concentration at a safety-related intake. Calculations performed to evaluate the habitability of the control room for accidental releases of hydrogen or oxygen from the hydrogen water chemistry system indicate control room personnel are not subject to the hazard of breathing air with insufficient oxygen inside the control room due to a release of hydrogen. Other identified chemicals are stored in amounts and locations that are adequately separated from the control room intakes such that detection and/or control room isolation is not required.

Safety-related toxic gas monitoring instrumentation is not required.

6.4.9 COL INFORMATION

6.4-1-A CRHA Procedures and Training

RBS COL 6.4-1-A

This COL item is addressed in Subsection 6.4.4.

6.4-2-A Toxic Gas Analysis

RBS COL 6.4-2-A

This COL item is addressed in Subsection 6.4.5 and Table 2.2-208.

6.4.10 REFERENCES

6.4-201 Webb, M. (NRC) letter to P. D. Hinnenkamp (Entergy), "River Bend, Unit 1, Issuance of Amendment, RE: Full-Scope Implementation of the Alternative Source Term Insights (TAC No. MB5021)," March 14, 2003 (ML030760746).

6.5 ATMOSPHERE CLEANUP SYSTEMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

6.6 PRE SERVICE AND IN SERVICE INSPECTION AND TESTING OF CLASS 2 AND 3 COMPONENTS AND PIPING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the last sentence and the parenthetical statement of the third paragraph of this section with the following.

STD COL 6.6-1-A

The PSI/ISI program description for Class 2 and 3 components and piping is provided in DCD Section 6.6.

6.6.10 PLANT SPECIFIC PSI/ISI PROGRAM INFORMATION

6.6.10.1 Relief Requests

Add the following at the end of this section.

STD COL 6.6-1-A

No relief requests for the PSI/ISI program have been identified.

6.6.10.2 Code Edition

Replace the second sentence of this section with the following:

STD COL 6.6-1-A

The initial ISI program incorporates the latest edition and addenda of the ASME Code approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load.

Add the following new section.

6.6.10.3 Program Implementation

STD COL 6.6-1-A

The milestones for preservice and inservice inspection program implementation are provided in Section 13.4.

6.6.11 COL INFORMATION

6.6-1-A PSI/ISI Program Description

STD COL 6.6-1-A

This COL item is addressed in Section 6.6.

APPENDIX 6A TRACG APPLICATION FOR CONTAINMENT ANALYSIS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 6B EVALUATION OF THE TRACG NODALIZATION FOR THE ESBWR LICENSING ANALYSIS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 6C EVALUATION OF THE IMPACT OF CONTAINMENT BACK PRESSURE ON THE ECCS PERFORMANCE

This section of the referenced DCD is incorporated by reference with no departures or supplements.

CHAPTER 7 INSTRUMENTATION AND CONTROL SYSTEMS

This chapter of the referenced DCD is incorporated by reference with no departures or supplements.

CHAPTER 8 ELECTRIC POWER

8.1 INTRODUCTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.1.2.1 Utility Power Grid Description

Add the following to the end of the first paragraph.

RBS SUP 8.1-1

The output of Unit 3 is delivered to the RBS 500/230 kV Fancy Point Substation through the unit main step-up transformers, as described in Sections 8.2 and 8.3. The plant is connected to the Fancy Point Substation by a 500 kV normal preferred transmission line and by a second 500 kV alternate preferred transmission line that supplies the two reserve auxiliary transformers (RATs). The 500/230 kV Fancy Point Substation is common to Units 1 and 3. It accommodates three 500 kV overhead lines and four 230 kV overhead lines. From Fancy Point Substation, one 500 kV transmission line terminates at the Webre Substation via the Big Cajun No. 2 Substation, one 500 kV transmission line terminates at the McKnight Switching Substation, and the last ties into the Hartburg-Mount Olive transmission line at an unnamed switching station. Of the four 230 kV transmission lines exiting Fancy Point Substation, one terminates at the Jaguar Bulk Substation via the Enjay Substation, two terminate at the Port Hudson Bulk Substation, and the last terminates at the Big Cajun No. 1 Substation. These intrasystem ties transit from the 500/230 kV Fancy Point Substation, as shown in Figure 8.2-201. Entergy's transmission system and intrasystem ties are further described in Section 8.2.

8.2 OFF-SITE POWER SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.2.1.1 Transmission System

Replace this section with the following.

RBS COL 8.2.4-1-A

The Entergy Gulf States Louisiana, L.L.C. (EGSL)/Entergy Electric System (EES) supplies off-site ac power from the power grid system to support plant operations. The EGSL/EES grid system consists of interconnected hydroelectric plants, fossil fuel plants, and nuclear plants supplying electric energy over a 500/345/230/161/138/115 and 69 kV transmission system, as shown in Figure 8.2-201.

EGSL is a member of the EES. Other members of the system include Entergy Arkansas, Inc., Entergy Louisiana, LLC (ELL), Entergy Texas, Inc., Entergy New Orleans, Inc., and Entergy Mississippi, Inc. (EMI).

The EES is interconnected with the Southwestern Power Administration, Associated Electric Cooperative, Inc., Missouri Utilities, AmerenUE, the Tennessee Valley Authority (TVA), Mississippi Power Company, Central Louisiana Electric Company, Southwestern Electric Power Company, Oklahoma Gas and Electric Company, Empire District Electric Company, and Arkansas Electric Cooperative Corporation.

The off-site power system is designed and constructed with sufficient capacity and capability to power safety systems under normal, abnormal and accident conditions.

RBS COL 8.2.4-1-A

RBS COL 8.2.4-10-A

There are two separate 500 kV transmission lines from the 500 kV section of the Fancy Point Substation to the RBS Unit 3 transformer area. They are the normal preferred source and the alternate preferred source. The normal preferred source is connected to the unit auxiliary transformers (UATs) and the main transformers, and the alternate preferred source is connected to the reserve auxiliary transformers (RATs) located in the transformer area, as shown in Figure 8.2-202. The normal preferred source and the alternate preferred source transmission lines are designed to carry the full output of Unit 3 and the full load of the RATs, respectively. The two 500 kV transmission lines are installed as overhead lines on separate towers and on separate rights-of-way from the Fancy Point Substation to the transformer yard.

The Fancy Point Substation is common to RBS Units 1 and 3 and has both 230 kV buses and 500 kV buses. The 230 kV buses are connected to Unit 1 and are described in the Unit 1 Updated Safety Analysis Report (USAR). The 500 kV buses are connected to Unit 3 and to three off-site 500 kV overhead lines: one line terminating at the Webre Substation via Big Cajun No. 2 Power Station, a second line terminating at the McKnight Switching Station, and another line terminating at a switching station on the Hartburg-Mount Olive line near Marthaville, Louisiana. These three lines provide the 500 kV off-site power sources to the RBS Fancy Point Substation.

RBS COL 8.2.4-1-A

The bulk power transmission and generation needs of the EES are planned on a systemwide basis. In 1965, the basic 500 kV system now in operation was designed and put into operation. The system has proven highly reliable.

To the east, the EES interconnects with the TVA at West Memphis, Arkansas, and at West Point, Mississippi. It interconnects to the southwest with EGSL at Willow Glen, Louisiana, and to the west with Oklahoma Gas and Electric at Fort Smith, Arkansas. Agreements with each of these utilities provide a reliable and widely dispersed source of power when connected at 500 kV over such relatively short distances. These interconnections serve to enhance the reliability of the 500 kV bulk power system of the EES. Other system connections exist at 345 kV, 230 kV, 161 kV, and 115 kV voltages. Direct generation connections to the 500 kV transmission system include Arkansas Nuclear One, Grand Gulf Nuclear Station, Baxter Wilson, and Little Gypsy. Other 500 kV connections in the EES, made through step-up transformers, include West Memphis, Mabelvale, El Dorado, Baxter Wilson, Ray Braswell, Franklin, Fancy Point, and Waterford. These diverse power inputs provide a highly reliable source of power for the grid that supplies off-site power to RBS Unit 3.

None of the 500 kV lines to the Fancy Point Substation share a common tower or a common right-of-way. The lines diverge as they emanate from the switchyard. The 500 kV transmission line to Webre Substation via the Big Cajun No. 2 Power Plant follows the right-of-way designated Route I, which exits the Fancy Point Substation in a westerly direction. The 500 kV line to McKnight Substation exits the Fancy Point Substation in a southeasterly direction on the right-of-way designated as Route III. The 500 kV line to the Hartburg-Mount Olive transmission line exits the Fancy Point Substation in a westerly direction on a new right-of-way. There are no 500 kV lines in the right-of-way designated as Route II. Table 8.2-201 provides information about the length and thermal rating of the three transmission lines that are connected to the Fancy Point Substation.

The 500 kV transmission lines associated with the Fancy Point Substation and RBS are designed for medium loading conditions and high thunderstorm occurrence rates. There are no unusual features of these lines. The terrain in the EGSL system area is flat to gently sloping. The off-site power system meets or exceeds the National Electrical Safety Code (NESC) (1977) requirements for a high density transmission system, Grade B.

The 500 kV lines are on steel lattice type towers. Two configurations of power conductors are used at the 500 kV level. Three conductor bundles of 1024.5 kcmil aluminum conductor alloy reinforced (ACAR) cable per phase, spaced 18 in.

(45.7 cm) on center, are used along Routes I and III, with a nominal power capacity of 2500 MVA. The Route I Mississippi River crossing utilizes one 3075 kcmil aluminum conductor steel reinforced (ACSR) cable per phase, with a nominal power capacity of 2500 MVA. The minimum phase-to-phase spacing on the 500 kV transmission line system is 30 ft. Two 7/16-in. extra-high strength (EHS) steel cable static lines are used on each 500 kV transmission tower, with the exception of the 19 static lines used on the Mississippi River crossing, which are No. 9 alumoweld cables.

The 500 kV Hartburg-Mount Olive line has not been designed yet but is expected to be similar to the existing 500 kV lines. The FSAR will be updated to reflect the design when information is available.

8.2.1.2.1 Switchyard

Replace the second, third, fourth, fifth, and sixth paragraphs of DCD Section 8.2.1.2.1 with the following subsections.

8.2.1.2.1.1 Transmission Switchyard

RBS COL 8.2.4-2-A

Unit 3 is connected to the RBS Fancy Point Substation.

RBS COL 8.2.4-10-A

The 500 kV portion of the Fancy Point Substation is extended to the west to accommodate the Unit 3 interconnection to the grid. The Fancy Point Substation has two 500 kV main buses running in a general east-west direction. Each bus is capable of carrying the total connected load, and there are positions for twelve 500 kV gas circuit breakers. The electrical configuration of the off-site power system is shown in Figure 8.2-203.

The 500 kV switchyard layout is a folded breaker-and-a-half scheme. The breaker switching configuration provides for the isolation of any faulted line without affecting the operation of any other lines. It also provides the isolation of any one breaker in the 500 kV bus for inspection or maintenance without affecting the operation of any of the connecting lines or any other connections to the buses. The design provides for the isolation of any breaker, without limiting the operation of the unit or the transmission lines connected to the 500 kV grid. Each bus in the Unit 3 section of the switchyard has sufficient capacity to carry its load under any postulated switching sequences.

A station ground grid is provided that consists of a ground mat below grade at the switchyard which is connected to the foundation embedded loop grounding system provided for the entire power block and associated buildings.

The 500 kV portion of the switchyard can be connected to the 230 kV portion via three single-phase auto-transformers located near the 500 kV breaker bays.

RBS COL 8.2.4-8-A

These transformers are protected on the 230 kV side by single-zone distance phase with directional overcurrent ground relaying that initiates local tripping. These are the only transformers located in the switchyard.

RBS COL 8.2.4-6-A

RBS COL 8.2.4-7-A

RBS COL 8.2.4-10-A

There are two sources of ac auxiliary power from the 6.9 kV plant investment protection (PIP) buses for the normal preferred switchyard power center and for the alternate preferred switchyard power center, as shown in DCD Figure 8.1-1. The switchyard auxiliary power system is designed with adequate equipment, standby power, and protection to provide maximum continuity of service for operation of the essential switchyard equipment during both normal and abnormal conditions. There are two independent sets of 125 volt dc batteries, chargers, and dc panels for the switchyard relay and control system dc supply requirements. Each charger is powered from a separate ac source with an automatic switchover to the alternate source in the event that the preferred source is lost. The distribution systems for the two battery systems are physically separated. This separation includes dual cable tray systems in the Control Building and dual cable trenches in the new portion of the switchyard.

High-speed circuit breakers with adequate operating and interrupting ratings are provided. The 500 kV circuit breakers are equipped with two independent trip coils for tripping by a separate set of protective relays. In addition, the circuit breakers are provided with breaker failure schemes. The protective relay systems are redundant. These systems are overlapping in such a way that each high-voltage component is covered by at least two sets of protective relays. The primary and backup relay systems are supplied from separate current inputs and separate dc circuits for control from each 125 volt dc battery; they are connected to separate trip coils of the power circuit breakers.

In case of a spurious relay trip or a trip due to a fault on one of the off-site circuits, the switchyard buses would remain energized. There is adequate capacity in the system and in the switchyard equipment to meet the auxiliary power requirements of RBS Unit 3.

RBS COL 8.2.4-10-A

Failure analysis indicates that a single fault in any section of a 500 kV bus is cleared by the adjacent breakers and does not interrupt the operation of the remaining part of the 500 kV switchyard bus or the connection of the unaffected transmission lines. Only those elements connected to the faulted section are interrupted.

The transmission line relay protection circuits continuously monitor the conditions of the off-site power system and are designed to detect and isolate faults with maximum speed, causing minimal disturbance to the system.

RBS COL 8.2.4-5-A

Each of the 500 kV transmission lines from the Fancy Point Substation is protected by two independent pilot systems to achieve a high-speed clearing for a fault on the lines. The 500 kV transmission line protective relay system is designed to maximize the reliability of the incoming power to the plant. The protective relaying provides for the fast detection of faults; should the transmission line protective relays fail to clear the fault, adequate backup protection is provided in the form of breaker failure relays.

Each of the 500 kV switchyard bus sections is protected by a dual bus differential relay scheme. In addition to the line and bus protection schemes, the 500 kV switchyard breakers are protected by breaker failure relays with current supervision from separate current transformers. The breaker failure relays operate through a timing relay, and if a breaker fails to trip within the time setting of its timing relay, the associated breaker failure trip relay will trip and lock out all breakers on the bus side and adjacent breaker(s).

The design of the protective relay scheme is coordinated, reviewed, and accepted by the Entergy organization responsible for grid reliability.

8.2.1.2.1.2 Transformer Area

RBS COL 8.2.4-2-A
RBS COL 8.2.4-3-A

The equipment arrangement at the transformer area is shown in Figure 8.2-204. The main transformers, UATs, and RATs are located in the area adjacent to the Turbine and Electrical Buildings. This area also contains circuit breakers, disconnect switches, and the bus arrangements necessary to establish connections to the transformers.

The generator output from the high side of the main transformers is connected through a 500 kV generator circuit breaker in a high/low bus arrangement. The 500 kV connections to the UATs (the preferred power source) are through individual high-voltage circuit breakers with disconnect switches on both ends. The 500 kV overhead line to the Fancy Point Substation emanates from a takeoff structure at the southern boundary of the transformer area. The UATs are powered from the unit during normal operation and from the grid via the Fancy Point Substation when the unit is not operating.

RBS COL 8.2.4-4-A

The source of power to the RATs (the alternate preferred power source) is from the alternate preferred off-site power 500 kV transmission line from the Fancy Point Substation. This overhead line terminates near the southwest corner of the transformer area boundary. A common 500 kV circuit breaker with disconnect switches on either side is provided for protection and isolation of the two RATs. An additional individual disconnect switch is provided for the isolation of each RAT. There are two sources of ac auxiliary power for the transformer area from the 6.9 kV PIP buses.

There are independent sets of 125 volt dc batteries, chargers, and dc panels for the transformer area dc supply requirements for relay and control systems. Each charger is powered from a separate ac source with an automatic switchover to the alternate source in the event that the preferred source is lost. The distribution systems for the two battery systems are physically separate. This separation includes dual cable tray systems in the Control House and dual cable trenches in the transformer area.

8.2.1.2.1.3 Transmission System Operator Agreement

RBS SUP 8.2-1

Prior to fuel load, the licensee will establish an agreement with the Transmission System Operator (TSO) to address switchyard and transmission interface issues, including the following items:

- Exclusion Area control, switchyard access, and security.
- Operation of equipment and activities performed in the switchyard.
- Maintenance of switchyard equipment.
- Coordination of planned plant outages and activities directly affecting power supply to the RBS.
- Review and approval of changes that might affect compliance with regulatory requirements and commitments that could affect off-site power supply to the RBS.
- Procedures and training on the critical need for power at the RBS during emergencies.

Entergy Gulf States Louisiana, L.L.C. is responsible for the maintenance of the Fancy Point Substation and transmission equipment.

8.2.2.1 Reliability and Stability Analysis

Replace this section with the following.

RBS COL 8.2.4-9-A

RBS COL 8.2.4-10-A

Entergy is a member of the Southeastern Electric Reliability Council (SERC). The guidelines of SERC provide assurance that transmission systems that are part of the interconnected network are planned, designed, and constructed to operate reliably within thermal, voltage, and stability limits. These guidelines, along with North American Electric Reliability Corporation transmission planning guidelines, were followed in the design of the off-site power system to support Unit 3 and are adhered to during the ongoing operation of the plant.

RBS Unit 1 has not experienced a complete loss of off-site power in the last 20 years of operation. In August 2004, there was a 230 kV off-site line failure event with subsequent reportable Fancy Point equipment failures that de-energized multiple 230 kV off-site transmission lines. This resulted in a turbine trip, scram, and de-energization of one out of two Unit 1 reserve station transformers. Off-site power to Unit 1 was not lost for the event. The event investigation determined that maintenance practices for certain 230 kV circuit breakers were deficient and these were corrected.

8.2.2.1.1 System Impact Study

A system impact study (SIS) was conducted to assess the effect of Unit 3 on the reliability of the EES and to analyze the reliability of the off-site power supply for Unit 3.

The SIS addressed various elements of the grid stability, namely: (1) a load flow analysis to determine the adequacy of the existing transmission system to handle the full output of the plant; (2) a short-circuit analysis to verify the fault duty of the existing equipment within the EES; (3) a transient stability study of the grid under normal and contingency conditions and an investigation of the grid voltage performance. The following criteria must be met in order to satisfy these elements:

- The grid must remain stable.
- Bus voltage at the RBS Fancy Point 500 kV Substation must remain within acceptable limits for the RBS Unit 3 equipment while supplying the required loads for the station.
- Grid frequency must be maintained between 57 and 61.8 Hz, and the potential short-circuit current must not exceed the current rating of the equipment.
- The analysis results establish that the grid is stable and that the 500 kV designated off-site power supply to Unit 3 is not degraded during various contingencies. The analysis included worst-case disturbances as a result of a single event, such as the loss of the largest generation capacity supplying the grid; removal of the largest load from the grid; and the loss of the most critical transmission line. The lowest study contingency 500 kV bus voltage observed for RBS Unit 3 was greater than 500 kV, and the highest contingency study voltage observed for RBS Unit 3 was less than 525 kV.

As a standard operating procedure, Entergy performs grid studies at least every 3 years. These periodic analyses incorporate updated grid configurations and conditions, which are projected for a future period of interest and include multiple contingencies, such as the unit trip combined with other concurrent transmission/generation contingencies to verify and to confirm the adequacy of the grid sources following such an event. These scenarios include future projections for system load peaks and power transfers through the EES.

8.2.2.1.2 Transmission System Monitoring and Analysis

RBS SUP 8.2-2

Compliance with General Design Criterion 18 is achieved by designing testability and inspection capability into the system and then implementing a comprehensive testing and surveillance program.

The transmission lines within the EES are inspected approximately every 6 mo. by an aerial observer.

Routine maintenance on power circuit breakers is performed, as required, to verify that the applicable design criteria for operation from DCD Section 8.2.3 are not exceeded.

Calibration checks of the protective relay systems in the switchyard are performed on a routine interval not to exceed two fuel cycles. Functional checks of relay and control equipment are also conducted on a two-fuel cycle interval.

Protective relay operation is annunciated locally and/or in the plant control room and may be simultaneously entered into the balance-of-plant computer. The computer acts as a data logger, with or without additional alarm, depending on the protective action.

The system dispatcher has control of the 500 kV Fancy Point substation components. The generator circuit breaker, the UAT circuit breakers, and the isolation circuit breaker for the RATs, which are located in the transformer area, are under the control of the plant operator. Information transmitted remotely to the system dispatcher includes watt and VAR loadings for all transmission lines, transformers, and generators, as well as the status of all controlled devices. Various switchyard alarms are transmitted remotely to the system dispatcher to enable the necessary steps to correct problems before they become serious. Events involving substation components requiring plant operator information or action are annunciated similar to protective devices.

Entergy Transmission System Planning utilizes the PTI transmission analysis program as the analysis tool to predict the plant's off-site power voltages under various transmission grid contingencies. Using this program, detailed transmission studies are performed for the next day, using daily cases representing that day of the month. These cases provide the advantage of the accuracy of a near-term projection of the expected loads and load flows, system generating unit status, expected transmission system in or out of service, and specific site requirements, in a single analysis. These cases are also re-performed during the period of interest (i.e., present day) if previously identified specific contingencies occur or if the system operator determines that system conditions have significantly changed during the period that could adversely affect the off-site power source post-trip voltage availability for the unit. This allows the analysis to remain bounding if system conditions change. If the results indicate the potential that site-specific requirements would not be met, the system operator then determines if these requirements can be met for the period of interest by making changes to transmission system configuration/operation. If the system operator determines that the requirements cannot be met, plant notification is required.

The analysis program results are validated against transmission system response to actual events.

The studies are performed periodically to confirm that the off-site power system will remain available following a trip of the unit. Grid studies are performed at least every 3 years and before significant changes to transmission system elements, such as loads, generators, and transmission lines. These periodic analyses incorporate updated grid configurations and conditions, which are projected for a future period of interest and include such multiple contingencies as the unit trip and accident condition loading, combined with significant other concurrent transmission/generation contingencies, to confirm the adequacy of these sources following such an event. This includes future projections for system load peaks and power transfers through the EES, as determined by Entergy Transmission System Planning.

The TSO has real-time monitoring of transmission system conditions. This capability includes data acquisition, alarms, and analysis related to power flow and system elements. The analysis includes the projection of future voltage conditions so that the plant may be notified of actual or potential conditions of degraded voltage and/or frequency in the case of loss of transmission system elements.

The existing protocols in plant procedures that require the TSO to monitor transmission system conditions and to notify and collaborate with the control room staff in the event of degraded transmission system are also applied to RBS Unit 3. Procedures exist that describe actions to be taken to limit the risk associated with transmission system degradation and operate the plant safely.

8.2.2.2 Failure Modes and Effects Analysis

Protective relaying systems in the RBS switchyard are redundant and overlapping so that high voltage components are protected by at least two sets of protective relays. The primary and backup protective relay systems are connected to separate current transformer inputs. Separate dc control circuits with power sources from each 125 volt dc battery are provided and connected to separate trip coils of the power circuit breakers. Each circuit breaker is also protected by a breaker failure relay.

The breaker failure relay operates through its timing relay and, if a breaker fails to trip within the time setting of its timing relay, the associated breaker failure relay trips and locks out all adjacent breakers.

8.2.2.2.1 Fault of a 500 kV Transmission Line

Each 500 kV transmission line fault was analyzed for faulted transmission line and faulted transmission line with a stuck breaker scenarios.

In each case, at least one of the two switchyard buses remained energized during all single transmission line fault scenarios, and the normal and alternate preferred power sources remained intact. At least one preferred source remained intact for a fault on a preferred source line.

8.2.2.2.2 Fault of a Bus

A fault on each bus, north and south, was analyzed both for normal circuit breaker tripping and for scenarios involving a stuck circuit breaker. In each of the postulated failure scenarios, the non-faulted bus remained energized, and the normal and alternate preferred power sources remained intact.

8.2.2.2.3 Spurious Relay Trip

Various cases of spurious relay actuations were investigated. In all cases, at least one of the two switchyard buses remained energized, and the normal and alternate preferred power sources remained intact. At least one preferred source remained intact for a spurious relay trip on relays associated with a preferred source.

8.2.2.2.4 Loss of DC Control Power

A loss of control power was considered in the analysis for the following scenarios:

- Loss of dc control power to a circuit breaker concurrent with an electrical fault.
- Loss of dc control power to a transmission line protective relay concurrent with an electrical fault.
- Loss of dc control power to a bus differential relay concurrent with an electrical fault.
- Loss of dc control power to an auto-transformer differential relay concurrent with an electrical fault.

In all cases, at least one of the two switchyard buses remained energized, and the normal and alternate preferred power sources remained intact. At least one preferred source remained intact for a loss of dc control power concurrent with a fault on a preferred source line.

8.2.2.2.5 Auto-Transformer Fault

A fault at or near the auto-transformer connecting the 230 kV and 500 kV portions of the RBS switchyard was analyzed for both normal breaker tripping and for stuck breaker scenarios.

In all cases, at least one of the two switchyard buses remained energized, and the normal and alternate preferred sources remained intact.

8.2.3 DESIGN BASES REQUIREMENTS

RBS COL 8.2.4-9-A

Revise the ninth bullet of DCD Section 8.2.3 to read as follows.

A transmission system reliability and stability review of the configuration to which the plant is connected was performed to determine the reliability of the off-site power system and verified that it is consistent with the probability risk analysis of Chapter 19. (Refer to Subsections 8.2.2.1 and 8.2.2.1.1.)

8.2.4 COL INFORMATION

8.2.4-1-A Transmission System Description

RBS COL 8.2.4-1-A

This COL item is addressed in Subsection 8.2.1.1.

8.2.4-2-A Switchyard Description

RBS COL 8.2.4-2-A

This COL item is addressed in Subsections 8.2.1.2.1.1 and 8.2.1.2.1.2.

8.2.4-3-A Normal Preferred Power

RBS COL 8.2.4-3-A

This COL item is addressed in Subsection 8.2.1.2.1.2.

8.2.4-4-A Alternate Preferred power

RBS COL 8.2.4-4-A

This COL item is addressed in Subsection 8.2.1.2.1.2.

8.2.4-5-A Protective Relaying

RBS COL 8.2.4-5-A

This COL item is addressed in Subsection 8.2.1.2.1.1.

8.2.4-6-A Switchyard DC Power

RBS COL 8.2.4-6-A

This COL item is addressed in Subsection 8.2.1.2.1.1.

8.2.4-7-A Switchyard AC Power

RBS COL 8.2.4-7-A

This COL item is addressed in Subsection 8.2.1.2.1.1.

8.2.4-8-A Switchyard Transformer Protection

RBS COL 8.2.4-8-A

This COL item is addressed in Subsection 8.2.1.2.1.1.

8.2.4-9-A Stability and Reliability of the Off-Site Transmission Power Systems

RBS COL 8.2.4-9-A

This COL item is addressed in Subsection 8.2.2.1and 8.2.3.

8.2.4-10-A Interface Requirements

RBS COL 8.2.4-10-A

This COL item is addressed in Subsections 8.2.1.1, 8.2.1.2.1.1, and 8.2.2.1.

RBS COL 8.2.4-1-A

Table 8.2-201
Fancy Point Substation 500 kV Transmission Lines

500 kV Line	Termination Point	Length (mi.)	Thermal Rating (MVA)
McKnight	McKnight Substation	27.2	2500
Big Cajun No. 2	Webre Substation	29.2	2500
Hartburg-Mount Olive	Hartburg-Mount Olive Switching Station	148.0	2500

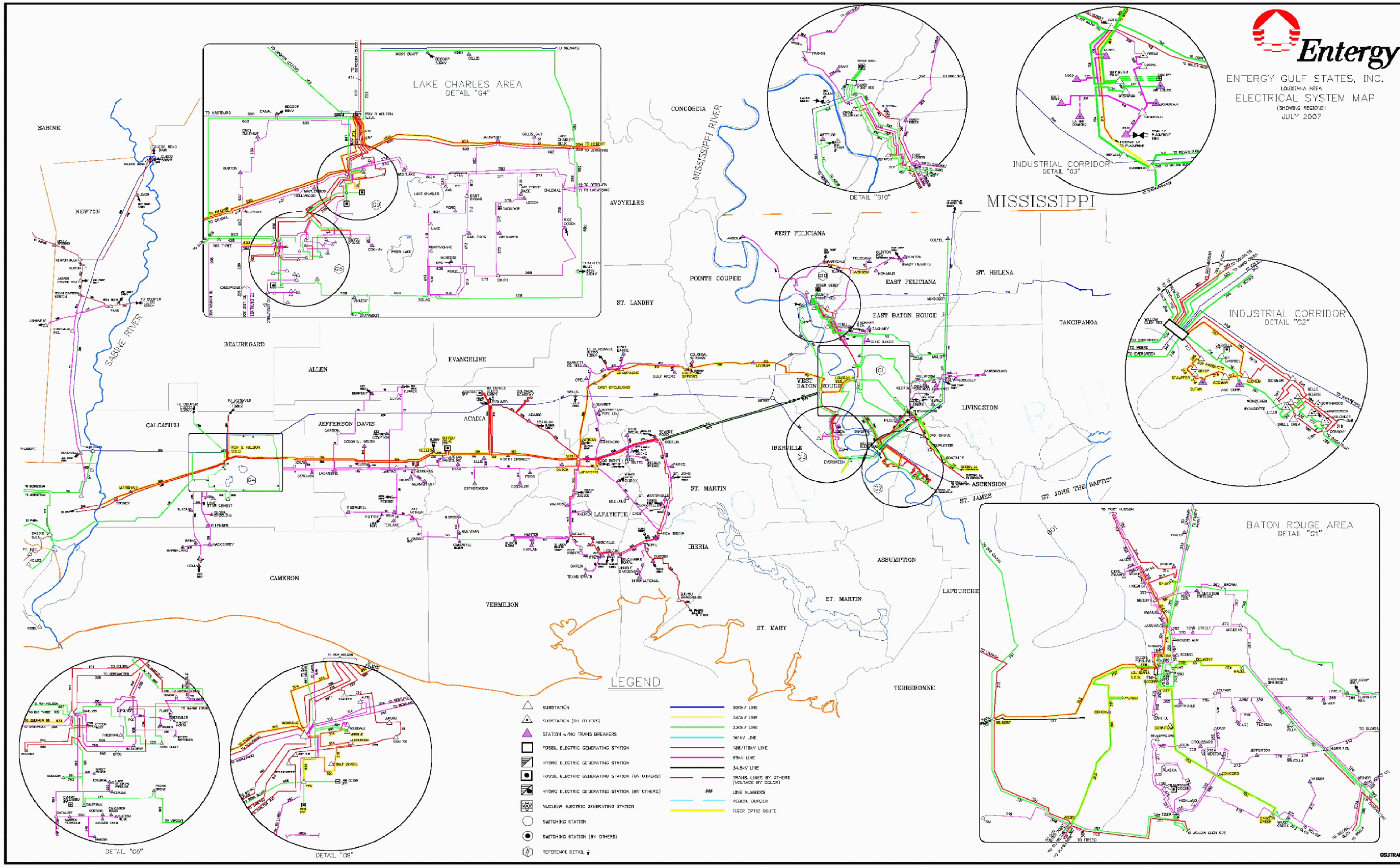

Figure 8.2-201. Entergy Gulf States Louisiana Electrical System Map

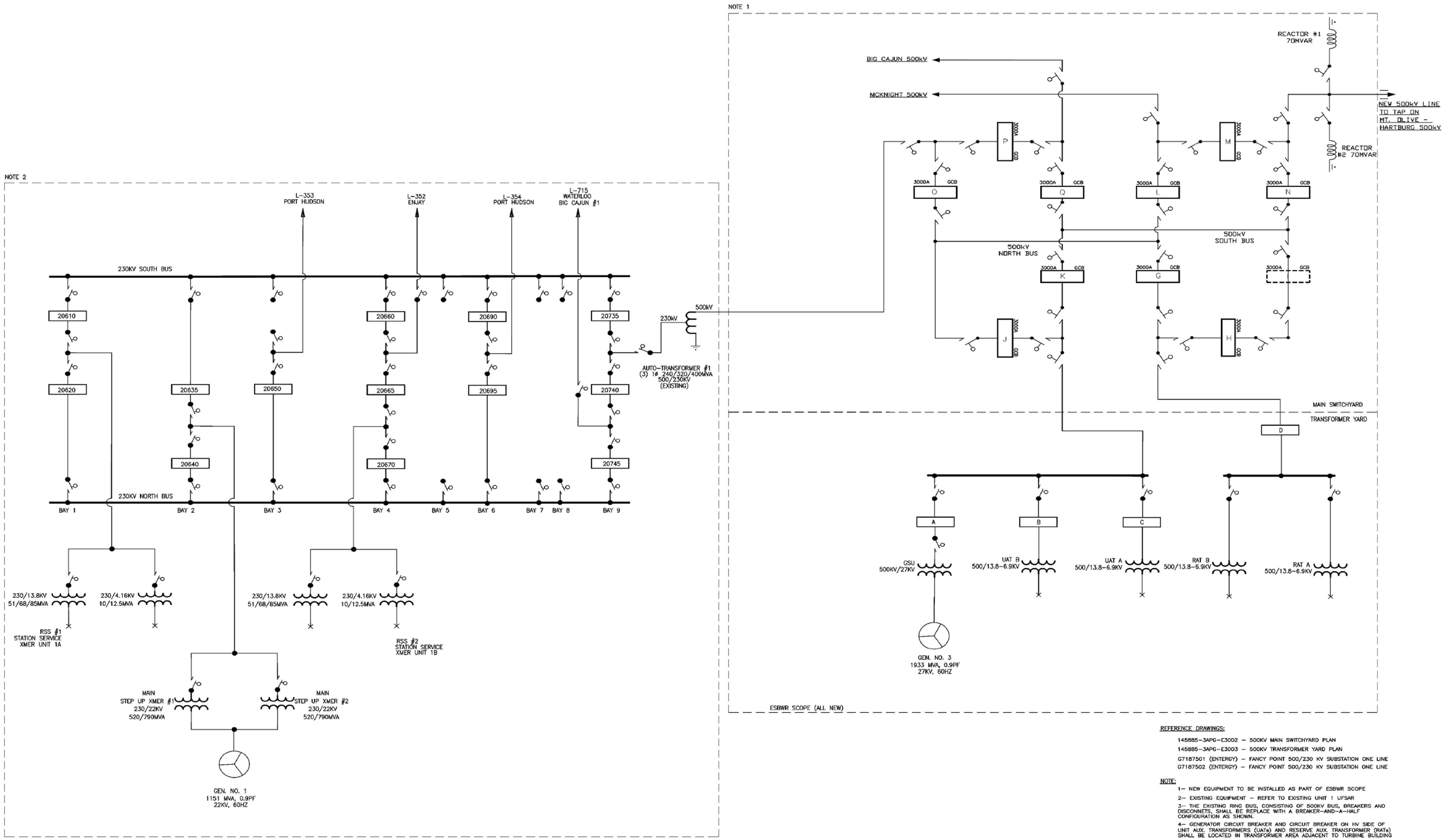

Figure 8.2-202. On-Site Power System One-Line Diagram

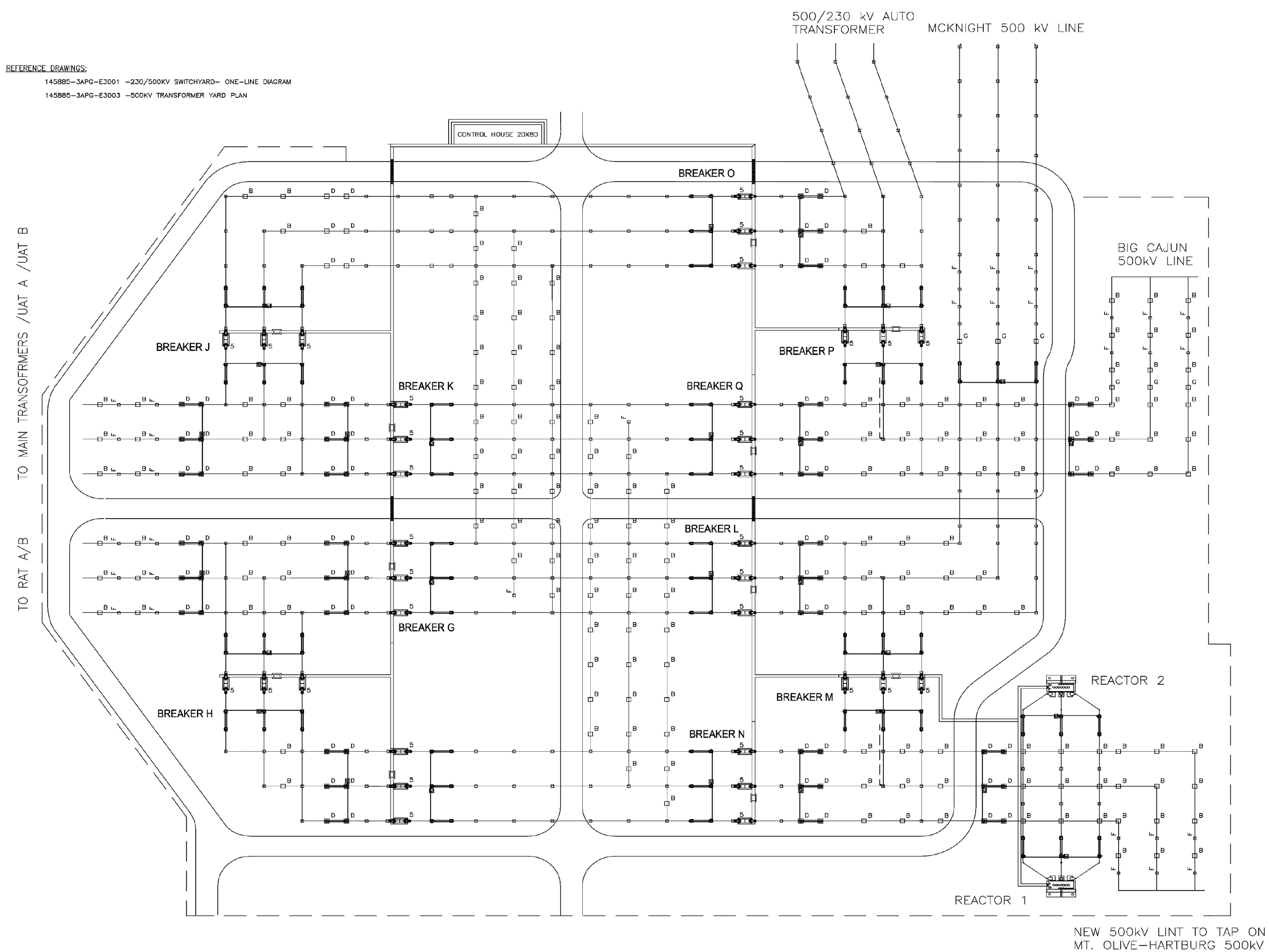

Figure 8.2-203. Switchyard Plan

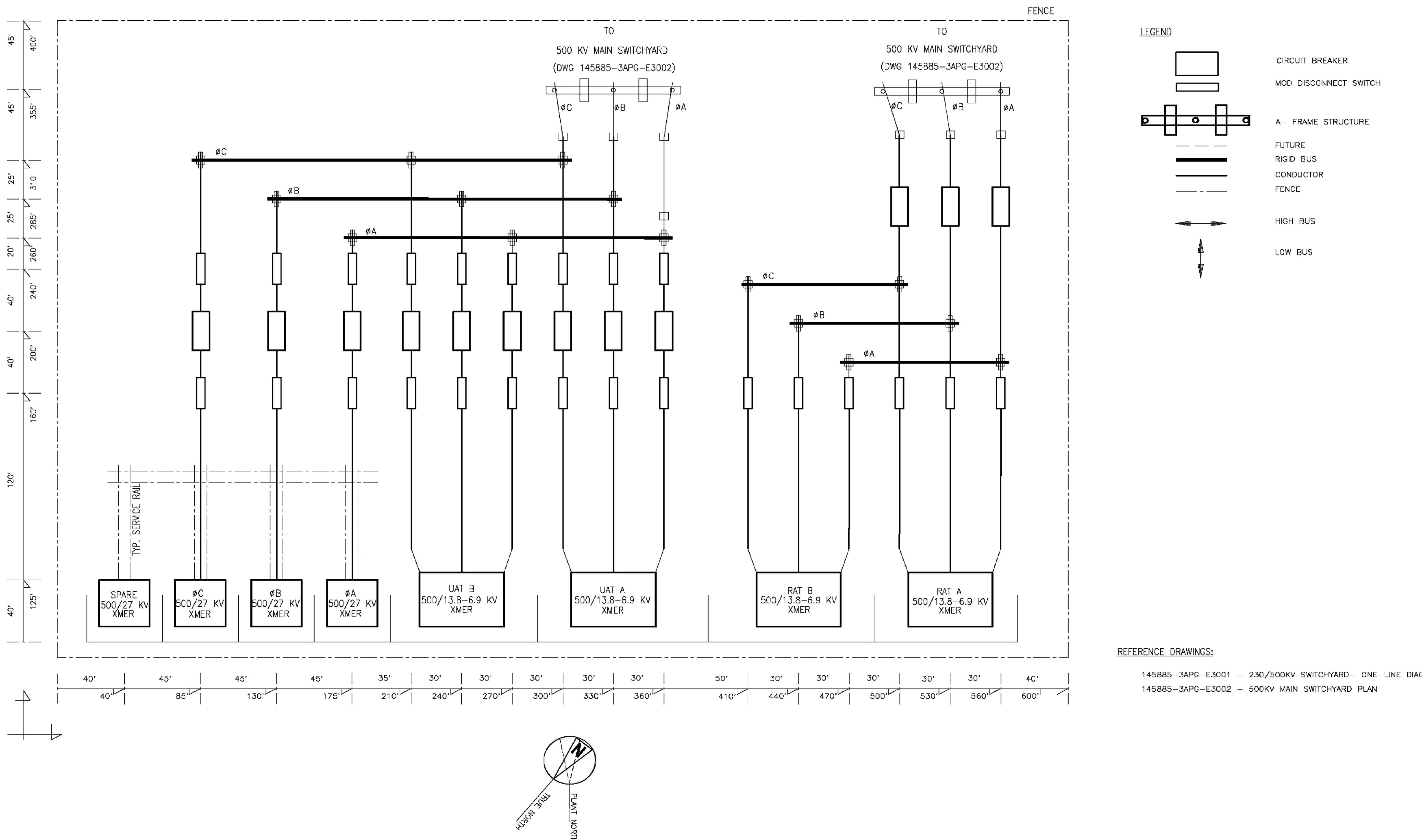

Figure 8.2-204. Transformer Area Plan

8.3 ON-SITE POWER SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.3.2.1.1 Safety-Related Station Batteries and Battery Chargers

Station Blackout

Add the following paragraph at the end of the Station Blackout section.

RBS SUP 8.3-1 Training and procedures to mitigate a station blackout (SBO) event are implemented in accordance with Sections 13.2 and 13.5, respectively. The ESBWR is a passive design and does not rely on off-site or on-site ac sources of power for at least 72 hr. after an SBO event, as described in DCD Subsection 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 could directly connect to the station to mitigate the SBO event. Restoration from an SBO event would be contingent upon power being made available from any one of the following sources:

- Either of the station diesel generators.
- Restoration of any one of the three 500 kV transmission lines or through the 230/500 kV autotransformer described in Section 8.2.

APPENDIX 8A MISCELLANEOUS ELECTRICAL SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8A.2 CATHODIC PROTECTION

8A.2.1 DESCRIPTION

Replace Subsection 8A.2.1 with the following.

RBS COL 8A.2.3-1-A

The need for a cathodic protection system will be determined during final design of the plant. If a cathodic protection system is required, it will be designed in accordance with the requirements of the National Association of Corrosion Engineers (NACE) Standards (DCD Reference 8A-5).

This section of the FSAR will be updated as necessary to describe the final design of the cathodic protection system.

8A.2.3 COL INFORMATION

8A.2.3-1-A Cathodic Protection System

RBS COL 8A.2.3-1-A

This COL item is addressed in Subsection 8A.2.1.

CHAPTER 9 AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.1.4 LIGHT LOAD HANDLING SYSTEM (RELATED TO REFUELING)

9.1.4.13 Refueling Operations

Add the following paragraphs at the end of this section.

STD COL 9.1.6-4-A

Section 13.5 requires development of fuel handling procedures. Fuel handling procedures address 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, and accountability of fuel for refueling operations. Fuel handling procedures are developed six months before fuel receipt to allow sufficient time for plant staff familiarization, to allow NRC staff adequate time to review the procedures, and to develop operator licensing examinations.

Personnel qualifications and training for fuel handlers are addressed in Section 13.2.

9.1.4.19 Inspection and Testing Requirements

Add the following paragraph at the end of this section.

STD COL 9.1.6-4-A

Section 17.5 describes the QA program that is applied to monitoring, implementing, and ensuring compliance with fuel handling procedures. As part of normal plant operations, the fuel-handling equipment is inspected for operating conditions before each refueling operation. During the operational testing of this equipment, procedures are followed that will affirm the correct performance of the fuel-handling system interlocks. Other maintenance and test procedures are developed based on manufacturer's requirements.

9.1.5 OVERHEAD HEAVY LOAD HANDLING SYSTEMS (OHLHS)

9.1.5.6 Other Overhead Load Handling System

Add the following at the end of this section.

STD COL 9.1.6-5-A

Special Lifting Devices

For special lifting devices, the guidelines of ANSI N14.6 are implemented as specified with the following exceptions/clarifications:

- The acceptance criteria of paragraph 5.5.2 are applied to fabrication and repair welds only.
- The acceptance criteria for inservice inspection shall be limited to "No Cracks."
- The use of later editions of ASME Section V may be used to permit the use of advanced NDE technology.
- For the Dryer/Separator Strongback the requirement to routinely examine the load bearing welds every fifth refueling outage by nondestructive examination (NDE) (Magnetic Particle or Liquid Penetrant) will not be used. The lifting device shall be examined visually and dimensionally. The visual and dimensional examination shall be performed prior to the initial lift each outage. Any cracks in the coating or dimension out of tolerance shall require magnetic particle or liquid penetrant examination of the suspect welds and/or additional welds as required by Design Engineering.

Other Lifting Devices

Slings used for heavy load lifts meet the requirements specified for slings in ANSI B30.9 with the following clarification. Since dynamic loads constitute a small percentage of the total load imposed on slings, the sling's ratings are expressed in terms of maximum static load only.

9.1.5.8 Operational Responsibilities

Replace this section with the following.

Procedures

STD COL 9.1.6-5-A

Section 13.5 requires the development of administrative procedures to control heavy loads prior to fuel load to allow sufficient time for plant staff familiarization, to allow NRC staff adequate time to review the procedures, and to develop operator licensing examinations. Heavy loads handling procedures address:

- Equipment identification
- Required equipment inspections and acceptance criteria prior to performing lift and movement operations
- Approved safe load paths and exclusion areas
- Special precautions and limitations
- Special tools, rigging hardware, and equipment required for the heavy load lift
- Rigging arrangement for the load
- Adequate job steps and proper sequence for handling the load

Safe load paths are defined for movement of heavy loads to minimize the potential for a load drop on irradiated fuel in the reactor vessel or spent fuel pool or on safe shutdown equipment. Paths are defined in procedures and equipment layout drawings. Safe load path procedures address the following general requirements:

- When heavy loads must be carried directly over the spent fuel pool, reactor vessel, or safe shutdown equipment, procedures will limit the height of the load and the time the load is carried.
- When heavy loads could be carried (i.e., no physical means to prevent) but are not required to be carried directly over the spent fuel pool, reactor vessel, or 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.
- Where intervening structures are shown to provide protection, no load travel path is required.
- Defined safe load paths will follow, to the extent practical, structural floor members.
- When heavy load movement is restricted by design or operational limitation, no safe load path is required.
- Supervision is present during heavy load lifts to enforce procedural requirements.

Inspection and Testing

Cranes addressed in this section are inspected, tested, and maintained in accordance with Section 2-2 of ANSI B30.2, Section 11.2 of ANSI B30.11, or Sections 16-1.2.1 and 16-1.2.3 of ANSI B30.16 with the exception that tests and inspections may be performed prior to use for infrequently used cranes. Prior to making a heavy load lift, an inspection of the crane is made in accordance with the above applicable standards.

Training and Qualification

Training and qualification of operators of cranes addressed in this section meet the requirements of ANSI B30.2, and include the following:

- Knowledge testing of the crane to be operated in accordance with the applicable ANSI crane standard.
- Practical testing for the type of crane to be operated.
- Supervisor signatory authority on the practical operating examination.
- Applicable physical requirements for crane operators as defined in the applicable crane standard.

Quality Assurance

Procedures for control of heavy loads are developed in accordance with Section 13.6. In accordance with Section 17.5, other specific quality program controls are applied to the heavy loads handling program, targeted at those characteristics or critical attributes that render the equipment a significant contributor to plant safety.

9.1.5.9 Safety Evaluations

Add the following paragraph at the end of this section.

STD COL 9.1.6-5-A No heavy loads are identified that are outside the scope of the certified design.

9.1.6 COL INFORMATION

9.1.6-4-A Fuel Handling Operations

STD COL 9.1.6-4-A

This COL item is addressed in Section 9.1.4.13 and Section 9.1.4.19.

9.1.6-5-A Handling of Heavy Loads

STD COL 9.1.6-5-A

This COL item is addressed in Section 9.1.5.6, Section 9.1.5.8, and Section 9.1.5.9.

9.2 WATER SYSTEMS

9.2.1 PLANT SERVICE WATER SYSTEM

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.2.1.2 System Description

Replace the Summary Description with the following information.

RBS CDI The source of cooling water to the plant service water system (PSWS) is from either the normal power heat sink (NPHS) or the auxiliary heat sink (AHS), depending on plant conditions. The PSWS rejects heat from nonsafety-related reactor component cooling water system (RCCWS) and turbine component cooling water system (TCCWS) heat exchangers to the environment via either the NPHS or the AHS. A combination of a natural draft cooling tower (NDCT) and mechanical draft cooling towers (MDCTs) is utilized for the NPHS, and MDCTs are utilized for the AHS. Table 9.2-201 provides information on the PSWS cooling tower design characteristics.

RBS COL 9.2.1-1-A Materials for the various components of the PSWS are selected to preclude long-term corrosion and fouling of the PSWS based on site water quality.

Materials for the MDCTs and accessories contain, to the maximum extent practicable, noncombustible materials as defined in National Fire Protection Association (NFPA) 220 (Reference 9.2.1-201).

RBS CDI A simplified diagram of the PSWS is shown in DCD Figure 9.2-1.

Detailed System Description

In the sixth paragraph, replace the last sentence with the following information.

RBS COL 9.2.1-1-A Fiberglass reinforced polyester pipe is used for buried PSWS piping to preclude long-term corrosion. Appropriate chemical treatment is added to the NPHS or the AHS, as required to preclude long-term corrosion and fouling of the PSWS based on site water quality analysis.

In the eighth paragraph, replace the first sentence with the following information.

RBS CDI Unit 3 design heat loads are shown in DCD Table 9.2-1.

Delete the last paragraph.

Operation

Add the following text to the end of the second paragraph of this section.

RBS SUP 9.2.1-1 During normal power operation, PSWS flow is directed to the NPHS cooling tower, where heat removed from the RCCWS and TCCWS is rejected to the NPHS. During this mode of operation, the NPHS basin provides makeup to the AHS basin. During other modes of power operation, PSWS flow is directed to the AHS cooling tower, where heat removed from the RCCWS and TCCWS is rejected to the AHS. During this mode of operation, makeup to the AHS basin is provided from the station water system (SWS).

9.2.1.6 COL Information

9.2.1-1-A Material Selection

RBS COL 9.2.1-1-A This COL item is addressed in Subsection 9.2.1.2.

9.2.1.7 References

9.2.1-201 National Fire Protection Association, "Standard on Types of Building Construction," NFPA 220.

9.2.2 REACTOR COMPONENT COOLING WATER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.2.3 MAKEUP WATER SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.2.3.2 System Description

Replace the introductory text and the demineralization subsystem portions of this section with the following.

RBS CDI The makeup water system (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 operating conditions except for shutdown/refueling.

The MWS major equipment is housed in the service water/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 MWS equipment 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 due to corrosion.

Based on local weather conditions, the demineralized water storage tank and MWS piping and instrumentation that are exposed to freezing conditions are provided with freeze protection.

Table 9.2-202 lists the major MWS components.

Clarified, filtered river water is supplied to the MWS by the station water system (SWS) (Subsection 9.2.10). Prior to transfer to the demineralized water storage tank, the clarified water is processed through a vendor-supplied mobile water treatment system.

9.2.4 POTABLE AND SANITARY WATER SYSTEMS

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the information in this section with the following information.

9.2.4.1 Design Bases

Safety Design Basis

RBS CDI The potable water system (PWS) and sanitary waste discharge system (SWDS) do not perform any safety-related function. Therefore, the PWS and SWDS have no safety design bases.

Power Generation Design Basis

The PWS and SWDS are designed to provide the potable water supplies and sewage treatment necessary for normal plant operation and shutdown periods. The PWS is designed to supply 200 gallons per minute (gpm) (12.6 liters per second [lps]) of potable water during peak demand periods.

The PWS is designed to produce and maintain the quality of water required by the authorities having jurisdiction.

The SWDS is designed to produce an effluent quality required by federal, state, and local regulations and permits.

9.2.4.2 System Description

Potable Water System

The PWS consists of water heaters and interconnecting piping and valves as shown in Figure 9.2-201. PWS component characteristics are shown in Table 9.2-202. Treated water from the West Feliciana Parish system is supplied to the potable water system. In addition to non-radiological areas, potable water is provided to areas where inadvertent backflow into the system could result in radiological contamination of the potable water. For those branches with outlets in areas where the potential for radiological contamination exists, backflow prevention is provided through the installation of air gaps.

Sanitary Waste Discharge System

The SWDS consists of a prefabricated, aerobic, digestion-type sewage treatment plant, capable of treating between 40,000 and 80,000 gallons per day (gpd). The quality of effluent meets, as a minimum, the standards established by federal, state, and local regulations and permits. A simplified diagram of the SWDS is shown in Figure 9.2-202.

9.2.4.3 Safety Evaluation

Potable Water System

The PWS has no safety-related function and is not connected to any safety-related structure, system, or component. The PWS meets General Design Criteria (GDC) 60 for features provided to control the release of liquid effluents containing radioactive material. Failure of the system will not compromise any safety-related equipment or component and will not prevent safe shutdown of the plant. The PWS does not handle radioactive fluids. It is not connected to any system that may contain radioactive fluids. Any possibility of backflow that could introduce radioactive fluids into the PWS is precluded by the installation of air gaps.

Sanitary Waste Discharge System

The SWDS has no safety-related function and is not connected to any safety-related structure, system, or component. The SWDS meets GDC 60 for features provided to control the release of liquid effluents containing radioactive material. Failure of the system will not compromise any safety-related equipment or component and will not prevent safe shutdown of the plant.

The SWDS does not handle radioactive fluids. It is neither connected to, nor does it interface with, any system that may contain radioactive fluids. This system does not have any potential for radioactive contamination. SWDS effluent is monitored as described in Table 11.5-201.

9.2.4.4 Inspection and Testing

Ongoing monitoring of the availability of the PWS and SWDS is maintained through regular use of the systems during plant operation.

9.2.4.5 Instrumentation Application

The PWS and SWDS are furnished with instrumentation that will permit local and/or remote monitoring and control of each respective process. This instrumentation includes all meters, switches, indicators, pressure gauges, transmitters, controllers, and valves required for service operation and for the protection of plant personnel and equipment.

9.2.5 ULTIMATE HEAT SINK

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the second to last sentence in the seventh paragraph with the following.

STD COL 9.2.5-1-A

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.

9.2.5.1 COL Information

9.2.5-1-A Post 7 Day Makeup to UHS

STD COL 9.2.5-1-A

This COL item is addressed in Section 9.2.5.

9.2.6 CONDENSATE STORAGE AND TRANSFER SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.2.6.2 SYSTEM DESCRIPTION

Add the following at the end of the first paragraph.

STD SUP 9.2.6-1 Freeze protection is provided for the CS&TS.

9.2.7 CHILLED WATER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.2.8 TURBINE COMPONENT COOLING WATER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.2.9 HOT WATER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.2.10 STATION WATER SYSTEM

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.2.10.2 System Description

Detailed System Description

Replace the detailed system description and system operation portions of this section with the following.

RBS CDI The station water system (SWS) provides clarified water from the Mississippi River to the circulating water system (CIRC) (Subsection 10.4.5) and plant service water system (PSWS) (Subsection 9.2.1) cooling tower basins to make up for losses resulting from evaporation, drift, and blowdown from the cooling towers. The SWS also provides filtered clarified water to the makeup water system (MWS) (Subsection 9.2.3) for further treatment for use as demineralized water and to the fire protection system (FPS) (Subsection 9.5.1) to fill the primary and yard fire water storage tanks.

The SWS is a shared system between Units 1 and 3 from the Mississippi River intake to the SWS pump discharge header. Components beyond the pump discharge header are independent for each unit. The system does not perform a safety function for either Unit 1 or Unit 3.

A simplified diagram of the SWS is shown in Figure 9.2-203. The design characteristics of the major SWS components are provided in Table 9.2-204.

Three motor-driven, vertical, centrifugal, SWS makeup water pumps are arranged in parallel and are located in a dry-pit pump house at the Mississippi River. Each pump has capacity to supply 50 percent of the two-unit flow requirements. Two pumps are normally operated, and the third pump is reserved for standby operation.

RBS CDI The total flow required for Units 1 and 3 is 40,927 gpm (9296 m^3/hr), comprised of maximum Unit 1 flow of 15,403 gpm (3498 m^3/hr) and a maximum Unit 3 flow of 25,524 gpm (5797 m^3/hr). The pumps take suction from the Mississippi River and discharge to a flow splitter box feeding the two clarifiers.

A vacuum system provides priming of the suction piping for starting of the SWS pumps and maintains prime during operation of the SWS. Provisions for venting, filling, and draining the suction and discharge piping are included in the SWS design. Recirculation lines that discharge back to the river embayment protect the SWS pumps during low-flow operation.

The intake flow enters through two pairs of intake screens located as shown in Figure 9.2-203. One 36-in. (0.91-m) diameter intake line for each intake screen pair conveys water to the makeup pump house. Within the pump house, two 36-in. (0.91-m) diameter intake lines manifold through a common header into three 36-in. (0.91-m) diameter lines, each directly connected to an SWS pump. The intake screens can be backwashed with a compressed air system. The screens are anticipated to require backwashing once per day for approximately 30 min. The actual frequency and duration are determined by operational experience.

The pump house is constructed to ensure a minimum submergence head over the pump impellers and to protect the pumps from the probable maximum flood level. The entrance to the structure is at Elevation 60 ft.-6 in. (18.44 m) mean sea level (msl).

Four, 33 percent clarifiers remove suspended solids from the Mississippi River water. The clarified effluent is discharged over a weir into the circulating water flume. Each clarifier is designed to satisfactorily treat the entire requirement of makeup water for the normal power heat sink (NPHS) in the event that one clarifier is out of service. Polyelectrolyte is added to the raw water to enhance flocculation and settling of suspended solids. The solids that settle are intermittently discharged to the sludge dilution tank, where the solids concentration is adjusted to a level suitable for pumping to the river. Clarified water under pressure is used to remove any buildup of solids in either clarifier sludge discharge pipe during a sequence of backflushing prior to each discharge of sludge. Two backflush pumps taking suction from each clarifier clear water zone are provided for this purpose.

One sludge dilution tank is provided near the clarifiers to receive clarifier bottoms sludge blowdown. The blowdown from the clarifiers flows to the dilution tank, where river water from the makeup water pipeline is continuously fed and mixed in the sludge dilution tank. The dilution tank is equipped with two full-capacity vertical mixers and two 100 percent capacity centrifugal pumps. The diluted clarifier blowdown is pumped through one pipeline to an outfall in the Mississippi River (combined with Unit 1 outfall).

Makeup to the NPHS is provided by gravity feed from the clearwell to the NPHS cooling tower basin via a flow control valve.

Two wet-pit type vertical pumps located in the clearwell basin provide PSWS makeup to the auxiliary heat sink (AHS) cooling tower basins via a flow control valve. Each pump is sized for full makeup capacity.

Two wet-pit type vertical demineralizer feed pumps, also located in the clearwell, discharge through granular media filters to provide continuous feed to the MWS demineralizers. One pump and two of the three filters function to support the MWS. The demineralizer feed pumps also provide pretreated filtered water for filling the FPS primary and yard fire water storage tanks. This equipment is sized such that the yard fire water storage tank can be refilled within 8 hours, as specified by Regulatory Guide 1.189, when one pump and two filters are in operation. Backwash from the filters is drained to the cooling tower blowdown piping for discharge to the river.

System Operation

The SWS operates during all modes of normal plant operations. Two SWS pumps provide sufficient flow for all plant requirements for Units 1 and 3. The standby pump starts automatically if an operating pump trips.

Makeup flow to the NPHS, which represents more than 90 percent of total plant makeup, is not normally required when the plant is not operating. During these low makeup conditions, the operating SWS pump is throttled to the minimum flow necessary for safe pump operation, and excess flow not required for makeup is recirculated to the intake embayment.

9.2.10.5 Instrumentation Requirements

Replace the first and second paragraphs of this section with the following.

RBS CDI

Instruments are provided for monitoring system parameters. Operation of the SWS pumps and clarifiers is monitored in the main control room (MCR). The high and low levels of pretreated water in the clarifier clearwell, and low suction pressure for each pump taking suction from the clearwell, are alarmed in the MCR.

RBS CDI Replace the "PSWS Cooling Towers and Basins" section of DCD Table 9.2-2 with the following:

Table 9.2-201
PSWS Component Design Characteristics

PSWS Mechanical Draft Cooling Towers

	Type	Mechanical draft, multi-cell, redundant dual-speed, reversible fans
	Quantity	2
	Heat Load Each[a]	[87.2 MW (2.98 x 10^8 Btu/hr)][b]
	Flow Rate (Water)	2.524 m^3/s (40,000 gpm)
	Ambient Wet-Bulb Temperature	26.4°C (80°F)
	Approach Temperature[c]	4.7°C (8°F)
	Cold Leg Temperature	31.1°C (88°F)
RBS SUP 1.2.1-1	Basin Reserve Storage Capacity[c]	2.4 million gallons

a) Minimum heat load cooling towers need to be able to reject.

b) In accordance with DCD Table 9.2-1.

c) PSWS required to remove 2.02 x 10^7 MJ (1.92 x 10^{10} Btu) for a period of 7 days without active makeup. The volume is defined as the minimum volume above the pump minimum submergence water level.

RBS CDI Replace DCD Table 9.2-9 with Table 9.2-202.

Table 9.2-202
Major Makeup Water System Components

One 950 m^3 (250,963 gal.) demineralized water storage tank.
Two 1249 l/min (330 gpm) makeup water transfer pumps.

Table 9.2-203
Potable Water System
Component Characteristics

Hot Water Tank	
Quantity	1 (per building)
Type	Electric immersion heater or on-demand in-line heaters

Table 9.2-204
Station Water System Component Design Characteristics

	Intake Screens (Shared with Unit 1)	
	Quantity	2 pair
	Capacity, each pair	5797 m^3/hr (25,524 gpm)
	Maximum Pressure Drop	14.95 kPa (5 ft.)
	Maximum Flow Velocity	0.152 m/s (0.5 fps)[(a)]
	SWS Pumps (Shared with Unit 1)	
	Type	Vertical, dry-pit
	Quantity	3 – 50 percent (Combined Unit 1 and Unit 3 Flow)
	Capacity, each	4648 m^3/hr (20,464 gpm)
	Clarifiers	
	Quantity	4 – 33 percent
	Type	Internal sludge recirculation
	Capacity, each	1932 m^3/hr (8508 gpm)
	Clearwell Basin	
	Storage volume	1136 m^3 (300,000 gal)
	Demineralizer Feed Pumps	
	Type	Vertical, wet-pit
	Quantity	2 – 100 percent
	Capacity, each	145.1 m^3/hr (639 gpm)
RBS CDI	Granular Media Filters	
	Type	Air scour
	Quantity	3 – 50 percent
	Capacity, each	72.7 m^3/hr (320 gpm)
RBS CDI	PSWS Makeup Pumps	
	Type	Vertical, wet-pit
	Quantity	2 – 100 percent
	Capacity, each	243 m^3/hr (1070 gpm)

a) The maximum flow velocity for the intake screens is based on 40 CFR 9, 122, et al., "Regulations Addressing Cooling Water Intake Structures for New Facilities."

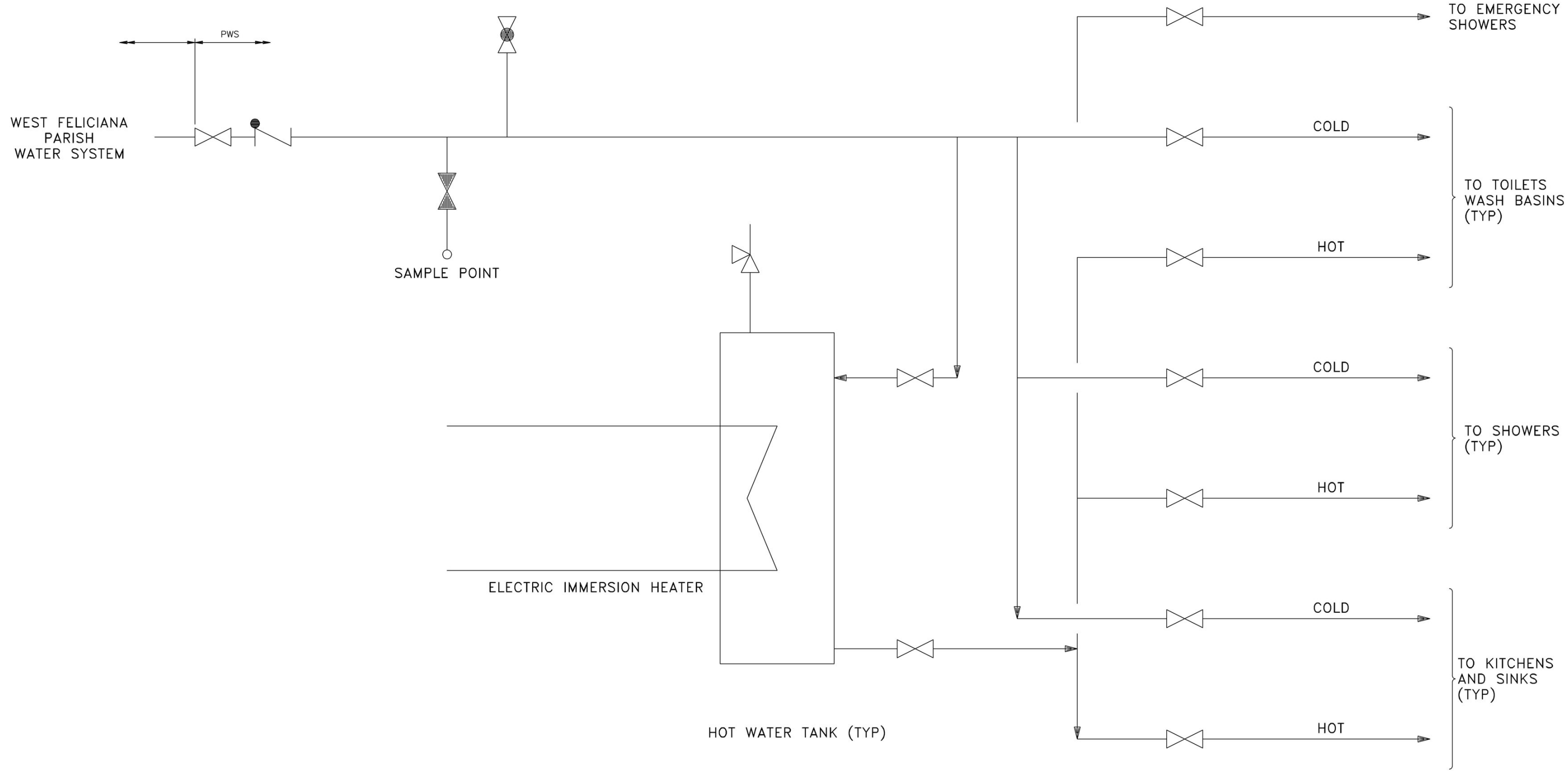

Figure 9.2-201. Potable Water System Simplified Diagram

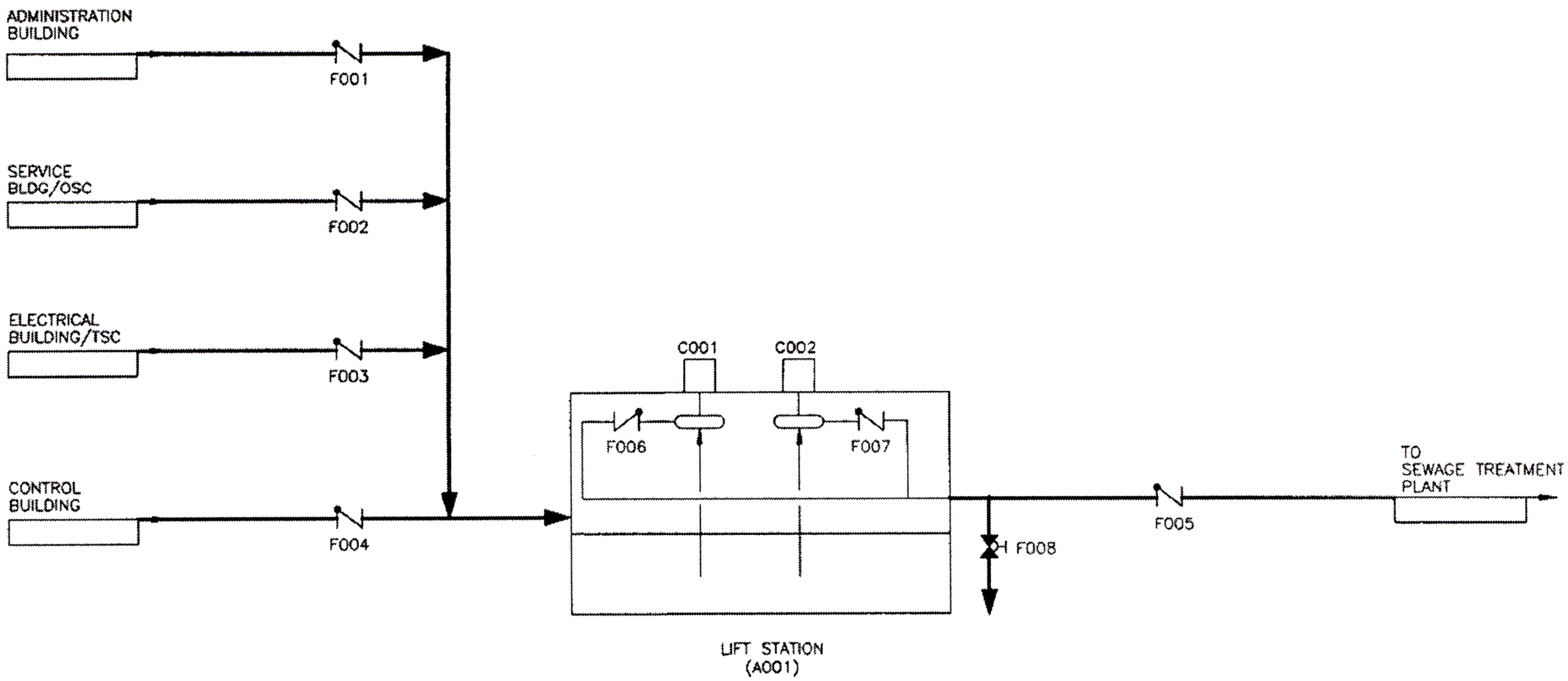

Figure 9.2-202. Sanitary Waste Discharge System Simplified Diagram

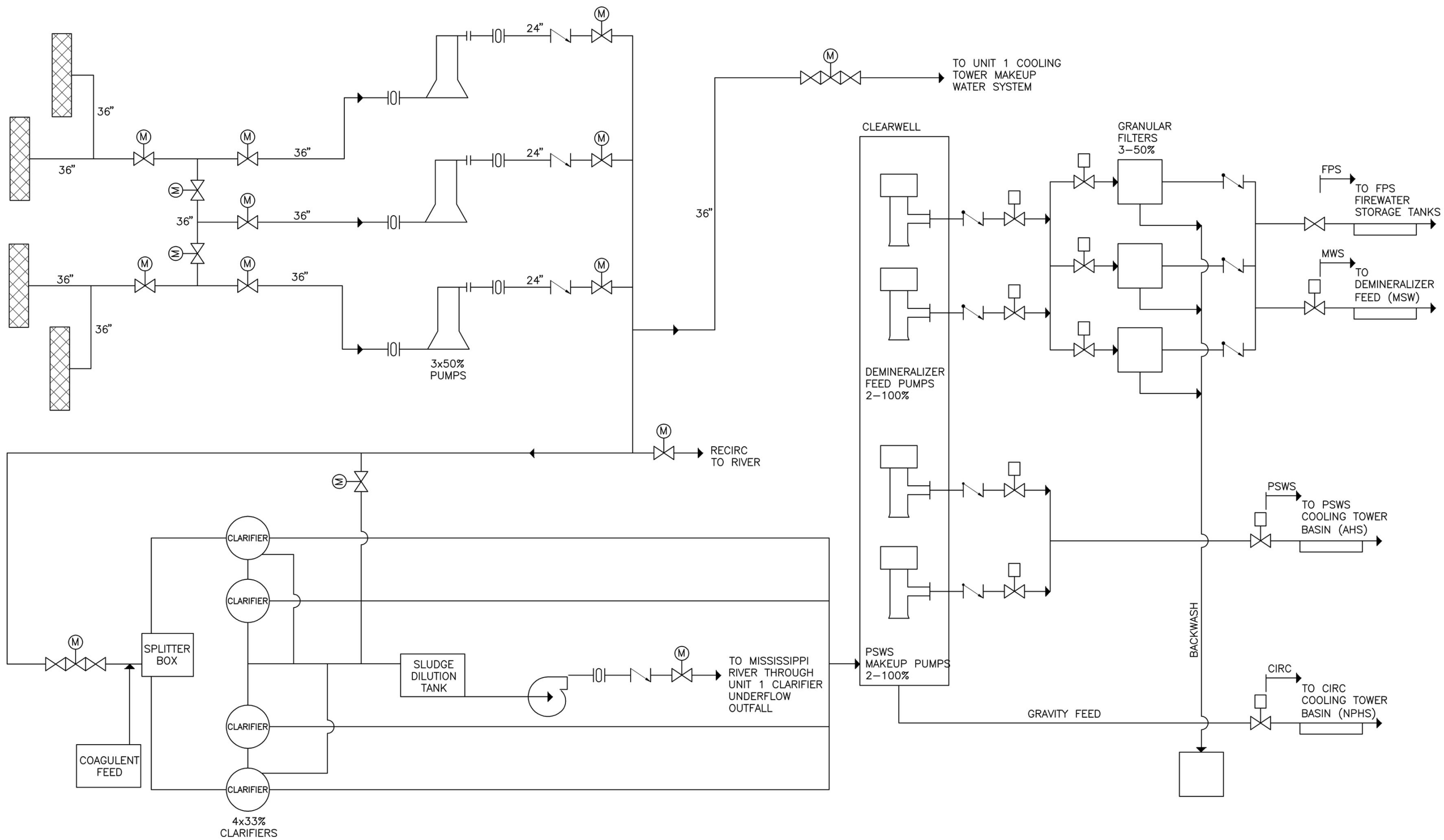

Figure 9.2-203. Station Water System Simplified Diagram

9.3 PROCESS AUXILIARIES

9.3.1 COMPRESSED AIR SYSTEMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.2 PROCESS SAMPLING SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.3.2.2 System Description

Add the following at the end of this section.

STD COL 9.3.2-1-A

Post-Accident Sampling Program

The post-accident sampling program consists of the following:

- Emergency Operating Procedures that rely on Emergency Action Levels, defined in the Emergency Plan, 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 RWCU/SDC sample line using the Reactor Building 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 Reactor Building 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 11.5.3.2.12 and analyzed for fission products.

- DCD Section 7.5.2.2 describes Containment Monitoring System operation in post-LOCA mode for gaseous sampling for O_2 and H_2.

- Effluent radiation monitoring is described in DCD Section 7.5. Field sampling and monitoring capability is maintained in accordance with the Emergency Plan.
- Post accident monitoring is adequate to implement the Emergency Plan without reliance on post accident sampling capability; therefore, the absence of a dedicated Post-Accident Sampling System does not reduce the effectiveness of the Emergency Plan.
- The post-accident sampling program meets the requirements of NUREG-0800, Section 9.3.2 for actions required in lieu of a Post Accident Sampling System.

9.3.2.6 COL Information

9.3.2-1-A Post-Accident Sampling Program

STD COL 9.3.2-1-A This COL item is addressed in Subsection 9.3.2.2.

9.3.3 EQUIPMENT AND FLOOR DRAIN SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.4 CHEMICAL AND VOLUME CONTROL SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.5 STANDBY LIQUID CONTROL SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.3.5.2 System Description

Detailed System Description

Add the following to the end of the fifth paragraph.

STD SUP 9.3.5-1 The above provisions adequately prevent loss of solubility of borated solutions (sodium pentaborate).

9.3.6 INSTRUMENT AIR SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.7 SERVICE AIR SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.8 HIGH PRESSURE NITROGEN SUPPLY SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.3.9 HYDROGEN WATER CHEMISTRY SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the first paragraph with the following.

STD COL 9.3.9-1-A The site specific design includes HWCS.

9.3.9.1 Design Basis

Power Generation Design Basis

Replace the first sentence with the following.

STD CDI Hydrogen is added into the feedwater at the suction of the feedwater pumps and oxygen into the offgas system.

9.3.9.2 System Description

Replace this section with the following.

RBS CDI

RBS COL 9.3.9-2-A

The hydrogen water chemistry system (HWCS), illustrated in DCD Figure 9.3-5, is composed of hydrogen and oxygen supply systems to inject hydrogen in the feedwater and oxygen in the offgas. Monitoring systems are used to track the effectiveness of the HWCS. The HWCS utilizes the existing Unit 1 cryogenic skid.

The skid is located west of Unit 3 outside the protected area to facilitate vendor deliveries. The cryogenic skid is vendor-supplied, -monitored, and -maintained.

RBS CDI

The HWCS is implemented with On-Line Noble ChemTM (OLNC). Plant personnel conduct the OLNC process while the plant is operating.

The hydrogen supply system is integrated with the generator hydrogen supply system (as described in DCD Section 10.2.2.2.8).

9.3.9.2.1 Hydrogen Storage Facility

RBS CDI

RBS COL 9.3.9-2-A

The Unit 1 cryogenic skid has 18,000 gallons of storage capacity for hydrogen and 9000 gallons of storage capacity for oxygen. The skid is more than 1050 ft. away from Unit 3 safety-related structures.

9.3.9.4 Inspection and Testing Requirements

Replace this section with the following.

STD CDI

The connections for the HWCS are tested and inspected with the feedwater and offgas piping.

Major components of the HWCS are tested and inspected as separate components prior to installation. The system is tested in accordance with vendor requirements after installation to ensure proper performance.

9.3.9.5 Instrumentation and Controls

Replace the first sentence with the following.

STD CDI

Instrumentation is provided to control the injection of hydrogen and augment the injection of oxygen.

9.3.9.6 COL Information

9.3.9-1-A Implementation of Hydrogen Water Chemistry

STD COL 9.3.9-1-A

This COL item is addressed in Section 9.3.9.

9.3.9-2-A Hydrogen and Oxygen Storage and Supply

RBS COL 9.3.9-2-A

This COL item is addressed in Sections 9.3.9.2 and 9.3.9.2.1.

9.3.10 OXYGEN INJECTION SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.3.10.2 System Description

Replace the last sentence in this section with the following.

RBS COL 9.3.10-1-A

The Unit 3 oxygen injection system is supplied from the Unit 1 liquid oxygen storage tank. The Unit 1 cryogenic skid holds 9000 gallons of oxygen. It is located west of Unit 3 outside the protected area to facilitate vendor deliveries. The cryogenic skid is vendor-supplied, -monitored, and -maintained. There are regular deliveries of oxygen based on vendor monitoring. Hazards associated with the storage of liquid oxygen are evaluated in FSAR Subsection 2.2.3.

9.3.10.6 COL Information

RBS COL 9.3.10-1-A

9.3.10-1-A Oxygen Storage Facility

This COL item is addressed in Section 9.3.10.2.

9.3.11 ZINC INJECTION SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.3.11.2 System Description

Replace the second paragraph with the following.

STD COL 9.3.11-1-A

A Zinc Injection System is not utilized.

9.3.11.4 Test and Inspections

Replace the second paragraph with the following.

STD COL 9.3.11-2-A

A Zinc Injection System is not utilized.

9.3.11.6 COL Information

9.3.11-1-A Determine Need for Zinc Injection System

STD COL 9.3.11-1-A

This COL item is addressed in Section 9.3.11.2.

9.3.11-2-A Provide System Description for Zinc Injection System

STD COL 9.3.11-2-A

This COL item is addressed in Section 9.3.11.4.

9.3.12 AUXILIARY BOILER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.4 HEATING, VENTILATION, AND AIR CONDITIONING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.4.2 FUEL BUILDING HVAC SYSTEM (FBVS)

RBS DEP 9.4-1 The FBVS exhaust is directed to the Reactor Building/Fuel Building Vent Stack as described in DCD Rev. 5, Section 9.4.2, instead of the plant vent stack. A Fuel Building HVAC Purge Exhaust Filter Unit is provided and exhaust air may be directed to this unit during periods of high radioactivity prior to release through the RB/FB Vent Stack.

Add to Table 9.4-4 design information for the FBVS Purge Exhaust Filter Unit:

Table 9.4-4R
Major Equipment for FBGAVS (Continued)

FB Purge exhaust filter unit	Quantity:	2 - 100% capacity
	Capacity	Flow - 4800 l/s (10,170 cfm)
	Type	Medium efficiency filter, HEPA filter (99% credited), Carbon filter (99%), and post-filter (95% DOP minimum)

9.4.3 RADWASTE BUILDING HEATING, VENTILATING AND AIR CONDITIONING SYSTEM

The RWVS exhaust is directed to the Radwaste Building Vent Stack as described in DCD Rev. 5, Section 9.4.3, instead of the plant vent stack.

9.4.4 TURBINE BUILDING HVAC SYSTEM

The TBVS exhaust is directed to the Turbine Building Vent Stack as described in DCD Rev. 5, Section 9.4.4, instead of the plant vent stack.

9.4.6 REACTOR BUILDING HVAC SYSTEM

The RBVS exhaust is directed to the Reactor Building/Fuel Building Vent Stack as described in DCD Rev. 5, Section 9.4.6, instead of the plant vent stack.

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 FIRE PROTECTION SYSTEM

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.5.1.1 Design Bases

Codes, Standards, and Regulatory Guidance

Add the following sentence at the end of this section.

RBS SUP 9.5.1-1 Table 9.5-201 supplements DCD Table 9.5-1 for those portions outside the DCD and operational aspects of the fire detection and suppression system.

9.5.1.2 System Description

Add the following sentence after the first sentence in the first paragraph.

RBS COL 9.5.1-4-A Figure 9.5-201 provides a simplified diagram of the site-specific fire water supply piping.

RBS COL 9.5.1-1-A 9.5.1-2-A Delete the "*" and "**" footnotes in DCD Table 9.5-2.

9.5.1.4 Fire Protection Water Supply System

Water Sources

Replace the first paragraph, with the exception of the next to last sentence, with the following.

RBS COL 9.5.1-4-A As identified by DCD Figure 9.5-1 and Figure 9.5-201, water for the fire protection system (FPS) is supplied from a minimum of two sources: (i) at least one "primary" source to the suctions of primary fire pumps and corresponding jockey fire pumps and (ii) at least one "secondary" source to the suctions of secondary fire pumps and corresponding jockey fire pumps. The primary source is two dedicated, Seismic Category I, fire water storage tanks. Each primary fire water storage tank has sufficient capacity to meet the maximum fire water demand for a period of up to 120 minutes.

RBS COL 9.5.1-1-A

The secondary fire water source is two 100 percent, non-seismic, fire water storage tanks. Each tank has a capacity of 300,000 gal., which meets National Fire Protection Association (NFPA) 804 requirements. The tanks are interconnected such that fire pumps can take suction from either or both of the storage tanks. The size of each tank is sufficient to supply the total water demand of the yard loop for a period of at least 120 minutes or 50 percent of the maximum fire water demand to the Turbine Building loop for a period of up to 2 hr. The tanks are nonsafety-related, non-seismic, and are constructed in accordance with NFPA 22. Clarified makeup water to the tanks is supplied from the station water system (SWS) with makeup capacity sufficient to refill the tank within an 8-hr. period.

Fire Pumps

Replace the sixth sentence in the first paragraph with the following.

RBS COL 9.5.1-2-A

Testing will be performed to demonstrate that the secondary fire protection pump circuit supplies a minimum of 484 m^3/hr (2130 gpm) with sufficient discharge pressure to develop a minimum of 107 psig line pressure at the Turbine Building/ yard interface boundary. This cannot be performed until the system is built. This activity will be completed prior to fuel receipt.

9.5.1.5 Fire Water Supply Piping, Yard Piping, and Yard Hydrants

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Delete the last sentence in this section, and add the following sentence at the end of the first paragraph of this section.

RBS COL 9.5.1-4-A

Figure 9.5-201 provides a simplified diagram of the site-specific firewater supply piping.

9.5.1.10 Fire Barriers

Replace the last paragraph with the following.

STD COL 9.5.1-5-A

Mechanical and electrical penetration seals and electrical raceway fire barrier systems are qualified to the requirements delineated in RG 1.189 by an independent testing laboratory in accordance with the applicable guidance of NFPA 251 and/or ASTM E-119. 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 review at least six months prior to fuel receipt.

9.5.1.11 Building Ventilation

Replace the last sentence in the third paragraph with the following.

STD COL 9.5.1-6-H

Procedures for manual smoke control will be developed as part of the Fire Protection Program implementation. The required elements of the Fire Protection Program are fully operational prior to receipt of new fuel for buildings storing new fuel and adjacent fire areas that could affect the fuel storage area. Other required elements of the Fire Protection Program described in this section are fully operational prior to initial fuel loading per Section 13.4.

9.5.1.12 Safety Evaluation

Replace the fifth paragraph with the following.

STD COL 9.5.1-7-H

A compliance review of the as-built design against the assumptions and requirements stated in the FHA will be completed in accordance with the milestones in Section 13.4.

Add the following after the fifth paragraph.

STD SUP 9.5.1-2

An as-built review of final post-fire safe-shutdown analysis will be performed based on final plant cable routing and equipment arrangement. This review will include verification that purchased components required for post-fire safe shutdown are not impacted by indirect effects of fire such as smoke migration from one fire area to another. This activity will be completed in accordance with the milestones in Section 13.4.

9.5.1.15 Fire Protection Program

Replace the last sentence of the first paragraph with the following.

STD COL 9.5.1-8-A

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 section are fully operational prior to initial fuel loading per Section 13.4.

9.5.1.15.1 Fire Protection Program Criteria

Add the following sentence at the end of this section.

RBS SUP 9.5.1-1

Table 9.5-201 supplements DCD Table 9.5-1.

9.5.1.15.2 Organization and Responsibilities

Replace the last sentence of the thirteenth bullet of the section as follows.

STD COL 9.5.1-9-A

Control of changes to the fire protection program is defined in a license condition. Changes to the approved fire protection program may be made without prior approval of the NRC only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire.

9.5.1.15.4 On-Site Fire Operations Training

Replace the first paragraph with the following.

RBS COL 9.5.1-10-H

The organization of the fire brigade is discussed in Section 13.1. Implementation of the fire brigade will be in accordance with the milestone in Section 13.4 for the Fire Protection Program.

9.5.1.15.9 Quality Assurance

Replace the last sentence of this section with the following.

STD COL 9.5.1-11-A

The Quality Assurance Program implements the requirements of RG 1.189 through site-specific administrative control procedures. The procedures will be developed six months prior to fuel receipt and will be fully implemented prior to fuel receipt.

9.5.1.16 COL Information

9.5.1-1-A Secondary Firewater Storage Source

RBS COL 9.5.1-1-A

This COL item is addressed in Sections 9.5.1.2 and 9.5.1.4.

9.5.1-2-A Secondary Firewater Capacity

RBS COL 9.5.1-2-A

This COL item is addressed in Sections 9.5.1.2 and 9.5.1.4.

9.5.1-4-A Piping and Instrumentation Diagrams

RBS COL 9.5.1-4-A

This COL item is addressed in Sections 9.5.1.2, 9.5.1.4, 9.5.1.5, and Figure 9.5-201.

9.5.1-5-A Fire Barriers

STD COL 9.5.1-5-A

This COL item is addressed in Section 9.5.1.10.

9.5.1-6-H Smoke Control

STD COL 9.5.1-6-H

This COL item is addressed in Section 9.5.1.11.

9.5.1-7-H FHA Compliance Review

STD COL 9.5.1-7-H

This COL item is addressed in Section 9.5.1.12.

9.5.1-8-A Fire Protection Program Description

STD COL 9.5.1-8-A

This COL item is addressed in Section 9.5.1.15.

9.5.1-9-A Fire Protection Program License Changes

STD COL 9.5.1-9-A

This COL item is addressed in Section 9.5.1.15.2.

9.5.1-10-H Fire Brigade

RBS COL 9.5.1.10-H

This COL item is addressed in Sections 9.5.1.15.4 and 13.1.2.1.5.

9.5.1-11-A Quality Assurance

STD COL 9.5.1.11-A

This COL item is addressed in Section 9.5.1.15.9.

9.5.2 COMMUNICATIONS SYSTEM

This subsection of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.5.2.2 System Description

Emergency Communications Systems

Replace the last sentence of the first bullet with the following.

RBS COL 9.5.2.5-1-A

The description of the Emergency Notification System (ENS) is provided in the plant Emergency Plan. The normal power for this system device is nonsafety-related station power. The nonsafety-related station power is de-energized during a loss of off-site power. The utility switch equipment on-site is battery powered for a period of approximately 8 hours following a loss of normal power. This design ensures that the ENS located at the site is fully operable from the site in the event of a loss of off-site power at the site and is in compliance with the requirements of NRC Bulletin 80-15 for the ENS. The Operational Hotlines (described in the plant Emergency Plan) are normally powered from nonsafety-related station power with battery and emergency diesel generator backup power supply. Computerized ENS is used to notify the plant emergency response personnel upon declaration of an emergency. The system is located in the Emergency Operations Facility (EOF) and receives electrical power from the EOF emergency diesel generator in the event of loss of normal power supply. A battery powered backed uninterruptible power supply provides power to the ENS during the electrical power switchover.

Replace the last bullet with the following.

RBS COL 9.5.2.5-2-A

- 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 Corporation 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.

9.5.2.5 COL Information

9.5.2.5-1-A Off-Site Interfaces

RBS COL 9.5.2.5-1-A

This COL item is addressed Subsection 9.5.2.

9.6.3.6-2-A Grid Transmission Operator

RBS COL 9.5.2.5-2-A

This COL item is addressed in Subsection 9.5.2.2.

9.5.3 LIGHTING SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.5.4 DIESEL GENERATOR FUEL OIL STORAGE AND TRANSFER SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9.5.4.2 System Description

Detailed System Description

Replace the third to last sentence in the first paragraph with the following.

STD COL 9.5.4-1-A

Procedures require that the quantity of DG fuel oil in the fuel oil storage tanks is monitored on a periodic basis. The diesel fuel oil usage is tracked against planned deliveries. Regular transport replenishes the fuel oil inventory during periods of high demand and ensures continued supply in the event of adverse weather conditions. These procedures ensure sufficient diesel fuel oil inventory is available on site so that the diesel can operate continually for seven days. The procedures will be developed in accordance with the milestone and processes described in Section 13.5.

Replace the 3rd paragraph with the following.

RBS COL 9.5.4-2-A

The material for the underground piping portion of the fuel oil transfer system is carbon steel. The buried section of the piping is provided with waterproof protected coating and cathodic protection.

9.5.4.6 COL Unit-Specific Information

STD COL 9.5.4-1-A

9.5.4-1-A Fuel Oil Capacity

This COL item is addressed in Section 9.5.4.2.

RBS COL 9.5.4-2-A

9.5.4-2-A Protection of Underground Piping

This COL item is addressed in Section 9.5.4.2.

9.5.5 DIESEL GENERATOR JACKET COOLING WATER SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.5.6 DIESEL GENERATOR STARTING AIR SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.5.7 DIESEL GENERATOR LUBRICATION SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

9.5.8 DIESEL GENERATOR COMBUSTION AIR INTAKE AND EXHAUST SYSTEM

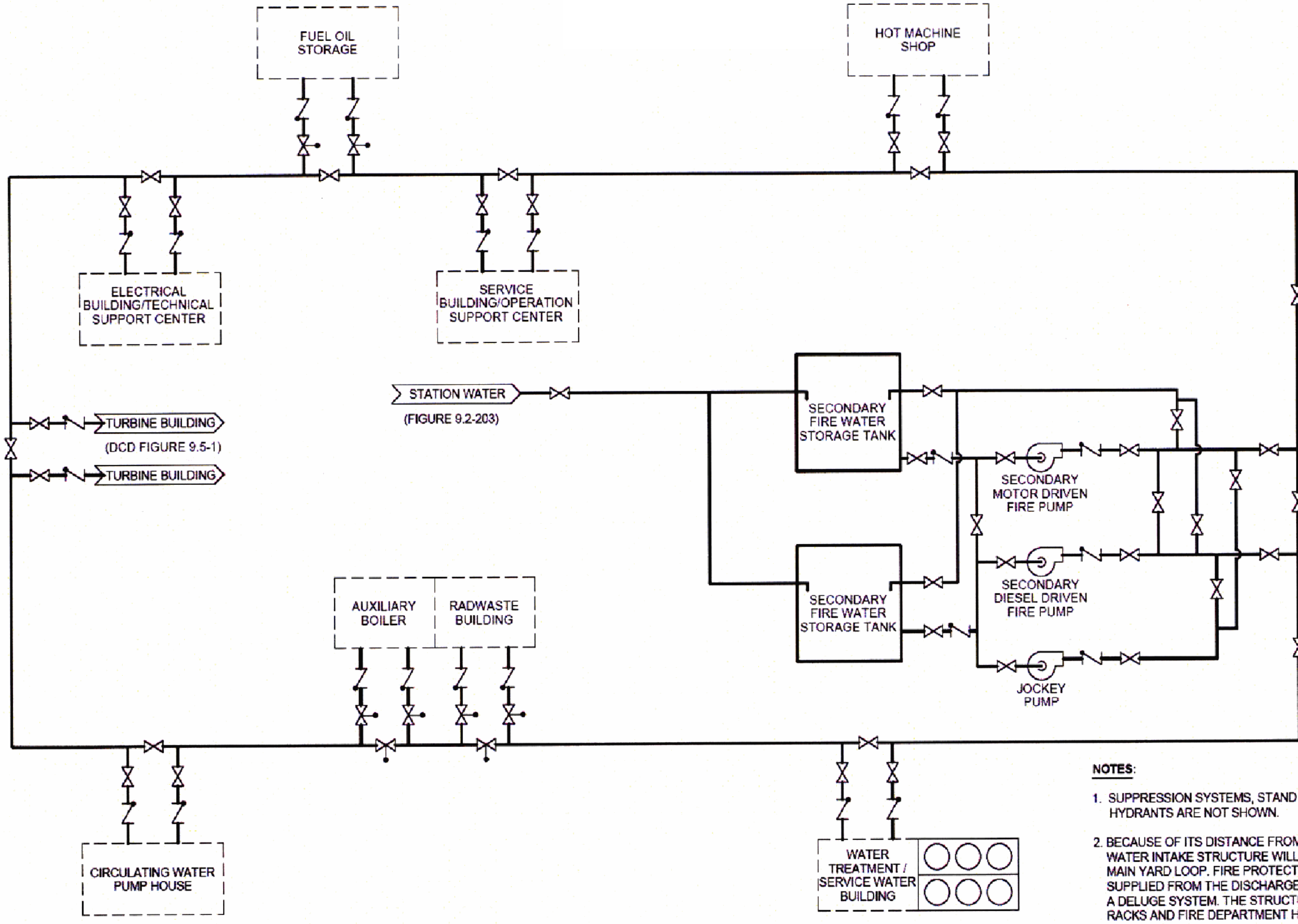
This section of the referenced DCD is incorporated by reference with no departures or supplements.

RBS SUP 9.5.1-1

RBS SUP 9A-1

Table 9.5-201
Codes and Standards

American Society of Mechanical Engineers	
Boiler and Pressure Vessel Code	Section IX, Qualification Standard for Welding and Brazing Procedures, Welder, Brazers and Welding and Brazing Operators
Applicable Building Codes	
Standard Southern Building Code	Standard Southern Building Code
Uniform Building Code	Uniform Building Code
National Fire Protection Association	
NFPA 25	Recommended Practices for Inspection, Testing, and Maintenance of Standpipes and Hose Systems
NFPA 55	Standard for Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks
Environmental Protection Agency	
EPA	EPA Standards of Performance for Stationary Compression Ignition Internal Combustion Engines; Final Rule (40 CFR 60, 85 et al.)



NOTES:

1. SUPPRESSION SYSTEMS, STAND PIPES, HOSE RACKS AND HYDRANTS ARE NOT SHOWN.
2. BECAUSE OF ITS DISTANCE FROM THE PLANT, THE STATION WATER INTAKE STRUCTURE WILL NOT BE CONNECTED TO THE MAIN YARD LOOP. FIRE PROTECTION FOR THIS AREA WILL BE SUPPLIED FROM THE DISCHARGE SIDE OF THE SWS PUMPS TO A DELUGE SYSTEM. THE STRUCTURE WILL ALSO INCLUDE HOSE RACKS AND FIRE DEPARTMENT HOSE CONNECTIONS, AS REQUIRED.

RBS COL 9.5.1-4-A

Figure 9.5-201. Fire Protection System Yard Main Loop

APPENDIX 9A FIRE HAZARDS ANALYSIS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

9A.2.1 CODES AND STANDARDS

Add the following second paragraph.

RBS SUP 9A-01

The codes and standards that are applicable to the design of the site-specific portions of the yard are listed in Table 9.5-201. Tables 1.9-202, 1.9-203, and 1.9-204 identify the relevant editions for each applicable code and standard. These codes and standards also apply to the operational aspects of the fire detection and suppression systems.

9A.4.7 YARD

Replace the first paragraph with the following.

RBS COL 9A-7-1-A

The yard includes all portions of the plant site external to the Reactor Building, Fuel Building, Control Building, Turbine Building, Radwaste Building, and Electrical Building. Fire zone drawings of those portions of the yard, except for that associated with the Turbine and Electrical Building equipment, will be developed 6 months prior to fuel load. The FSAR will be revised to include this information, as appropriate, as part of a subsequent FSAR update.

RBS COL 9A-7-2-A

Replace the second sentence of the second paragraph with the following.

The more detailed evaluations of the Service Water/Water Treatment Building, Service Building, and the portions of the yard area outside the scope of the certified design are addressed in Sections 9A.5.7, 9A.5.8, and 9A.5.9.

9A.5.7 YARD

Replace the last two sentences with the following.

RBS COL 9A-7-2-A

A detailed fire hazards analysis (FHA) of the yard area that is outside the scope of the certified design cannot be completed until cable routing is performed during final design. This analysis will be completed 6 months prior to fuel load. The FSAR will be revised to include this information, as appropriate, as part of a subsequent FSAR update.

9A.5.8 SERVICE BUILDING

Replace the last two sentences with the following.

RBS COL 9A-7-2-A

A detailed FHA of the yard area that is outside the scope of the certified design, which includes the Service Building, cannot be completed until cable routing is performed during final design. This analysis will be completed 6 months prior to fuel load. The FSAR will be revised to include this information, as appropriate, as part of a subsequent FSAR update.

9A.5.9 SERVICE WATER/WATER TREATMENT BUILDING

Replace the last two sentences with the following.

RBS COL 9A-7-2-A

A detailed FHA of the yard area that is outside the scope of the certified design, which includes the Service Water/Water Treatment Building, cannot be completed until cable routing is performed during final design. This analysis will be completed 6 months prior to fuel load. The FSAR will be revised to include this information, as appropriate, as part of a subsequent FSAR update.

9A.5.10 REFERENCES

None.

9A.7 COL INFORMATION

9A-7-1-A Yard Fire Zone Drawings

RBS COL 9A-7-1-A

This COL item is addressed in Section 9A.4.7.

9A-7-2-A FHA for Site-Specific Areas

RBS COL 9A-7-2-A

This COL item is addressed in Sections 9A.4.7, 9A.5.7, 9A.5.8, and 9A.5.9.

APPENDIX 9B SUMMARY OF ANALYSIS SUPPORTING FIRE PROTECTION DESIGN REQUIREMENTS

This section of the referenced DCD is incorporated by reference with no departures and/or supplements.

CHAPTER 10 STEAM AND POWER CONVERSION SYSTEM

10.1 SUMMARY DESCRIPTION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

10.2 TURBINE GENERATOR

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.2.3.4 Turbine Design

Insert the following as the first paragraph:

STD SUP 10.2-1

The General Electric Company manufactures the turbine and generator. The model N1R turbine is from General Electric's N series nuclear steam turbines.

10.2.3.8 Turbine Missile Probability Analysis

Replace the last paragraph with the following.

STD COL 10.2-1-H

The probability of turbine missile generation will be calculated for the specific turbine selected. Final information on TGS material properties, fabrication, and design features will also be provided in the turbine missile analysis. This analysis will be completed no later than one year prior to fuel load. The FSAR will be revised, as necessary, to reflect this analysis as part of a subsequent FSAR update. COM 10.2-001

10.2.5 COL INFORMATION

10-2-1-H Turbine Missile Probability Analysis

This COL item is addressed in Section 10.2.3.8.

10.3 TURBINE MAIN STEAM SYSTEM

This section of the referenced DCD is incorporated by reference with no departures or supplements.

10.4 OTHER FEATURES OF STEAM AND POWER CONVERSION SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.4.5.2.1 General Description

Replace the text with the following.

RBS CDI The Circulating Water System (CIRC) is depicted in Figures 10.4-201 through 10.4-204. The CIRC consists of the following components:

- Condenser water boxes, piping, and valves.
- Condenser tube cleaning equipment.
- Water box drain subsystem.
- Four 25 percent capacity pumps and pump discharge valves.
- One hyperbolic natural draft cooling tower (NDCT) and one mechanical draft cooling tower (MDCT).

Table 10.4-3R includes the normal power heat sink (NPHS) temperature range of the water return from the main condenser to the cooling towers and the temperature range of the water delivered by the CIRC pumps to the main condenser.

The CIRC water is normally circulated by four motor-driven pumps through the condenser and back to the cooling towers. The operating circulating water flow rate varies depending on ambient conditions, system configuration, and heat load.

The four pumps are arranged in parallel. Discharge lines combine into two parallel circulating water supply lines to the main condenser. Each main circulating water supply line connects to a low-pressure condenser inlet water box. An interconnecting line fitted with a butterfly valve is provided to connect both circulating water supply lines. The discharge of each pump is fitted with a remotely-operated valve. This arrangement permits isolation and maintenance of any one pump while the others remain in operation and minimizes the backward flow through an out-of-service pump.

The CIRC and condenser are designed to permit isolation of half of the three series connected tube bundles to permit repair of leaks and cleaning of water boxes while operating at reduced power.

The CIRC includes water box vents to help fill the condenser water boxes during startup and remove accumulated air and other gases from the water boxes during normal operation.

Circulating water chemistry is maintained by the circulating water chemical feed system and with blowdown. Circulating water chemical equipment injects the required chemicals into the cooling tower basin before entering the circulating water pumps. Additional injection points are located in the inlet piping of each cooling tower.

10.4.5.2.2 Component Description

Replace the text with the following.

RBS CDI Codes and standards applicable to the CIRC are listed in DCD Section 3.2, with the exception of large bore piping (piping with a nominal diameter of 28 in. [700 mm] and larger). Large bore CIRC piping is constructed using American Water Works Association (AWWA) standards (Reference 10.4-201). The system is designed and constructed in accordance with Quality Group D specifications.

Table 10.4-3R provides reference parameters for the major components of the CIRC.

10.4.5.2.2.1 CIRC Chemical Injection

Circulating water chemistry is maintained by the circulating water chemical feed system. Chemical feed equipment injects the required chemicals into the circulating water in the cooling tower basin before water enters the circulating water pumps.

Additional injection points are located at the inlet of the cooling towers. This maintains a non-corrosive, nonscale-forming condition and limits the biological film formation that reduces the heat transfer rate in the condenser and cooling tower fill.

Plant chemistry specifies the required chemicals used within the system. The chemicals can be divided into five categories based upon function: 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 required to maintain proper concentrations. Biocide application frequency may vary with the seasons. Algaecide is applied, as necessary, to control algae formation in the cooling towers.

The following chemicals are used, as specified by plant chemistry to control circulating water chemistry:

- Biocide - 10 to 15 percent sodium hypochlorite with the aid of a surfactant, if required.
- Algaecide - 10 to 15 percent sodium hypochlorite with the aid of a surfactant, if required.
- pH Adjuster - 90 percent sulfuric acid.
- Corrosion Inhibitor - 30 to 40 ppm phosphinosuccinic oligomer (PSO).
- Scale Inhibitor - 55 percent organic phosphate with the aid of a dispersant, if required.

Chemicals selected are compatible with selected materials or components used in the CIRC.

10.4.5.2.3 System Operation

Add the following at the end of this section.

RBS CDI

The four circulating water pumps take suction from the circulating water pump pit and circulate the water through the main condenser. Circulating water returns through the condenser discharge to the cooling towers. During normal operation, the NDCT and MDCT distribute circulating water through nozzles in the cooling tower distribution headers. The water then falls through fill material to the basin beneath the tower and, in the process, rejects heat to the atmosphere. Provisions are made during cold weather to stop circulating water flow through the MDCT and reduce overall flow through the system. Circulating water flow may also be returned directly to the NDCT basin.

The station water system (SWS) supplies makeup water to the NDCT basin to replace water losses because of evaporation, wind drift, and blowdown. Blowdown from the CIRC is taken from the discharge weir of the NDCT and is discharged to the plant outfall.

A condenser tube cleaning subsystem cleans the circulating water side of the main condenser tubes.

Leakage of condensate from the main condenser into the CIRC via a condenser tube leak is not likely during power operation, because the CIRC normally operates at a greater pressure than the shell (condensate) side of the condenser.

10.4.5.5 Instrumentation Applications

Insert the following between the fourth and fifth paragraphs.

RBS CDI Level instrumentation provided in the circulating water pump pit controls makeup flow from the SWS to the NDCT basin. Level instrumentation in the pump pit initiates alarms in the main control room on abnormally low or high water level.

Pressure indication is provided on the circulating water pump discharge. Differential pressure instrumentation is provided between one inlet and outlet branch to the condenser and may be used to determine the frequency of operating the condenser tube cleaning system.

Local grab samples are used to periodically test the circulating water quality.

10.4.5.8 Normal Power Heat Sink

Replace the text with the following.

RBS CDI A NDCT, in conjunction with a MDCT, supports a maximum cold water temperature of 95°F (35°C).

The NDCT design flow rate is 720,000 gpm (163,529.8 m^3/hr), including the plant service water system supply. The operating flow rate varies from 100 percent to 66 percent of the total design flow depending on ambient conditions and heat load.

The MDCT is sized for approximately 33 percent of the total circulating water flow. The MDCT is a fiber-reinforced plastic counterflow cluster design with low clog PVC film fill.

The NDCT and MDCT are located at least 550 ft. (168 m) away from any Seismic Category I or II structures. Thus, if there were any structural failure of the cooling towers, no Seismic Category I or II structures or any safety-related systems or components would be affected or damaged. Also, given the location of the cooling towers and the prevailing northeast wind at the plant site, cooling tower plumes are normally directed away from the plant toward the Mississippi River. Under prevailing conditions, the plumes will have no effect on the plant heating, ventilating, and air conditioning (HVAC) intakes or the plant switchyard. The direction of the prevailing wind and location of the towers make fogging near the plant unlikely. The NDCT is made of non-combustible material. The materials used in the construction of the MDCT are of the type with a low flame spread rating.

The MDCT has multiple fans with associated motors, couplings, and gearboxes. The fans rotate at relatively slow speed and the fan blades are made of relatively low-density material. A failure of a fan could result in the generation of missiles. However, because of the attributes discussed above and the location of the MDCT, any damage would be confined to the MDCT itself. Therefore, there would be no damage to any Seismic Category I or II structures or any safety-related systems or components.

10.4.6.3 Evaluation

Replace the second sentence in the third paragraph with the following.

STD COL 10.4-1-A

A table summarizing the manufacturer's recommended threshold values of key chemistry parameters and associated operator actions is provided as Table 10.4-201.

10.4.10 COL INFORMATION

10.4-1-A Leakage (of Circulating Water Into the Condenser)

STD COL 10.4-1-A

This COL Item is addressed in Section 10.4.6.3.

10.4.11 REFERENCES

10.4-201 Applicable American Water Works Association standards.

STD COL 10.4-1-A

Table 10.4-201
Recommended Water Quality and Action Levels

Reactor Water Quality-Power Operation

	Action Levels			
Control Parameter	0	1	2	3
Conductivity, S/cm at 25°C*	≤ 0.100	> 0.300	> 1	≥ 2
Chloride, ppb	≤ 0.3	> 5	> 50	≥ 200
Silica, ppb	≤ 200	> 500	N/A	N/A
Sulfate, ppb	≤ 2	> 5	> 50	≥ 200

Feedwater Quality – Power Operation***

	Action Levels		
Control Parameter	0	1	2
Conductivity, S/cm at 25°C**	< 0.057	> 0.065	>0.100
Dissolved Oxygen, ppb as O_2**	30-50	< 20 or > 200	N/A

*Value depends on Hydrogen Water Chemistry System operation

**Applicable when Reactor Power >10%

***Also Condensate Purification System Effluent

Action Level 0: Target Value. The parameter may be outside the Action Level 0 value and not in Action Level 1, 2, or 3. In this case, efforts should be made to return the parameter to the Action Level 0 value.

Action Level 1: Lowest Severity. The parameter should be brought below this value within 96 hours. A technical review should be performed to determine the appropriate response.

Action Level 2: Moderate Severity. If the parameter is not reduced below this level within 24 hours, an orderly shutdown should be initiated.

Action Level 3: Highest Severity. If the parameter is not reduced below this level within 6 hours, an orderly shutdown should be initiated.

RBS CDI

Table 10.4-3R
Circulating Water System

Parameter	Value
Circulating Water Pumps:	
Number of pumps	4
Pump type	Vertical, wet pit
Unit flow capacity**, gpm (m^3/hr)	Approx. 170,000 (38,300)
Driver type	Electric motor
Ball Cleaning System:	
Ball recirculation pump	2 (one for each condenser train)
Ball discharge pump	2 (one for each condenser train)
Chemical Injection Pumps:	Various metering pumps
Mechanical Draft Cooling Tower:	
Number of towers	1
Basin diameter*, ft. (m)	260 (79.2)
Height*, ft. (m)	60 (18.3)
Mechanical draft fans, gearboxes, and motors	12
Natural Draft Cooling Tower:	
Number of towers	1
Basin diameter*, ft. (m)	460 (140)
Height*, ft. (m)	550 (168)
Operating Temperatures:	
Normal power heat sink temperature range for water entering the CIRC, °F (°C)	32 to 100 (0*** to 37.8)
Temperature range of water delivered to the main condenser, °F (°C)	41 to 100 (5*** to 37.8)
CIRC temperature for rated turbine performance, °F (°C)	86 (30)
Maximum CIRC temperature for 100% turbine bypass capability, °F (°C)	96 (35.6)
System Design Pressure, psi (MPa):	65 (0.448)

* Cooling tower dimensions are approximate.

** This capacity is for condenser cooling requirements only; refer to DCD Table 9.2-2 for potential additional capacity requirements for plant service water.

*** If the normal power heat sink does not maintain temperatures above the minimum temperature, then the minimum temperature is maintained by warm water recirculation.

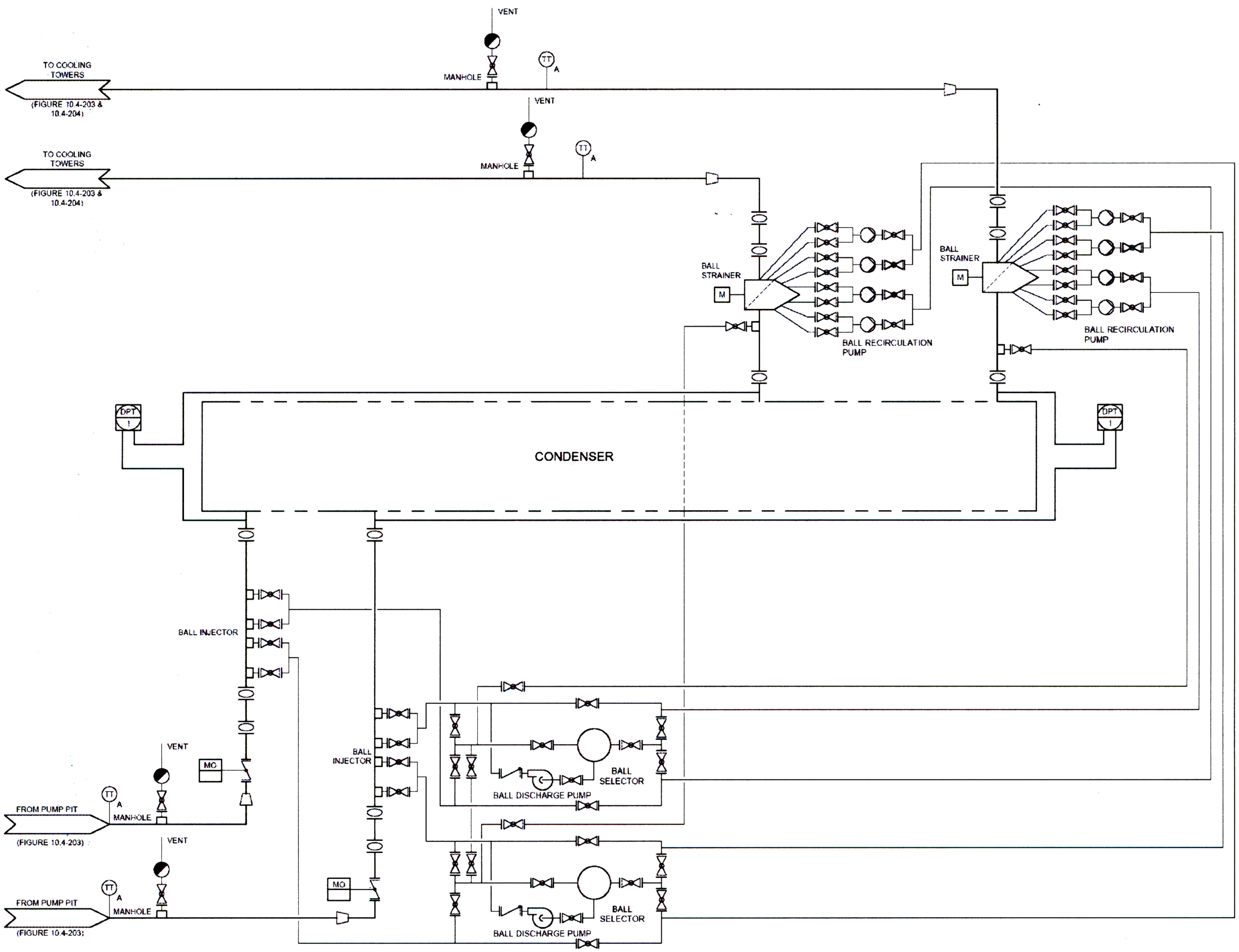


Figure 10.4-201. CIRC Condenser Inlet and Outlet Including Ball Cleaning Subsystem

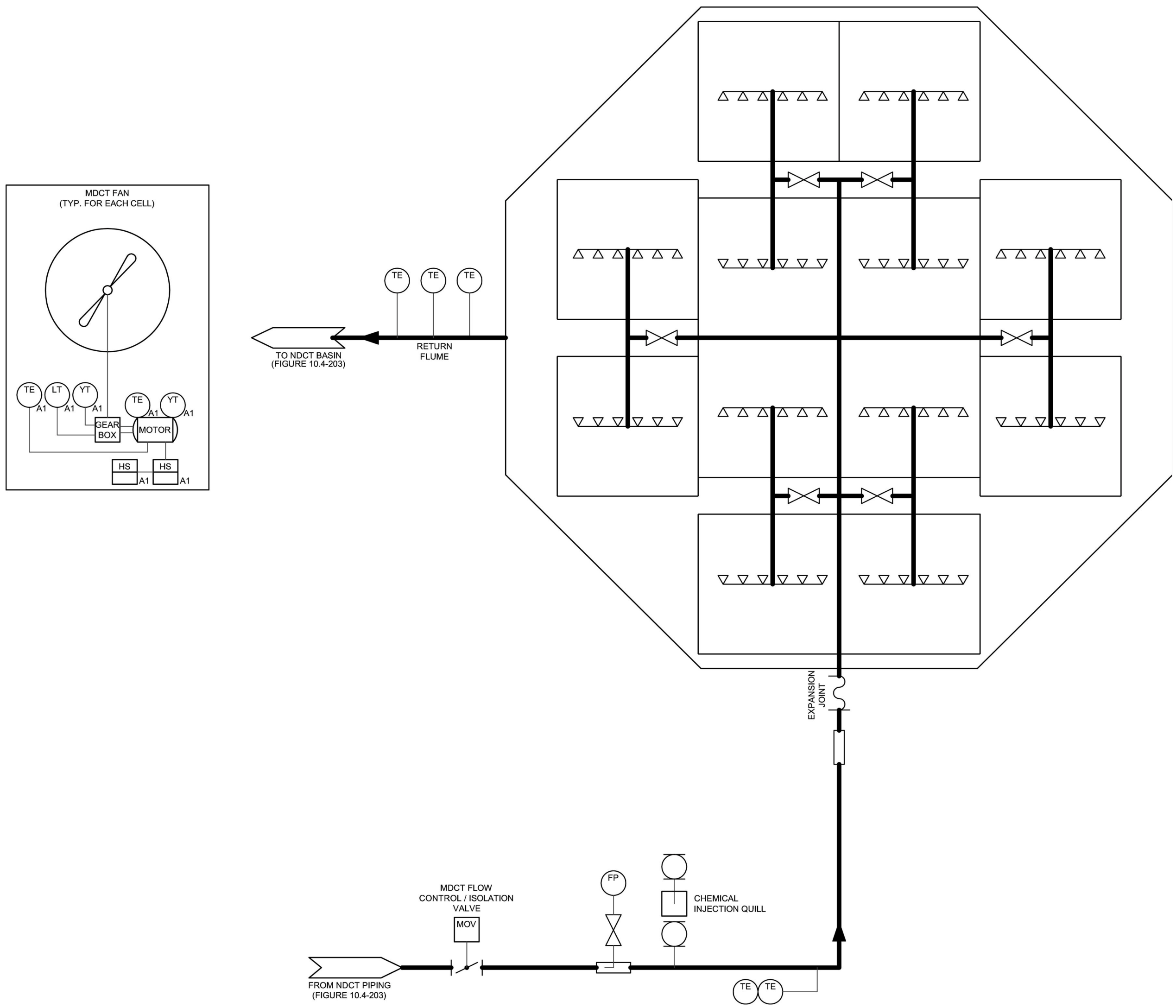


Figure 10.4-202. CIRC Mechanical Draft Cooling Tower

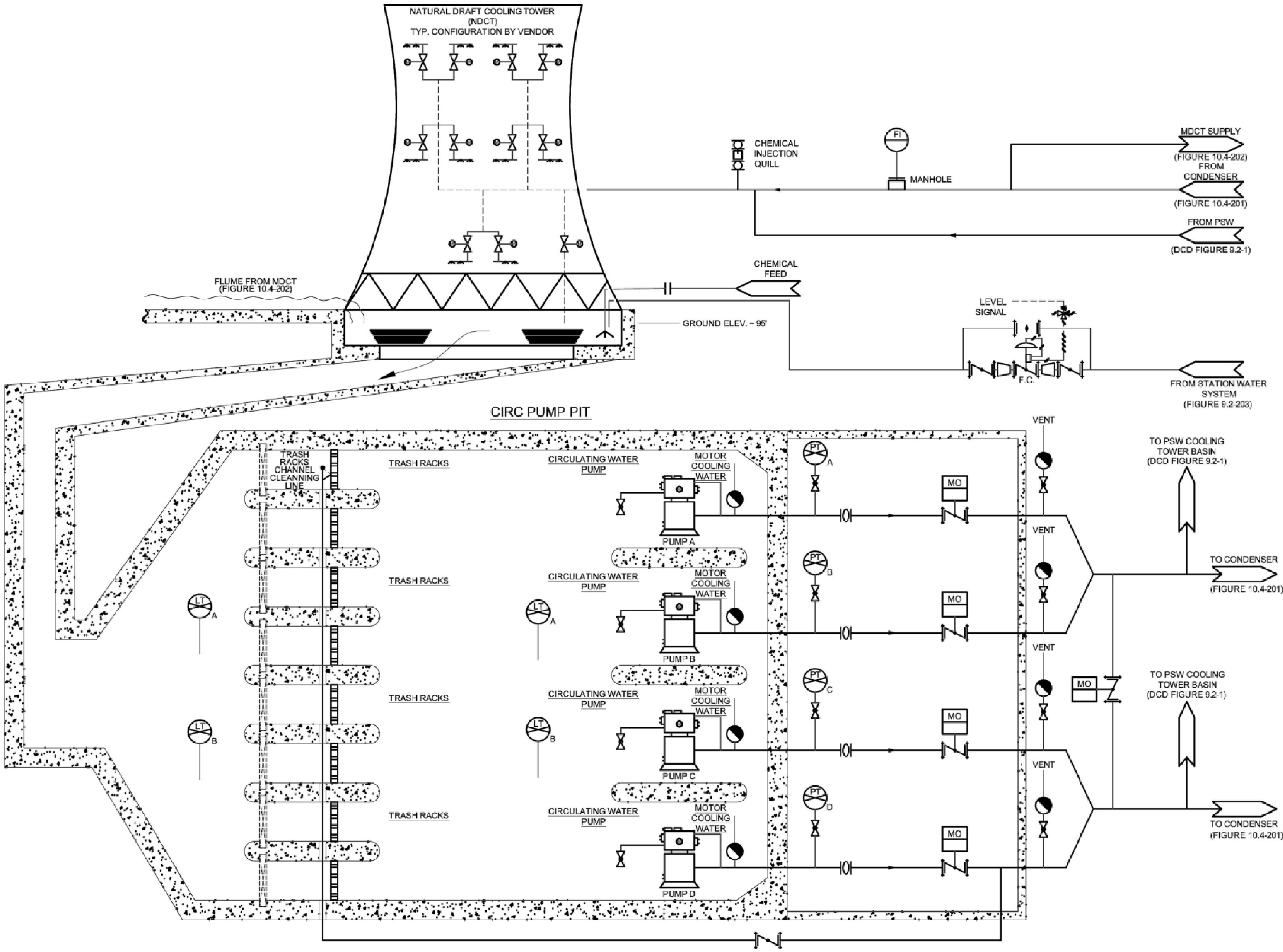


Figure 10.4-203. CIRC Natural Draft Cooling Tower and Pump Pit

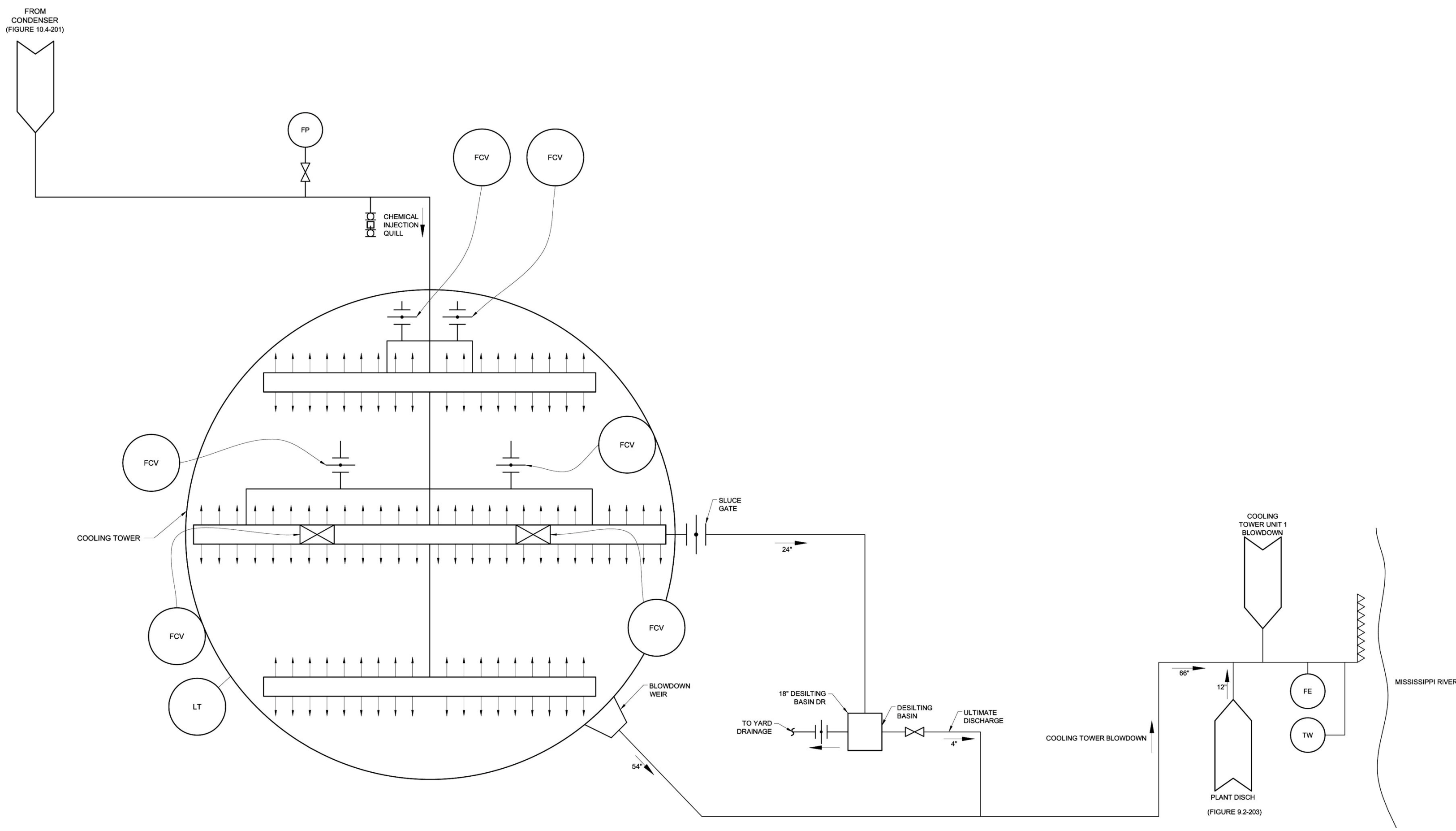


Figure 10.4-204. Circulating Water Blowdown

CHAPTER 11 RADIOACTIVE WASTE MANAGEMENT

11.1 SOURCE TERMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

11.1.2 ACTIVATION PRODUCTS

RBS DEP 12.2-1 Replace the paragraph titled "Argon-41" with the following as incorporated in DCD Rev. 5:

Argon-41

Argon-41 is produced in the reactor coolant as a consequence of neutron activation of naturally occurring Argon-40 in air that is entrained in the feedwater. The Argon-41 gas is carried out of the vessel with the steam and stripped from the system with the non-condensables in the main condenser. Observed Argon-41 levels are highly variable due to the variability in air in-leakage rates into the system. DCD Reference 11.1-3 specifies a normal operation Argon-41 release rate from the vessel into the offgas treatment system of 1.5 MBq/sec (40 μCi/sec). This value is considered conservative as it bounds the available experimental database; this value is provided in Table 11.1-1R.

Table 11.1-1R
Source Term Design Basis Parameters

Parameter	Value
Total of the design basis release rates of the 13 noble gases (30 minute decay reference, t30)	3700 MBq/sec (100,000 μCi/sec)
Normal operational noble gas release rate (t30)	740 MBq/sec (20,000 μCi/sec)
Design basis I-131 radioiodine core release rate	26 MBq/sec (700 μCi/sec)
Expected I-131 radioiodine core release rate	3.7 MBq/sec (100 μCi/sec)
I^{131} concentration scale factor	5
Reactor core exit N^{16} concentration (design basis same as normal operation)	1.85 MBq/gm (50 μCi/gm) w/o HWC 9.25 MBq/gm (250 μCi/gm) w/HWC
Normal operational $Argon^{41}$ release rate	1.5 MBq/sec (40μCi/sec)

11.2 LIQUID WASTE MANAGEMENT SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD CDI The conceptual design information in this DCD section is the plant specific design.

11.2.1 DESIGN BASIS

Safety Design Bases

Add the following paragraph at the end of this section.

RBS SUP 11.2-1 Regulatory Guide 1.110 was used as the basis for a cost benefit evaluation to evaluate liquid radioactive waste (radwaste) system augments. The overall principle behind Regulatory Guide 1.110 is to determine when it is economically feasible to implement an augmented system to reduce radiation exposure to the public further below the regulatory threshold. The guidance used to make this decision is that the cumulative dose to a population within a 50-mi. radius of the reactor site cannot be reduced at an annual cost of no more than $1000 per person-rem or $1000 per person-thyroid-rem. Regulatory Guide 1.110 provides values in 1975 dollars and instructs that these values are not to be adjusted for inflation.

Table A-1 of Regulatory Guide 1.110 lists several liquid radwaste augments for light-water-cooled nuclear power reactors.

If it is conservatively assumed that each radwaste treatment system augment is a "perfect" technology that would reduce the effluent dose by 100 percent, the annual cost of the augment can be determined and the lowest annual cost can be considered a threshold value. The lowest-cost option for augments is a 20-gpm cartridge filter at $11,500 per year, which yields a threshold value of 11.5 person-rem whole-body or thyroid dose from liquid effluents.

Neglecting the modeling of filters in the development of the source term, the addition of a 20-gpm filter cartridge would treat only 20 percent of the total analyzed liquid radwaste discharge of 105 gpm. Assuming 100 percent effectiveness, this would represent a dose reduction of 26.9 person-rem x 20 percent = 5.38 person-rem. The cost benefit ratio for this augment is therefore greater than the $1000/person-rem and not a cost-beneficial augment.

11.2.2.3 Detailed System Component Description

Mobile Systems

Replace the sixth paragraph with the following.

STD COL 11.2-1-A Specific equipment connection configuration and plant sampling procedures are used to implement the guidance in Inspection and Enforcement (IE) Bulletin 80-10 (DCD Reference 11.2-10). The permanent and mobile/portable non-radioactive systems, which are connected to radioactive or potentially radioactive portions of mobile/portable LWMS, are protected from contamination with an arrangement of double check valves in each line. The configuration of each line is also equipped with a tell-tale connection, which permits periodic checks to confirm the integrity of the line and its check valve arrangement. Sampling of permanently installed clean system normal sample points further upstream is also included in the plant's sampling program.

Replace the seventh paragraph with the following:

STD COL 11.2-2-A Section 12.6 discusses how ESBWR design features and procedures for operation will minimize contamination of the facility and environment, facilitate decommissioning, and minimize the generation of radioactive wastes, in compliance with 10 CFR 20.1406. Section 13.5 describes the requirement for procedures for operation of radioactive waste processing system. Operating procedures for mobile/portable LWMS required by Section 12.4, Section 12.5, and Section 13.5 address the requirements of 10 CFR 20.1406.

11.2.6 COL INFORMATION

11.2-1-A Implementation of IE Bulletin 80-10

STD COL 11.2-1-A This COL item is addressed in Section 11.2.2.3.

11.2-2-A Implementation of Part 20.1406

STD COL 11.2-2-A This COL item is addressed in Section 11.2.2.3.

11.2.7 REFERENCES

None.

11.3 GASEOUS WASTE MANAGEMENT SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

RBS DEP 9.4.-1 The Turbine Building stack, as described in DCD Rev. 5, Section 11.3, is credited as the release point instead of the single plant vent stack described in DCD Rev. 4. The offgas releases, as developed from the design parameters from Table 11.3-1 of DCD Rev. 5, are also credited. This table is included as Table 11.3-1R to provide additional information.

11.3.1 DESIGN BASIS

Add the following text at the end of this section.

RBS SUP 11.3-1 Regulatory Guide 1.110 was used as the basis for a cost benefit evaluation to assess gaseous radwaste system augments. The overall principle behind Regulatory Guide 1.110 is to determine when it is economically feasible to implement an augmented system to reduce radiation exposure to the public further below the regulatory threshold. The guidance used to make this decision is that the cumulative dose to a population within a 50-mi. radius of the reactor site cannot be reduced at an annual cost of no more than $1000 per person-rem or $1000 per person-thyroid-rem.

Only the augments applicable to the ESBWR conceptual design were considered.

Cost Benefit Analysis Determination

Appendix A of Regulatory Guide 1.110 states that augments with a Total Annual Cost (TAC) lower than the reduced dose (or "benefit"), multiplied by $1000 per person-rem and/or $1000 per person-thyroid-rem, should be implemented in order of diminishing cost benefit. The maximum reduction of any augment is bounded by the total annual dose exposures, which are 1.99 total body person-rem and 5.37 person-thyroid-rem, as shown in Table 12.2-205. Therefore, for the purpose of reducing total body person-rem, any augment with a TAC greater than $1700 would not be cost-beneficial, and for the purpose of reducing person-thyroid-rem, any augment with a TAC greater than $5370 would not be cost-beneficial.

BWR Offgas Recombiner

The ESBWR design contains an Offgas Recombiner; therefore, this augment is already implemented.

3-Ton Charcoal Adsorber

The TAC of the 3-ton charcoal adsorber would be $9646. This is greater than the $5370 threshold and is determined to not be cost-beneficial.

Desiccant Dryer

The ESBWR OGS design contains a dryer, as shown in DCD Figure 11.3-1; therefore, this augment is already implemented.

Charcoal Vault Refrigeration

Charcoal vault refrigeration would have a TAC of $29,655. This is greater than the $5370 threshold and is, therefore, not cost-beneficial.

Main Condenser Vacuum Pump Charcoal/HEPA Filtration System

The addition of a main condenser vacuum pump charcoal/HEPA filtration system would provide for a reduction in the amount of iodides discharged from the plant.

The TAC for this system is calculated to be $8282. This is greater than the $5370 threshold and is, therefore, not cost-beneficial.

Clean Steam to Turbine Glands

The TAC of this augment is greater than $70,000 based on the values and methods prescribed in Regulatory Guide 1.110. This value exceeds the $5370 threshold and is, therefore, not cost-beneficial.

Clean Steam to Steam Valves, 24 In. and Larger

The TAC of this augment is greater than $40,000, based on the values and methods prescribed in Regulatory Guide 1.110. This value exceeds the $5370 threshold and is, therefore, not cost-beneficial.

Clean Steam to Steam Valves, 2-1/2 In. and Less than 24 In.

The TAC of this augment is greater than $45,000, based on the values and methods prescribed in Regulatory Guide 1.110. This value exceeds the $5370 threshold and is, therefore, not cost-beneficial.

15,000-cfm HEPA Filtration System

The ESBWR has four structures that contain potentially radioactive air: the Fuel Building, Radwaste Building, Reactor Building, and Turbine Building. The exhaust systems for these buildings and their flow rates are listed in Table 11.3-201.

Since all of the buildings have flow rates that exceed the 15,000-cfm flow rate, multiple 15,000-cfm HEPA filters would be needed. The TAC for each 15,000-cfm HEPA filter is $17,082 for those located in the Turbine Building, and $27,815 for all other locations.

These values exceed the $5370 threshold; therefore, this augment is not cost-beneficial for reducing the person-rem/yr.

Charcoal/HEPA Filtration Systems

Table A-1 of Regulatory Guide 1.110 lists several charcoal/HEPA filtration system sizes, 1000 cfm, 15,000 cfm, and 30,000 cfm. It is assumed that these are to be combined in the most economical manner to envelop the building flow rates. There are different direct costs for the 15,000-cfm and 30,000-cfm systems, depending on their location.

The ESBWR has four structures that contain potentially radioactive air: the Fuel Building, Radwaste Building, Reactor Building, and Turbine Building. The exhaust systems for these buildings and their flow rates are listed in Table 11.3-201.

Since all of the buildings have flow rates that exceed the 30,000-cfm flow rate, combinations of 1000-cfm, 15,000-cfm, and 30,000-cfm charcoal/HEPA filters are needed. The TAC for each 1000-cfm charcoal/HEPA filter is $8100, each 15,000-cfm charcoal/HEPA filter located in the Turbine Building is $33,149, and each 15,000-cfm charcoal/HEPA filter for all other locations is $34,489; and each 30,000-cfm charcoal/HEPA filter is $54,796 for those located in the Turbine Building and $57,053 for all other locations.

All of these values exceed the $5370 threshold; therefore, this augment is not cost-beneficial.

Turbine Building Chilled Water HVAC System

The ESBWR design contains a chilled water HVAC system, as discussed in DCD Subsection 9.2.7; therefore, this augment is already implemented.

600-ft^3 Gas Decay Tank

The gas decay tank would be used as an augment to the OGS. The gas decay tank would be utilized to allow noble gas decay before release through the exhaust.

Each 600-ft^3 tank has a TAC of $8377. This exceeds the $5370 threshold; therefore, this augment is not cost-beneficial.

CONCLUSION

There are no gaseous radwaste system augments that are cost-beneficial to implement for RBS Unit 3.

11.3.2 OFFGAS SYSTEM DESCRIPTION

Releases

RBS COL 12.2-2-A Replace the last sentence of the first paragraph of the Releases portion of this section with the following.

RBS DEP 9.4-1 As indicated in Section 12.2.2.2 and Table 12.2-17R, releases from the Turbine Building stack, when combined with the releases from the Radwaste Building and Reactor Building/Fuel Building stacks, do not exceed the maximum permissible concentration to the environment.

11.3.9 REFERENCES

None.

Table 11.3-201
Exhaust Systems and Flow Rates

Building	HVAC Subsystem[a]	Flow (cfm)	Reference
Fuel Building	FBGAVS	28,710	DCD Table 9.4-4
	FBFPVS	33,457	DCD Table 9.4-5
Radwaste Building	RWGAVS	53,000	DCD Table 9.4-7
Reactor Building	REPAVS	67,910	DCD Table 9.4-10
	CONAVS	42,272	DCD Table 9.4-11
Turbine Building	TBE	111,876	DCD Table 9.4-15

a) Acronyms from ESBWR DCD:

FBGAVS - Fuel Building General Area HVAC Subsystem.
FBFPVS - Fuel Building Fuel Pool Area HVAC Subsystem.
RWGAVS - Radwaste Building General Area HVAC Subsystem.
REPAVS - Reactor Building Refueling and Pool Area HVAC Subsystem.
CONAVS - Reactor Building Contaminated Area HVAC Subsystem.
TBE - Turbine Building Exhaust.

RBS DEP 9.4-1

Table 11.3-1R (Sheet 1 of 2)
Offgas System Design Parameters

Design Parameter	Design Value
Design basis noble radiogas release rate	3700 MBq/s (100,000 μCi/s)
Assumed air in-leakage	51 m^3/h standard (30 scfm)
Xenon delay	60-day[a]
Krypton delay	78.6 hours[a]
Argon delay	27.2 hours[a]
Iodine removal efficiency	99.99[a] and [b]
Maximum gaseous waste stream temperature	67°C (153°F)
Charcoal temperature (approximate)	35°C (95°F)
Maximum cooler condenser temperature	18°C (65°F)
Chilled water temperature (approximate)	7°C (45°F)
Gaseous waste stream temperature (approximate)	35°C (95°F)
Nominal recombiner preheater temperature	177°C (351°F)
Maximum recombiner preheater temperature	210°C (410°F)
Out-of-service hydrogen/oxygen catalytic recombiner minimum temperature	121°C (250°F)
Minimum activated charcoal ignition temperature	156°C (313°F)
Minimum air bleed supply rate[c]	0.17 m^3/min (6 scfm)
Air bleed to standby recombiner train at startup and normal operation	0.17 m^3/min (6 scfm)
Radiolytic gas flow range	0 to 8.6 m^3/min (302 scfm)
Charcoal adsorber vault temperature range	29°C (84°F) to 40°C (104°F)

RBS DEP 9.4-1

Table 11.3-1R (Sheet 2 of 2)
Offgas System Design Parameters

Design Parameter	Design Value
Charcoal particle size	8–16 mesh United States Standard (USS), with less than 0.5% under 20 mesh
Charcoal moisture content	< 5% by weight
Maximum offgas activity input concentration	5.9E+6 Bq/cm^3
Charcoal guard bed mass	33,000 lb. (15 metric tons)
Charcoal bed mass	490,000 lb. (222 metric tons)

a) Offgas processing equipment will meet or exceed these values.

b) No Iodine is assumed to be released.

c) Minimum 6 scfm refers to leakage plus bleed air.

11.4 SOLID WASTE MANAGEMENT SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD CDI The conceptual design information in this DCD section is the plant specific design.

11.4.1 DESIGN BASES

SWMS Bases

Add the following after the second paragraph.

STD SUP 11.4-1 The LWMS offsite dose calculations, which are described in Section 12.2.2.4, include the offsite doses from the SWMS liquid effluents, as they are processed by the LWMS. Similarly, the GWMS offsite dose calculations, which are described in Section 12.2.2.2, include the offsite doses from the SWMS gaseous effluents, as they are inputs processed by the GWMS. The cost-benefit analyses in Section 11.2.1 for the LWMS and in Section 11.3.1 for the GWMS address the liquid and gaseous effluents that are generated from solid waste processing by the SWMS. Because these two cost-benefit analyses include the liquid and gaseous effluents from the SWMS, the augments considered for the LWMS and GWMS apply to the SWMS, which provides inputs to those systems. As described in Sections 11.2.1 and 11.3.1, no augments are needed for the LWMS and GWMS to comply with 10 CFR 50, Appendix I, Section II.D. Therefore, no augments are needed for the SWMS to comply with 10 CFR 50, Appendix I, Section II.D.

Add the following to the seventh bullet.

RBS COL 11.4-4-A
RBS COL 11.4-5-A
As of July 1, 2008, the Low Level Waste (LLW) disposal facility in Barnwell, South Carolina is no longer accepting Class B and C waste from LLW generators in states other than Connecticut, South Carolina and New Jersey. The disposal facility in Clive, Utah, is still accepting Class A waste from all LLW generators. Class B and C waste is disposed of by one or both of the following methods:

1. Disposal at a LLW disposal facility that accepts Class B and C waste from the new unit. It is anticipated that such a disposal facility will be available well before the unit loads fuel and begins operation. If necessary, some waste may be stored on-site in the Radwaste Building as described above. LLW is stored on-site only when disposal capacity is unavailalbe and for no longer than necessary. If additional storage capacity were needed, the COL

Holder could construct and manage an on-site temporary LLW facility, as allowed by NRC regulations and Standard Review Plan 11.4.

2. Conversion of Class B and C waste into Class A waste by mixing with other Class A waste and disposal at a facility that accepts Class A waste. Such mixing could be done on-site or by a licensed third party at another location.

Replace the fourth sentence of the fifth paragraph with the following:

STD COL 11.4-5-A Section 12.6 discusses how the ESBWR design features and procedures for operation will minimize contamination of the facility and environment, facilitate decommissioning, and minimize the generation of radioactive wastes, in compliance with 10 CFR 20.1406. Section 13.5 describes the requirement for procedures for operation of the radioactive waste processing system. Operating procedures for mobile/portable SWMS required by Sections 12.4, 12.5, and 13.5 address requirements of 10 CFR 20.1406.

11.4.2.3 Detailed System Component Description

Mobile Systems

Replace the last three sentences of the second paragraph with the following paragraphs.

STD COL 11.4-1-A Mobile/portable SWMS that are used at the plant to process wet solid radioactive wastes are procured with specifications that comply with RG 1.143 (DCD Reference 11.4-3). By procuring mobile/portable systems rather than permanent systems, the turnover in equipment results in continuously improved designs for access, operation, inspection, testing, and maintenance. The improved designs in turn help maintain radiation exposures to operating and maintenance personnel as low as is reasonably achievable. This type of continuous improvement meets the requirements of RG 8.8 (DCD Reference 11.4-4) for mobile/portable SWMS. Placing requirements in procurement specifications ensures compliance with RG 1.143 for mobile/portable SWMS. Implementing the Radiation Protection Program to meet ALARA goals and repeated upgrades ensures compliance with RG 8.8 for mobile/portable SWMS.

STD COL 11.4-2-A Specific equipment connection configuration and plant sampling procedures are used to implement the guidance in Inspection and Enforcement (IE) Bulletin 80-10 (DCD Reference 11.4-19). The permanent and mobile/portable non-radioactive systems, which are connected to radioactive or potentially radioactive portions of mobile/portable SWMS, are protected from contamination with an arrangement of double check valves in each line. The configuration of each line is also equipped with a tell-tale connection, which permits periodic checks to confirm the integrity of the line and its check valve arrangement. Sampling of permanently installed clean system normal sample points further upstream is also included in the plant's sampling program.

STD COL 11.4-3-A Waste classification and process controls are described in the PCP. NEI 07-10, "Generic FSAR Template Guidance for Process Control Program (PCP) Description," which is under review by the NRC, is incorporated by reference. (Reference 11.4-201). The milestone for development and implementation of the PCP is addressed in Section 13.4.

11.4.6 COL INFORMATION

11.4-1-A Mobile System Regulatory Guide Compliance

STD COL 11.4-1-A This COL item is addressed in Section 11.4.2.3.

11.4-2-A Compliance with IE Bulletin 80-10

STD COL 11.4-2-A This COL item is addressed in Section 11.4.2.3.

11.4-3-A Process Control Program

STD COL 11.4-3-A This COL item is addressed in Section 11.4.2.3.

11.4-4-A Temporary Storage Facility

RBS COL 11.4-4-A This COL item is addressed in Section 11.4.1.

11.4-5-A Compliance with Part 20.1406

STD COL 11.4-5-A This COL item is addressed in Section 11.4.1.

11.4.7 REFERENCES

11.4-201 Nuclear Energy Institute, "Generic FSAR Template Guidance for Process Control Program (PCP) Description," NEI 07-10.

11.5 PROCESS RADIATION MONITORING SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following paragraph at the end of this section.

STD COL 11.5-3-A Replace text references to DCD Table 11.5-5 with Table 11.5-201.

11.5.4.4 Setpoints

Replace the first sentence in this section with the following.

STD COL 11.5-2-A The derivation of setpoints used for offsite dose monitors are described in the ODCM. Refer to Section 11.5.4.5 for a discussion regarding ODCM development and implementation.

11.5.4.5 Offsite Dose Calculation Manual

Replace this section with the following.

STD COL 11.5-2-A The methodology and parameters used for calculation of offsite dose and monitoring are described in the ODCM. NEI 07-09, Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description, which is under review by the NRC, is incorporated by reference. (Reference 11.5-201) The milestone for development and implementation of the ODCM is addressed in Section 13.4. The provisions for sampling liquid and gaseous waste streams identified in Table 11.5-201 and DCD Table 11.5-6 will be included in the ODCM.

11.5.4.6 Process and Effluent Monitoring Program

Replace this section with the following.

STD COL 11.5-3-A The program for process and effluent monitoring and sampling are described in the ODCM. Refer to Section 11.5.4.5 for a discussion regarding ODCM development and implementation.

11.5.4.7 Subsystem Lower Limit of Detection

Replace this section with the following.

STD COL 11.5-1-A The methodology for derivation of each subsystem lower limit of detection are described in the ODCM. Refer to Section 11.5.4.5 for a discussion regarding ODCM development and implementation.

11.5.4.8 Site Specific Offsite Dose Calculation

Replace this section with the following.

STD COL 11.5-4-A 10 CFR 50, Appendix I guidelines are addressed in the ODCM. Refer to Section 11.5.4.5 for a discussion regarding ODCM development and implementation.

Site-specific evaluations for dose to members of the public are addressed in Section 12.2.

11.5.4.9 Instrument Sensitivities

Replace this section with the following.

STD COL 11.5-5-A The sensitivities, frequencies and bases for each gaseous and liquid sample are described in the ODCM. Refer to Section 11.5.4.5 for a discussion regarding ODCM development and implementation.

11.5.5.8 Setpoints

Replace this section with the following:

STD COL 11.5-2-A Refer to Section 11.5.4.4.

Replace DCD Table 11.5-5 with Table 11.5-201.

11.5.7 COL INFORMATION

11.5-1-A Subsystem Lower Limit of Detection

STD COL 11.5-1-A This COL item is addressed in Section 11.5.4.7.

11.5-2-A Offsite Dose Calculation Manual

STD COL 11.5-2-A This COL item is addressed in Sections 11.5.4.4, 11.5.4.5, 11.5.5.8, and Section 12.2.

11.5-3-A Process and Effluent Monitoring Program

STD COL 11.5-3-A This COL item is addressed in Sections 11.5 and 11.5.4.6, and Table 11.5-201.

11.5-4-A Site Specific Offsite Dose Calculation

STD COL 11.5-4-A This COL item is addressed in Section 11.5.4.8.

11.5-5-A Instrument Sensitivities

STD COL 11.5-5-A This COL item is addressed in Section 11.5.4.9.

11.5.8 REFERENCES

11.5-201 Nuclear Energy Institute, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," NEI 07-09.

STD COL 11.5-3-A

Table 11.5-201 (Sheet 1 of 3)
Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System(s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7
1	Liquid Radwaste (Batch) Effluent System Note 3	Equipment (Low Conductivity Drain Subsystem Floor (High Conductivity) Drain Subsystem	S&A	S&A, H3	--
2	Service Water System	Plant Service Water System	--	S&A, H3	(S&A) Notes 6 & 8
3	Component Cooling Water System	Reactor Component Cooling Water System	S&A	S&A H3	(S&A) Notes 6 & 8
4	Spent Fuel Pool Treatment System	Spent Fuel Pool Treatment System	S&A	S&A H3	(S&A) Notes 6 & 8
5	Equipment & Floor Drain Collection and Treatment Systems	LCW Drain Subsystem HCW Drain Subsystem Detergent Drain Subsystem Chemical Waste Drain Subsystem Reactor Component Cooling Water System (RCCWS) Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
6	Phase Separator Decant & Holding Basin Systems	Equipment (Low Conductivity) Drain Subsystem Floor (High) Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
7	Chemical & Regeneration Solution Waste Systems	Chemical Waste Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
8	Laboratory & Sample System Waste Systems	Chemical Waste Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8

STD COL 11.5-3-A

Table 11.5-201 (Sheet 2 of 3)
Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System(s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7
9	Laundry & Decontamination Waste Systems	Detergent Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
10	Resin Slurry, Solidification & Baling Drain Systems	Equipment (Low Conductivity) Drain Subsystem Floor (High) Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
11	Storm & Underdrain Water System	Storm Drains and Cooling Tower Blowdown	--	(S&A, H3) Notes 3, 4, & 6	(S&A) Notes 3& 6
12	Tanks and Sumps Inside Reactor Building	Equipment (Low Conductivity) Drain Subsystem Floor (High) Drain Subsystem Chemical Waste Drain Subsystem Detergent Drain Subsystem	--	S&A H3	(S&A) Notes 6 & 8
13	Ultrasonic Resin Cleanup Waste Systems	Note 5	--	Note 5	Note 5
14	Non-Contaminated Waste Water System	Sanitary Waste Water	--	S&A, H3 Notes 3, 4 & 6	(S&A) Note 4
15	Mobile Liquid Radioactive Waste Processing Systems (Includes Reverse Osmosis Systems)	Mobile Liquid Radioactive Waste Processing Systems (Includes Reverse Osmosis Systems)	S&A	S&A, H3	(S&A) Notes 6 & 8

STD COL 11.5-3-A

Table 11.5-201 (Sheet 3 of 3)
Provisions for Sampling Liquid Streams

No.	Process Systems as listed in NUREG-0800, SRP 11.5 Table 2 (Draft Rev. 4)	ESBWR System(s) that Perform the Equivalent SRP 11.5 Function (Note 1)	In Process	In Effluent	
			Grab Notes 2 & 7	Grab Notes 2 & 7	Continuous Notes 2 & 7

Notes for Table 11.5-201:

1. Table 11.5-5 addresses sampling provisions for BWRs as identified in Table 2 of SRP 11.5. For process systems identified for BWRs in Table 2, but not shown in Table 11.5-5, those systems are not applicable to ESBWR. In some cases, there are multiple subsystems that are used to perform the overall equivalent SRP function and are listed as such in the column.

2. S&A = Sampling & Analysis of radionuclides, to include gross radioactivity, identification and concentration of principal radionuclides and concentration of alpha emitters; R = Gross radioactivity (beta radiation, or total beta plus gamma); H3 = Tritium

3. Liquid Radwaste is processed on a batch-wise basis. The Liquid Waste Management System sample tanks can be sampled for analysis of the batch. See DCD Section 11.2.2.2 for more information on Liquid Radwaste Management.

4. Monitoring of effluents from storm drains, the cooling tower blow down, and sanitation wastes are included in the plant specific Offsite Dose Calculation Manual.

5. The ESBWR does not include ultrasonic resin cleanup waste system at this time. Should one be installed, the Liquid Waste Management System would provide sampling and monitoring provisions.

6. The use of parenthesis indicates that these provisions are required only for the systems not monitored, sampled, or analyzed (as indicated) prior to release by downstream provisions.

7. The sensitivity of detection, also defined here as the Lower Limit of Detection (LLD), for each indicated measured variable, is based on the applicable radionuclide (or collection of radionuclides as applicable) as given in ANSI/IEEE N42.18.

8. Processed through radwaste Liquid Waste Management System (LWMS) prior to discharge. Therefore, this process system is monitored, sampled, or analyzed prior to release by downstream provisions. See Note 6 above. Depending on Utility's discretion, additional sampling lines may be installed. Continuous Effluent sampling is not required per Standard Review Plan 11.5 Draft Rev. 4, April 1996, Table 2 for this system function.

CHAPTER 12 RADIATION PROTECTION

12.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE ALARA

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following as introductory text.

STD SUP 12.1-1

The ALARA program is addressed in Appendices 12AA and 12BB.

12.1.4 COL INFORMATION

12.1-1-A Regulatory Guide 8.10

STD COL 12.1-1-A

This COL item is addressed in Appendix 12BB.

12.1-2-A Regulatory Guide 1.8

STD COL 12.1-2-A

This COL item is addressed in Appendix 12BB.

12.1-3-A Occupational Radiation Exposures

STD COL 12.1-3-A

This COL item is addressed in Appendix 12BB.

12.1-4-A Regulatory Guide 8.8

STD COL 12.1-4-A

This COL item is addressed in Appendix 12BB.

12.2 PLANT SOURCES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD SUP 12.2-1

12.2.1.5 Other Contained Sources

In addition to the contained sources identified above, additional contained sources which contain byproduct, source, or special nuclear materials may be maintained on site. These contained sources are typically used as calibration or radiography sources. These sources are not part of the permanent plant design, and their control and use are governed by plant procedures. The procedures consider the guidance provided in RG 8.8 to ensure that occupational doses from the control and use of the sources are as low as is reasonably achievable (ALARA).

Various types and quantities of radioactive sources are employed to calibrate the process and effluent radiation monitors, the area radiation monitors, and portable and laboratory radiation detectors. Check sources that are integral to the area, process, and effluent monitors consist of small quantities of by-product material and do not require special handling, storage, or use procedures for radiation protection purposes. The same consideration applies to solid and liquid radionuclide sources of exempt quantities or concentrations which are used to calibrate or check the portable and laboratory radiation measurement instruments.

Instrument calibrators are normally used for calibrating gamma dose rate instrumentation. These may be self-contained, heavily shielded, multiple source calibrators. Beta and alpha radiation sources are also available for instrument calibration. Calibration sources are traceable to the National Institute of Standards and Technology, or equivalent.

Radiography sources are surveyed upon entry to the site. Radiation protection personnel maintain copies of the most recent leak test records for owner-controlled sources. Contractor radiography personnel provide copies of the most recent leak test records upon radiation protection personnel request. Radiography is conducted in accordance with approved procedures.

12.2.2.1 Airborne Release Off-Site

RBS COL 12.2-2-A

Add the following at the beginning of this subsection.

The discussion in this subsection, and the associated DCD Tables 12.2-15, 12.2-16, 12.2-17, and 12.2-18a, are applicable to the ESBWR standard plant design and the associated airborne release concentrations and dose analyses for a generic site, and for which representative off-site doses were calculated and reported in DCD Table 12.2-18b. As discussed in Subsection 12.2.2.2 below, the Unit 3 off-site dose analysis was performed using site-specific atmospheric dispersion coefficients and relative deposition factors and the DCD source term as described in Tables 12.2-15R, 12.2-16R, and 12.2-17R. DCD Tables 12.2-18a and 12.2-18b specifically related to the DCD dose results are not applicable for Unit 3.

12.2.2.2 Airborne Dose Evaluation Off-Site

Replace the last two sentences of this subsection with the following.

RBS DEP 9.4-1
RBS DEP 12.2-1

Doses from gaseous effluents were calculated using the GASPAR II computer code. This code (Reference 12.2-201) implements guidance found in Regulatory Guide 1.109. The bases for the calculation of Unit 3-specific airborne off-site doses are provided in Table 12.2-201. Unless otherwise specified, default values from Reference 12.2-201 are used to determine the doses. The gaseous releases used in the dose evaluation are provided in Table 12.2-16R. These releases are taken from Table 12.2-16 of Revision 5 of the DCD (Reference 12.2-204). The annual gaseous pathway doses to the maximally exposed individual (MEI) are provided in Table 12.2-203.

Individual doses from noble gas and radioiodine and particulate releases are calculated at the site boundary locations with the most limiting χ/Q values for each of the three release points as determined from Tables 2.3-341 through 2.3-343 in Subsection 2.3.5. The maximally exposed individual for the ground, vegetable, meat, and inhalation pathways is assumed to be located at these most limiting site boundary locations. The milk pathway is not considered because there are no milk animals within a 5-mi. radius of the plant.

Because there are different atmospheric dispersion factors that apply to the different release points, the individual system releases given in Table 12.2-16R are combined into three source terms. The releases labeled "Radwaste Building" are input as one source term that utilizes the ground level atmospheric dispersion factors. The releases labeled "Reactor Building" and "Drywell" are combined into a second source term that utilizes the mixed mode atmospheric dispersion factors calculated for the Reactor and Fuel Buildings Stack. The remaining releases labeled "Turbine Building," "Mechanical Vacuum Pump," "Turbine Seal," and "Offgas System" are combined into a third source term that utilizes the mixed mode atmospheric dispersion factors calculated for the Turbine Building Stack.

12.2.2.2.1 Compliance with 10 CFR 50, Appendix I, Sections II.B and II.C

RBS COL 12.2-2-A

The airborne dose evaluation for off-site locations was performed using the GASPAR II code (NUREG/CR-4653) (Reference 12.2-201). The significant input parameters are shown in Table 12.2-201. The off-site doses calculated using the gaseous effluent releases from Table 12.2-16R and site-specific input parameters meet the guidelines of 10 CFR 50, Appendix I, Sections II.B and II.C (Table 12.2-204).

12.2.2.2.2 Compliance with 10 CFR 50, Appendix I, Section II.D

The population doses determined for the gaseous effluent releases from Unit 3 provided in Table 12.2-205 are used for development of a cost-benefit analysis. Refer to Subsection 11.3.1 for the cost-benefit analysis results. Therefore, Unit 3 complies with 10 CFR 50, Appendix I, Section II.D.

12.2.2.2.3 Compliance with 10 CFR 20 Appendix B, Table 2, Column 1

The gaseous effluent concentrations of Table 12.2-17R, when adjusted by the highest ratio of the site-specific χ/Q value and the χ/Q values from Table 12.2-15R, are less than (bounded by) the 10 CFR 20 Appendix B, Table 2, Column 1 concentration limits.

12.2.2.2.4 Compliance with 10 CFR 20.1301

10 CFR 20.1301(a)(1) indicates that operations shall be conducted such that the total effective dose equivalent (TEDE) to individual members of the public from the licensed operation does not exceed 0.1 rem (1 millisievert [mSv]) in a year, and additionally, the dose in any unrestricted area from external sources does not exceed 0.002 rem (0.02 mSv) in any 1 hour.

Using the Unit 3-specific gaseous effluent release activities identified in Table 12.2-16R and the Unit 3 liquid effluent release activities identified in DCD Table 12.2-19b, the total annual doses to the MEI resulting from Unit 3 gaseous and liquid effluents are calculated and presented in Tables 12.2-203 and 12.2-208, respectively.

The direct radiation contribution from operation of Unit 3 is negligible. The direct dose contribution from Unit 3 at two distances is provided in DCD Table 12.2-21. The annual dose of 1.66E-04 mrem/yr at 1000 m (0.62 mi) is negligible. The distance to the site boundary from Unit 3 is at least 1000 m (0.62 mile).

The total annual doses to the MEI and the population resulting from RBS Unit 1 liquid and gaseous effluents are provided in Table 12.2-211. The values shown are representative based on review of Unit 1 annual radiological environmental operating reports (e.g., References 12.2-205 through 12.2-207).

The direct radiation contribution from operation of Unit 1 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 NRC concludes that the direct radiation from normal operation results in "small contributions at site boundaries" (NUREG-1437, Section 4.6.1.2).

The direct radiation contribution at the site boundary from operation of the RBS ISFSI is small. The bounding annual contribution at the site boundary from the ISFSI is no more than 4.71 mrem/yr (Reference 12.2-208). The Unit 1 site boundary dose reported in Table 12.2-211 includes actual dose contribution from the current ISFSI configuration.

As shown in Table 12.2-211, the combined annual dose to the MEI is 0.79 mrem TEDE. This is well below the limit of 0.1 rem given in 10 CFR 20.1301. The MEI dose rate also meets the limit of 2 mrem/hr given in 10 CFR 20.1301(a)(2).

Table 12.2-211 shows that the total site doses from all pathways resulting from the normal operation of Unit 1 and Unit 3 are well within the regulatory limits of 40 CFR 190 (Reference 12.2-202).

12.2.2.2.5 Compliance with 10 CFR 20.1302

Surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas are conducted to demonstrate compliance with the dose limits given in 10 CFR 20.1302 for individual members of the public. These surveys are conducted in accordance with the Off-Site Dose Calculation Manual (ODCM) required by the Technical Specifications.

12.2.2.4 Liquid Doses Off-Site

RBS COL 12.2-3-A

Delete DCD Tables 12.2-20a and 12.2-20b and replace this section with the following.

Exposure Pathways

The release of small amounts of radioactive liquid effluents is permitted as long as releases comply with the requirements specified in 10 CFR 20. The important exposure pathways for liquid effluents include the following:

- Internal exposure from the ingestion of water or contaminated food chain components.
- External exposure from the surface of contaminated water or from shoreline sediment.
- External exposure from immersion in contaminated water.

Irrigation has not been found necessary or observed in the area around the RBS site; therefore, this pathway has not been considered. The dose resulting from drinking water intake has been considered. There is no record of consumption of aquatic vegetation in the area surrounding the RBS site; therefore, this pathway is not evaluated. Shoreline use is very limited, with essentially no swimming, sunbathing, or fishing from the bank; consequently, this would be an insignificant pathway in comparison with the pathways of aquatic foods consumption and drinking water. Nevertheless, for purposes of conservatism, this pathway has been included in the evaluation of doses for the maximally exposed individual. Rates for fish and invertebrate consumption and shoreline use are the default values given in LADTAP-II (NUREG/CR-4013) (Reference 12.2-203). Invertebrate usage factors for saltwater sites are applied to the Mississippi River crawfish and shrimp catch.

Liquid pathway doses were calculated to demonstrate compliance with 10 CFR 50, Appendix I. Dose conversion factors and methodologies consistent with Regulatory Guide 1.109 were used. The liquid effluent pathway off-site dose calculation bases are provided in Tables 12.2-206 and 12.2-207. The LADTAP-II code (NUREG/CR-4013) is used to perform the liquid effluent dose analysis. The results of the dose calculation are provided in Table 12.2-208.

Discharge from the liquid radwaste is combined with the discharge from the cooling tower blowdown before discharging to the Mississippi River. Other dilution from the clarifier blowdown and from Unit 1 are not considered, which adds conservatism to the calculation. Mixing of the diluted radioactive effluent with the Mississippi River water is analyzed for the mean river level of 32 feet msl, corresponding to a discharge of 500,013 cfs. The isotopic releases in the liquid effluent are given in DCD Table 12.2-19b. The outflow from the combined discharge mixes with the Mississippi River water, resulting in additional dilution of the effluent.

Pathway Doses

Maximum dose rate estimates to man due to liquid effluent releases were determined in the following ways:

- Eating fish or invertebrates caught near the point of discharge.

- Using the shoreline for activities, such as sunbathing or fishing.

- Swimming and boating on the Mississippi River near the point of discharge.

The calculated whole-body and critical organ doses from these interactions are presented in Table 12.2-208. These doses are within the limits given in 10 CFR 50, Appendix I and would only occur under conditions that maximize the resultant dose.

12.2.2.4.1 Compliance with 10 CFR 50, Appendix I, Section II.A

The maximally exposed individual annual doses from the discharge of radioactive materials in liquid effluents meet the guidelines of Appendix I, Section II.A, to 10 CFR 50, as shown in Table 12.2-210. In addition, the maximally exposed individual dose calculated was compared to and meets the 40 CFR 190 criteria (refer to Table 12.2-211) for liquid effluents.

12.2.2.4.2 Compliance with 10 CFR 50, Appendix I, Section II.D

The population doses determined for the liquid effluent releases from Unit 3 given in Table 12.2-209 are used for the cost-benefit analysis for the liquid radwaste management system. Refer to Subsection 11.2.1 for the cost-benefit analysis results. Therefore, Unit 3 complies with 10 CFR 50, Appendix I, Section II.D.

12.2.2.4.3 Compliance with 10 CFR 20 Appendix B, Table 2, Column 2

Compliance with 10 CFR 20 Appendix B, Table 2, Column 2 is demonstrated in DCD Table 12.2-19b.

12.2.2.4.4 Compliance with 10 CFR 20.1301

Refer to Subsection 12.2.2.2.4.

12.2.2.4.5 Compliance with 10 CFR 20.1302

Refer to Subsection 12.2.2.2.5.

12.2.4 COL INFORMATION

12.2-2-A Airborne Effluents and Doses

RBS COL 12.2-2-A

This COL item is addressed in Subsections 11.3.2, 12.2.2.1 and 12.2.2.2.

12.2-3-A Liquid Effluents and Doses

RBS COL 12.2-3-A

This COL item is addressed in Subsection 12.2.2.4.

12.2.5 REFERENCES

12.2-201 U.S. Nuclear Regulatory Commission, *GASPAR II - Technical Reference and User Guide*, NUREG/CR-4653, March 1987.

12.2-202 40 CFR 190, "Environmental Radiation Protection Requirements for Normal Operations of Activities in the Uranium Fuel Cycle."

12.2-203 U.S. Nuclear Regulatory Commission, *LADTAP II - Technical Reference and User Guide*, NUREG/CR-4013, April 1986.

12.2-204 GEH, ESBWR Design Control Document, Revision 5.

12.2-205 River Bend Station Radioactive Effluent Release Report, Unit 1, January 1, 2006 through December 31, 2006.

12.2-206 River Bend Station Radioactive Effluent Release Report, Unit 1, January 1, 2005 through December 31, 2005.

12.2-207 River Bend Station Radioactive Effluent Release Report, Unit 1, January 1, 2004 through December 31, 2004.

12.2-208 Entergy Nuclear South 10 CFR 72.212 Evaluation Report, Appendix D RBS Specific Information for Independent Spent Fuel Storage Installations Utilizing the Holtec, Interational HI-STORM 100 Cask System.

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-15R
Airborne Sources Calculation

Calculation Bases

Methodology	DCD Revision 5, Appendix 12B (Reference 12.2-204)
Noble Gas Source at t=30 min	740 MBq/sec (20,000 μCi/sec)
I131 Release Rate	3.7 MBq/sec (100 μCi/sec)
Meteorology χ/Q[(a)]	
RB/FB Ventilation Stack	3.0E-07 s/m^3
TB Ventilation Stack	2.0E-07 s/m^3
RWB Ventilation Stack	2.0E-05 s/m^3
Meteorology D/Q[(a)]	
RB/FB Ventilation Stack	1.0E-08 m^{-2}
TB Ventilation Stack	6.0E-09 m^{-2}
RWB Ventilation Stack	3.0E-08 m^{-2}
Meteorology Boundary	800 m
Plant Availability Factor	0.92
Offgas System:	
Offgas stream temperature	100°F
Flow rate at 100°F	54 m^3/hr
K_d (Kr)	18.5 cm^3/g
K_d (Xe)	330 cm^3/g
K_d (Ar)	6.4 cm^3/g
Guard tank charcoal mass	7500 kg (single tank)
Adsorber tank charcoal mass	27,750 kg (each)
Adsorber tank arrangement	2 parallel trains of 4 tanks each
Turbine Gland Sealing System Exhaust:	
I-131 release	0.81 Ci/yr per μCi/g of I-131 in coolant
I-133 release	0.22 Ci/yr per μCi/g of I-133 in coolant

a) Refer to Table 12.2-201 for meteorology factors applied to airborne off-site dose calculations.

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-16R (Sheet 1 of 3)
Annual Airborne Releases for Off-Site Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
Kr-83m						1.4E-04	8.5E+01
Kr-85m	9.0E+04	5.6E+05				6.6E+03	3.4E+02
Kr-85						5.2E+06	7.5E+01
Kr-87	4.5E+04	1.4E+06				8.5E-10	3.1E+02
Kr-88	9.0E+04	2.0E+06				1.4E+01	6.9E+02
Kr-89	4.5E+04	1.3E+07	6.5E+05				8.3E+01
Xe-131m						1.5E+05	4.1E+01
Xe-133m						8.1E-01	1.9E+02
Xe-133	2.5E+06	3.4E+06	5.0E+06	2.9E+07		8.5E+05	1.1E+04
Xe-135m	1.4E+06	9.0E+06	1.2E+07				8.5E+01
Xe-135	2.9E+06	7.4E+06	6.3E+06	1.1E+07		4.4E-37	2.6E+03
Xe-137	4.1E+06	2.3E+07	1.9E+06				1.2E+02
Xe-138	1.8E+05	2.3E+07	4.5E+04				2.7E+02
I-131	9.4E+02	5.2E+03	3.4E+02	1.8E+03	4.7E+01		6.8E+01
I-132	8.5E+03	4.6E+04	3.0E+03				9.9E+00
I-133	6.2E+03	3.4E+04	2.2E+03		8.4E+01		6.5E+01
I-134	1.5E+04	8.4E+04	5.5E+03				6.9E+00
I-135	8.6E+03	4.7E+04	3.1E+03				2.9E+01
H-3	1.2E+06	1.2E+06					2.6E+05
C-14						5.3E+05	
Na-24							5.4E+00
P-32							1.3E+00
Ar-41						1.4E+03	

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-16R (Sheet 2 of 3)
Annual Airborne Releases for Off-Site Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
Cr-51	2.6E+01	2.2E+01	1.7E+01				1.1E+02
Mn-54	3.3E+01	1.4E+01	9.6E+01				1.7E+00
Mn-56							1.1E+01
Fe-55							4.7E+01
Fe-59	9.3E+00	2.4E+00	7.2E+00				1.2E+00
Co-58	7.2E+00	2.4E+01	4.8E+00				4.4E+00
Co-60	1.2E+02	2.4E+01	1.7E+02				9.4E+00
Ni-63							4.7E-02
Cu-64							6.9E+00
Zn-65	1.2E+02	1.4E+02	7.2E+00				4.6E+01
Rb-89							2.0E-01
Sr-89	1.2E+00	1.4E+02					4.3E+00
Sr-90	2.4E-01	4.8E-01					3.3E-01
Y-90							8.1E-0
Sr-91							6.7E+00
Sr-92							4.6E+00
Y-91							1.7E+00
Y-92							3.7E+00
Y-93							7.2E+00
Zr-95	2.4E+01	9.6E-01	1.9E+01				3.5E-01
Nb-95	2.4E+02	1.4E-01	9.6E-02				3.3E-01
Mo-99	1.6E+03	4.8E+01	7.2E-02				2.4E+01
Tc-99m							2.2E+00
Ru-103	1.0E+02	1.2E+00	2.4E-02				8.2E-01
Rh-103m							3.5E-03
Ru-106							1.4E-01
Rh-106							4.5E-06

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-16R (Sheet 3 of 3)
Annual Airborne Releases for Off-Site Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
Ag-110m	5.7E-02						4.6E-02
Sb-124	1.2E+00	2.4E+00	1.7E+00				
Te-129m							1.6E+00
Te-131m							5.5E-01
Te-132							1.4E-01
Cs-134	1.1E+02	4.8E+00	5.7E+01				1.3E+00
Cs-136	1.2E+01	2.4E+00					5.8E-01
Cs-137	1.4E+02	2.4E+01	9.6E+01				3.4E+00
Cs-138							8.5E-01
Ba-140	5.3E+02	2.4E+02	9.6E-02				1.3E+01
La-140							1.3E+01
Ce-141	2.2E+01	2.4E+02	1.7E-01				1.2E+00
Ce-144							1.3E-01
Pr-144							1.6E-04
W-187							1.3E+00
Np-239							8.3E+01

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-17R (Sheet 1 of 3)
Comparison of Site-Specific Airborne Concentrations with 10 CFR 20, Table 2, Column 1 Concentrations

Nuclide	Airborne Release MBq/yr	Concentration Bq/m^3	Unit 3[(a)] Bq/m^3	10 CFR 20 Bq/m^3	Ratio 10 CFR 20/Unit 3
Kr-83m	8.5E+01	8.0E-07	2.2E-06	2.E+06	9.3E+11
Kr-85m	6.6E+05	4.5E-03	1.2E-02	4.E+03	3.3E+05
Kr-85	5.2E+06	3.3E-02	8.9E-02	3.E+04	3.4E+05
Kr-87	1.4E+06	9.1E-03	2.5E-02	7.E+02	2.8E+04
Kr-88	2.1E+06	1.4E-02	3.8E-02	3.E+02	7.9E+03
Kr-89	1.4E+07	5.0E-01	1.4E+00	4.E+01	3.0E+01
Xe-131m	1.5E+05	9.3E-04	2.5E-03	7.E+04	2.8E+07
Xe-133m	1.9E+02	1.8E-06	4.9E-06	2.E+04	4.1E+09
Xe-133	4.1E+07	3.4E+00	9.2E+00	2.E+04	2.2E+03
Xe-135m	2.2E+07	7.6E+00	2.1E+01	1.E+03	4.9E+01
Xe-135	2.8E+07	4.1E+00	1.1E+01	3.E+03	2.7E+02
Xe-137	2.8E+07	1.4E+00	3.8E+00	4.E+01	1.1E+01
Xe-138	2.3E+07	1.7E-01	4.6E-01	7.E+02	1.5E+03
I-131	8.4E+03	2.7E-04	7.3E-04	7.E+00	9.6E+03
I-132	5.8E+04	2.3E-03	6.2E-03	7.E+02	1.1E+05
I-133	4.2E+04	1.7E-03	4.6E-03	4.E+01	8.7E+03
I-134	1.1E+05	4.2E-03	1.1E-02	2.E+03	1.8E+05
I-135	5.9E+04	2.3E-03	6.2E-03	2.E+02	3.2E+04
H-3	2.8E+06	2.2E-02	5.9E-02	4.E+03	6.7E+04
C-14	5.3E+05	3.4E-03	9.2E-03	1.E+02	1.1E+04
Na-24	5.4E+00	5.2E-08	1.4E-07	3.E+02	2.1E+09
P-32	1.3E+00	1.3E-08	3.5E-08	2.E+01	5.7E+08
Ar-41	1.4E+03	9.0E-06	2.4E-05	4.E+02	1.6E+07
Cr-51	1.8E+02	1.2E-05	3.2E-05	1.E+03	3.1E+07
Mn-54	1.5E+02	6.1E-05	1.6E-04	4.E+01	2.4E+05
Mn-56	1.1E+01	1.0E-07	2.7E-07	7.E+02	2.6E+09

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-17R (Sheet 2 of 3)
Comparison of Site-Specific Airborne Concentrations with 10 CFR 20, Table 2, Column 1 Concentrations

Nuclide	Airborne Release MBq/yr	Concentration Bq/m^3	Unit 3[(a)] Bq/m^3	10 CFR 20 Bq/m^3	Ratio 10 CFR 20/Unit 3
Fe-55	4.7E+01	4.5E-07	1.2E-06	1.E+02	8.2E+07
Fe-59	2.0E+01	4.7E-06	1.3E-05	2.E+01	1.6E+06
Co-58	4.0E+01	3.3E-06	8.9E-06	4.E+01	4.5E+06
Co-60	3.2E+02	1.1E-04	3.0E-04	2.E+00	6.7E+03
Ni-63	4.7E-02	4.5E-10	1.2E-09	4.E+01	3.3E+10
Cu-64	6.9E+00	6.6E-08	1.8E-07	1.E+03	5.6E+09
Zn-65	3.2E+02	7.0E-06	1.9E-05	1.E+01	5.3E+05
Rb-89	2.0E-01	1.9E-09	5.1E-09	7.E+03	1.4E+12
Sr-89	1.5E+02	9.6E-07	2.6E-06	7.E+00	2.7E+06
Sr-90	1.0E+00	8.4E-09	2.3E-08	2.E-01	8.8E+06
Y-90	8.1E-02	7.7E-10	2.1E-09	3.E+01	1.4E+10
Sr-91	6.7E+00	6.4E-08	1.7E-07	2.E+02	1.2E+09
Sr-92	4.6E+00	4.4E-08	1.2E-07	3.E+02	2.5E+09
Y-91	1.7E+00	1.7E-08	4.6E-08	7.E+00	1.5E+08
Y-92	3.7E+00	3.5E-08	9.5E-08	4.E+02	4.2E+09
Y-93	7.2E+00	6.9E-08	1.9E-07	1.E+02	5.4E+08
Zr-95	4.4E+01	1.2E-05	3.2E-05	1.E+01	3.1E+05
Nb-95	2.4E+02	2.3E-06	6.2E-06	7.E+01	1.1E+07
Mo-99	1.7E+03	1.6E-05	4.3E-05	7.E+01	1.6E+06
Tc-99m	2.2E+00	2.1E-08	5.7E-08	7.E+03	1.2E+11
Ru-103	1.0E+02	9.9E-07	2.7E-06	3.E+01	1.1E+07
Rh-103m	3.5E-03	3.3E-11	8.9E-11	7.E+04	7.9E+14
Ru-106	1.4E-01	1.3E-09	3.5E-09	7.E-01	2.0E+08
Rh-106	4.5E-06	4.3E-14	1.2E-13	4.E+01	3.4E+14
Ag-110m	1.0E-01	9.9E-10	2.7E-09	4.E+00	1.5E+09
Sb-124	5.3E+00	1.1E-06	3.0E-06	1.E+01	3.4E+06
Te-129m	1.6E+00	1.5E-08	4.1E-08	1.E+01	2.5E+08

RBS DEP 9.4-1
RBS DEP 12.2-1

Table 12.2-17R (Sheet 3 of 3)
Comparison of Site-Specific Airborne Concentrations with 10 CFR 20, Table 2, Column 1 Concentrations

Nuclide	Airborne Release MBq/yr	Concentration Bq/m^3	Unit 3[(a)] Bq/m^3	10 CFR 20 Bq/m^3	Ratio 10 CFR 20/Unit 3
Te-131m	5.5E-01	5.2E-09	1.4E-08	4.E+01	2.8E+09
Te-132	1.4E-01	1.3E-09	3.5E-09	3.E+01	8.5E+09
Cs-134	1.8E+02	3.8E-05	1.0E-04	7.E+00	6.8E+04
Cs-136	1.5E+01	1.3E-07	3.5E-07	3.E+01	8.5E+07
Cs-137	2.7E+02	6.2E-05	1.7E-04	7.E+00	4.2E+04
Cs-138	8.5E-01	8.1E-09	2.2E-08	3.E+03	1.4E+11
Ba-140	7.8E+02	6.7E-06	1.8E-05	7.E+01	3.9E+06
La-140	1.3E+01	1.2E-07	3.2E-07	7.E+01	2.2E+08
Ce-141	2.6E+02	1.8E-06	4.9E-06	3.E+01	6.2E+06
Ce-144	1.3E-01	1.3E-09	3.5E-09	7.E-01	2.0E+08
Pr-144	1.6E-04	1.5E-12	4.1E-12	7.E+00	1.7E+12
W-187	1.3E+00	1.2E-08	3.2E-08	4.E+02	1.2E+10
Np-239	8.3E+01	7.9E-07	2.1E-06	1.E+02	4.7E+07

a) Adjusted based on the highest ratio of site-specific χ/Q and DCD χ/Q values from the three release points (RBS Unit 3 TB Ventilation Stack 5.3E-07 s/m^3 [Table 12.2-202] ÷ 2.0E-07 s/m^3 = 2.7 [Table 12.2-15R]).

Table 12.2-201
Airborne Off-Site Dose Calculation Bases

RBS COL 12.2-2-A	Meteorology χ/Q	Tables 2.3-305 through 2.3-313 Table 12.2-202 for Special Locations
	Meteorology D/Q	Tables 2.3-313 through 2.3-316 Table 12.2-202 for Special Locations
	Meteorology Boundary	Table 2.3-304
RBS DEP 12.2-1	Airborne Release Source Term	Table 12.2-16R
RBS COL 12.2-2-A	Calculation Methodology	Regulatory Guide 1.109
	Computer Code Utilized	GASPAR II (NUREG/CR-4653)
	Individual Consumption Rates	Table E-5 of Regulatory Guide 1.109
	Misc. Calculation Inputs (other than Regulatory Guide 1.109 default values)	
	Midpoint of plant operating life	30 years
	Fraction of year that leafy vegetables are grown	0.58
	Fraction of year beef cattle graze on pasture	0.75
	Fraction of beef cattle feed intake from pasture while on pasture	0.75
	Animal milk considered for milk pathway	No milk animals within 5 mi.
	Average Absolute Humidity	12.9 g/m^3
	MEI Consumption Rates	RG 1.109 default values
	50-mi. Population	1,803,302
	Annual 50-mi. Cow Milk Production	5.42E+07 L/yr
	Annual 50-mi. Meat Production	3.94E+07 kg/yr
	Annual 50-mi. Vegetable Production	6.35E+08 kg/yr

Table 12.2-202
Annual Average χ/Q Values for Individual Gaseous Dose Receptors

Location	Sector	Distance (mi.)	Undecayed, Undepleted χ/Q (sec/m^3)	2.26-Day Decay, Undepleted χ/Q (sec/m^3)	8-Day Decay, Depleted χ/Q (sec/m^3)	D/Q (m^{-2})
Ground Level Release for Radwaste Building						
Site Boundary	NW	0.76	2.1E-05[(a)]	2.1E-05	1.9E-05	4.40E-08
Site Boundary	N	0.76	1.2E-05	1.1E-05	1.0E-05	3.2E-08
Reactor Building/Fuel Building Stack						
Site Boundary	NW	0.76	5.6E-07[(a)]	5.6E-07	5.3E-07	8.5E-09
Site Boundary	N	0.76	6.0E-07[(a)]	6.0E-07	5.6E-07	8.9E-09
Turbine Building Stack						
Site Boundary	NW	0.76	4.8E-07[(a)]	4.8E-07	4.5E-07	7.5E-09
Site Boundary	N	0.76	5.3E-07[(a)]	5.3E-07	4.9E-07	7.9E-09

a) Undecayed, Undepleted χ/Q is conservatively increased by 0.10E-05 (or 0.10E-07) in the analysis to avoid a divide-by-0 error in the GASPAR II computer code.

Table 12.2-203
Gaseous Pathway Doses from Airborne Releases to the MEI

Location	Pathway	Annual Dose (mrads/yr) Air	Annual Dose (mrem/yr)		
			Total Body	Thyroid	Skin
Site Boundary (0.76 mi. NW)	Plume	N/A	1.55E-01	1.55E-01	4.09E-01
	Beta Air Dose	3.67E-01	N/A	N/A	N/A
	Gamma Air Dose	2.39E-01	N/A	N/A	N/A
Site Boundary (0.76 mi. NW)	Ground	N/A	2.67E-01	2.67E-01	3.13E-01
	Vegetable				
	Adult	N/A	1.02E-01	3.15E+00	3.80E-02
	Teen	N/A	1.24E-01	4.18E+00	6.28E-02
	Child	N/A	2.15E-01	8.01E+00	1.52E-01
	Meat				
	Adult	N/A	2.10E-02	1.05E-01	1.47E-02
	Teen	N/A	1.58E-02	7.77E-02	1.24E-02
	Child	N/A	2.66E-02	1.22E-01	2.33E-02
	Inhalation				
	Adult	N/A	2.97E-03	2.48E-01	8.63E-04
	Teen	N/A	2.84E-03	3.23E-01	8.71E-04
	Child	N/A	2.26E-03	3.96E-01	7.69E-04
	Infant	N/A	1.32E-03	3.61E-01	4.42E-04
	Total				
	Adult	N/A	5.48E-01	3.93E+00	7.76E-01
	Teen	N/A	5.65E-01	5.01E+00	7.98E-01
	Child	N/A	6.66E-01	8.96E+00	8.98E-01
	Infant	N/A	4.24E-01	7.83E-01	7.23E-01

Table 12.2-204
Comparison of Annual Maximally Exposed Individual Gaseous Doses with 10 CFR 50, Appendix I Limits

		Annual Dose	
Type of Dose	**Location**	**RBS Unit 3**	**Limit**
Noble Gases	Site Boundary 0.76 mi. NW		
Total External Body (mrem/yr)		1.55E-01	5
Skin (mrem/yr)		4.09E-01	15
Beta Air Dose (mrad/yr)		3.67E-01	20
Gamma Air Dose (mrad/yr)		2.39E-01	10
Iodine and Particulates	Site Boundary 0.76 mi. NW		
Max Organ - Thyroid (mrem/yr)		8.96E+00[a]	15

a) Total dose from all applicable pathways for a child.

Table 12.2-205
50-Mi. Population Doses from Gaseous Effluents

Pathway	Dose person-rem/yr
Plume	
Total Body	6.69E-01
Max Organ--Skin	1.99E+00
Ground	
Total Body	4.65E-01
Max Organ--Skin	5.45E-01
Inhalation	
Total Body	3.32E-02
Max Organ--Thyroid	2.53E+00
Vegetable	
Total Body	6.58E-01
Max Organ--Bone	3.08E+00
Cow Milk	
Total Body	7.10E-02
Max Organ--Thyroid	8.75E-01
Meat	
Total Body	8.45E-02
Max Organ--Bone	4.08E-01
Total	
Total Body	1.99E+00
Max Organ--Thyroid	5.37E+00

Table 12.2-206
Liquid Pathway Parameters

Description	Parameter
Effluent Discharge	105 gpm
Dilution Flow	6422 gpm
Mississippi River Dilution Factor	11
Shore Width Factor	0.2
Source Term	DCD Table 12.2-19b
Commercial Fish Catch	446,467 kg
Invertebrate Harvest	3511 kg
Dilution Factor for MEI Pathways	697
Transit Time for MEI Pathways	0 hr
MEI Consumption/Usage Rages	Table 12.2-207
50-mi. Population	1,803,302
50-mi. Sport Fish Catch	3.00E+06 kg/yr
50-mi. Commercial Invertebrate Catch	6.53E+06 kg/yr
Dilution Factor for Fish and Invertebrate Catches	697
Transit Time for Fish and Invertebrate Catches	24 hr
Population Served by Nearest Drinking Water Source	300,000
Dilution Factor for Population Drinking Water	30,581
Transit Time for Population Drinking Water	30.2 hr

Table 12.2-207
Liquid Pathway Consumption Factors[(a)]

Age Group	Fish (kg/yr)	Invertebrates (kg/yr)	Shoreline (hr/yr)
Adult	21	5.0	12
Teen	16	3.8	67
Child	6.9	1.7	14
Infant	0.0	0.0	0.0

a) Consumption factors from Regulatory Guide 1.109, Table E-5.

Table 12.2-208
Liquid Pathway Doses from Unit 3 for Maximally Exposed Individual

	Annual Dose (mrem/yr)		
Pathway	**Total Body**	**Bone**	**Thyroid**
Fish	1.07E-01	1.63E+00	N/A
Invertebrate	1.13E-02	8.88E-02	N/A
Drinking Water	5.55E-03	7.64E-03	2.40E-01
Shoreline	1.08E-04	1.26E-04	N/A
Total	1.24E-01	1.73E+00	2.40E-01
Age Group with Maximum Dose	Adult	Child	Infant

Table 12.2-209
50-Mi. Population Doses from Liquid Effluents

Pathway	Dose person-rem/yr
Fish	
Total Body	1.65E+01
Organ--Bone	2.10E+02
Organ--Thyroid	3.99E+00
Invertebrates	
Total Body	1.04E+01
Organ--Bone	6.84E+01
Organ--Thyroid	2.08E+00
Drinking Water	
Total Body	1.92E-02
Organ--Bone	1.25E-02
Organ--Thyroid	2.27E-01
Total	
Total Body	2.69E+01
Total Organ--Bone	2.78E+02
Total Organ--Thyroid	6.30E+00

Table 12.2-210
Liquid Pathway Comparison of Maximum Individual Dose to Appendix 10 CFR 50, Appendix I Criteria

		Annual Dose	
Type of Dose	**Location**	**RBS Unit 3**	**Limit**
Total Body (mrem/yr)	Mississippi River	1.24E-01[a]	3
Max Organ--Bone (mrem/yr)	Mississippi River	1.73[b]	10

a) Total dose from all pathways for an adult.

b) Total dose from all pathways for a child.

Table 12.2-211
Comparison of Site Doses to the MEI

Type of Dose	Unit 3 (ESBWR) Liquid	Unit 3 (ESBWR) Gaseous	Unit 3 (ESBWR) Total	Existing Units[(a)]	Site Total[(b)]	40 CFR 190 Limit
Total Body (mrem/yr)	0.12	0.67	0.79	1.65	2.44	25
Thyroid (mrem/yr)	0.24	8.96	9.20	1.16	10.36	75
Critical Organ[(c)] (mrem/yr)	1.73	-	1.73	0.05	1.78	25

a) The doses from existing units include ISFSI contribution.

b) This site total dose includes the Unit 3 total dose and the dose from the existing units.

c) Critical organ for Unit 1 liquid release is GG-LLI; critical organ for Unit 3 liquid release is child-bone.

1 mrem = 0.01 mSv

Source: Reference 12.2-205.

12.3 RADIATION PROTECTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.3.1.3 Radiation Zoning

Replace the last sentence with the following.

STD COL 12.3-3-A

Access to "Very High Radiation Areas" is discussed in Section 12.5.

12.3.4 AREA RADIATION AND AIRBORNE RADIOACTIVITY MONITORING INSTRUMENTATION

Replace the last bullet with the following.

STD COL 12.3-2-A

The radiation instrumentation that monitors airborne radioactivity is classified as nonsafety-related. Airborne radiation monitoring operational considerations, such as the procedures for operation and calibration of the monitors, as well as the placement of the portable monitors, are discussed in Section 12.5.

12.3.7 COL INFORMATION

12.3-2-A Operational Considerations

STD COL 12.3-2-A

This COL item is addressed in Section 12.3.4.

12.3-3-A Controlled Access

STD COL 12.3-3-A

This COL item is addressed in Section 12.3.1.3.

12.4 DOSE ASSESSMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following paragraph at the end of Section 12.4 prior to Subsection 12.4.1.

RBS SUP 12.4-1

Doses to Unit 3 construction workers from the operation of Unit 1 are addressed in Appendix 12CC.

12.5 OPERATIONAL RADIATION PROTECTION PROGRAM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following as introductory text:

STD COL 12.5-1-A
STD COL 12.5-2-A
STD COL 12.5-3-A
The operational program for radiation protection is addressed in Appendix 12BB.

12.5.4 COL INFORMATION

12.5-1-A Radiation Protection Program

STD COL 12.5-1-A This COL item is addressed in Appendix 12BB.

12.5-2-A Equipment, Instrumentation, and Facilities

STD COL 12.5-2-A This COL item is addressed in Appendix 12BB.

12.5-3-A Compliance with Paragraph 50.34(f)(xxvii) of 10 CFR 50 and NUREG-0737 Item III.D.3.3

STD COL 12.5-3-A This COL item is addressed in Appendix 12BB.

12.6 MINIMIZATION OF CONTAMINATION AND RADWASTE GENERATION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

12.6.1 MINIMIZATION OF CONTAMINATION TO FACILITATE DECOMMISSIONING

Add the following at the end of this section.

STD SUP 12.6-1 In addition to design features, measures are implemented in operating procedures to minimize contamination. Appendix 12BB establishes contamination control measures to ensure compliance with 10 CFR 20.1406. Practical measures to prevent the spread of contamination are employed, including:

- Engineering controls, such as portable ventilation or filtration units to reduce concentrations of radioactivity in air or fluids, are used where practical
- Criteria for selecting tools, material, and equipment for use in contaminated areas include minimizing the use of porous or other materials that are difficult to decontaminate
- Leaks and spills are contained promptly and repaired or cleaned up as soon as practical
- Containments, caches, and enclosures are used during maintenance, repairs, and testing, when practical, to contain spills or releases
- Contaminated tools and equipment are segregated from clean tools and equipment
- Potentially contaminated systems, equipment, and components are surveyed for the presence of contamination when opened or prior to removal
- Procedures ensure that equipment performs and is operated in accordance with the design requirements
- Temporary and permanent design modifications require compensatory measures be taken to prevent and limit the spread of contamination

APPENDIX 12A CALCULATION OF AIRBORNE RADIONUCLIDES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 12AA ALARA PROGRAM

STD SUP 12.1-1 NEI 07-08, Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA), which is currently under review by the NRC staff, is incorporated by reference. (Reference 12AA-201)

12AA.1 REFERENCES

12AA-201 Nuclear Energy Institute, "Generic FSAR Template Guidance for Ensuring that Occupational Radiation Exposures Are As Low As Is Reasonably Achievable (ALARA)," NEI 07-08.

APPENDIX 12BB RADIATION PROTECTION

STD COL 12.1-1-A
STD COL 12.1-2-A
STD COL 12.1-3-A
STD COL 12.1-4-A
STD COL 12.5-1-A
STD COL 12.5-2-A
STD COL 12.5-3-A

NEI 07-03, Generic FSAR Template Guidance for Radiation Protection Program Description, which is currently under review by the NRC staff, is incorporated by reference. (Reference 12BB-201)

12BB.1 REFERENCES

12BB-201 Nuclear Energy Institute, "Generic FSAR Template Guidance for Radiation Protection Program Description," NEI 07-03.

RBS SUP 12.4-1

APPENDIX 12CC DOSES TO CONSTRUCTION WORKERS HISTORICAL INFORMATION

This section evaluates the potential radiological dose impacts to construction workers at the proposed new facility location on the RBS site resulting from the operation of the RBS Unit 1.

12CC.1 SITE LAYOUT

The proposed RBS Unit 3 is located to the southwest of RBS Unit 1. RBS Unit 1 is expected to be operating normally during the construction period for RBS Unit 3. Construction support areas such as offices, parking, warehouses, and laydown areas are also located to the south and west of the new facility location.

Figure 12CC-201 shows the construction areas relative to the existing RBS Unit 1 power block and associated facilities.

12CC.2 RADIATION SOURCES

Construction workers at a new facility on the site could be exposed to radiation from a range of sources associated with the normal operation of RBS Unit 1. These sources include direct radiation, radiation from gaseous and liquid effluents, and radiation associated with on-site dry waste and spent fuel storage.

Figure 12CC-201 shows the location of the primary sources of radiation from RBS Unit 1 relative to the construction areas, as discussed below.

12CC.2.1 Direct Radiation Sources

A large portion of the radiation dose to construction workers is expected to be due to the skyshine from the nitrogen-16 (N-16) source present in the operating RBS Unit 1 main turbine steam cycle. The N-16 activity present in the reactor steam in the main steam lines, turbines, and moisture separators provides an air-scattered radiation dose contribution to locations outside the RBS Unit 1 structures as a result of the high energy gamma rays that it emits as it decays. The RBS Unit 1 USAR, Table 11.1-7 (Reference 12CC-201), indicates an N-16 specific activity of 50 μCi/gm for normal water chemistry. Operations with hydrogen water chemistry (HWC) lead to dose rates that drop below 1 mR/yr at 1900 ft. from turbine centerline (Reference 12CC-201, Subsection 12.4.2.2).

12CC.2.2 Radiation from Gaseous Effluents

RBS Unit 1 releases airborne effluents via three gaseous effluent release points to the environment. These points are the Radwaste Building vent, the Fuel Building vent, and the main plant exhaust vent. The main plant exhaust is the primary release point and includes the Reactor Building vent, Auxiliary Building vent, Turbine Building vent, piping tunnel vent, standby gas treatment system exhaust, and Off-Gas Building vent exhausts. The expected radiation sources (nuclides and activities) in the gaseous effluents are listed in the RBS Unit 1 USAR, Table 11.3-1 (Reference 12CC-201).

12CC.2.3 Radiation from Liquid Effluents

RBS Unit 1 releases radioactive liquid effluents via the radwaste discharge pipe, which are diluted by mixing with the cooling tower blowdown flow of approximately 2200 gpm. The annual expected releases of activity to the environment in liquid effluents are presented in the RBS Unit 1 USAR (Reference 12CC-201, Table 11.2.4). These effluents are released directly to the Mississippi River via an underground pipe from the RBS Unit 1 site to the river. Construction activities at the river for a new facility would be primarily upstream of the RBS Unit 1 release point for liquid effluents.

12CC.2.4 Radiation from Solid Waste Storage and On-Site Spent Fuel Storage

Other sources that exist outside of RBS Unit 1 plant buildings with the potential for a direct radiation dose contribution to construction workers are the condensate storage tank, the temporary dry active waste storage facilities, and the two turbine rotor modular enclosures. The minimal activity within the tank, temporary dry active waste storage facilities, and the two turbine rotor modular enclosures produces a negligible dose rate at the restricted access boundary (Reference 12CC-201, Subsection 12.4.2.1).

An Independent Spent Fuel Storage Installation (ISFSI) is located west of the RBS Unit 1 Turbine Building and immediately adjacent to the proposed construction area for the RBS Unit 3 power block.

12CC.3 MEASURED AND CALCULATED RADIATION DOSE RATES

Measured and reported data from RBS Unit 1 are available for gaseous and liquid effluents. This information is reported annually to the NRC as part of the Radiological Effluents Monitoring Program (REMP) for the operating unit.

Direct measured data are very limited for evaluation of the dose rates from direct radiation (N-16 skyshine) or from the ISFSI. Calculations are developed in this section to estimate the dose rates from these sources.

12CC.3.1 Dose Rate from Direct Radiation Sources

RBS Unit 1 measures the radiation dose at various distances using thermoluminescent dosimeters (TLDs) near the exclusion area boundary. These TLDs are beyond the boundary of the expected construction areas. Measurements from these instruments that are used to determine dose would underestimate the construction worker dose because of their locations relative to the construction areas.

RBS Unit 1 also measures direct radiation dose inside the protected area (PA). Results of these radiation surveys are documented and capture values that are greater than a threshold of 2 mR/hr. Using the threshold dose rate would greatly overestimate the dose to construction workers.

The RBS added TLDs to measure radiation exposure at the PA and ISFSI boundary in 2006. These limited measurements for 2006 are shown in Table 12CC-201.

RBS Unit 1 performed detailed calculations and evaluations as a part of the implementation of the use of HWC controls. The detailed calculations included radiation surveys at the PA boundary and analysis to evaluate the expected dose rates at those locations. Measured data show that the HWC analysis is appropriate for estimating direct radiation dose rates from N-16 skyshine.

The distance from the RBS Unit 1 Turbine Building centerline to the nearest construction impact area is approximately 360 ft. The estimated bounding dose rate at this location due to N-16 is 41 mrem/yr. The far side boundary of the power block construction area is more than 1395 ft. from the centerline. At this point, the dose rate drops to less than 3 mrem/yr. The average dose rate across the power block construction area is 10 mrem/yr.

12CC.3.2 Dose Rate from Gaseous Effluents

Environmental radiological monitoring data obtained from the RBS Annual Radiological Environmental Operating Report and from the RBS Annual Effluent Release Report were used to assess any potential radiological effect on construction workers due to the operation of RBS Unit 1. The data from these reports are considered representative for the RBS site dose evaluations.

As stated in the radiological reports for 2004 through 2006 (References 12CC-202 through 12CC-204), the airborne effluent doses presented in Table 12CC-202 were computed for locations at the site boundary or at unrestricted areas beyond the site boundary. Locations within the site boundary were also considered when selecting locations for dose calculations. Consideration of site boundary locations as well as unrestricted areas within and beyond the site boundary provides assurance that off-site doses would not be substantially underestimated while attempting to provide an accurate dose calculation. The most limiting location of the three annual reports for a dose to a member of the public was used for this estimate and is shown in Table 12CC-203.

12CC.3.3 Dose Rate from Liquid Effluents

The radiological reports for 2004 through 2006 provide a summary of off-site doses for water-related exposure pathways (References 12CC-202 through 12CC-204).

As stated in the radiological reports, the liquid effluent doses presented in Table 12CC-204 were computed for the maximally exposed individual.

12CC.3.4 Dose Rate from On-Site Spent Fuel Storage

The ISFSI is located directly adjacent to the RBS Unit 3 power block construction area. As with the areas inside the PA, dose rates at the ISFSI boundary are measured but the values are not recorded unless they are greater than the threshold value of 2 mrem/hr. Using the threshold dose rate would greatly overestimate the dose to construction workers.

A site-specific calculation of dose rates from the ISFSI was performed for the RBS Unit 1 installation. This calculation determined an expected dose rate at the controlled area boundary per cask of 1.35E-05 mrem/hr. The controlled area boundary is approximately 2296 ft. from the ISFSI.

The dose rate can be estimated as a function of distance to the ISFSI using the site-specific analysis results and based on an expected number of casks to be in place during the construction period.

A maximum of 40 spent fuel casks can be stored in the ISFSI. Since the installation in 2005, a total of seven casks have been loaded and stored on-site. RBS Unit 1 plans for additional casks and estimates the loading and placement of 19 casks by the time construction begins. There could be as many as 31 casks loaded by the end of the construction period. Over the course of the construction period, the work focus would shift from earth and civil work outdoors to equipment installation and testing inside the structures. The structures provide some measure of shielding from the ISFSI exposure. For the estimate of dose to construction workers, a total of 27 casks were assumed to be in place for an average year of construction.

The distance from the ISFSI centerline to the nearest construction impact area is about 120 ft. Assuming 27 casks in the ISFSI, the estimated dose rate at this location is 0.13 mrem/hr. The far side boundary of the power block construction area is more than 1000 ft. from the ISFSI. At this location, the dose rate drops to 0.002 mrem/hr. The average dose rate for the power block construction area is 0.016 mrem/hr.

Table 12CC-201 shows TLD measurements taken from the ISFSI fence for the year 2006. These measurements include the effect of the ISFSI as well as direct radiation from N-16 skyshine. The methodology described above for determining direct radiation and ISFSI dose rates would overpredict the annual dose as 580 mrem near the "Dry Fuel North" TLD. The 2006 measured dose at this location was 112 mrem.

12CC.4 CONSTRUCTION WORKER DOSE ESTIMATES

The overall estimate of dose to construction workers considers an occupational exposure period of 2080 hours per year, and a construction workforce of 3150. All annualized dose estimates developed in this section were based on a 2080-hr. year. Where there is a strong variance in the dose rates over the construction areas, such as with direct radiation from skyshine or from the ISFSI, an average rate for the power block construction area was used. The power block construction area is the area nearest to these contributors and also a primary area of construction activity.

Contributions from each type of source are developed below, and a total estimated dose is provided in the conclusions.

12CC.4.1 Dose Estimate from Direct Radiation Sources

An average dose rate of 10 mrem/yr for the RBS Unit 3 power block construction area was used to determine the total dose estimate for N-16 skyshine.

12CC.4.2 Dose Estimate from Gaseous Effluents

Table 12CC-203 provides the estimated bounding doses to critical organs, total body, and skin.

12CC.4.3 Dose Estimate from Liquid Effluents

Liquid effluents are released to the Mississippi River via the discharge outfall at the existing barge slip. The location and the workers subject to exposure from the liquid effluent are limited to work in the area of the barge slip and raw water intake. The work location is upstream of the effluent release point. The primary contributor to worker dose is from consumption of fish taken from the Mississippi River.

The whole-body dose reported in References 12CC-202 through 12CC-204 was a maximum of 0.001 mrem. The GI-LLI dose for the same year was 0.015 mrem. These values will be used as conservative annual estimates of dose to construction workers from liquid effluents.

12CC.4.4 Dose Estimate from On-Site Spent Fuel Storage

An average dose rate for the power block construction area of 0.016 mrem/hr was determined for the ISFSI dose rate. The estimated annual dose per worker is 33 mrem/yr.

12CC.5 SUMMARY AND CONCLUSIONS

The annual dose to an individual construction worker from all three pathways is summarized in Table 12CC-205 and compared to the public dose criteria in

10 CFR 20.1301 and 40 CFR 190 (Reference 12CC-205) in Tables 12CC-206 and 12CC-207, respectively. Since the calculated doses meet the public dose criteria of 10 CFR 20.1301 and 40 CFR 190, the workers would not need to be classified as radiation workers. Table 12CC-208 shows that the doses also meet the design objectives of 10 CFR 50, Appendix I for gaseous and liquid effluents.

The maximum annual collective dose to the construction workforce (3150 workers) is estimated to be 139 person-rem.

It is concluded that annual construction worker doses attributable to the operation of RBS Unit 1 for the proposed construction areas for a new facility would be SMALL since it would be a fraction of 10 CFR 20 and 10 CFR 50, Appendix I limits. Thus, monitoring of individual construction workers would not be required. Construction workers are to be treated as if they were members of the general public in unrestricted areas.

12CC.6 REFERENCES

12CC-201 Entergy Operations, Inc., "River Bend Station Updated Safety Analysis Report," through Revision 19, July 2006.

12CC-202 Entergy Operations, Inc., *River Bend Station, Unit 1 - 2006 Annual Effluent Release Report*, 2006.

12CC-203 Entergy Operations, Inc., *River Bend Station - Annual Radiological Environmental Operating Report*, 2005.

12CC-204 Entergy Operations, Inc., *River Bend Station - Annual Radiological Environmental Operating Report*, 2004.

12CC-205 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

RBS SUP
12.4-1

Table 12CC-201
TLD Dose (mrem/yr) for 2006[a]

Location on Protected Area Fence	mrem/yr (8760 hr.)
Area West Fence No. 1	18
Area West Fence No. 2	244
Dry Fuel South	91
Dry Fuel North	176
Dry Fuel West	112

a) There were seven casks loaded and in place in the ISFSI in 2006.

RBS SUP
12.4-1

Table 12CC-202
Doses to Members of the Public On-Site from Gaseous Releases from RBS Unit 1

Year	Location from Main Plant Stack	Critical Organ Dose Annual (mrem)	Total Body Dose Annual (mrem)	Skin Dose Annual (mrem)	Annual Duration Factor
2004	994 m	6.58E-03	1.63E-03	2.76E-03	5.48E-02
2005	115 m	8.40E-05	1.02E-04	9.68E-05	4.57E-03
2006	115 m	3.60E-02	1.74E-01	1.36E-01	4.11E-02

Source: References 12CC-202, 203, 204.

RBS SUP
12.4-1

Table 12CC-203
Estimated Doses to Construction Workers from Gaseous Releases from RBS Unit 1

	Critical Organ Dose Annual (mrem)	Total Body Dose Annual (mrem)	Skin Dose Annual (mrem)	Annual Duration Factor
2006	3.60E-02	1.74E-01	1.36E-01	4.11E-02
For 2080 hr. per year	2.08E-01	1.00E+00	7.85E-01	2.37E-01

RBS SUP 12.4-1

Table 12CC-204
Liquid Effluent Dose (mrem)

		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	TOTAL
GI-LLI	2004	0.00E+00	2.71E-03	4.25E-03	1.05E-02	1.46E-02
	2005	0.00E+00	1.67E-03	1.28E-02	3.54E-04	8.28E-03
	2006	2.09E-03	5.36E-04	9.69E-04	1.73E-04	4.81E-03
Whole Body	2004	0.00E+00	2.11E-04	3.57E-04	7.39E-04	1.12E-03
	2005	0.00E+00	1.52E-04	9.12E-04	3.03E-05	6.26E-04
	2006	1.40E-04	3.73E-05	7.87E-05	1.15E-05	3.31E-04

Source: References 12CC-202, 203, 204.

RBS SUP 12.4-1

Table 12CC-205
Annual Dose to a Construction Worker by Source (mrem/yr)[a]

	Direct	Gaseous	Liquid	ISFSI	Total
Critical Organ	-	0.2	0.015	-	0.22
Skin	-	0.8	-	-	0.8
Whole Body	10	1.0	0.001	33	44
TEDE	10	1.06	0.006	33	44

a) 10 CFR 20 requires that the dose to an individual from radioactive effluents also meet 40 CFR 190 limits.

RBS SUP 12.4-1

Table 12CC-206
Comparison of Construction Worker Public Dose to 10 CFR 20.1301 Criteria

Type of Dose	Annual Dose Limits	Estimated Dose
Whole-body dose equivalent	100 mrem	44 mrem
Maximum dose rate in any hr.	2 mrem/hr	<< 1 mrem

RBS SUP
12.4-1

Table 12CC-207
Comparison of Construction Worker Public Dose from Gaseous Effluent Discharges to 40 CFR 190 Criteria[(a)]

Type of Dose	Annual Dose Limits	Estimated Dose
Whole-body dose	25 mrem	1 mrem
Thyroid doses	75 mrem	< 1 mrem
Other organ doses	25 mrem	< 1 mrem

a) 10 CFR 20 requires that the dose to an individual from radioactive effluents also meet 40 CFR 190 limits.

RBS SUP
12.4-1

Table 12CC-208
Comparison with 10 CFR 50 Appendix I Criteria for Effluent Doses

	Annual Dose (mrem)	
	Annual Limit	Estimated Dose
Whole-body dose from liquid effluents	3	0.001
Organ dose from liquid effluents	10	0.015
Whole-body dose from gaseous effluents	5	1.0
Skin dose from gaseous effluents	15	0.785
Organ dose from all effluents	15	0.22

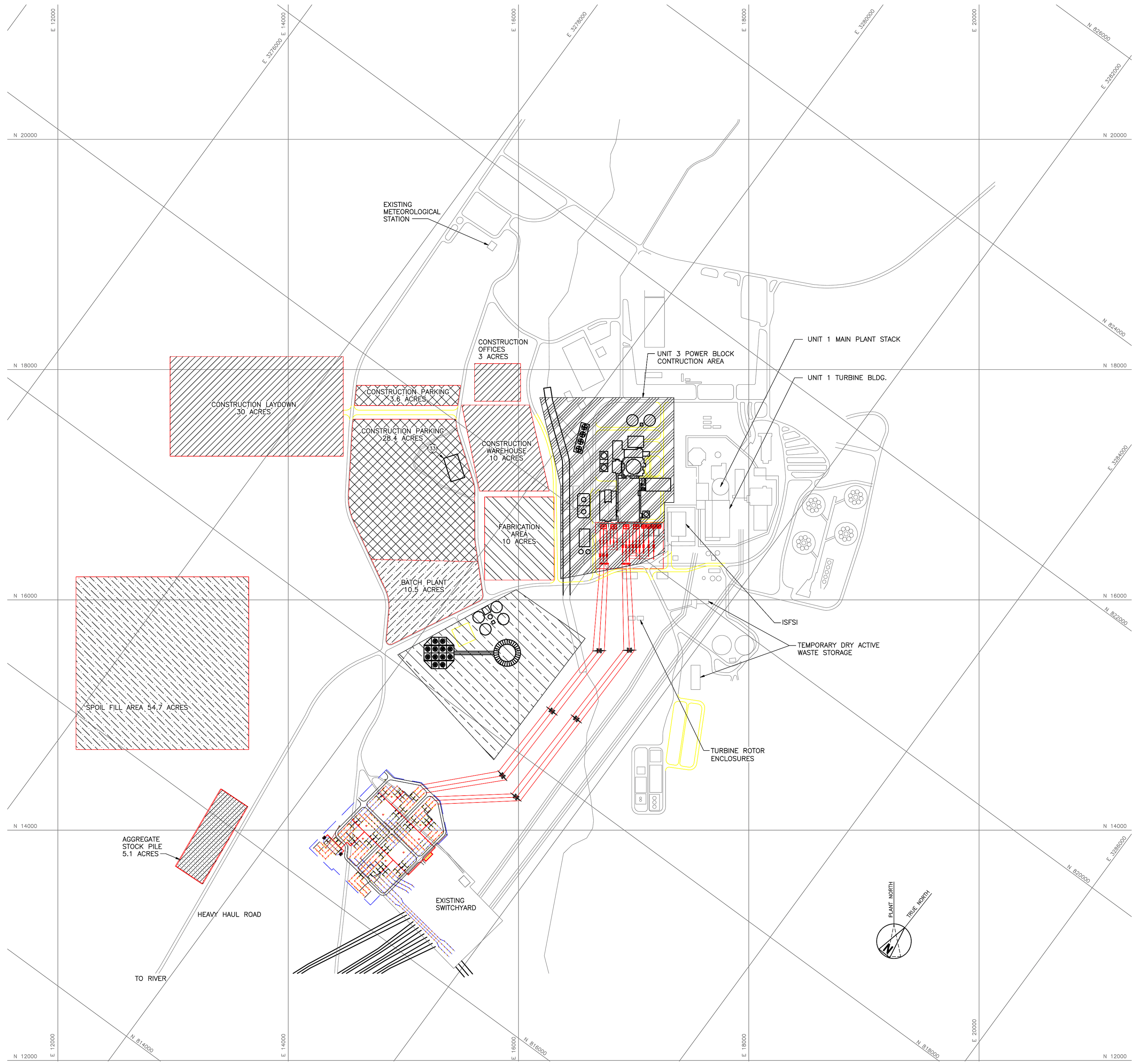


Figure 12CC-201. Radiation Sources for RBS Unit 1

CHAPTER 13 CONDUCT OF OPERATIONS

The introductory paragraph of this chapter of the referenced Design Control Document (DCD) is incorporated by reference with no departures or supplements.

13.1 ORGANIZATIONAL STRUCTURE OF APPLICANT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

DCD Section 13.1.1, COL Information, is renumbered in this FSAR section to 13.1.4 for administrative purposes to allow section numbering to be consistent with RG 1.206.

Replace the first paragraph with the following.

RBS COL 13.1-1-A The organizational structure is described in this section and is consistent with the Human System Interface (HSI) design assumptions used in the design of the ESBWR as described in DCD Chapter 18. The 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).

This section describes the organizational positions of a nuclear power station and owner/applicant corporations and associated functions and responsibilities. The position titles used in the text are generic and describe the function of the position. Table 13.1-201 is a cross-reference to site-specific position titles. Appendix 13AA contains organizational structure historical information.

13.1.1 MANAGEMENT AND TECHNICAL SUPPORT ORGANIZATION

Entergy has more than 30 years of experience in the design, construction, and operation of nuclear generating stations. Entergy operates and/or manages multiple nuclear plants across the south, central, and northeast portions of the United States.

Regional corporate offices provide support for the nuclear stations. This support includes executive level management to provide strategic and financial support for plant initiatives, coordination of functional efforts division-wide, and functional level management in areas such as training, security, emergency planning, and engineering analysis. Executives, managers, and staff in corporate positions support functions at multiple nuclear plant sites within the corporation. These functions are generally applicable to each site such that standardization and efficiency are accomplished in these areas. The specific needs of each nuclear plant are addressed appropriately.

Figure 13.1-203 provides a high-level illustration of the corporate organization. More detailed charts and position descriptions, including qualification requirements and staffing numbers for corporate support staff, are maintained in the corporate offices.

13.1.1.1 Design, Construction, and Operating Responsibilities

The chief executive officer, nuclear operations has overall responsibility for functions involving planning, design, construction, and operation. Line responsibilities for those functions are assigned to the executives in charge of nuclear operations, engineering and technical services, and planning, development, and oversight who maintain direct control of nuclear plant activities. The first priority and responsibility of each member of the nuclear staff throughout the life of the plant is nuclear safety. Decision making for station activities is performed in a conservative manner, with expectations of this core value regularly communicated to appropriate personnel by management interface, training, and station directives.

Lines of authority and communication are clearly and unambiguously established to enable the understanding of the various project members, including contractors, that utility management is in charge and directs the project.

Key executive and corporate management positions, functions, and responsibilities are discussed in Subsection 13.1.1.3.1. The corporate organization is shown in Figure 13.1-203. The management and technical support organization for design, construction, and preoperational activities is addressed in Appendix 13AA for future designation as historical information.

13.1.1.2 Technical Support for Operations

Before beginning preoperational testing, the site executive in charge of plant management establishes the organization of managers, functional managers, supervisors, and staff sufficient to perform required functions for support of safe plant operation. These functions include the following:

- Nuclear, mechanical, structural, electrical, thermal-hydraulic, metallurgical and material, and instrumentation and controls (I&C) engineering.
- Plant chemistry.
- Health physics.
- Fueling and refueling operations support.
- Maintenance support.
- Operations support.

- Quality assurance.
- Training.
- Safety review.
- Fire protection.
- Emergency organization.
- Outside contractual assistance.

In the event that station personnel are not qualified to deal with a specific problem, the services of qualified individuals within the company or an outside consultant are engaged. Figure 13.1-201 illustrates the management and technical support organizations supporting operation of the plant. Subsection 13.1.1.3.2 provides descriptions of responsibilities and authorities of management positions for organizations providing technical support. Table 13.1-201 shows the estimated number of positions required for each function.

Unit 3 shares its site with Unit 1. Multiple layers of protection are provided to preserve unit integrity including organization. Organizationally, operators and other shift members are assigned to a specific unit. Physical separation of units helps to minimize wrong-unit activities. In addition, station procedures and programs provide operating staff with methods to minimize human error, including tagging programs, procedure adherence requirements, and training.

13.1.1.2.1 Engineering

The site engineering department consists of system engineering, design engineering, and engineering programs. These groups are responsible for performing the classical design activities as well as providing engineering expertise for programs, such as in-service inspection/in-service testing (ISI/IST), fire protection, snubbers, and valves. Corporate engineering provides support for engineering projects, safety and engineering analysis, and nuclear fuels engineering. They are responsible for probabilistic safety assessment and other safety issues, plant system reliability analysis, performance and technical support, core management, and periodic reactor testing.

Each of the site engineering groups has a functional manager who reports to the manager in charge of engineering on site or to managers and executives in corporate engineering and technical services.

The engineering organization is responsible for the following:

- Support of plant operations in the engineering areas of mechanical, structural, electrical, thermal-hydraulic, metallurgy and materials, electronic, I&C, and fire protection. Priorities for support activities are established based on input from the plant manager, with an emphasis on issues affecting safe operation of the plant.

- Support of procurement, chemical and environmental analysis, and maintenance activities in the plant as requested by the plant manager.
- Performance of design engineering of plant modifications.
- Maintaining the design basis by updating the record copy of design documents as necessary to reflect the actual as-built configuration of the plant.
- Accident and transient analyses.
- HFE design process.

Reactor engineering, part of system engineering, provides technical assistance in the areas of core operations, core thermal limits, and core thermal hydraulics.

Engineering work may be contracted to and performed by outside companies in accordance with the Quality Assurance (QA) program.

Engineering resources are shared between units. A single management organization oversees the engineering work associated with the station units.

13.1.1.2.2 Safety Review

Review and audit activities are addressed in the Quality Assurance Program Description (QAPD).

Oversight of safety review of station programs, procedures, and activities is performed by a plant safety review committee, a corporate safety review committee, and the Nuclear Safety Assurance (NSA) organization. NSA is responsible for corrective actions and assessments. The manager in charge of NSA reports to the site executive in charge of plant management.

Personnel resources of the NSA organization are shared between units. A single management organization oversees the NSA organization for the station units.

13.1.1.2.3 Quality Assurance

Safety-related activities associated with the operation of the plant are governed by QA direction as established in Chapter 17 and the QAPD. QA is a function of the QA Department and includes the following:

- General QA indoctrination and training for the nuclear station personnel.
- Maintenance of the QAPD.

- Coordination of the development of audit schedules.
- Audit, surveillance, and evaluation of Nuclear Division suppliers.
- Quality control (QC) inspection/testing activities.

QA/QC management is independent of the station management line organization. The manager of QA reports to the corporate-stationed director of oversight.

Personnel resources of the QA organization are shared between units. A single management organization oversees the QA group for the station units.

13.1.1.2.4 Chemistry

A chemistry program is established to monitor and control the chemistry of various plant systems such that corrosion of components and piping is minimized and radiation from corrosion by-products is kept to levels that allow operations and maintenance staff to maintain radiation doses as low as reasonably achievable (ALARA).

The functional manager in charge of chemistry is responsible to the plant manager for maintaining chemistry programs and for monitoring and maintaining the water chemistry of plant systems. The staff of the chemistry department consists of laboratory technicians, support personnel, and supervisors who report to the functional manager in charge of chemistry.

Personnel resources of the chemistry organization are shared between units. A single management organization oversees the chemistry group for the station units.

13.1.1.2.5 Radiation Protection

A radiation protection (RP) program is established to protect the health and welfare of the surrounding public and personnel working at the plant. The RP program is described in Chapter 12.

The RP department is staffed by RP technicians, support personnel, and supervisors who report to the functional manager in charge of RP. To provide sufficient organizational freedom from operating pressures, the manager in charge of RP reports directly to the plant manager.

Personnel resources of the RP organization are shared between units. A single management organization oversees RP for both units.

13.1.1.2.6 Fueling and Refueling Support

The function of fueling and refueling is performed by a combination of personnel from various departments including operations, maintenance, RP, engineering, and reactor technology vendor or other contractor staff. Initial fueling is a function of the startup management organization discussed in Appendix 13AA. Refueling operations are a function of the outage management organization. The functional manager in charge of outages is responsible for planning and scheduling outages and for refueling support and reports to the manager in charge of planning, scheduling, and outages.

Personnel resources of the outage management organization are shared between units. A single management organization oversees the outage management department work associated with the station units.

13.1.1.2.7 Training

The training department is responsible for providing training programs that are established, maintained, and implemented in accordance with applicable plant administrative directives, regulatory requirements, and company operating policies so that station personnel can meet the performance requirements of their jobs in operations, maintenance, technical support, and emergency response. The training department's responsibilities encompass operator initial license training, requalification training, and plant staff training as well as the plant access training (general employee training) course and radiation worker training. To provide for independence from operating pressures, the manager of training reports to the corporate-stationed executive in charge of training and development. Nuclear plant training programs are described in Section 13.2.

Personnel resources of the training department are shared between units. A single management organization provides oversight of station training activities.

13.1.1.2.8 Maintenance Support

In support of maintenance activities, planners, schedulers, and parts specialists prepare work packages, acquire proper parts, and develop procedures that provide for the successful completion of maintenance tasks. Maintenance tasks are integrated into the station schedule for evaluation of operating or safe shutdown risk elements and to provide for efficient and safe performance. Functional managers in charge of planning and scheduling report to the manager in charge of planning, scheduling, and outages.

Personnel of the planning and scheduling organizations are shared between units. A single management organization oversees the function of maintenance support for the station units.

13.1.1.2.9 Operations Support

The operations support function is provided under the direction of the manager in charge of operations. Operations support includes the following programs:

- Operations procedures.

- Operations surveillances.
- Equipment tagging preparation.

13.1.1.2.10 Fire Protection

The station is committed to maintaining a fire protection program as described in Subsection 9.5.1. The site executive in charge of plant management has overall responsibility for the Fire Protection Program. Assigning the responsibilities at that level provides the authority to obtain the resources and assistance necessary to meet fire protection program objectives, resolve conflicts, and delegate appropriate responsibility to fire protection staff. Fire protection for the facility is organized and administered by the engineer in charge of fire protection. The engineer in charge of fire protection is responsible for development and implementation of the fire protection program, including development of fire protection procedures, site personnel and fire brigade training, and inspections of fire protection systems and functions. The engineer in charge of fire protection reports to the functional manager in charge of engineering programs. Functional descriptions of position responsibilities are included in appropriate procedures. Station personnel are responsible for adhering to the fire protection/prevention requirements detailed in Subsection 9.5.1. The site executive in charge of plant management has the lead responsibility for overall site fire protection during construction of new units. The fire brigade is described in Subsection 13.1.2.1.5.

Personnel resources of the fire protection organization are shared between units. A single management organization oversees the fire protection group for the station units.

13.1.1.2.11 Emergency Organization

The emergency organization is a matrix organization composed of personnel who have the experience, training, knowledge, and ability necessary to implement actions to protect the public in the case of emergencies. Managers and station personnel assigned positions in the emergency organization are responsible for supporting the emergency preparedness organization and emergency plan as required. The staff members of the emergency planning organization administer and orchestrate drills and training to maintain qualification of station staff members and develop procedures to guide and direct the organization's response to an emergency. The functional manager in charge of emergency preparedness reports to the corporate executive in charge of emergency planning. The site emergency plan organization is described in the Emergency Plan.

Resources of the emergency planning group are shared between units. A single management organization oversees the emergency planning group for both station units.

13.1.1.2.12 Outside Contractual Assistance

Contract assistance with vendors and outside suppliers is provided by the materials, procurement, and contracts organization. The functional manager in charge of materials, procurement, and contracts reports to the corporate senior manager in charge of materials, purchasing, and contracts.

Resources of the materials, procurement, and contracts organization are shared between units. A single management organization oversees the materials, procurement, and contracts group for both station units.

13.1.1.3 Organizational Arrangement

13.1.1.3.1 Executive/Management Organization

Executive management is ultimately responsible for execution of activities and functions for Unit 3. Executive management establishes expectations such that a high level of quality, safety, and efficiency is achieved in aspects of plant operations and support activities through an effective management control system and an organization selected and trained to meet the above expectations. A high-level chart of the corporate organization is shown in Figure 13.1-203. The executives with direct line of authority for activities associated with the design, construction, and operation of the plant are shown in Figure 13.1-201. Responsibilities of those executives are specified below.

13.1.1.3.1.1 Chief Executive Officer, Nuclear

The chief executive officer (CEO), nuclear is the chief nuclear officer and has the ultimate responsibility for the safe and reliable operation of each nuclear station owned and/or operated by the utility. It is the responsibility of the CEO to provide guidance and direction such that safety-related activities under his/her direction, including engineering, construction, operations, operations support, maintenance, and planning, are performed following the guidelines of the QA program. The CEO delegates authority and responsibility for the operation and support of the site through executives in charge of nuclear operations, engineering and technical services, and planning, development, and oversight, and other executive staff in the nuclear generation branch of the corporation. The CEO has no ancillary responsibilities that might detract attention from nuclear safety matters.

13.1.1.3.1.2 Executive in Charge of Nuclear Operations

The executive in charge of nuclear operations is responsible for the operation of all nuclear plants owned and/or managed by the utility. The executive in charge of nuclear operations maintains direct control of nuclear plant operations through a regional senior executive and the site executive in charge of plant management. The executive in charge of nuclear operations is also responsible for the support functions of emergency planning, training and development, and security. The executive in charge of nuclear operations reports to the CEO, nuclear.

13.1.1.3.1.3 Executive in Charge of Engineering and Technical Services

The executive in charge of engineering and technical services is responsible for the engineering activities associated with the nuclear plants in the system and for technical services such as licensing, information technology, and materials, procurement, and contracts. He performs this function through executives and managers who are responsible for the functions and programs discussed in Subsection 13.1.1.2.1. The executive in charge of engineering and technical services reports to the CEO, nuclear.

13.1.1.3.1.4 Executive in Charge of Planning, Development, and Oversight

The executive in charge of planning, development, and oversight is responsible for ensuring that regulatory requirements associated with the combined operating license (COL) are implemented, establishing the necessary licensing framework for the site, and maintaining lines of communication with the regulatory commission during the pre- and post-combined operating license application phase and up through the construction phase of the plant, and for oversight and QA throughout the life of the plant. The direct reports of the executive in charge of planning, development, and oversight include executives and managers responsible for construction, new plant licensing, and QA. The executive in charge of planning, development, and oversight reports to the CEO, nuclear.

13.1.1.3.1.5 Site Executive in Charge of Plant Management

The site executive in charge of plant management reports to the executive in charge of nuclear operations through a regional senior executive. The site executive in charge of plant management is directly responsible for management and direction of activities associated with the efficient, safe, and reliable operation of the nuclear station, except for those functions delegated to the executive in charge of engineering and technical services and the executive in charge of planning, development, and oversight. The site executive in charge of plant management is assisted in management and technical support activities by the plant manager and manager in charge of nuclear safety assurance. The site executive in charge of plant management is responsible for the site fire protection program through the engineer in charge of fire protection. Refer to Subsection 13.1.1.2.10.

13.1.1.3.1.6 Manager in Charge of Nuclear Support

The manager in charge of nuclear support is responsible for providing a corporate contact point and assistance in the plant staff areas of operations, chemistry, radwaste, maintenance, and RP. He is also responsible for overseeing the site coordinators of operating experience. The manager in charge of nuclear support reports to the senior executive in charge of nuclear operations via corporate support management.

13.1.1.3.1.7 Manager in Charge of Nuclear Fuels

The manager in charge of nuclear fuels is responsible for providing nuclear fuel and related business and technical support consistent with the operational needs of plant. The manager in charge of nuclear fuels is assisted by an engineering staff and reports directly to the CEO, nuclear.

13.1.1.3.2 Site Organization

13.1.1.3.2.1 Manager in Charge of Engineering

The manager in charge of engineering is the on-site lead position for engineering and reports to the senior executive in charge of engineering and technical services via corporate engineering management. The manager in charge of engineering is responsible for engineering activities related to design engineering, system engineering, and programs and components as described in Subsection 13.1.1.2.1. The manager in charge of engineering directs functional managers responsible for each of the engineering areas noted above.

13.1.1.3.2.1.1 Functional Manager in Charge of System Engineering

The functional manager in charge of system engineering supervises a technical staff of engineers and other engineering specialists and coordinates their work with that of other groups. System engineering staff includes reactor engineering, as discussed in Subsection 13.1.1.2.1. The functional manager in charge of system engineering reports to the manager in charge of engineering and is responsible for providing direction and guidance to system engineers as follows:

- Monitoring the efficiency and proper operation of balance-of-plant and reactor systems.
- Planning programs for improving equipment performance, reliability, or work practices.
- Conducting operational tests and analyzing the results.
- Identifying plant spare parts for cognizant systems.

13.1.1.3.2.1.2 Functional Manager in Charge of Design Engineering

The functional manager in charge of design engineering reports to the manager in charge of engineering and is responsible for the following:

- Resolution of design issues.
- On-site development of design-related change packages and plant modifications.

- Implementation of effective project management methods and procedures, including cost controls, for implementation of modifications and construction activities.
- Management of contractors who may perform modification or construction activities.
- Maintainance of the configuration control program.

13.1.1.3.2.1.3 Functional Manager in Charge of Engineering Programs

The functional manager in charge of engineering programs reports to the manager in charge of engineering and is responsible for programs such as the following:

- Materials engineering.
- Performance/ISI engineering.
- Valve engineering.
- Maintenance rule tracking and trending.
- Piping erosion corrosion.
- IST.
- Fire protection.

13.1.1.3.2.1.4 Functional Manager in Charge of Projects

The functional manager in charge of projects reports to the senior executive in charge of engineering and technical services through corporate project management and is responsible for the following:

- Development of maintenance programs and specifications of selected plant equipment.
- Planned upgrades to equipment such as turbine rotors and major component replacement.
- Implementation of effective project management of contractors.

13.1.1.3.2.1.5 Functional Manager in Charge of Probabilistic Safety Assessment

The functional manager in charge of probabilistic safety assessment (PSA), a corporate-located position, reports to the corporate-located manager of fuels and analysis and is responsible for PSA studies for maintenance activities, outage management planning, and other activities requiring probabilistic safety analysis. The functional manager in charge of PSA provides guidance and direction to a site-located PSA engineer.

13.1.1.3.2.2 Manager in Charge of Nuclear Safety Assurance

The manager in charge of nuclear safety assurance is responsible for corrective actions and assessments and reports to the site executive in charge of plant management.

13.1.1.3.2.2.1 Functional Manager in Charge of Corrective Actions and Assessments

The responsibilities of the functional manager in charge of corrective actions and assessments include establishing processes and procedures to facilitate identification and correction of conditions adverse to quality and implement corrective actions. The functional manager in charge of corrective actions and assessments reports to the manager in charge of nuclear safety assurance.

13.1.1.3.2.3 Functional Manager in Charge of Plant Licensing

The functional manager in charge of plant licensing is responsible for providing a coordinated focus for interface with the NRC, and for technical direction and administrative guidance to the licensing staff for the following activities:

- Developing licensee event reports (LERs) and responding to notices of violations.
- Preparing/submitting license amendments and updating the FSAR.
- Tracking commitments and answering generic letters.
- Analyzing operating experience data and monitoring industry issues.
- Preparing the station for special NRC inspections, interfacing with NRC inspectors, and interpreting NRC regulations.
- Maintaining the licensing basis.

The functional manager in charge of plant licensing reports to the senior executive in charge of engineering and technical services through corporate licensing management.

13.1.1.3.2.4 Functional Manager in Charge of Emergency Preparedness

The functional manager in charge of emergency preparedness is responsible for the following:

- Coordinating and implementing the plant emergency response plan with state and local emergency plans.
- Developing, planning, and executing emergency drills and exercises.
- Coordinating emergency action level development.
- Overseeing NRC reporting associated with 10 CFR 50.54(q).

The functional manager in charge of emergency preparedness reports to the senior executive in charge of nuclear operations through the corporate emergency planning and support management.

13.1.1.3.2.5 Functional Manager in Charge of Training

The functional manager in charge of training is responsible for training programs at the site required for the safe and proper operation and maintenance of the plant as described in Subsection 13.1.1.2.7. The functional manager in charge of training supervises a staff of training supervisors who coordinate the development, preparation, and presentation of training programs for nuclear plant personnel and reports through corporate training and development and support management to the executive in charge of nuclear operations.

13.1.1.3.2.6 Functional Manager in Charge of Materials, Procurement, and Contracts

The functional manager in charge of materials, procurement, and contracts (MP&C) is responsible for providing sufficient and proper materials to support the material needs of the plant and performing related activities including the following:

- Procedure development.
- Materials storage.
- Supply system database maintenance.
- Meeting of QA and internal audit requirements.

The functional manager in charge of MP&C is also responsible for site purchasing. The functional manager in charge of MP&C reports to the senior executive in charge of engineering and technical services via corporate materials, procurement, and contracts management.

13.1.1.3.2.7 Functional Manager in Charge of Security

The functional manager in charge of security is responsible for the following:

- Implementation and enforcement of security directives, procedures, and instructions received from appropriate authorities.
- Day-to-day supervision of the security guard force.
- Administration of the security program.

The functional manager in charge of security reports to the senior executive in charge of nuclear operations via corporate security and support management.

13.1.1.3.2.8 Functional Manager in Charge of Quality Assurance

The functional manager in charge of QA is responsible for those functions listed in Subsection 13.1.1.2.3. The functional manager in charge of QA reports to the senior executive in charge of planning, development, and oversight via corporate oversight management.

13.1.1.4 Qualifications of Technical Support Personnel

The managers and supervisors in the technical support organizations meet the qualification requirements in education and experience for those described in American National Standards Institute (ANSI)/American Nuclear Society (ANS)-3.1 (Reference 13.1-201) as endorsed and amended by RG 1.8. The qualification and experience requirements of headquarters staff are established in corporate policy and procedure manuals.

13.1.2 OPERATING ORGANIZATION

13.1.2.1 Plant Organization

The plant management, technical support, and plant operating organizations are shown in Figure 13.1-201. The on-shift operating organization is presented in Figure 13.1-202, which shows those positions requiring NRC licenses. Additional personnel are required to augment normal staff during outages. The hiring schedule for plant staff is provided in Figure 13AA-202.

Nuclear plant employees are responsible for reporting problems with plant equipment and facilities. They are required to identify and document equipment problems in accordance with the QA program. QA program requirements as they apply to the operating organization are described in the QAPD. Administrative procedures or standing orders include the following:

- Establishment of a QA program for the operational phase.

- Preparation of procedures necessary to carry out an effective QA program. Refer to Section 13.5 for a description of the station procedure program.

- A program for review and audit of activities affecting plant safety. Refer to Section 17.5 for a description of station review and audit programs.

- Programs and procedures for rules of practice as described in Section 5.2 of ANSI/ANS-3.2 (Reference 13.1-203).

Managers and supervisors within the plant operating organization are responsible for establishing goals and expectations for their organization and for reinforcing behaviors that promote RP. Specifically, managers and supervisors are responsible for the following, as applicable to their position within the plant organization:

- Interface directly with RP staff to integrate RP measures into plant procedures and design documents and into the planning, scheduling, conduct, and assessment of operations and work.

- Notify RP personnel promptly when RP problems occur or are identified, take corrective actions, and resolve deficiencies associated with operations, procedures, systems, equipment, and work practices.

- Train site personnel on RP, and provide periodic retraining, in accordance with 10 CFR Part 19, so that they are properly instructed and briefed for entry into restricted areas.

- Periodically observe and correct, as necessary, radiation worker practices.

- Support RP management in implementing the RP program.

- Maintain exposures to site personnel ALARA.

13.1.2.1.1 Plant Manager

The plant manager reports to the site executive in charge of plant management, is responsible for overall safe operation of the plant, and has control over those on-site activities necessary for safe operation and maintenance of the plant, including the following:

- Operations.

- Maintenance and modification.

- Chemistry and radiochemistry.

- Outage management.

Additionally, the plant manager has overall responsibility for occupational and public radiation safety. RP responsibilities of the plant manager are consistent with the guidance in RG 8.8 and RG 8.10, including the following:

- Provide management RP policy throughout the plant organization.
- Provide an overall commitment to RP by the plant organization.
- Interact with and support the manager in charge of RP on the implementation of the RP program.
- Support identification and implementation of cost-effective modifications to plant equipment, facilities, procedures, and processes to improve RP controls and reduce exposures.
- Establish plant goals and objectives for RP.
- Maintain exposures to site personnel ALARA.
- Support timely identification, analysis, and resolution of RP problems (e.g., through the plant corrective action program).
- Provide training to site personnel on RP in accordance with 10 CFR Part 19.
- Establish an ALARA Committee with delegated authority from the plant manager that includes, at a minimum, the managers in charge of operations, maintenance, engineering, and RP to help provide for the effective implementation of line organization responsibilities for maintaining worker doses ALARA.

The line of succession of authority and responsibility for overall operations in the event of unexpected events of a temporary nature is as follows:

a. Site executive in charge of plant management.

b. Manager in charge of operations.

c. Manager in charge of plant maintenance.

d. Assistant manager in charge of operations.

As described in Subsection 13.1.2.1.2.4, the manager in charge on-shift is the plant manager's direct representative for the conduct of operations. The succession of authority includes the authority to issue standing or special orders as required.

13.1.2.1.1.1 Manager in Charge of Maintenance

Maintenance of the plant is performed by the maintenance department mechanical, electrical, and I&C disciplines. The functions of this department are to perform preventive and corrective maintenance, perform equipment testing, and implement modifications as necessary. The manager in charge of plant maintenance is responsible for the performance of preventive and corrective maintenance and modification activities required to support operations, including compliance with applicable standards, codes, specifications, and procedures. The manager in charge of plant maintenance reports to the plant manager and provides direction and guidance to the maintenance discipline functional managers and maintenance support staff.

13.1.2.1.1.2 Maintenance Discipline Functional Managers

The functional managers of each maintenance discipline (mechanical, electrical, I&C, and support) are responsible for maintenance activities within their discipline including plant modifications. They provide guidance in maintenance planning and craft supervision. They establish the necessary manpower levels and equipment requirements to perform both routine and emergency type maintenance activities, seeking the services of others in performing work beyond the capabilities of the plant maintenance group. Each discipline functional manager is responsible for liaison with other plant staff organizations to facilitate safe operation of the station. These functional managers report to the manager in charge of plant maintenance.

13.1.2.1.1.3 Maintenance Discipline Supervisors

The maintenance discipline supervisors (mechanical, electrical, and I&C) supervise maintenance activities, assist in the planning of future maintenance efforts, and guide the efforts of the craft within their discipline. The maintenance discipline supervisors report to the appropriate maintenance discipline functional managers.

13.1.2.1.1.4 Manager in Charge of Planning, Scheduling, and Outages

The manager in charge of planning, scheduling, and outages (PS&O) is responsible for those functions described in Subsections 13.1.1.2.6 and 13.1.1.2.8. The manager in charge of P&SO safely fulfills the responsibilities of planning and scheduling all plant work through a staff that includes a functional manager in each area of planning, scheduling, and outages. The manager in charge of P&SO reports to the plant manager.

13.1.2.1.1.5 Functional Manager in Charge of RP

The functional manager in charge of RP has the direct responsibility for providing adequate protection of the health and safety of personnel working at the plant and members of the public during activities covered within the scope and extent of the license. RP responsibilities of the functional manager in charge of RP are consistent with the guidance in RG 8.8 and RG 8.10. They include the following:

- Managing the RP organization.
- Establishing, implementing, and enforcing the RP program.
- Providing RP input to facility design and work planning.
- Tracking and analyzing trends in radiation work performance and taking necessary actions to correct adverse trends.
- Supporting the plant emergency preparedness program and assigning emergency duties and responsibilities within the RP organization.
- Delegating authority to appropriate RP staff to stop work or order an area evacuated (in accordance with approved procedures) when, in his or her judgment, the radiation conditions warrant such an action and such actions are consistent with plant safety.

The functional manager in charge of RP reports to the plant manager and is assisted by the supervisors in charge of RP.

13.1.2.1.1.6 Supervisor in Charge of Radiation Protection

The supervisors in charge of RP are responsible for carrying out the day-to-day operations and programs of the RP department as listed in Subsection 13.1.1.2.5. Supervisors in charge of RP report to the functional manager in charge of RP.

13.1.2.1.1.7 Radiation Protection Technicians

RP technicians (RPTs) directly carry out responsibilities defined in the RP program and procedures. In accordance with technical specifications, an RPT is on-site whenever there is fuel in the vessel.

The following are some of the duties and responsibilities of the RPTs:

- In accordance with authority delegated by the manager in charge of RP, stop work or order an area evacuated (in accordance with approved procedures) when, in his or her judgment, the radiation conditions warrant such an action and such actions are consistent with plant safety.
- Provide coverage and monitor radiation conditions for jobs potentially involving significant radiation exposure.
- Conduct surveys, assess radiation conditions, and establish RP requirements for access to and work within restricted, radiation, high

radiation, very high radiation, airborne radioactivity areas, and areas containing radioactive materials.

- Provide control over the receipt, storage, movement, use, and shipment of licensed radioactive materials.
- Review work packages, proposed design modifications, and operations and maintenance procedures to facilitate integration of adequate RP controls and dose-reduction measures.
- Review and oversee implementation of plans for the use of process or other engineering controls to limit the concentrations of radioactive materials in the air.
- Provide personnel monitoring and bioassay services.
- Maintain, prescribe, and oversee the use of respiratory protection equipment.
- Perform assigned emergency response duties.

13.1.2.1.1.8 Functional Manager in Charge of Chemistry

The functional manager in charge of chemistry is responsible for the development, implementation, and direction and coordination of the chemistry, radiochemistry, and nonradiological environmental monitoring programs. This area includes overall operation of the hot lab, cold lab, emergency off-site facility lab, and non-radiological environmental monitoring. The functional manager in charge of chemistry is responsible for the development, administration, and implementation of procedures and programs that provide for effective compliance with environmental regulations. The functional manager in charge of chemistry reports to the plant manager and directly supervises the chemistry supervisors and chemistry technicians as assigned.

13.1.2.1.1.9 Supervisor of Radwaste/Rad Material Control

The supervisor of radwaste/rad material control is responsible for the development, implementation, direction, and coordination of the radwaste program. The supervisor of radwaste/rad material control reports to the manager in charge of RP.

13.1.2.1.2 Operations Department

All operations activities are conducted with the safety of personnel, the public, and equipment as the overriding priority. The operations department is responsible for the following:

- Operation of station equipment.

- Monitoring and surveillance of safety- and nonsafety-related equipment.
- Fuel loading.
- Providing the nucleus of emergency and firefighting teams.

The operations department maintains sufficient licensed and senior licensed operators to staff the control room continuously using a crew rotation system. The operations department is under the authority of the manager in charge of operations who, through the assistant manager in charge of shift operations, directs the day-to-day operation of the plant.

Specific duties, functions, and responsibilities of key shift members are discussed in Subsections 13.1.2.1.2.4 through 13.1.2.1.2.8 and in plant administrative procedures and the technical specifications. The minimum shift staffing requirements are presented in Table 13.1-202. This table reflects the staffing and qualifications assumed in Topical Report ESBWR HFE Staffing and Qualifications, NEDO-33266 (Reference 13.1-204). This table is updated to reflect changes required upon issuance of the Result Summary Report of NEDO-33266. This table complies with the requirements of 10 CFR 50.54 (i) through (m).

Some resources of the operations organization are shared between units. Administrative and support personnel perform their duties on either unit. Additional operations staff is required to fill the on-shift staffing requirements of the additional units. To operate or supervise the operation of more than one unit, an operator (Senior Reactor Operation [SRO] or Reactor Operator [RO]) must hold an appropriate, current license for each unit. A single management organization oversees the operations group for the station units. Refer to Table 13.1-201 for the estimated number of staff in the operations department.

The operations support section is staffed with sufficient personnel to provide support activities for the operating shifts and overall operations department. The following is an overview of the operations organization.

13.1.2.1.2.1 Manager in Charge of Operations

The manager in charge of operations has overall responsibility for the day-to-day operation of the plant. The manager in charge of operations reports to the plant manager and is assisted by the assistant managers in charge of shift operations, operations support, and operations training. The manager in charge of operations or the assistant manager of shift operations is SRO-licensed.

13.1.2.1.2.2 Assistant Manager in Charge of Operations-Shift

The assistant manager in charge of operations-shift, under the direction of the manager in charge of operations, is responsible for the following:

- Overseeing shift plant operations in accordance with the operating license, technical specifications, and written procedures.
- Providing supervision of operating shift personnel for operational shift activities, including those of emergency and firefighting teams.
- Coordinating with the assistant manager in charge of operations support and other plant staff sections.
- Verifying that nuclear plant operating records and logs are properly prepared, reviewed, evaluated, and turned over to the assistant manager in charge of operations support.

The assistant manager in charge of operations-shift is assisted in these areas by the managers in charge on-shift who direct the operating shift personnel. The assistant manager in charge of operations-shift reports to the manager in charge of operations and, in the absence of the manager in charge of operations or assistant manager in charge of operations-support, may assume the duties and responsibilities of either of these positions.

13.1.2.1.2.3 Assistant Manager in Charge of Operations-Support

The assistant manager in charge of operations-support, under the direction of the manager in charge of operations, is responsible for the following:

- Directing and guiding plant operations support activities in accordance with the operating license, technical specifications, and written procedures.
- Providing supervision of operating support personnel, for operations support activities, and coordination of support activities.
- Providing for nuclear plant operating records and logs to be turned over to the nuclear records group for maintenance as QA records.

The assistant manager in charge of operations-support is assisted by the supervisors of work management, radwaste operations, operations procedures group, and other support personnel. In the absence of the manager in charge of operations or assistant manager in charge of operations-shift, the assistant manager in charge of operations-support may assume the duties and responsibilities of either of these positions.

13.1.2.1.2.4 Assistant Manager in Charge of Operations-Training

The assistant manager in charge of operations-training is responsible for coordination of training for new operations personnel, for personnel preparing for licensing, and miscellaneous training requirements not covered or addressed by the normal operations training programs. The assistant manager in charge of operations-training reports to the manager in charge of operations.

13.1.2.1.2.5 Manager in Charge On-Shift

The manager in charge on-shift is a licensed SRO responsible for the control room command function and is the plant manager's direct management representative for the conduct of operations. As such, the manager in charge on-shift has the responsibility and authority to direct the activities and personnel on-site as required to accomplish the following:

- Protect the health and safety of the public, the environment, and personnel on the plant site.
- Protect the physical security of the plant.
- Prevent damage to site equipment and structures.
- Comply with the operating license.

The manager in charge on-shift retains this responsibility and authority until formally relieved of operating responsibilities by a licensed SRO. Additional responsibilities of the manager in charge on-shift include the following:

- Directing nuclear plant employees to report to the plant for response to potential and real emergencies.
- Seeking the advice and guidance of the shift technical advisor and others in executing his or her duties whenever in doubt as to the proper course of action.
- Promptly informing responsible supervisors of significant actions affecting their responsibilities.
- Participating in operator training, retraining, and requalification activities from the standpoint of providing guidance, direction, and instruction to shift personnel.

The manager in charge on-shift is assisted in carrying out the above duties by the supervisors in charge on-shift and the operating shift personnel. The manager in charge on-shift reports to the assistant manager in charge of operations-shift. If the individual filling this position is qualified, the manager in charge on-shift position may serve as a dual role SRO/shift technical advisor (STA) position.

13.1.2.1.2.6 Supervisor On-Shift, Control Room

The supervisor on-shift, control room is a licensed SRO. The primary function of the supervisor on-shift, control room is to administratively support the manager in charge on-shift such that the "command function" is not overburdened with administrative duties and to supervise the licensed and non-licensed operators in carrying out the activities directed by the manager in charge on-shift. Other duties include the following:

- Being aware of maintenance and testing performed during his/her shift.
- Shutting down the reactor if conditions warrant this action.
- Informing the manager in charge on-shift and other station management in a timely manner of conditions that may affect public safety, plant personnel safety, plant capacity or reliability, or cause a hazard to equipment.
- Initiating immediate corrective action as directed by the manager in charge on-shift in any upset situation until assistance, if required, arrives.
- Participating in operator training, retraining, and requalification activities from the standpoint of providing guidance, direction, and instruction to shift personnel.

The supervisor on-shift, control room reports directly to the manager in charge on-shift. If the individual filling this position is qualified, the supervisor on-shift, control room position may serve as a dual role SRO/STA position.

13.1.2.1.2.7 Supervisor On-Shift, Field

The supervisor on-shift, field is a licensed SRO. The primary function of the supervisor on-shift, field is to directly supervise any activities being performed in the plant, or that could affect the safe operation of the plant, by non-licensed personnel outside of the control room. These activities include, but are not limited to, the following:

- Valve lineups.
- Equipment tagging.
- Surveillances or other testing activities.
- Building rounds.
- Maintenance activities.

The supervisor on-shift, field reports directly to the manager in charge on-shift. If the individual filling this position is qualified, the supervisor on-shift, field position may serve as a dual role SRO/STA position.

13.1.2.1.2.8 Supervisor On-Shift, Work Control

The supervisor on-shift, work control is a licensed SRO. The primary function of the supervisor on-shift, work control is to review and authorize maintenance, surveillance, or other work or testing activities being performed in the plant. The responsibilities of the supervisor on-shift, work control include keeping the manager on-shift and other operations personnel informed of activities for which they need to be cognizant, verifying that work and testing is safe and appropriate for the existing conditions of the plant, and tracking the work and testing to provide assurance that any limiting conditions for operation or other requirements will not be exceeded. If the individual filling this position is qualified, the supervisor on-shift, work control position may serve as a dual role SRO/STA position.

13.1.2.1.2.9 Reactor Operator

The ROs are licensed and normally report to the supervisor in charge on-shift or manager in charge on-shift. They are responsible for routine plant operations and performance of major evolutions at the direction of the manager/supervisor in charge on-shift. The RO duties include the following:

- Monitoring control room instrumentation.
- Responding to plant or equipment abnormalities in accordance with approved plant procedures.
- Directing the activities of non-licensed operators.
- Documenting operational activities, plant events, and plant data in shift logs.
- Initiating plant shutdowns, scrams, or other compensatory actions when observation of plant conditions indicates a nuclear safety hazard exists or when approved procedures so direct.

Whenever there is fuel in the reactor vessel, at least one reactor operator is in the control room monitoring the status of the unit at the main control panel. The RO assigned to the main control panel is designated the "operator at the controls" and conducts monitoring and operating activities in accordance with the guidance set forth in RG 1.114, which is further described in Subsection 13.1.2.1.3.

13.1.2.1.2.10 Non-Licensed Operator

The non-licensed operators perform routine duties outside the control room as necessary for continuous, safe plant operation, including the following:

- Assisting in plant startup, shutdown, surveillance, and emergency response by manually or remotely changing equipment operating conditions, placing equipment in service, or securing equipment from service at the direction of the reactor operator.
- Performing assigned tasks in procedures and checklists (such as valve manipulations for plant startup or data sheets on routine equipment checks) and making accurate entries according to the applicable procedure, data sheet, or checklist.
- Assisting in the training of new employees and for the improvement and upgrading of their own performance by participating in the applicable sections of the training program.

13.1.2.1.2.11 Shift Technical Advisor

The station is committed to meeting NUREG-0737 TMI Action Plan Item I.A.1.1 for STAs. The STA reports directly to the manager in charge on-shift and provides advanced technical assistance to the operating shift complement during normal and abnormal operating conditions. The STA's responsibilities are detailed in plant administrative procedures as required by TMI Action Plan I.A.1.1 and NUREG-0737, Appendix C. These responsibilities include the following:

- Activities to monitor core power distribution and critical parameters.
- Activities to assist the operating shift with technical expertise during normal and emergency conditions.
- Evaluation of technical specifications, special reports, and procedural issues.

The STA is to contribute primarily to maximizing the safety of operations by independently observing plant status and advising shift supervision of conditions that could compromise plant safety. During transients or accident situations, the STA independently assesses plant conditions and provides technical assistance and advice to mitigate the incident and minimize the effect on personnel, the environment, and plant equipment.

An SRO on-shift who meets the qualifications for the combined SRO/STA position specified by Option 1 of Generic Letter 86-04 (Reference 13.1-202) may also serve as the STA. If this option is used for a shift, then the separate STA position may be eliminated for that shift.

13.1.2.1.2.12 Engineer in Charge of Fire Protection

The engineer in charge of fire protection and his or her staff are responsible for the following:

- Fire protection program requirements, including consideration of potential hazards associated with postulated fires, knowledge of building layout, and system design.
- Post-fire shutdown capability.
- Design, maintenance, surveillance, and QA of fire protection features (e.g., detection systems, suppression systems, barriers, dampers, doors, penetration seals, and fire brigade equipment).
- Fire prevention activities (e.g., administrative controls and training).
- Fire brigade organization and training.
- Pre-fire planning including the review and updating of pre-fire plans at least every 2 years.

The engineer in charge of fire protection reports to the functional manager in charge of engineering programs for direction in formulating, implementing, and assessing the effectiveness of the fire protection program. The site executive in charge of plant management has ultimate responsibility for fire protection of the plant. Additionally, the engineer in charge of fire protection works with the assistant manager in charge of operations support to coordinate activities and program requirements with the operations department. In accordance with RG1.189, the engineer in charge of fire protection is a graduate of an engineering curriculum of accepted standing and has completed not less than 6 years of engineering experience, three of which were in a responsible position in charge of fire protection engineering work.

13.1.2.1.3 Conduct of Operations

Station operations are controlled and/or coordinated through the control room. Maintenance activities, surveillances, and removal from/return to service of structures, systems, and components (SSCs) affecting the operation of the plant may not commence without the authority of senior control room personnel. The rules of practice for control room activities, as described by administrative procedures, which are based on RG 1.114, address the following:

- Position/placement of operator at the controls workstation and the expected area of the control room, where the supervisor/manager in charge on-shift should spend the majority of his or her time.

- Definition and outline of "surveillance area" and requirement for continuous surveillance by the operator at the controls.
- Relief requirements for operator at the controls and the supervisor/ manager in charge on-shift.

In accordance with 10 CFR 50.54:

- Reactivity controls may be manipulated only by licensed operators and senior operators, except as allowed for training under 10 CFR Part 55.
- Apparatus and mechanisms other than controls that may affect reactivity or power level of the reactor shall be operated only with the consent of the operator at the controls or the manager/supervisor in charge on-shift.
- During operation of the facility in modes other than cold shutdown or refueling, a senior operator shall be in the control room, and a licensed operator or senior operator shall be present at the controls.

13.1.2.1.4 Operating Shift Crews

Plant administrative procedures implement the required shift staffing. These provisions establish crews with sufficient qualified plant personnel to man the operational shifts and be readily available in the event of an abnormal or emergency situation. The objective is to operate the plant with the required staff and to develop work schedules that minimize overtime for plant staff members who perform safety-related functions. Work-hour limitations and shift manning requirements defined by TMI Action Plan I.A.1.3 are retained in station procedures. When overtime is necessary, the provisions in the technical specifications and the plant administrative procedures apply. Shift crew staffing plans may be modified during refueling outages to accommodate safe and efficient completion of outage work in accordance with the proceduralized work hour limitations.

The minimum composition of the operating shift crew is contingent upon the unit operating status. Position titles, license requirements, and minimum shift manning for various modes of operation are contained in Technical Specifications, administrative procedures, and Table 13.1-202. Figure 13.1-202 illustrates a typical operating organization based on operating experience and exceeds minimum shift requirements in some cases.

13.1.2.1.5 Fire Brigade

RBS COL 9.5.1-10-H The station is designed and the fire brigade organized to be self-sufficient with respect to firefighting activities. The fire brigade is organized to deal with fires and related emergencies that could occur. It consists of a fire brigade leader and a sufficient number of team members to be consistent with the equipment that must be put in service during a fire emergency. A sufficient number of trained and physically qualified fire brigade members are available on-site during each shift. The fire brigade consists of at least five members on each shift. Members of the fire brigade are knowledgeable of building layout and system design. The assigned fire brigade members for any shift do not include the manager in charge on-shift nor any other members of the minimum shift operating crew necessary for safe shutdown of the unit, nor does it include any other personnel required for other essential functions during a fire emergency. Fire brigade members for a shift are designated in accordance with established procedures at the beginning of the shift. The fire brigade responds to fire emergencies in both Units 1 and 3.

13.1.3 QUALIFICATIONS OF NUCLEAR PLANT PERSONNEL

13.1.3.1 Qualification Requirements

RBS COL 13.1-1-A Qualifications of managers, supervisors, operators, and technicians of the operating organization meet the qualification requirements in education and experience for those described in ANSI/ANS-3.1 (Reference 13.1-201), as endorsed and amended by RG 1.8. For operators and SROs, these requirements are modified in Section 13.2.

13.1.3.2 Qualifications of Plant Personnel

Résumés and/or other documentation of the qualification and experience of initial appointees to appropriate management and supervisory positions are available for review by regulators upon request after position vacancies are filled.

13.1.4 COL INFORMATION

13.1-1-A Organizational Structure

RBS COL 13.1-1-A This COL item is addressed in Subsections 13.1.1 through 13.1.3 and Appendix 13AA.

13.1.5 REFERENCES

13.1-201 American Nuclear Society, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants," ANSI/ANS-3.1.

13.1-202 U.S. Nuclear Regulatory Commission, "Generic Letter 86-04, Policy Letter, Engineering Expertise on Shift."

13.1-203 American Nuclear Society, "American National Standard for Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants," ANSI/ANS-3.2.

13.1-204 General Electric Company, "ESBWR HFE Staffing and Qualifications Plan," NEDO-33266, Revision 1, January 2007.

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 1 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
Executive Management	Chief Executive Officer	(n/a)	CEO Entergy Nuclear Operations	1	0
	Senior Executive, Nuclear Operations	(n/a)	Senior Vice President, Entergy Nuclear Operations	1	0
	Senior Executive, Planning, Development, and Oversight	(n/a)	President, Planning, Development, and Oversight	1	0
	Senior Executive, Engineering and Technical Services	(n/a)	Senior Vice President, Engineering and Technical Services	1	0
Nuclear Support	Executive, Operations Support	(n/a)	Vice President, Operations Support	1	0
Site Management	Executive	(n/a)	Site Vice President	1	0
	Plant Manager	4.2.1	General Manager, Plant Operations	1	0

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 2 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
Engineering	Executive	(n/a)	Vice President, Engineering	1	0
	Manager	4.2.4	Director, Engineering	1	0
Projects	Functional Manager	4.3.9	Manager, Projects	1	0
	Projects Engineer	4.4.10	Project Manager	5	2
System Engineering	Functional Manager	4.3.9	Manager, System Engineering	1	0
	System Engineer	4.6.1	System Engineer	39	12
Design Engineering	Functional Manager	4.3.9	Manager, Design Engineering	1	0
	Design Engineer	4.6 – Staff Engineer	Design Engineer	33	8
Safety and Engineering Analysis	Functional Manager	4.3.9	Manager, Fuels and Analysis	1	0
	Analysis Engineer	4.6 – Staff Engineer	Engineer, Nuclear Analysis	2	1

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 3 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1	Section Reference	Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
Engineering Programs	Functional Manager	4.3.9	Manager, Programs and Components	1	0
	Programs Engineer	4.6 – Staff Engineer	Engineer, Code Programs	16	5
Reactor Engineering	Functional Manager	4.3.9	Supervisor, Reactor Engineering	1	0
	Reactor Engineer	4.6 – Staff Engineer	Engineer, Reactor	5	2
Maintenance	Manager	4.2.3	Manager, Maintenance	1	0
Instrumentation and Control	Functional Manager	4.3.4	Superintendent, I&C	1	0
	Supervisor	4.4.7	Supervisor, I&C	8	2
	Technician	4.5.3.3	Technician, I&C	47	17
Mechanical	Functional Manager	4.3.6	Superintendent, Mechanical	1	0

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 4 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
	Supervisor	4.4.9	Supervisor, Mechanical	8	2
	Technician	4.5.7.2	Mechanic	52	20
Electrical	Functional Manager	4.3.5	Superintendent, Electrical	1	0
	Supervisor	4.4.8	Supervisor, Electrical	8	2
	Technician	4.5.7.1	Electrician	40	15
Support	Functional Manager	4.3	Superintendent, Support	1	0
Operations	Manager	4.2.2	Manager, Operations	1	0
Operations, Plant	Functional Manager	4.3.8	Assistant Manager, Operations – Shift	2	1
Operations, Admin	Functional Manager	4.3.8	Assistant Manager, Operations – Support	1	0
Operations, Training	Functional Manager	4.3.8	Assistant Manager, Operations - Training	2	1
Operations, (On-Shift)	Functional Manager	4.4.1	Shift Manager	12	6

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 5 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1	Section Reference	Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
	Supervisor	4.4.2	Supervisor, Control Room	12	6
	Supervisor	4.4.2	Supervisor, Work Control	12	6
	Supervisor	4.4.2/ 4.6.2	Supervisor, Field/STA	12	6
	Licensed Operator	4.5.1	Control Room Operator	36	18
	Non-Licensed Operator	4.5.2	Auxiliary Operator	64	25
Operations – Rad Waste	Supervisor	4.4	Operations Specialist	2	1
Fire Protection	Supervisor	4.4	Fire Protection Engineer	3	1
Radiation Protection	Functional Manager	4.3.3	Manager, Radiation Protection	1	0
	Supervisor	4.4.6	Radiation Protection Supervisor	6	1

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 6 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
	Technician	4.5.3.2	Radiation Protection Technician	40	10
	ALARA Specialist	(N/A)	ALARA Specialist	6	3
	Decon Technician	(N/A)	Decon Technician	10	5
Chemistry	Functional Manager	4.3.2	Superintendent Chemistry	1	0
	Supervisor	4.4.5	Chemistry Supervisor	8	4
	Technician	4.5.3.1	Chemistry Technician	20	10
Nuclear Safety Assurance	Manager	4.2	Director, Nuclear Safety Assurance	1	0
Licensing	Functional Manager	4.3	Manager, Plant Licensing	1	0
	Licensing Engineer	(N/A)	Licensing Engineer, Licensing Specialist	8	3
Corrective Action	Functional Manager	4.3	Manager, Corrective Action and Assessments	1	0

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 7 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
	Corrective Action Engineer	(N/A)	Corrective Action Engineer	4	1
Emergency Preparedness	Functional Manager	4.3	Manager, Emergency Planning	1	0
	EP Planner	(N/A)	EP Planner	3	0
Training	Functional Manager	4.3.1	Manager, Training	1	0
	Supervisor OPS Trng	4.4.4	Superintendent, Operations Training	3	1
	Supervisor, Simulator	4.4.4	Superintendent, Simulator & Training Support	1	0
	Ops Training Instructor	4.5.4	Ops Training Instructor	22	9
	Supervisor Tech Staff Trng	4.4.4	Superintendent, Tech Training	1	0
	Supervisor Maint Trng	4.4.4	Superintendent, Maintenance Training	1	0
	Tech Staff/Maint Instructors	4.5.4	Tech Staff/Maint Instructor	13	4

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 8 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
Purchasing and Contracts	Functional Manager	4.3	Manager, Procurement and Contracts	1	0
Security	Functional Manager	4.3	Manager, Security	1	0
Planning and Scheduling and Outage	Manager	4.3	Manager, Planning, Scheduling, & Outages	1	0
	Functional Manager	4.3	Manager, Outage	2	1
	Functional Manager	4.3	Superintendent, Online Maintenance Scheduling	1	0
	Functional Manager	4.3	Supervisor, Planning	1	0
Quality Assurance	Functional Manager	4.3.7	Manager, Quality Assurance	1	0
	QA Auditor	4.5.6	QA Auditor	8	2
	QC Inspector	4.5.5	Refer to Note 5	0	0

RBS COL
13.1-1-A

Table 13.1-201 (Sheet 9 of 9)
Generic Position/Site-Specific Position Cross-Reference

Nuclear Function	Function Position - ANSI/ANS-3.1 Section Reference		Entergy/RBS Position	Estimated Positions for Site	Estimated Positions Added for Unit 3
Startup Testing	Supervisor	4.4.12	Startup Testing Supervisor	N/A	1
	Startup Test Engineer	(N/A)	Startup Test Engineer	N/A	6
	Supervisor	4.4.11	Preop Testing Supervisor	N/A	1
	Preop Test Engineer	(N/A)	Preop Test Engineer	N/A	20

Notes:

1. This table represents post-commercial operations.
2. During construction, preoperational testing, and startup testing, some of the shared staff depicted here will be augmented with additional personnel to minimize the effect on the existing unit.
3. Estimated positions are evaluated and numbers adjusted when additional staffing requirements are identified.
4. Startup testing staff are reassigned to other duties following the start of commercial operation.
5. May be filled by qualified individuals who serve in other positions.

Table 13.1-202
Minimum On-Duty Operations Shift Organization for One ESBWR

Unit Shutdown	1 SM (SRO)
	1 RO
	2 NLO
Unit Operating[(a)]	1 SM (SRO)
	1 SRO
	2 RO
	2 NLO

a) Operating modes other than cold shutdown or refueling.

Notes:

1. In addition, one STA is assigned per shift during plant operation in modes other than cold shutdown or refueling. A shift manager or another SRO on shift, who meets the qualifications for the combined SRO/STA position, as specified by Option 1 of Generic Letter 86-04 (Reference 13.1-202), the commission's policy statement on engineering expertise on shift, may also serve as the STA. If this option is used for a shift, then the separate STA position may be eliminated for that shift.

2. In addition to the minimum shift organization above, during refueling, a licensed SRO or SRO limited (fuel handling only) is required to directly supervise any core alteration activity.

3. A shift manager/supervisor shall be on-site at all times when the unit is loaded with fuel.

4. A radiation protection technician shall be on-site at all times where there is fuel in a reactor.

5. A chemistry technician shall be on-site during plant operation in modes other than cold shutdown or refueling.

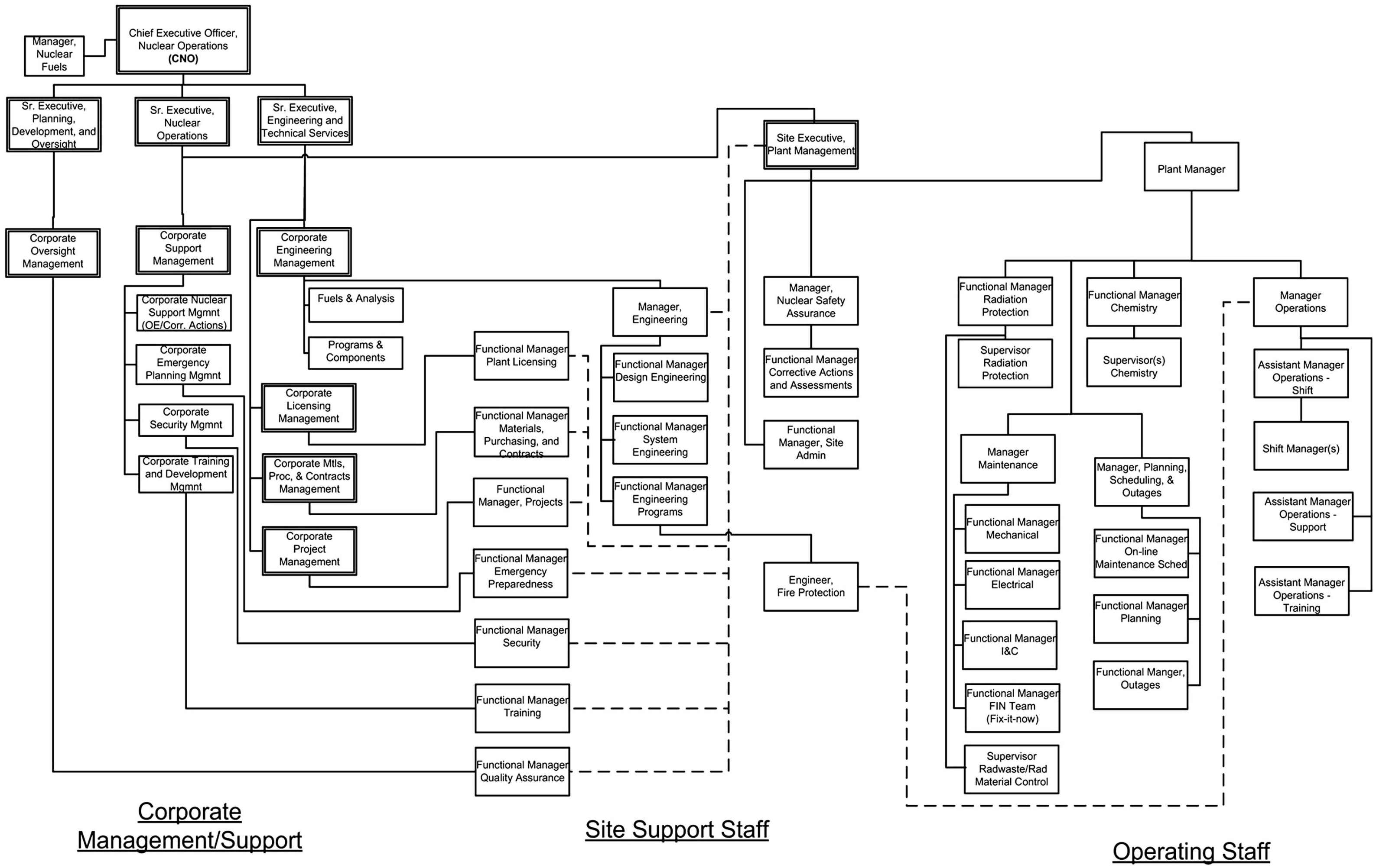
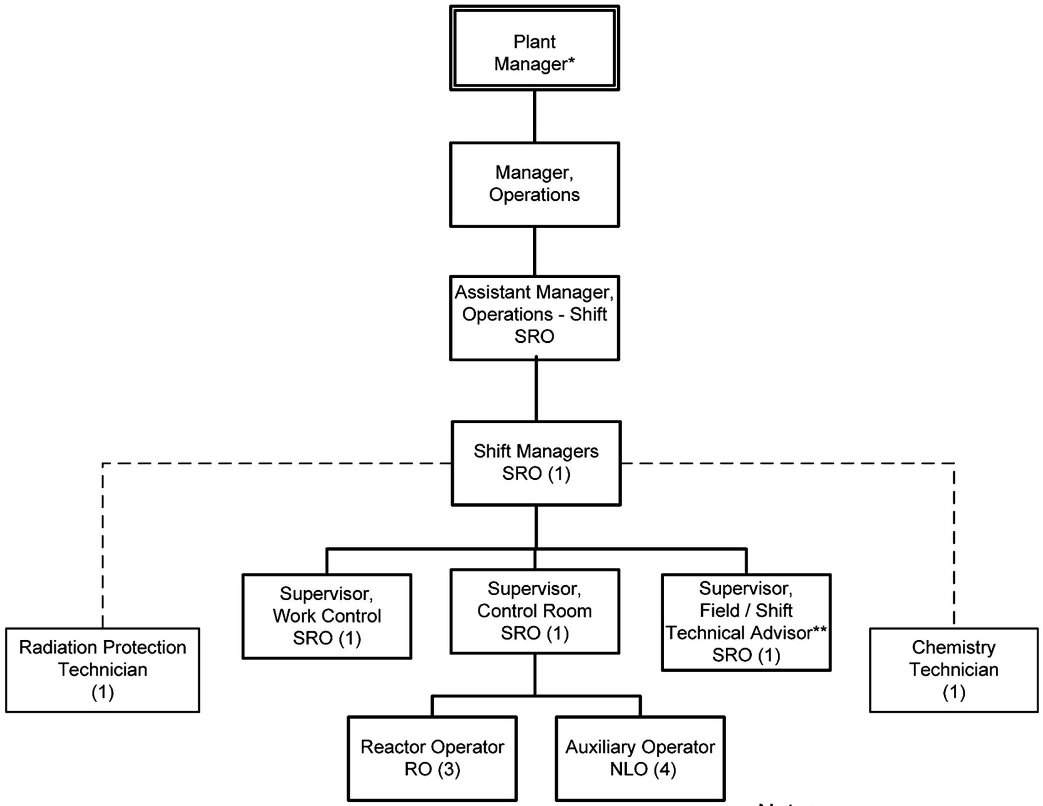


Figure 13.1-201. Nuclear Organization



Notes
1) * position SRO-qualified
2) ** may be met by on-shift combined SRO/STA
3) SRO – licensed senior reactor operator
4) RO – licensed reactor operator
5) NLO – non-licensed operator
6) Shift Manning – 5 shifts (minimum)
7) (No.) - estimated number of positions per shift
8) Minimum shift staffing requirements are in Table 13.1-202

Figure 13.1-202. Shift Operations

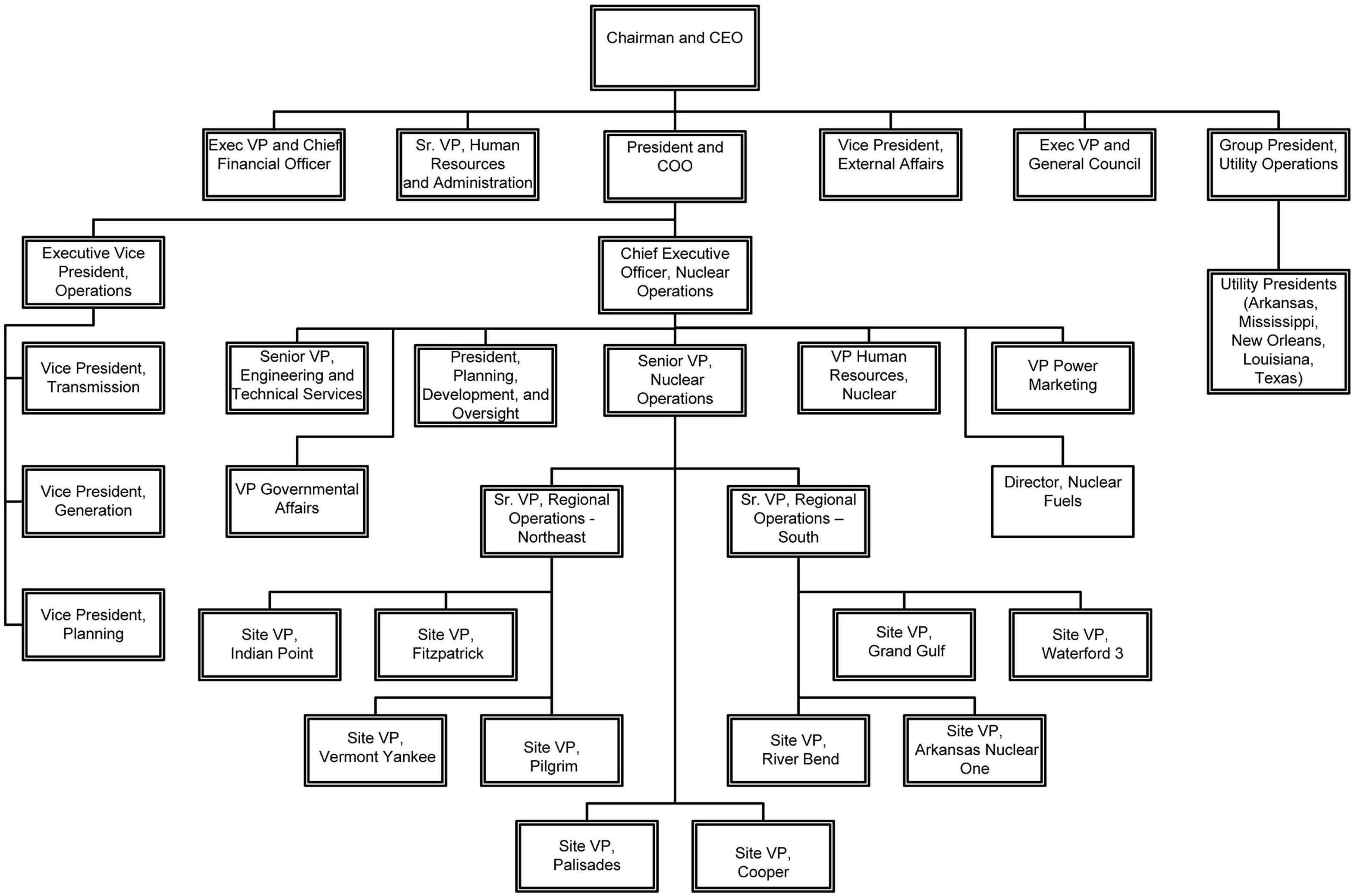


Figure 13.1-203. Entergy Nuclear Corporate Organization

13.2 TRAINING

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following as introductory material under Section 13.2:

STD SUP 13.2-1 Training programs are addressed in Appendix 13BB. Implementation milestones are addressed in Section 13.4.

13.2.1 REACTOR OPERATOR TRAINING

Replace the second sentence of the second paragraph with the following:

RBS COL 13.2-1-A Descriptions of the training program and licensed operator requalification program for ROs and SROs are addressed in Appendix 13BB. A schedule showing the 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.

13.2.2 TRAINING FOR NON-LICENSED PLANT STAFF

Replace the second sentence of the second paragraph with the following:

STD COL 13.2-2-A 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.

13.2.5 COL INFORMATION

13.2-1-A Reactor Operator Training

RBS COL 13.2-1-A This COL item is addressed in Subsection 13.2.1 and Appendix 13BB.

13.2-2-A Training for Non-Licensed Plant Staff

STD COL 13.2-2-A This COL item is addressed in Section 13.2.2 and Appendix 13BB.

13.3 EMERGENCY PLANNING

This section of the DCD is incorporated by reference with the following departures and/or supplements.

Replace the fifth and sixth paragraphs with the following.

STD COL 13.3-1-A As addressed in the emergency plan, the TSC is provided with reliable voice and data communication with the MCR and Emergency Operations Facility (EOF) and reliable voice communications with the Operational Support Center (OSC), NRC, and state and local operations centers.

The OSC communications system has at least one dedicated telephone extension to the control room, one dedicated telephone extension to the TSC, and one telephone capable of reaching on-site and off-site locations, as a minimum.

Replace the second sentence in the seventh paragraph with the following.

STD COL 13.3-3-A Supplies are provided in the service building adjacent to the main change rooms for decontamination of on-site individuals.

13.3.2 EMERGENCY PLAN

STD COL 13.3-1-A
STD COL 13.3-2-A
STD COL 13.3.3-A

The emergency plan, prepared in accordance with 10 CFR 52.79(d), is maintained as a separate document.

13.3.3 COL INFORMATION

13.3-1-A Identification of OSC and Communication Interfaces with Control Room and TSC

STD COL 13.3-1-A This COL item is addressed in Section 13.3 and in Emergency Plan Sections II-F and II-H.

13.3-2-A Identification of EOF and Communication Interfaces with Control Room and TSC

STD COL 13.3-2-A This COL item is addressed in Section 13.3 and in Emergency Plan Sections II-F and II-H.

13.3-3-A Decontamination Facilities

STD COL 13.3-3-A This COL item is addressed in Section 13.3 and in Emergency Plan Section II-J.

13.4 OPERATIONAL PROGRAM IMPLEMENTATION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace this section with the following.

STD COL 13.4-1-A STD COL 13.4-2-A 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 in which the operational program is fully described as required by RG 1.206, Combined License Applications for Nuclear Power Plants (LWR edition).

13.4.1 COL INFORMATION

13.4-1-A Operation Programs

STD COL 13.4-1-A This COL Item is addressed in Section 13.4.

13.4-2-A Implementation Milestones

STD COL 13.4-2-A This COL Item is addressed in Section 13.4.

13.4.2 REFERENCES

13.4-201 American Society of Mechanical Engineers (ASME), "Boiler and Pressure Vessel Code (B&PVC), Rules for Inservice Inspection of Nuclear Power Plant Components," BPVC Section XI.

13.4-202 American Society of Mechanical Engineers (ASME), "Code for the Operation and Maintenance of Nuclear Power Plants," OM Code.

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 1 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation Milestone	Implementation Requirement
1.	Inservice Inspection Program	10 CFR 50.55a(g)	5.2.4 6.6 DCD 3.8.1.7.3 3.9.3.7.1(3)(e)	Prior to commercial service	10 CFR 50.55a(g); ASME XI 2001 IWA 2430(b) (Reference 13.4-201)
2.	Inservice Testing Program	10 CFR 50.55a(f)	3.9.6 5.2.4 6.6 3.9.3.7.1(3)(e)	After generator online on nuclear heat	10 CFR 50.55a(f); ASME OM Code (Reference 13.4-202)
3.	Environmental Qualification Program	10 CFR 50.49(a)	3.11	Prior to fuel load	License Condition
4.	Preservice Inspection Program	10 CFR 50.55a(g)	5.2.4 6.6 DCD 3.8.1.7.3 3.9.3.7.1(3)(e)	Completion prior to initial plant startup	10 CFR 50.55a(g); ASME Code Section XI IWB/ IWC/IWD-2200(a) (Reference 13.4-201)
5.	Reactor Vessel Material Surveillance Program	10 CFR 50.60 10 CFR 50, Appendix H	DCD 5.3.1	Prior to fuel load	License Condition
6.	Preservice Testing Program	10 CFR 50.55a(f)	3.9.6 5.2.4 3.9.3.7.1(3)(e)	Prior to fuel load	License Condition
7.	Containment Leakage Rate Testing Program	10 CFR 50.54(o) 10 CFR 50, Appendix J	DCD 6.2.6	Prior to fuel load	10 CFR Part 50, Appendix J Option B - Section III.a

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 2 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation: Milestone	Implementation: Requirement
8.	Fire Protection Program	10 CFR 50.48	9.5.1.15	Prior to fuel receipt for elements of the Fire Protection Program necessary to support receipt and storage of fuel on-site. Prior to fuel load for elements of the Fire Protection Program necessary to support fuel load and plant operation	License Condition

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 3 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation: Milestone	Implementation: Requirement
9.	Process and Effluent Monitoring and Sampling Program:				
	Radiological Effluent Technical Specifications/ Standard Radiological Effluent Controls	10 CFR 20.1301 and 20.1302 10 CFR 50.34a 10 CFR 50.36a 10 CFR 50, Appendix I, Section II and IV	11.5.4.6	Prior to fuel load	License Condition
	Off-site Dose Calculation manual	Same as above	11.5.4.5 11.5.4.8	Prior to fuel load	License Condition
	Radiological Environmental Monitoring Program	Same as above	11.5.4.5	Prior to fuel load	License Condition
	Process Control Program	10 CFR 20.1301 and 20.1302 10 CFR 50.34a 10 CFR 61.55 and 61.56 10 CFR 71	11.4.2.3	Prior to fuel load	License Condition

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 4 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation: Milestone	Implementation: Requirement
10.	Radiation Protection Program	10 CFR 20.1101	12.5	Prior to initial receipt of by-product, source, or special nuclear materials (excluding Exempt Quantities as described in 10 CFR 30.18) for those elements of the Radiation Protection (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 on-site Prior to fuel load for those elements of the RP Program necessary to support fuel load and plant operation Prior to first shipment of radioactive waste for those elements of the RP Program necessary to support shipment of radioactive waste	License Condition

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 5 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation: Milestone	Implementation: Requirement
11.	Non Licensed Plant Staff Training Program	10 CFR 50.120	13.2.2	18 months prior to scheduled fuel load	10 CFR 50.120(b)
12.	Reactor Operator Training Program	10 CFR 55.13 10 CFR 55.31 10 CFR 55.41 10 CFR 55.43 10 CFR 55.45	13.2.1	18 months prior to scheduled fuel load	License Condition
13.	Reactor Operator Requalification Program	10 CFR 50.34(b) 10 CFR 50.54(i) 10 CFR 55.59	13.2	Within 3 months after issuance of an operating license or the date the Commission makes the finding under 10 CFR 52.103(g)	10 CFR 50.54(i-1)

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 6 of 8)
Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation: Milestone	Implementation: Requirement
14.	Emergency Planning	10 CFR 50.47 10 CFR 50, Appendix E	13.3	Full participation exercise conducted within 2 years prior to the scheduled date for initial loading of fuel.	10 CFR Part 50, Appendix E, Section IV.F.2.a (ii)
				On-site exercise conducted within 1 year prior to the schedule date for initial loading of fuel	10 CFR Part 50, Appendix E, Section IV.F.2.a(ii)
				Applicant's detailed implementing procedures for its emergency plan submitted at least 180 days prior to the scheduled date for initial loading of fuel	10 CFR Part 50, Appendix E, Section V

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 7 of 8) Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation Milestone	Implementation Requirement
15	Security Program:	10 CFR 50.34(c)			
	Physical Security Program	10 CFR 73.55 10 CFR 73.56 10 CFR 73.57	13.6	Prior to fuel receipt	License Condition
	Safeguards Contingency Program	10 CFR 50.34(d) 10 CFR Part 73, Appendix C	13.6	Prior to fuel receipt	License Condition
	Training and Qualification Program	10 CFR Part 73, Appendix B	13.6	Prior to fuel receipt	License Condition
	Fitness for Duty Program (Construction - Mgt & Oversight personnel)	10 CFR Part 26, Subparts A-H, N, and O	13.6	Prior to on-site construction of safety- or security-related SSCs	License Condition
	Fitness for Duty Program (Construction - Workers & First Line Supv.)	10 CFR Part 26 Subpart K	13.7	Prior to on-site construction of safety- or security-related SSCs	License Condition
	Fitness for Duty Program (Operation)	10 CFR Part 26	13.7	Prior to fuel receipt	License Condition

STD COL 13.4-1-A

STD COL 13.4-2-A

Table 13.4-201 (Sheet 8 of 8) Operational Programs Required by NRC Regulations

Item	Program Title	Program Source (Required by)	Section	Implementation	
				Milestone	Requirement
16.	Quality Assurance Program - Operation	10 CFR 50.54(a) 10 CFR Part 50, Appendix A (GDC 1) 10 CFR Part 50, Appendix B	17.5	30 days prior to scheduled date for initial loading of fuel	10 CFR 50.54(a)(1)
17.	Maintenance Rule	10 CFR 50.65	17.6	Prior to fuel load authorization per 10 CFR 52.103(g)	10 CFR 50.65(a)(1)
18.	Motor-Operated Valve Testing	10 CFR 50.55a(b)(3)(ii)	3.9.6	Prior to fuel load	License Condition
19.	Initial Test Program	10 CFR 50.34 10 CFR 52.79(a)(28)	14.2	Prior to the first construction test being conducted for the Construction Test Program 60 days prior to the scheduled date of the first preoperational test for the Preoperational Test Program 60 days prior to the scheduled date of initial fuel loading for the Startup Test Program	License Condition

13.5 PLANT PROCEDURES

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD SUP 13.5-1 This section describes the administrative and operating procedures that the operating organization (plant staff) uses to conduct the routine operating, abnormal, and emergency activities in a safe manner.

STD SUP 13.5-2 The 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 COL 13.5-4 Procedures are developed prior to fuel load to allow sufficient time for plant staff familiarization and to allow NRC staff adequate time to review the procedures and to develop operator licensing examinations.

RBS COL 13.5-4-A Regulatory and industry guidance for the appropriate format, content, and typical activities delineated in written procedures is implemented as appropriate. Examples include, but are not limited to, the following:

- RG 1.33, "Quality Assurance Program Requirements (Operation)."
- ANSI/ANS 3.2, "Administrative Control and Quality Assurance for the Operational Phase of Nuclear Power Plants" (DCD Reference 13.5-2).

RBS SUP 13.5-1

- ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications" (Reference 13.5-202).

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 contained in the procedure is commensurate with the qualifications of the individual normally performing the function.

STD SUP 13.5-7 Procedures are developed consistent with guidance described in DCD Section 18.9, Procedure Development, and with input from the human factors engineering 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 HRA/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 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 consistent with 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 (RCS) boundary and inventory during shutdown conditions. (Reference 13.5-203)

13.5.1 ADMINISTRATIVE PROCEDURES

Replace the first sentence of the first paragraph with the following:

STD SUP 13.5-9 This section describes administrative procedures that provide administrative control over activities that are important to safety for the operation of the facility.

Replace the second paragraph with the following:

STD COL 13.5-1-A Administrative procedures are developed in accordance with the nominal schedule presented in Table 13.5-202.

RBS SUP 13.5-2 Procedures outline the essential elements of the administrative programs and controls as described in ANSI/ANS 3.2 (DCD Reference 13.5-2) and the QAPD. 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.

RBS SUP 13.5-3 The plant procedure program complies with the applicable guidance of RG 1.33, "Quality Assurance Program Requirements (Operation)."

STD SUP 13.5-12 A procedure style (writer's) guide promotes the standardization and application of human factors engineering 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 includes criteria for procedure content and format including the writing of action steps and the specification of acceptable acronym lists and acceptable terms to be used.

STD SUP 13.5-13 Procedure maintenance and control of procedure updates are performed in accordance with the QAPD.

STD SUP 13.5-14 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).

13.5.1.1 Administrative Procedures-General

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 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 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 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
- 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

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STD SUP 13.5-17

13.5.2 OPERATING AND MAINTENANCE PROCEDURES

Replace the third paragraph with the following:

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.

Replace the fifth paragraph with the following:

RBS COL 13.5-4-A A Plant Operations Procedures Development Plan is established in accordance with Section 13.5.2.1.

Replace the second sentence of "Procedures for Calibration, Inspection and Testing" with the following:

STD COL 13.5-6-H Surveillance procedures that cover safety-related logic circuitry are addressed in Section 13.5.2.2.6.3.

Replace the second paragraph with the heading "Procedures for Handling of Heavy Loads" with the following:

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.

Replace the last sentence of DCD Section 13.5.2 with the following:

STD COL 13.5-3-A Emergency Procedures are developed in accordance with Section 13.5.2.1.4.

Add the following at the end of Section 13.5.1.1.

13.5.2.1 Operating and Emergency Operating Procedures

STD COL 13.5-2-A This section describes the operating procedures used by the operating organization (plant staff) to conduct routine operating, abnormal, and emergency activities in a safe manner.

Operating procedures are developed at least six months prior to fuel load to allow sufficient time for plant staff familiarization and to allow NRC staff adequate time to review the procedures and to develop operator licensing examinations.

STD SUP 13.5-18 The classifications of operating procedures are:

- System Operating Procedures
- General Operating Procedures
- Abnormal (Off-Normal) Operating Procedures
- Emergency Operating Procedures
- Alarm Response Procedures

STD COL 13.5-2-A The Plant Operating Procedures Development Plan establishes:

- A scope that includes those operating procedures defined below, which direct operator actions during normal, abnormal, and emergency operations, and considers plant operations during periods when plant systems/equipment are undergoing test, maintenance, or inspection.

- The methods and criteria for the development, verification and validation, implementation, maintenance, and revision of procedures. The methods and criteria are in accordance with NUREG-0737 TMI Items I.C.1 and I.C.9.

STD COL 13.5-5-A The following procedures are included in the scope of the Plant Operating Procedures Development Plan:

- System operating procedures
- General operating procedures
- Abnormal (off-normal) or alarm response procedures
- Procedures for combating emergencies and other significant events
- Procedures for maintenance and modification
- Procedures for radiation monitoring and control
- Fuel handling procedures
- Temporary procedures
- Procedures for handling of heavy loads

STD COL 13.5-5-A
STD COL 13.5-6-H
- Procedures for calibration, inspection, and testing

RBS COL 13.5-4-A Implementation of the Plant Operating Procedures Development Plan establishes:

- Procedures that are consistent with the requirements of 10 CFR Part 50 and the TMI requirements described in NUREG-0737 and Supplement 1 to NUREG-0737.
- Requirements that the procedures developed include, as necessary, the elements described in ANSI/ANS-3.2 (DCD Reference 13.5-2), as endorsed by RG 1.33.
- Bases for specifying plant operating procedures including:
    - Operator actions identified in the vendor's task analysis and PRA efforts in support of the design certification

- Standardized plant emergency procedure guidelines
- Consideration of plant-specific equipment selection and site specific elements such as the station water intake structure and the ultimate heat sink

• The definition of the methods through which specific operator skills and training needs, as may be considered necessary for the reliable execution of the procedures, are identified and documented.

• Requirements that the procedures specified above are made available for the purposes of the Human Factors V&V described in GE Report NEDE-33217P, ESBWR Man-Machine Interface System and Human Factors Engineering Implementation Plan (DCD Reference 13.5-1).

• Procedures for the incorporation of the results of operating experience and the feedback of pertinent information into plant procedures in accordance with the provisions of TMI Item I.C.5 (NUREG-0737).

STD SUP 13.5-19

13.5.2.1.1 System Operating Procedures

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.

STD SUP 13.5-20

13.5.2.1.2 General Operating Procedures

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 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 recovery 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.

STD SUP 13.5-21

13.5.2.1.3 Abnormal (Off-Normal) Operating Procedures

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.

RBS SUP 13.5-4

13.5.2.1.4 Emergency Operating Procedures

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 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.

- ANSI/ANS-3.2 Section 5.3.12 and Appendix A10 (DCD Reference 13.5-2).

STD COL 13.5-3-A The emergency operating procedure program (e.g., the procedures generation package (PGP)) describes the objectives of the emergency procedure development process, the program for developing EOPs and the required content of the EOPs.

The procedure development program, as described in the PGP for EOPs, is submitted to the NRC at least three months prior to the planned date to begin formal operator training on the EOPs. The PGP includes:

- GTGs, which are guidelines based on analysis of transients and accidents that are specific to the plant design and operating philosophy. The submitted documentation includes: a) identification of significant deviations from the generic guidelines (including identification of additional equipment beyond that identified in the generic guidelines), along with necessary engineering evaluations or analyses to support the adequacy of each deviation, and b) a description of the process used for identifying operator information and control requirements.
- A generic writer's guide (GWG) that details the specific methods used in preparing EOPs based on GTGs. The writer's guide contains objective criteria that require that the emergency procedures developed are consistent in organization, style, content, and usage of terms.
- A description of the program for verification and validation (V&V) of EOPs.
- A description of the program for training operators on EOPs.
- The objectives of the emergency procedure development.
- Discussion of any design change recommendations and/or negative implications that the current design may have on safe operation as noted during implementation of the emergency procedures development plan.

STD SUP 13.5-23

13.5.2.1.5 Alarm Response Procedures

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.

13.5.2.1.6 Temporary Procedures

RBS SUP 13.5-5

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 ANSI/ANS 3.2 (DCD Reference 13.5-2) and Technical Specifications, as applicable.

STD SUP 13.5-25

13.5.2.1.7 Fuel Handling Procedures

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.

STD SUP 13.5-26

13.5.2.2 Maintenance and Other Operating Procedures

The QAPD provides guidance for procedural adherence.

STD SUP 13.5-27

13.5.2.2.1 Plant Radiation Protection Procedures

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; and maintaining radiation exposure records of workers and others.

STD SUP 13.5-28 13.5.2.2.2 Emergency Preparedness Procedures

A discussion of emergency preparedness procedures can be found in the Emergency Plan. A list of implementing procedures is maintained in the Emergency Plan.

STD SUP 13.5-29 13.5.2.2.3 Instrument Calibration and Test Procedures

The QAPD provides a description of procedural requirements for instrumentation calibration and testing.

STD SUP 13.5-30 13.5.2.2.4 Chemistry Procedures

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.

STD SUP 13.5-31 13.5.2.2.5 Radioactive Waste Management Procedures

Procedures for the operation of the radwaste processing systems provide for the control, treatment, and management of on-site radioactive wastes. These procedures are included in Section 13.5.2.1.1, System Operating Procedures.

STD SUP 13.5-32 13.5.2.2.6 Maintenance, Inspection, Surveillance, and Modification Procedures

STD COL 13.5-2-A 13.5.2.2.6.1 Maintenance Procedures

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.

Maintenance procedures contain sufficient detail to permit the maintenance work to be performed correctly and safely. Procedures include provisions for conducting and recording results of required tests and inspections, if not performed and documented under separate test and inspection procedures. References are made to vendor manuals, plant procedures, drawings, and other sources, as applicable.

Instructions are included, or referenced, for returning the equipment to its normal operating status. Testing is commensurate with the maintenance that has been performed. Testing may be included in the maintenance procedure or be covered in a separate procedure.

Where appropriate sections of related documents, such as vendor manuals, equipment operating and maintenance instructions, or approved drawings with acceptance criteria, provide adequate instructions to provide the required quality of work, the applicable sections of the related documents are referenced in the procedure, or may, in some cases, constitute adequate procedures in themselves. Such documents receive the same level of review and approval as maintenance documents.

The preventive maintenance program, including preventive and predictive procedures, as appropriate, prescribes the frequency and type of maintenance to be performed. An initial program based on service conditions, experience with comparable equipment and vendor recommendations is developed prior to fuel loading. The program is revised and updated as experience is gained with the equipment. To facilitate this, equipment history files are created and maintained. The files are organized to provide complete and easily retrievable equipment history.

STD SUP 13.5-33 13.5.2.2.6.2 Inspection Procedures

The QAPD provides a description of procedural requirements for inspections.

13.5.2.2.6.3 Surveillance Testing Procedures

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."

13.5.2.2.6.4 Modification Procedures

STD SUP 13.5-34 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.

STD SUP 13.5-35 13.5.2.2.6.5 Heavy Load Handling Procedures

Procedures to control handling of heavy loads are provided and meet the guidance of NUREG-0612, Section 5.1. These procedures include:

- Identification of required equipment
- Inspections and acceptance criteria required before movement of load
- The steps and proper sequence to be followed in handling the load
- Defining the safe load path
- Other special precautions

13.5.2.2.7 Material Control Procedures

STD SUP 13.5-36 The QAPD provides a description of procedural requirements for material control.

STD SUP 13.5-37 13.5.2.2.8 Security Procedures

A discussion of security procedures is provided in the Security Plan.

STD SUP 13.5-38 13.5.2.2.9 Refueling and Outage Planning Procedures

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)

13.5.3 COL INFORMATION

13.5-1-A Administrative Procedures Development Plan

STD COL 13.5-1-A This COL item is addressed in Section 13.5.1.

13.5-2-A Plant Operating Procedures Development Plan

STD COL 13.5-2-A This COL item is addressed in Section 13.5.1.1.

13.5-3-A Emergency Procedures Development

STD COL 13.5-3-A This COL item is addressed in Section 13.5.1.1.

13.5-4-A Implementation of the Plant Procedures Plan

STD COL 13.5-4-A This COL item is addressed in Section 13.5 and Section 13.5.1.1.

13.5-5-A Procedures for Calibration, Inspection, and Testing

STD COL 13.5-5-A This COL item is addressed in Section 13.5.1.1.

13.5-6-H Procedures Included in Scope of Plan

STD COL 13.5-6-H This COL item is addressed in Section 13.5.1.1.

13.5.4 REFERENCES

13.5-201 American National Standards Institute, Overhead and Gantry Cranes, ANSI B30.2-2001.

13.5-202 American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, NQA-1-1994.

13.5-203 Nuclear Utilities Management and Resources Council, Guidelines for Industry Actions to Assess Shutdown Management, NUMARC 91-06, December 1991.

13.5-204 General Electric Corporation, Licensing Topical Report ESBWR Human Factors Engineering Procedures Development Implementation Plan, NEDO-33274, Revision 2, March 2007.

STD SUP 13.5-39

Table 13.5-201
Pre-COL Phase Administrative Programs and Procedures

(This table is included for future designation as historical information.)
Design/Construction Quality Assurance Program
Reporting of Defects and Noncompliance,10 CFR 21 Program
Construction License Fitness for Duty Programs, 10 CFR 26
Design Reliability Assurance Program

STD COL 13.5-1-A

Table 13.5-202
Nominal Procedure Development Schedule

(This table is included for future designation as historical information.)

Category A: Controls

Group	Procedure Type	Preparation Milestone
1	Procedures review and approval	6 months before first license class
2	Equipment control procedures	18 months before fuel load
3	Control of maintenance and modifications	18 months before fuel load
4	Fire Protection procedures	1. 6 months before fuel receipt for elements of the program supporting fuel onsite 2. 6 months before fuel load for elements supporting fuel load and plant operation
5	Crane operation procedures	6 months before fuel receipt
6	Temporary changes to procedures	6 months before first license class
7	Temporary procedures	6 months before first license class
8	Special orders of a transient or self-canceling character	6 months before first license class

Category B: Specific Procedures

Group	Procedure Type	Preparation Milestone
1	Standing orders to shift personnel including the authority and responsibility of the shift supervisor, licensed senior reactor operator in the control room, control room operator, and shift technical advisor	6 months before first license class
2	Assignment of shift personnel to duty stations and definition of "surveillance area"	6 months before first license class
3	Shift relief and turnover	6 months before fuel load
4	Fitness for duty	1. Construction FFD program: 6 months before on-site construction of safety- or security-related SSCs 2. Operational FFD program: 6 months before fuel load
5	Control room access	6 months before fuel load
6	Limitations on work hours	6 months before fuel load
7	Feedback of design, construction, and applicable important industry and operating experience	6 months before fuel load
8	Shift supervisor administrative duties	6 months before fuel load
9	Verification of correct performance of operating activities	6 months before first license class

13.6 PHYSICAL SECURITY

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

13.6.2 SECURITY PLAN

Add the following paragraph at the end of this section:

STD SUP 13.6-1 The Physical Security Plan during construction, including control of access to the new plant construction site, is consistent with NEI 03-12, Appendix F (Reference 13.6-201), which is currently under NRC review. Table 13.4-201 provides milestones for security program implementation.

13.6.4 REFERENCES

13.6-201 Nuclear Energy Institute, Security Measures During New Reactor Construction, NEI 03-12 Appendix F.

13.7 FITNESS FOR DUTY

RBS SUP 13.7-1 The Fitness for Duty (FFD) Program is implemented and maintained in two phases: the construction phase program and the operating phase program. The construction phase program is consistent with NEI 06-06 (Reference 13.7-201), which is currently under NRC review. The construction phase program is implemented, as identified in Table 13.4-201, prior to on-site construction of safety- or security-related SSCs. The operations phase program is consistent with NEI 03-01 (Reference 13.7-202), which is currently under NRC review. The operations phase program is implemented prior to fuel receipt, as identified in Table 13.4-201.

13.7.1 REFERENCES

13.7-201 Nuclear Energy Institute (NEI) "Fitness for Duty Program Guidance for New Nuclear Power Plant Construction Sites," NEI 06-06.

13.7-202 Nuclear Energy Institute (NEI) "Nuclear Power Plant Access Authorization Program," NEI 03-01.

APPENDIX 13AA ORGANIZATIONAL STRUCTURE HISTORICAL INFORMATION

RBS COL 13.1-1-A

13AA.1 DESIGN AND CONSTRUCTION RESPONSIBILITIES

It is anticipated that GE-Hitachi will engineer, procure, and construct the ESBWR. This includes all portions of the facility within the certified design. Subsection 1.4.3 provides detailed information regarding GE-Hitachi's past experience in design, development, and manufacturing of nuclear power facilities. Operating experience from design, construction, and operation of earlier GE BWRs is applied in the design, construction, and operation of the ESBWR as described in numerous locations throughout the DCD (e.g., DCD Sections 4.6.2.1.4, 5.3.1.1, 7.1.3.1.3).

A construction architect/engineer (AE) provides the construction of the plant and additional design engineering for selected site-specific portions of the plant. The AE is selected based on experience and proven technical capability in nuclear construction projects or projects of similar scope and complexity.

Other design and construction activities are generally contracted to qualified suppliers of such services. The implementation or delegation of design and construction responsibilities is described in the sections below. QA aspects are described in Chapter 17.

13AA.1.1 Principal Site-Related Engineering Work

The principal site engineering activities accomplished toward the construction and operation of the plant are as follows:

a. Meteorology

Information concerning local (site) meteorological parameters is developed and applied by station and contract personnel to assess the effect of the station on local meteorological conditions. An on-site meteorological measurements program is employed by station personnel to produce data for the purpose of making atmospheric dispersion estimates for postulated accidental and expected routine airborne releases of effluents. A maintenance program is established for the surveillance, calibration, and repair of instruments. More information regarding the study and meteorological program can be found in Section 2.3.

b. Geology

Information relating to site and regional geotechnical conditions is developed and evaluated by utility and contract personnel to determine if geologic conditions could present a challenge to safety of the plant. Items of interest include geologic structure, seismicity, geological history, and groundwater conditions. During construction, foundations within the power block area are mapped or visually inspected and photographed. Section 2.5 provides details of these investigations.

c. Seismology

Information relating to seismological conditions is developed and evaluated by utility and contract personnel to determine if the site location and area surrounding the site is appropriate from a safety standpoint for the construction and operation of a nuclear power plant. Information regarding tectonics, seismicity, correlation of seismicity with tectonic structure, characterization of seismic sources, and ground motion are assessed to estimate the potential for strong earthquake ground motions or surface deformation at the site. Section 2.5 provides details of these investigations.

d. Hydrology

Information relating to hydrological conditions at the plant site and the surrounding area is developed and evaluated by utility and contract personnel. The study includes hydrologic characteristics of streams, lakes, shore regions, the regional and local groundwater environments, and existing or proposed water control structures that could influence flood control and plant safety. Section 2.4 includes more detailed information regarding this subject.

e. Demography

Information relating to local and surrounding area population distribution is developed and evaluated by utility and contract personnel. The data is used to determine if requirements are met for the establishment of the exclusion area, low population zone, and population center distance. Section 2.1 includes more detailed information regarding population around the plant site.

f. Environmental Effects

Monitoring programs are developed to enable the collection of data necessary to determine possible impact on the environment as a result of construction, startup, and operational activities and to establish a baseline from which to evaluate future environmental monitoring.

13AA.1.2 Design of Plant and Ancillary Systems

Responsibility for design and construction of systems outside the power block, such as circulating water, service water, switchyard, and secondary fire protection systems, are delegated to qualified contractors.

13AA.1.3 Review and Approval of Plant Design Features

Design engineering review and approval is performed in accordance with the reactor vendor QA program and Section 17.1. The reactor vendor is responsible for design control of the power block. Design work is performed in accordance with the design and construction QA manual including the reviews necessary to verify the adequacy of the design. Verification is performed by competent individuals or groups other than those who performed the original design. Design issues arising during construction are addressed and implemented with notification and communication of changes to the manager in charge of engineering for review. As systems are tested and approved for turnover and operation, control of the design is turned over to plant staff. The manager in charge of engineering, along with functional managers and staff, assumes responsibility for review and approval of modifications, additions, or deletions in plant design features, as well as control of design documentation, in accordance with the Operational QA program. Design control becomes the responsibility of the manager in charge of engineering prior to loading fuel. During construction, startup, and operation, changes to human system interfaces of control room design are approved using a Human Factors Engineering evaluation addressed within DCD Chapter 18. Refer to Figures 13.1-201 and 13AA-201 for reporting relationships.

13AA.1.4 Site Layout With Respect to Environmental Effects and Security Provisions

Site layout was considered when determining the expected environmental effects from construction.

The Physical Security Plan is designed with provisions that meet the applicable NRC regulations. Site layout was considered when developing the Security Plan.

13AA.1.5 Development of Safety Analysis Reports

Information regarding the development of the FSAR can be found in Chapter 1.

13AA.1.6 Review and Approval of Material and Component Specifications

Safety-related material and component specifications of SSCs designed by the reactor vendor are reviewed and approved in accordance with the reactor vendor QA program and Section 17.1. Review and approval of items not designed by the reactor vendor are controlled for review and approval by Section 17.5 and the QA program document.

13AA.1.7 Procurement of Materials and Equipment

Procurement of materials during the construction phase is the responsibility of the reactor technology vendor and constructor. The process is controlled by the construction QA programs of these organizations. Oversight of the inspection and receipt of materials process is the responsibility of the manager in charge of QA.

13AA.1.8 Management and Review of Construction Activities

Overall management and responsibility for construction activities is assigned to the site executive in charge of plant management. The reactor technology vendor site manager and the constructor site manager are accountable to the site executive in charge of plant management for the construction activities for which they are responsible, as shown in Figure 13AA-201. Monitoring and review of construction activities by utility personnel is a continuous process at the plant site. Contractor performance is monitored to provide objective data to utility management in order to identify problems early and develop solutions. Monitoring of construction activities verifies that contractors are in compliance with contractual obligations for quality, schedule, and cost. Monitoring and review of construction activities is divided functionally across the various disciplines of the utility construction staff (i.e., electrical, mechanical, I&C, etc.) and tracked by schedule based on system and major plant components/areas.

After each system is turned over to plant staff, the construction organization relinquishes responsibility for that system. At that time, the construction organization will be responsible for completion of construction activities as directed by plant staff and will be available to provide support for startup testing, as necessary.

13AA.2 PREOPERATIONAL RESPONSIBILITIES

The plant manager, with the aid of those managers that report directly to the plant manager, is responsible to the site executive in charge of plant management for the activities required to transition the unit from the construction phase to the operational phase. These activities include turnover of systems from construction, preoperational testing, schedule management, procedure development for tests, fuel load, integrated startup testing, and turnover of systems to plant staff.

13AA.2.1 Development of Human Factors Engineering Design Objectives and Design Phase Review of Proposed Control Room Layouts

HFE design objectives are initially developed by the reactor vendor in accordance with DCD Chapter 18. As a collaborative team, personnel from the reactor vendor design staff and personnel, including licensed operators, engineers, and I&C technicians from owner and other organizations in the nuclear industry, assess the design of the control room and man-machine interfaces to attain safe and efficient operation of the plant. Refer to DCD Section 18.2 for additional details of HFE program management.

Modifications to the certified design of the control room or man-machine interface described in the DCD are reviewed according to engineering procedures, as required by DCD Section 18.2, to evaluate the effect on plant safety. The manager in charge of engineering is responsible for the HFE design process and for the design commitment to HFE during construction and throughout the life of the plant as noted in Subsection 13.1.1.2.1. The HFE program is established in accordance with the description and commitments in DCD Chapter 18.

13AA.2.2 Preoperational and Startup Testing

The manager in charge of startup is assigned responsibility for organizing and developing the preoperational and startup testing organization and reports to the plant manager. The preoperational and startup testing organization prepares procedures and schedules, and performs preoperational and startup testing. Personnel that staff the positions of the preoperational and startup testing organization consist of testing engineers, procedure writers, and planners/schedulers. The qualification requirements of testing engineers in the startup organization meet those established in ANSI/ANS-3.1 (Reference 13AA-201). Test engineers are responsible for integrated testing of systems to prove the functionality of system design requirements. They provide guidance and supervision to procedure writers and communicate closely with operations personnel and other supporting staff to facilitate safe and efficient performance of preoperational and startup tests. The scope of testing to be accomplished is presented in Chapter 14. As systems are turned over from the constructor, they are tested by component then by integrated system preoperational test. Sufficient numbers of personnel are assigned to perform preoperational and startup testing to facilitate the safe and efficient implementation of the testing program. Plant-specific training provides instruction on the administrative controls of the test program. The startup test program provides data and experience. During the preoperational and startup testing phase, the constructor and reactor vendor staff support, as necessary, the testing performed by the nuclear plant preoperational and startup testing staff. The manager in charge of startup is assisted in the area of preoperational testing by other station organizations and staff operations, plant maintenance, and engineering. Operations and technical staff are used as support in conducting the test program and in reviewing test results.

Procedures are written to describe organizational responsibilities and interfaces between staff, constructor, and reactor vendor, and to establish direction in writing, reviewing, and performing tests. Refer to Figure 13AA-201 for the organization chart for preoperational and startup testing.

13AA.2.3 Development and Implementation of Staff Recruiting and Training Programs

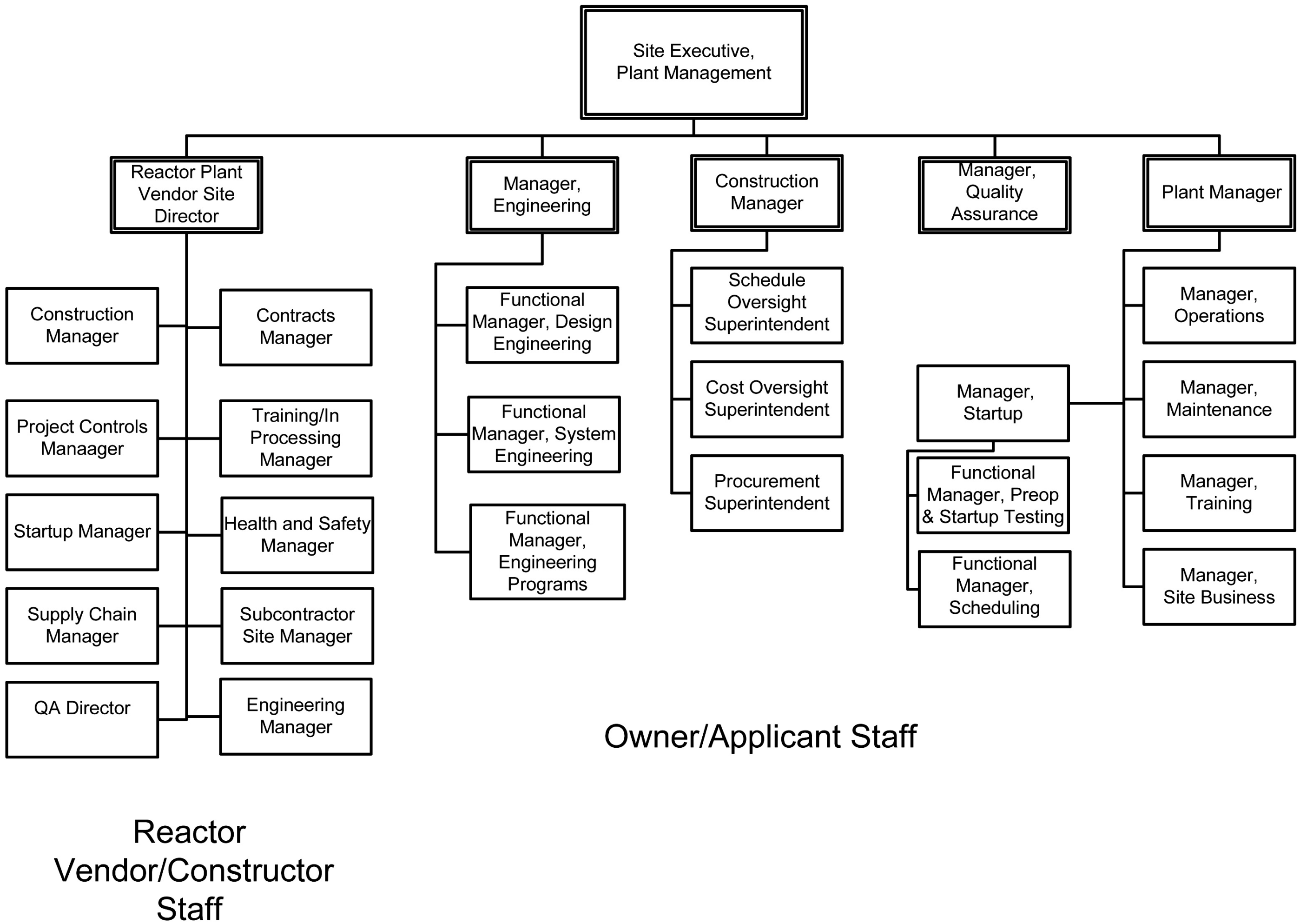
Staffing plans are developed based on operating plant experience with input from the reactor technology vendor as determined by HFE (DCD Section 18.6). These plans are developed under the direction and guidance of the site executive in charge of plant management, executive in charge of engineering and technical services, and executive in charge of operations support. Staffing plans are completed, and manager level positions are filled prior to the start of preoperational testing. Personnel selected to be licensed ROs and SROs, along with other staff necessary to support the safe operation of the plant, are hired with sufficient time available to complete appropriate training programs and become qualified and licensed (if required) prior to fuel being loaded in the reactor vessel. Refer to Figure 13AA-202 for an estimated timeline of hiring requirements for operator and technical staff relative to fuel load.

Because of the dynamic nature of the staffing plans and changes that occur over time, it is expected that specific numbers of personnel on-site will change, Table 13.1-201 includes the initial estimated number of staff for selected positions (for the combined Units 1 and 3 site) representative of staff during commercial operation. The table also includes an estimated number of staff added to support the operation of Unit 3. Recruiting of personnel to fill positions is the shared responsibility of the manager in charge of human resources and the various heads of departments.

The training program is described in Section 13.2.

13AA.3 REFERENCES

13AA-201 American Nuclear Society, "American National Standard for Selection, Qualification, and Training of Personnel for Nuclear Power Plants," ANSI/ANS-3.1.



RBS COL 13.1.1-A

Figure 13AA-201. Construction Management Organization

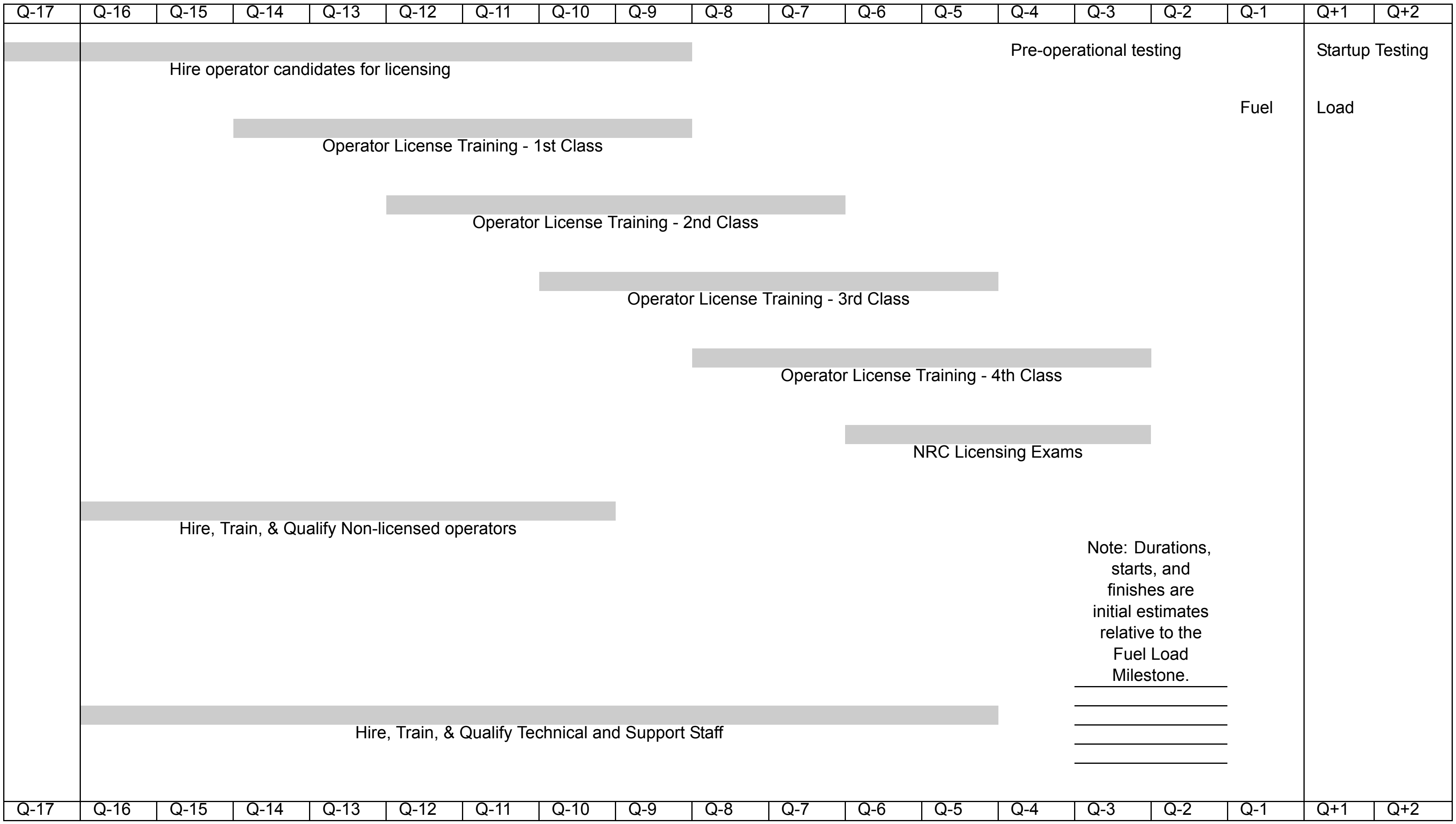


Figure 13AA-202. Hiring Schedule for Plant Staff

APPENDIX 13BB TRAINING PROGRAM

STD SUP 13.2-1
RBS COL 13.2-1-A
STD COL 13.2-2-A

NEI 06-13-A (Reference 13BB-201), Technical Report on a Template for an Industry Training Program Description, is incorporated by reference with the following supplements.

Add the following information to NEI 06-13, as numbered:

13BB.1.1.3 Licensed Operator Training Program Prior to Commercial Operation

RBS SUP 13.2-2
RBS COL 13.2-1-A

Prior to initial commercial operation, licensed operator training is conducted early in the construction phase to support preoperational testing and cold and hot functional activities. Licensed operator training conducted prior to commercial operation is referred to as "cold" licensed operator training. Cold licensed operator training is conducted as described below.

Cold licensing of operators at a new plant provides the method for operations personnel to acquire the knowledge and experience required for licensed operator duties during the unique conditions of new plant construction.

Prior to commercial operation, plant experience requirements specified in RG 1.8 (Revision 3) and ANSI/ANS 3.1-1993 cannot be met. Therefore, during cold license operator training, the Regulatory Position C.1.b of RG 1.8 (Revision 2) applies: cold license operator candidates will meet the training elements defined in ANSI/ANS 3.1, but are exempt from the experience requirements defined in ANSI/ANS 3.1. Alternate methods of gaining plant experience, in addition to those referenced in RG 1.8 and associated ANSI/ANS standards, are described in Subsection 13BB.1.1.3.1.

Approximately 18 months prior to expected fuel load, the NRC examination is administered for cold licensed operator candidates and includes a written examination, simulator examination, and in-plant job performance measures (JPMs). Sufficient operator licenses are obtained to support operational shifts prior to first fuel load.

The cold licensed operator training process terminates when the last licensed operator training class initiated during the plant construction/preoperational test phases has taken a scheduled NRC license examination or the plant becomes operational, whichever is later.

13BB.1.1.3.1 Licensed Operator Continuing Training Prior to Commercial Operation

The SAT process is utilized to determine continuing training needs for cold licensed operator candidates following the completion of the initial phases of their training. Structured continuing training is provided to maintain the license candidates' knowledge and ability and includes topics related to plant modifications, construction, functional testing, and OE related to construction activities.

An accredited licensed operator requalification training program is implemented within 90 days following the issuance of the first NRC operator licenses. This facilitates maintaining the licensed operators' knowledge and ability and meets the milestone guidance related to the Reactor Operator Requalification Training Program provided in RG 1.206.

13BB.1.1.3.2 Licensed Operator Experience Requirements Prior to Commercial Operation

Each cold licensed operator candidate's operational experience is assessed prior to the selection for a licensed training program; however, experience requirements are not required to be fully met prior to enrolling in an operator training program. In addition, total experience requirements and 1-year on-site experience requirements not fully met at the time of the licensed operator application submittal shall be met prior to issuing the individual's NRC operator license. Following the satisfactory completion of an NRC license examination, the licensee notifies the NRC when the candidate's experience requirements are met.

Experience is gained any time prior to fuel load by participating in construction and testing activities. Operational experience on a one-for-one basis is achieved during the construction and testing phases while performing one or more of the following tasks:

- Plant operating procedure development and verification.
- Human engineering and task analysis verification.
- Preoperational testing of plant systems.
- Participating in the cold and hot functional testing program.
- Acting as an operations classroom, simulator, or on-the-job (OJT) instructor.

The above practical work assignments provide experience and fulfills the 1-year on-site experience requirement cited in RG 1.8 and the 3-month on-shift requirement cited in ANSI/ANS 3.1. On-site experience is also gained on a one-for-one basis at a nuclear reactor site of similar design (e.g., PWR or BWR).

An RO candidate who completes a site-specific non-licensed operator training program for critical non-licensed operator tasks and completes a site familiarization course designed on a systematic evaluation of site design features and operator site familiarization needs satisfies the 1-year on-site experience and

6 months as a non-licensed operator at the facility for which the license is sought requirements cited in RG 1.8.

A non-degreed SRO candidate who completes a combined RO and SRO course and completes a site familiarization course designed on a systematic evaluation of site design features and operator site familiarization needs satisfies the 1-year experience requirement as a licensed RO cited in RG 1.8.

For a degreed SRO, performing construction and testing activities described above on a one-for-one basis satisfies the 6-month on-site experience requirement as a staff engineer cited in RG 1.8.

An SRO candidate (degreed or non-degreed) who completes a plant-referenced simulator course or an observation course at an operating reactor of similar design meets the special experience requirements related to at power and startup operations described in ANSI/ANS 3.1. These courses are based on a systematic analysis of the supervisory skill, knowledge, and ability required of a SRO. A systematic process to identify the objectives associated with experience gained at an operating facility, coupled with high fidelity simulation, provides assurance that the requisite knowledge, skill, and ability level has been achieved.

13BB.1.1.3.3 On-the-Job Training Prior to Commercial Operation

Until equipment installation is sufficiently complete, viable alternatives for performance of in-plant JPMs are identified including, but not limited to, discussion, mock-ups, virtual presentations, and part task simulation. Time spent in OJT training is counted as on-site and total nuclear power plant experience.

Until the plant becomes operational, viable alternatives for the main control room OJT (3 months on-shift as an extra person) are identified including, but not limited to, preoperational testing activities, simulator time focused on crew operations, or dedicated observation time in the main control room of an operating nuclear power plant.

13BB.1.1.3.4 Plant-Referenced Simulation Facilities Prior to Commercial Operation

The initial phase of licensed operator simulator training is performed with a simulation facility modeled in accordance with the guidance of RG 1.149 and its associated ANSI/ANS standards as described below. The simulation facility is a high fidelity/quality training device and is maintained in accordance with the criteria of ANSI/ANS 3.5 1998, Appendix D.

Simulation models are updated as information concerning plant design and performance is obtained. These updates ensure that the simulator is current with plant design and can be used as a reliable training tool.

The following provides a generic simulator training sequence, indicating the use of part task/limited scope simulator and plant-referenced simulator for licensed operator training. The actual sequence may vary depending on plant construction scheduling:

- Phase 1 (approximately 40 months prior to fuel load) - The part task/limited scope simulator is used to provide licensed operator training based on standardized design simulator modeling and operating procedures.
- Phase 2 (approximately 24 months prior to fuel load) - An ANSI/ANS 3.5 1998 plant-referenced simulator is used in final phase of licensed operator initial training to perform reactivity manipulations and complete required NRC license candidate training.
- Phase 3 (approximately 18 months prior to fuel load) - An ANSI/ANS 3.5 1998 plant-referenced simulator is used for performance of NRC operator initial license examinations.

Prior to conducting the simulator portion of licensed operator examination, the plant-referenced simulator response is tested and validated against plant design data to ensure that the simulator meets the operational and testing criteria of 10 CFR 55.46, Paragraph (c).

13BB.2 REFERENCES

13BB-201 Nuclear Energy Institute, "Technical Report on a Template for an Industry Training Program Description," NEI 06-13-A.

CHAPTER 14 INITIAL TEST PROGRAM

14.1 INITIAL TEST PROGRAM FOR PRELIMINARY SAFETY ANALYSIS REPORTS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

14.2 INITIAL PLANT TEST PROGRAM FOR FINAL SAFETY ANALYSIS REPORTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

14.2.1.4 Organization and Staffing

Add the following at the end of this section.

RBS SUP 14.2-1 Section 13.1 and Appendix 13AA provide additional information regarding responsibilities, qualifications, and organization for implementing the pre-operational and startup testing program.

14.2.2.1 Startup Administration Manual

Replace the first two sentences with the following, and delete the last sentence in this section.

STD COL 14.2-1-H The Startup Administration Manual will be developed and made available for review 60 days prior to scheduled start of the preoperational test program.

14.2.2.2 Test Procedures

Replace the last two sentences in this section with the following.

STD COL 14.2-2-H Approved test procedures for satisfying the commitments of this section will be developed and available for review no later than 60 days prior to their intended use for preoperational tests and no later than 60 days prior to scheduled fuel loading for power ascension tests.

14.2.2.5 Test Records

Add the following at the end of this section.

STD SUP 14.2-2 Startup test reports are prepared in accordance with RG 1.16.

14.2.7 TEST PROGRAM SCHEDULE AND SEQUENCE

Replace the last paragraph with the following.

RBS COL 14.2-3-H The detailed testing schedule will be developed and made available for review prior to actual implementation. The schedule may be updated and continually optimized to reflect actual progress and subsequent revised projections.

The implementation milestones for the Initial Test Program are provided in Section 13.4.

14.2.9 SITE-SPECIFIC PREOPERATIONAL AND STARTUP TESTS

Replace the second and third paragraphs with the following.

RBS COL 14.2-4-H This section describes the site-specific preoperational and initial startup tests not addressed in DCD Subsection 14.2.8.

Specific testing to be performed and the applicable acceptance criteria for each preoperational test are documented in test procedures to be made available to the NRC approximately 60 days prior to their intended use. Site-specific preoperational and startup 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 Subsection 14.2.8. The tests demonstrate that the installed equipment and systems perform within the limits of these specifications.

14.2.9.1 Site-Specific Preoperational Tests

Replace this section with the following.

14.2.9.1.1 Station Water System Pre-Operation Test

RBS SUP 14.2-2 **Purpose**

The objective of this test is to verify proper operation of the SWS and its ability to supply design quantities and quality of water to the CIRC, PSWS cooling tower basin, MWS, and FPS.

Prerequisites

The construction tests have been successfully completed, and the SCG has reviewed the test procedure and approved the initiation of testing. Electrical power, the CIRC, PSWS, MWS, and FPS, instrument air, chemical storage and transfer system, and other required interfacing systems are available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

Performance is observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

- Proper operation of instrumentation and equipment in appropriate design combinations of logic and instrument channel trip;
- Proper functioning of instrumentation and alarms used to monitor system operation and availability;
- Proper operation of pumps, motors, and valves in all design operating modes;
- Proper operation of clarifiers;
- Proper system flow paths and flow rates, including pump capacity and discharge head;
- Proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;
- Proper operation of freeze protection methods and devices, where installed; and
- Acceptability of pump/motor vibration levels.

14.2.9.1.2 Cooling Tower Preoperational Test

Purpose

The objective of this test is to verify proper operation of the waste heat rejection portion of the CIRC (i.e., the mechanical draft cooling tower and basin.) Testing of the balance of the CIRC is addressed in DCD Subsection 14.2.8.1.50.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. Electrical power, the CIRC, SWS, instrument air system, chemical storage and transfer system, and other required interfacing systems are available, as needed, to support the specific testing.

General Test Methods and Acceptance Criteria

Because of insufficient heat loads during the preoperational test phase, cooling tower performance evaluations are performed during the startup phase with the turbine generator on line.

Operation is observed and recorded during a series of individual component and integrated system tests to demonstrate the following:

- Proper operation of instrumentation and equipment in appropriate design combinations of logic and instrument channel trip;
- Proper functioning of instrumentation and alarms used to monitor system operation and availability;
- Proper operation of pumps, fans, motors, and valves in all design operating modes;
- Proper system flow paths and flow rates, including pump capacity and discharge head;
- Proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;
- Proper operation of freeze protection methods and devices, where installed; and
- Acceptability of pump/motor vibration levels.

14.2.9.1.3 Personnel Monitors and Radiation Survey Instruments Preoperational Test

Purpose

To verify the ability of the personnel monitors and radiation survey equipment to indicate and alarm normal and abnormal radiation levels.

Prerequisites

The construction tests have been successfully completed, and the SCG has reviewed the test procedure and approved the initiation of testing. High radiation alarm set points have been properly established based on sensor location, background radiation level, expected radiation level, and low occupation dose prior to the test. Indicator, power supplies, and sensor/converters have been calibrated according to vendor instructions.

General Test Methods and Acceptance Criteria

Operation is observed and recorded during a series of individual component and integrated subsystem tests to demonstrate the following:

- Proper functioning of indicators, annunciators, and audible alarms;
- Proper alarm at correct prescribed setpoints in response to high radiation and downscale/inoperative conditions; and
- Proper functioning and operation of the self-test feature for gross failure and loss of power detection.

14.2.9.1.4 Electrical Switchyard System Preoperational Test

Purpose

To verify the ability of the electrical switchyard system to provide a means for supplying AC power to plant on-site systems from the off-site sources.

Prerequisites

The construction tests have been successfully completed, and the SCG has reviewed the test procedure and approved the initiation of testing. All the necessary permanently installed and test instrumentation have been calibrated and are operational. All interfacing systems and equipment required to support system operation are available, as needed, for the specified testing configurations.

General Test Methods and Acceptance Criteria

The capability of the electrical switchyard system to provide power to plant loads under various plant operating conditions and via normal and alternate paths will be demonstrated. 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; and

- The capability to transfer between on-site and off-site power sources in accordance with design.

14.2.9.2 Site-Specific Startup Tests

Replace this section with the following.

14.2.9.2.1 Cooling Tower Performance Test

RBS SUP 14.2-3 **Purpose**

The objective of this test is to demonstrate acceptable performance of the waste heat rejection portion of the CIRC (i.e., the natural draft and the mechanical draft cooling towers and basins), particularly its ability to cool design quantities of circulating water to design temperature under expected operational load conditions.

Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and approved the initiation of testing. The plant is in the appropriate operational configuration for the scheduled testing. The necessary instrumentation is checked or calibrated.

Description

Power ascension phase testing of the waste heat rejection portions of the CIRC is necessary to the extent that fully loaded conditions could not be approached during the preoperational phase. Pertinent parameters are monitored in order to provide a verification of proper system flow balancing and performance of both the natural draft and mechanical draft cooling towers.

Criteria

System performance is consistent with design requirements.

14.2.10 COL INFORMATION

14.2-1-H

STD COL 14.2-1-H This COL Item is addressed in Section 14.2.2.1.

14.2-2-H

STD COL 14.2-2-H This COL Item is addressed in Section 14.2.2.2.

14.2-3-H

RBS COL 14.2-3-H This COL Item is addressed in Section 14.2.7.

14.2-4-H

RBS COL 14.2-4-H This COL Item is addressed in Section 14.2.9.

14.3 INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

14.3.8 OVERALL ITAAC CONTENT FOR COMBINED LICENSE APPLICATIONS

Replace the last paragraph with the following.

STD COL 14.3-1-A

The requirements for inclusion of EP-ITAAC in a COLA are provided in 10 CFR 52.80(a). In SRM-SECY-05-0197, the NRC-approved generic EP-ITAAC for use in COL and ESP applications. This set of EP-ITAAC was considered in the development of the plant-specific EP-ITAAC, which are tailored to the ESBWR design. The plant-specific EP-ITAAC are included in a separate part of the COLA.

14.3.9 SITE-SPECIFIC ITAAC

Add the following paragraph at the end of this section.

STD COL 14.3-2-A

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.

14.3.10 COL INFORMATION

14.3-1-A EP-ITAAC

STD COL 14.3-1-A

This COL item is addressed in Section 14.3.8.

14.3-2-A Site-Specific ITAAC

STD COL 14.3-2-A

This COL item is addressed in Section 14.3.9.

CHAPTER 15 SAFETY ANALYSES

This chapter of the referenced DCD is incorporated by reference with the following departures and/or supplements.

15.3 ANALYSIS OF INFREQUENT EVENTS

15.3.10.5 Radiological Consequences

Add the following sentence at the end of this section.

STD SUP 15.3-1 In addition, procedures discuss the use of nuclear instrumentation to aid in detecting a possible mislocated fuel bundle after fueling operations.

CHAPTER 16 TECHNICAL SPECIFICATIONS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

STD SUP 16.0-1 The Technical Specifications and the Technical Specification Bases are maintained as separate documents.

COL Information Item 16.0-1

STD COL 16.0-1 This COL Item is addressed in the Technical Specifications and Technical Specification Bases.

CHAPTER 17 QUALITY ASSURANCE

17.0 INTRODUCTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following after the last paragraph.

RBS SUP 17.0-1

Quality Assurance (QA) activities beyond the scope of the certified design are discussed in Section 17.1 through Section 17.6. Section 17.1 addresses QA activities that take place prior to the implementation of the Quality Assurance Program Description (QAPD). Section 17.2 and Section 17.3 respond to DCD COL information items and reference Section 17.5. Section 17.4 responds to DCD COL information items and describes reliability assurance activities. Section 17.5 describes the QAPD that is applicable during the construction and operations phases. A description of the Maintenance Rule Program, which is based on the requirements in 10 CFR 50.65, is provided in Section 17.6.

The QAPD described in Section 17.5, is based on 10 CFR Part 50, Appendix B and 10 CFR Part 52, and the requirements of ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear Facility Applications," Parts I and II as specified in the QAPD.

17.1 QUALITY ASSURANCE DURING DESIGN

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Insert the following information at the end of DCD Section 17.1.

RBS COL 17.2-2-A

Entergy is responsible for the establishment and execution of the quality assurance program during the design, construction and operations phases of RBS Unit 3. Entergy may delegate and has delegated to others, such as GEH and Black & Veatch (B&V) Energy, the work of establishing and executing the quality assurance program, or any parts thereof, but retains responsibility for the quality assurance program.

Effective during the combined operating license application (COLA) development, the B&V QA Program (Reference 17.1-201) and the "GE Nuclear Energy Quality Assurance Program Description" (Reference 17.1-202) define the QA program requirements for design activities.

The Quality Assurance Program Description (QAPD) discussed in Section 17.5 will be phased in based on the stage of the project and will be fully implemented in accordance with Table 13.4-201. During the implementation period, the Entergy Corporate QA Manual (Reference 17.1-203) will be applicable unless the QAPD requirements have been implemented. The phased implementation/conversion commenced with the submittal of this COL application.

17.1.25 REFERENCES

17.1-201 Black & Veatch, "Nuclear Organization Quality Assurance Manual," Revision 3, March 21, 2008.

17.1-202 "GE Nuclear Energy Quality Assurance Program Description," NEDO-11209-04A (NRC accepted), March 1989.

17.1-203 Entergy Operations, Inc., "Entergy Quality Assurance Program Manual," Revision 18, April 2008.

17.2 QUALITY ASSURANCE DURING CONSTRUCTION AND OPERATIONS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the first paragraph with the following.

RBS COL 17.2-1-A

The Quality Assurance Program in place during the construction and operations phases, including adapting the design to specific plant implementation, is described in Section 17.5.

17.2.1 COL INFORMATION

17.2-1-A QA Program for the Construction and Operations Phases

RBS COL 17.2-1-A

This COL item is addressed in Sections 17.2 and 17.5.

17.2-2-A QA Program for Design Activities

RBS COL 17.2-2-A

This COL Item is addressed in Sections 17.1 and 17.5.

17.3 QUALITY ASSURANCE PROGRAM DESCRIPTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Replace the first and second sentences of this section with the following.

RBS COL 17.3-1-A The Quality Assurance Program Description applicable to the combined license applicant is described in Section 17.5.

17.3.1 COL INFORMATION

17.3-1-A Quality Assurance Program Document

RBS COL 17.3-1-A This COL Item is addressed in Sections 17.3 and 17.5.

17.4 RELIABILITY ASSURANCE PROGRAM DURING DESIGN PHASE

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

17.4.1 INTRODUCTION

Replace the third paragraph and subsequent bulleted list with the following.

STD COL 17.4-1-A

The objectives of reliability assurance during the operations phase are integrated into the Quality Assurance Program (Section 17.5), the Maintenance Rule (MR) Program (Section 17.6), and other operational programs. Specific reliability assurance activities are addressed within operational programs (e.g., maintenance rule, surveillance testing, inservice testing, inservice 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 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 risk-significant SSCs
- 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 design reliability assurance program (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

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17.4.6 SSC IDENTIFICATION/PRIORITIZATION

Add the following new paragraph at the end of this section.

STD COL 17.4-1-A

The list of risk-significant SSCs will be confirmed via ITAAC (see DCD Tier 1, Table 3.6-1).

17.4.9 OPERATIONAL RELIABILITY ASSURANCE ACTIVITIES

Replace the second paragraph with the following.

STD COL 17.4-1-A

Refer to Section 17.4.1 for the implementation of reliability assurance during the operations phase.

17.4.10 OWNER/OPERATOR'S RELIABILITY ASSURANCE PROGRAM

Replace the fifth bullet with the following.

STD COL 17.4-1-A

- MR Program: The MR Program is described in Section 17.6.

Replace the last sentence in this section with the following.

Refer to Section 17.4.1 for the implementation of reliability assurance activities.

17.4.13 COL INFORMATION

17.4-1-A Operation Reliability Assurance Activities

STD COL 17.4-1-A

This COL Item is addressed in Sections 17.4.1, 17.4.6, 17.4.9, 17.4.10, and 17.6.

STD SUP 17.5-1

17.5 QUALITY ASSURANCE PROGRAM DESCRIPTION - DESIGN CERTIFICATION, EARLY SITE PERMIT, AND NEW LICENSE APPLICANTS

QA applied to the DC activities is described in DCD Section 17.1.

RBS COL 17.2-1-A
RBS COL 17.3-1-A

The Quality Assurance Program in place during the construction and operations phases is described in the Quality Assurance Program Description (QAPD), which is maintained as a separate document. This QAPD is based on NEI 06-14A, "Quality Assurance Program Description" (Reference 17.5-201).

RBS COL 17.2-2-A

The Quality Assurance Program in place prior to implementation of the QAPD is described in Section 17.1.

The implementation milestones for the Operational Quality Assurance Program are provided in Section 13.4.

17.5.1 REFERENCES

17.5-201 Nuclear Energy Institute, "Quality Assurance Program Description," NEI 06-14A.

17.6 MAINTENANCE RULE PROGRAM

STD COL 17.4-1-A

NEI 07-02, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," (Reference 17.6-201) is incorporated by reference with the following supplemental information.

STD SUP 17.6-1

The text of the template provided in NEI 07-02 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."

17.6.1.1 Maintenance Rule Scoping per 10 CFR 50.65(b)

STD SUP 17.6-3

In Paragraph 17.6.1.1.b, replace "(DRAP - see FSAR Section 17.Y)" with the following.

(See Section 17.4)

17.6.3 MAINTENANCE RULE PROGRAM RELATIONSHIP WITH RELIABILITY ASSURANCE ACTIVITIES

Replace with the following.

STD SUP 17.6-2

Reliability during the operations phase is assured through the implementation of operational programs, i.e., the MR program (Section 17.6), the Quality Assurance Program (Section 17.5), the Inservice Inspection Program (Sections 3.9.3.7.1(3)(e), 5.2.4, and 6.6, and DCD Section 3.8.1.7.3), and the Inservice Testing Program (Section 3.9.6, Section 5.2.4, Section 6.6, and Section 3.9.3.7.1(3)(e)), as well as the Technical Specifications Surveillance Requirements (Chapter 16), and the preventive maintenance program.

17.6.6 REFERENCES

17.6-201 Nuclear Energy Institute, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," NEI 07-02.

CHAPTER 18 HUMAN FACTORS ENGINEERING

This chapter of the referenced DCD is incorporated by reference with no departures or supplements.

CHAPTER 19 PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENTS

19.1 INTRODUCTION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.2 PRA RESULTS AND INSIGHTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

19.2.3.2.4 Evaluation of External Event Seismic

Significant Core Damage Sequences of External Event Seismic

Replace the second and third sentences of the first paragraph with the following.

STD COL 19.2.6-1-H

As-built SSC High Confidence Low Probability of Failure (HCLPF)s will be compared to those assumed in the ESBWR seismic margin analysis shown in DCD Table 19.2-4. 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.

19.2.6 COL INFORMATION

19.2.6-1-H Seismic High Confidence Low Probability of Failure Margins

STD COL 19.2.6-1-H

This COL Item is addressed in Section 19.2.3.2.4.

19.3 SEVERE ACCIDENT EVALUATIONS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.4 PRA MAINTENANCE

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.5 CONCLUSIONS

This section of the referenced DCD is incorporated by reference with following departures and/or supplements.

RBS SUP 19.5-1 In accordance with 10 CFR 52.79(a)(46), this report is required to contain a description of the plant-specific PRA and its results. As part of the development of the certified design PRA, site and plant specific information were reviewed to determine if any changes from the certified design PRA were warranted. This review 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. Subsection 1.8.5 was also reviewed to determine if there were any departures affecting the PRA results.

The review of site-specific information and plant-specific design information determined that: (1) the DCD PRA bounds site-specific and plant-specific design parameters and design features and (2) these parameters and features have no significant impact on the DCD PRA results and insights. Therefore, based on this review, it is concluded that there is no significant change from the certified design PRA. In that there are no significant changes from the certified design PRA, incorporation of DCD Chapter 19 into the FSAR satisfies the requirement of 10 CFR 52.79(a)(46) for a description of the plant-specific PRA and its results.

APPENDIX 19A REGULATORY TREATMENT OF NON-SAFETY SYSTEMS (RTNSS)

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19ACM AVAILABILITY CONTROLS MANUAL

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19B DETERMINISTIC ANALYSIS FOR CONTAINMENT PRESSURE CAPABILITY

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19C PROBABILISTIC ANALYSIS FOR CONTAINMENT PRESSURE FRAGILITY

This section of the referenced DCD is incorporated by reference with no departures or supplements.