APR1400
DESIGN CONTROL DOCUMENT TIER 2

CHAPTER 19
PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENT EVALUATION

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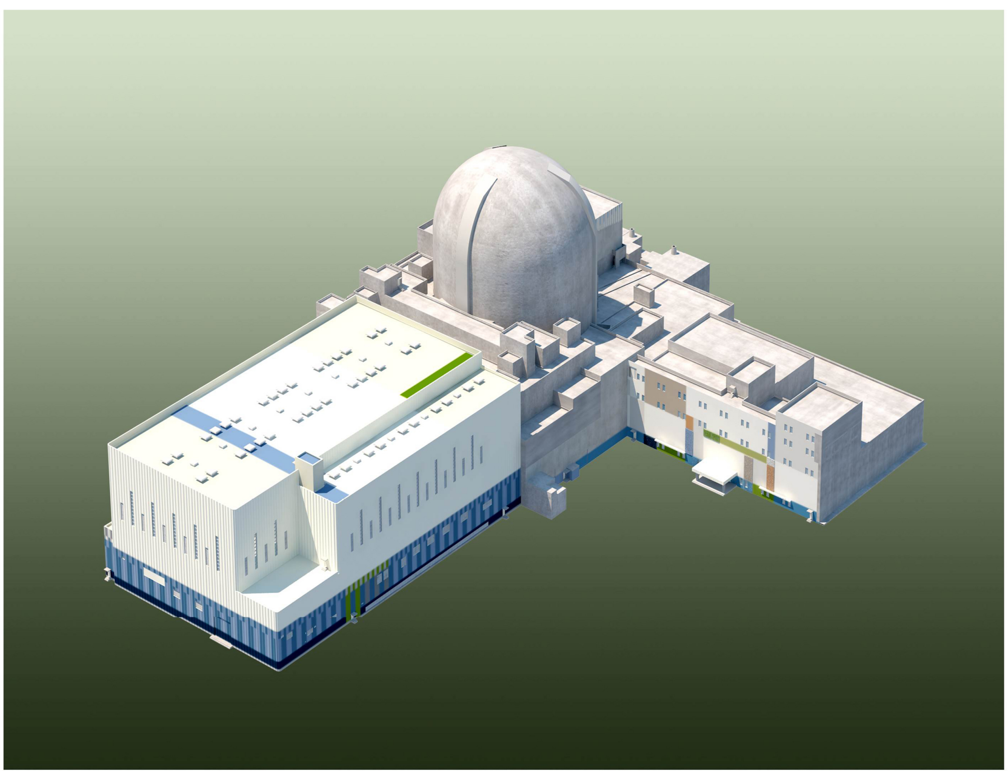

KOREA ELECTRIC POWER CORPORATION
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CHAPTER 19CHAPTER 19 – PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENT EVALUATION

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYM AND ABBREVIATION LIST

AAC	alternate alternating current
AC	alternating current
ACP	auxiliary charging pump
ACU	air cleaning units
ADV	atmospheric dump valve
AF	auxiliary feedwater
AFAS	auxiliary feedwater actuation signal
AFW	auxiliary feedwater
AFWS	auxiliary feedwater system
AFWST	auxiliary feedwater storage tank
AHU	air handling units
AIA	aircraft impact assessment
AICC	adiabatic isochoric complete combustion
ALWR	Advanced Light Water Reactor
AM	accident management
ANS	American Nuclear Society
ANSI	American National Standards Institute
ANPR	Advance Notice of Proposed Rulemaking
AOC	averted offsite property damage costs
AOE	averted occupational exposures
AOO	anticipated operational occurrence
AOSC	averted onsite costs
AOV	air-operated valve
APC-S	auxiliary process cabinet – safety
APE	averted public exposure
APR	Advanced Power Reactor
APR1400	Advanced Power Reactor 1400
ARM	annunciator response model

AS	1) accident sequenceanalysis 2) auxiliary steam
ASD	alternate shutdown
ASEP	Accident Sequence Evaluation Program
ASME	American Society of Mechanical Engineers
ATWS	anticipated transient without scram
BAMP	boric acid makeup pump
BAST	boric acid storage tank
BDBEE	beyond design basis external event
BMT	basemat melt through
BOP	balance of plant
BWR	boiling water reactor
CBDTM	cause-based decision tree methodology
CBP	computer based procedure
CC	component cooling water
CCDP	conditional core damage probability
CCF	common cause failure
CCFP	conditional containment failure probability
CCI	corium-concrete interaction
CCP	centrifugal charging pump
CCS	component control system
CCTV	closed-circuit television
CCW	component cooling water
CCWS	component cooling water system
CD	1) complete dependence (HRA) 2) condensate system
CDF	core damage frequency
CDI	conceptual design information
CET	1) containment event tree 2) core-exit thermocouple
CF	cavity flooding

CFBRB	containment failure before RPV breach
CFF	containment failure frequency
CFR	Code of Federal Regulations
CFS	cavity flooding system
CEUS	Central and Eastern United States
CHR	containment heat removal
CI	containment isolation
CIAS	containment isolation actuation signal
CIS	containment isolation system
CIV	containment isolation valve
CLRP	conditional large release probability
COE	cost of enhancement
COL	combined license
COLA	combined license application
CPLR	conditional probability of large release
CRTF	central receiver test facility
CS	containment spray
CSAS	containment spray actuation signal
CSP	containment spray pump
CSS	containment spray system
CST	condensate storage tank
CT	condensate storage and transfer system
CV	chemical volume control system
CVCS	chemical volume control system
CW	circulating water system
DA	data analysis
DAS	diverse actuation system
DBA	design basis accident
DC	direct current
DCD	Design Control Document
DCF	dynamic containment failure

DCH	direct containment heating
DDT	deflagration-to-detonation transition
DET	decomposition event tree
DG	diesel generator
DHR	decay heat removal
DIS	diverse indication system
DMA	diverse manual ESF actuation
DNBR	departure from nucleate boiling ration
DPS	diverse protection system
DST	deaerator storage tank
DVI	direct vessel injection
EBS	estimated break size
ECCS	emergency core cooling system
ECF	early containment failure
ECSBS	emergency containment spray backup system
ECW	essential chilled water system
ECWS	essential chilled water system
EDG	emergency diesel generator
EDMG	extensive damage mitigation guideline
EF	1) error factor 2) engineered safety features actuation system
ELAP	extended loss of ac power
EOG	emergency operating guideline
EOL	emergency overflow line
EOP	emergency operating procedure
EPA	electrical penetration assembly
EPRI	Electric Power Research Institute
EQ	equipment qualification
ERVC	external reactor vessel cooling
ES	equipment survivability
ESD	event sequence diagram

ESF	engineered safety features
ESF-CCS	engineered safety feature – component control system
ESFAS	engineered safety features actuation system
ESW	essential service water
ESWS	essential service water system
ET	event tree
EVSE	ex-vessel steam explosion
FA	flame acceleration
FCI	fuel-coolant interaction
FD	fluidic device
FLC	factored load category
FLEX	diverse and flexible coping strategies
FME	foreign material exclusion
FMEA	failure modes and effects analysis
FP	fire protection
FP-FPRA	full power fire probabilistic risk assessment
FPRA	fire probabilistic risk assessment
FT	fault tree
FV	Fussell-Vesely
FW	feedwater
FWCV	feedwater control valve
FWLB	feedwater line break
GOTHIC	generation of thermal hydraulic information for containment
GRID-LOOP	grid-centered loss of offsite power
GRID-SBO	grid-centered station blackout
GTG	gas turbine generator
GTRN	general transient
GW	gaseous radwaste system
GWR	guided wave radar
H2	hydrogen
HCLPF	high confidence of low probability of failure

HCOG	Hydrogen Control Owner's Group
HCR/ORE	human cognitive reliability / operator reliability experiment
HD	high dependence (HRA)
HE	human error
HELB	high-energy line break
HEP	human error probability
HFE	human failure event
HG	containment hydrogen control system
HI	hydrogen igniter
HJTC	heated junction thermocouple
HLI	hot leg injection
HLO	house load operation
HLR	high level requirement
HPME	high pressure melt ejection
HRA	human reliability analysis
HRR	heat release rate
HSI	human-system interface
HT	high temperature
HVAC	heating, ventilation, and air conditioning
HVT	holdup volume tank
HX	heat exchanger
I&C	instrumentation and control
IA	instrument air
IAS	instrument air system
ICDP	incremental core damage probability
ICI	in-core instrumentation
IE	initiating event
IEEE	Institute of Electrical and Electronic Engineers
IF	internal flooding analysis
INJ	injection status
INVINJ	in-vessel injection

IRWST	in-containment refueling water storage tank
ISLOCA	interfacing systems loss of coolant accident
ITAAC	inspections, tests, analyses, and acceptance criteria
IVSE	in-vessel steam explosion
IW	in-containment refueling water storage system
IWS	in-containment refueling water storage system
KEPCO	Korea Electric Power Corporation
KEPCO E&C	KEPCO Engineering & Construction Company
KHNP	Korea Hydro & Nuclear Power Company
LBLOCA	large break loss of coolant accident
LCF	late containment failure
LCL	local coincidence logic
LD	low dependence (HRA)
LDP	large display panel
LE	LERF analysis
LERF	large early release frequency
LHS	Latin Hypercube Sampling
LL	Large LOCA
LOCA	loss-of-coolant accident
LOCCW	loss of component cooling water
LOCV	loss of condenser vacuum
LODC	loss of dc power
LODCA	loss of dc power (Train A)
LODCB	loss of dc power (Train B)
LOESW	loss of essential service water
LOFW	loss of main feedwater
LOIA	loss of instrument air
LOLA	loss of large area
LOOP	loss of offsite power
LOSC	loss of shutdown cooling
LPD	local power density

LPSD	low power and shutdown
LRF	large release frequency
LSSB	large secondary side break
LT	low temperature
LUHS	loss of normal access to ultimate heat sink
LWR	light water reactor
MAAP	modular accident analysis program
MBLOCA	medium break loss of coolant accident
MCA	multiple compartment analysis
MCB	main control board
MCC	motor control center
MCCI	molten core-concrete interaction
MCR	main control room
MCSG	main control switchgear
MELB	moderate-energy line break
MFIV	main feedwater isolation valve
MFW	main feedwater
ML	medium LOCA
MOV	motor operated valve
MS	main steam
MSADV	main steam atmospheric dump valve
MSIS	main steam isolation signal
MSIV	main steam isolation valve
MSIVBV	main steam isolation valve bypass valve
MSLB	main steam line break
MSPI	mitigating systems performance index
MSS	main steam system
MSSV	main steam safety valve
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association

NP	non-Class 1E 13.8 kV auxiliary power system
NPSH	net positive suction head
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
NSSS	nuclear steam supply system
NTS	Nevada Test Site
NTTF	Near Term Task Force
NUREG	NRC technical report designation
NUREG/CR	NRC technical report designation – performed by contractor
OECD	Organization for Economic Cooperation and Development
P&ID	piping and instrument diagram
PAL	personnel air lock
PAR	passive autocatalytic recombiners
PASS	post-accident sampling system
PAU	physical analysis unit
PCB	power circuit breaker
PDS	plant damage state
PF	4.16 kV Class 1E auxiliary power
PGA	peak ground acceleration
PI-SGTR	pressure-induced steam generator tube rupture
PI	position indicator
PLOCCW	partial loss of component cooling water
PLOESW	partial loss of essential service water
POS	plant operational state(s)
POSRV	pilot-operated safety relief valve
PPS	plant protection system
PRA	probabilistic risk assessment
PRCSCD	RCS pressure at the time of core damage
PSA	probabilistic safety assessment
PSF	performance shaping factor
PWR	pressurized water reactor

PZR	pressurizer
QU	quantification
RAP	reliability assurance program
RAW	risk achievement worth
RB	reactor building
RBCM	rupture before core melt
RC	release category
RCB	reactor containment building
RCC	remote control center
RCGV	reactor coolant gas vent
RCGVS	reactor coolant gas vent system
RCP	reactor coolant pump
RCS	reactor coolant system
RCRY	reactor critical year
RCY	reactor calendar year
RD	rapid depressurization
RF	range factor
RFI	request for information
RG	Regulatory Guide
RLE	review level earthquake
RMI	reflective metallic insulation
RP	reactor protection
RPCS	reactor power cutback system
RPS	reactor protection system
RPV	reactor pressure vessel
RRS	reactor regulating system
RSC	remote shutdown console
RSF	RCP seal LOCA
RSG	rapid ex-vessel steam generation
RSR	remote shutdown room
RTD	resistance temperature detector

RTNSS	regulatory treatment of non-safety-related systems
RTSG	reactor trip switchgear
RTSS	reactor trip switchgear system
RV	reactor vessel
RVLMS	reactor vessel level monitoring system
RVR	reactor vessel rupture
RWT	raw water tank
RY	reactor year
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SAMG	severe accident management guideline
SAT	standby auxiliary transformer
SBCS	steam bypass control system
SBLOCA	small break loss of coolant accident
SBO	station blackout
SC	1) success criteria analysis 2) shutdown cooling
SCA	single compartment analysis
SCETCh	severe combined environment test chamber
SCP	shutdown cooling pump
SCS	shutdown cooling system
SD	steam generator blowdown
SDP	significance determination process
SDR	safety injection and rapid depressurization
SEL	seismic equipment list
SFD	spent fuel damage
SFP	spent fuel pool
SFPCCS	spent fuel pool cooling and cleanup system
SG	steam generator
SGTR	steam generator tube rupture
SI	safety injection

SIAS	safety injection actuation signal
SIP	safety injection pump
SIS	safety injection system
SIT	safety injection tank
SL	Small LOCA
SLB	steam line break
SLOCA	small break loss of coolant accident
SMA	seismic margin analysis
SOV	solenoid operated valve
SPAR-H	standardized plant analysis risk – human reliability
SPND	self-powered neutron detector
SR	supporting requirement
SRM	Staff Requirements Memorandum
SRP	Standard Review Plan
SSCs	structures, systems, and components
SSE	safe-shutdown earthquake
SSIE	supporting system initiating event
STC	source term category
STP	standard temperature and pressure
SWGR	switchgear
SX	essential service water system
SY	systems analysis
T&M	test and maintenance
TB	turbine building
TBV	turbine bypass valve
TCE	two-cell equilibrium
TDAFWP	turbine-driven auxiliary feedwater pump
TDR	time domain reflectometry
TEPCO	Tokyo Electric Power Company
TF	transfer
THERP	technique for human error rate prediction

TI-SGTR	temperature-induced steam generator tube rupture
TLOCCW	total loss of component cooling water
TLOESW	total loss of essential service water
TLOFW	total loss of feedwater
TMI	Three Mile Island
TRAN	transient
TS	Technical Specifications
TSP	trisodium phosphate
UAT	unit auxiliary transformer
UHS	ultimate heat sink
UPC	ultimate pressure capacity
VB	vessel breach
VCT	volume control tank
VD	emergency diesel generator area HVAC
VDU	visual display unit
VEWFDS	very early warning fire detection system
VG	ESW building/CCW heat exchanger building HVAC
VK	auxiliary building controlled area HVAC
VO	auxiliary building clean area HVAC
VOPT	variable over-power trip (signal)
VU	miscellaneous building HVAC
WH	turbine generator building open cooling water system
WO	chilled water system
WT	turbine generator building closed cooling water system
ZD	zero dependence (HRA)

CHAPTER 19 – PROBABILISTIC RISK ASSESSMENT AND SEVERE ACCIDENT EVALUATION

19.0 Probabilistic Risk Assessment and Severe Accident Evaluation

This chapter summarizes information related to the probabilistic risk assessment (PRA) and severe accident evaluations performed to support design certification of the APR1400. The primary objectives of this chapter during the design phase are as follows:

a. Identify and address potential design features and plant operational vulnerabilities, where a small number of failures could lead to core damage, containment failure, or large releases.

b. Reduce or eliminate the significant risk contributors of existing operating plants that are applicable to the new design by introducing appropriate features and requirements.

c. Select among alternative features, operational strategies, and design options to demonstrate that the design poses an acceptably low risk of severe accidents.

The PRA also identifies risk-informed safety insights based on systematic evaluations of the risk associated with the design, construction, and operation of the plant to support the following as described in Regulatory Guide (RG) 1.206 (Reference 1):

a. Describe the design robustness, levels of defense-in-depth, and tolerance of severe accidents initiated by either internal or external events.

b. Describe the risk significance of specific human errors associated with the design, including a characterization of the significant human errors that may be used as an input to operator training programs and procedure refinement.

c. Demonstrate how the risk associated with the design compares against the U.S. Nuclear Regulatory Commission's (NRC's) goals of less than 1×10^{-4}/year for core damage frequency (CDF) and less than 1×10^{-6}/year for large release frequency (LRF). In addition, compare the design against the NRC's approved use of a containment performance goal, which includes: (1) a deterministic goal that containment integrity be maintained for approximately 24 hours following the onset of core damage for the more likely severe accident challenges and (2) a probabilistic goal that the conditional containment failure probability be less than approximately 0.1 for the composite of all core damage sequences assessed in the PRA.

d. Assess the balance of preventive and mitigative features of the design, including consistency with the NRC's guidance in SECY-93-087 (Reference 2) and the associated Staff Requirements Memorandum (SRM).

e. Demonstrate whether the plant design, including the impact of site-specific characteristics, represents a reduction in risk compared to existing operating plants.

f. Demonstrate that the design addresses known issues related to the reliability of core and containment heat removal systems at some operating plants (i.e., the additional Three Mile Island (TMI) related requirements in 10 CFR 50.34(f) (Reference 3)).

The results and insights of the PRA are used to support other programs as follows:

a. Support regulatory oversight processes such as the Mitigating Systems Performance Index (MSPI) and the significance determination process (SDP), and other programs that are associated with plant operations (e.g., Technical Specifications, reliability assurance, human factors, Maintenance Rule implementation).

b. Identify and support the development of specifications and performance objectives for the plant design, construction, inspection, and operation, such as the inspections, tests, analyses, and acceptance criteria (ITAAC); the reliability assurance program (RAP); Technical Specifications (TS); and combined license (COL) action items and interface requirements.

A COL applicant that references the APR1400 design certification is to confirm that the PRA in the design certification bounds the site-specific design information and any design changes or departures, or update the PRA to reflect the site-specific design information and any design changes or departures.

19.0.1 NRC Regulatory Requirements and Related Policies

The primary requirements, guidance, policies, and standards utilized to complete the PRA and severe accident evaluations are as follows:

a. 10 CFR 52.47 (Reference 4)

b. 10 CFR 50.34

c. NRC Policy Statement 50 FR 32138 (Reference 5)

d. NRC Policy Statement 51 FR 28044 (Reference 6)

e. NRC Policy Statement 52 FR 34884 (Reference 7)

f. NRC Policy Statement 59 FR 35461 (Reference 8)

g. NRC Policy Statement 60 FR 42622 (Reference 9)

h. RG 1.200 (Reference 10)

i. RG 1.206

j. SECY-90-016 (Reference 11)

k. SECY-93-087

l. SECY-06-0220 (Reference 12)

m. NUREG-0800, Section 19.0 (Reference 13)

n. American Society of Mechanical Engineers (ASME) / American Nuclear Society (ANS) RA-S-2008 (Reference 14)

o. ASME/ANS RA-Sa-2009 (Reference 15)

19.0.2 Structure of Chapter 19

This chapter is structured in the following manner:

a. PRA results and insights are addressed, including internal and external event evaluation during full-power operations and during low power and shutdown operations (Section 19.1). External events that are evaluated include seismic, internal fire, and internal flood. Level 1 and Level 2 results are reported. This section also describes the uses and applications of the PRA, PRA quality, design and operational features that are intended to improve plant safety, and PRA input to design programs and processes.

b. Severe accident evaluations are provided, including an assessment of preventive and mitigative features (Section 19.2). This section also describes containment performance capability, accident management, and considerations of potential design improvements under 10 CFR 50.34 (f).

c. Additional requirements established to manage and mitigate beyond design basis external events (BDBEEs) as a result of the Fukushima Dai-Ichi event are provided in Section 19.3, which addresses conformance with SECY-12-0025 (Reference 16), including the requirements contained in NRC Orders EA-12-049 (Reference 17) and EA-12-051 (Reference 18), and the related Request for Information (Reference 19).

d. Evaluation of loss of large areas (LOLAs) as required by 10 CFR 52.80(d) (Reference 20) and 10 CFR 50.54(hh)(2) (Reference 21) is provided in Section 19.4.

e. Evaluation of the aircraft impact assessment (AIA) as required by 10 CFR 50.150 (Reference 22) is provided in Section 19.5.

19.0.3 Combined License Information

COL 19.0(1) The COL applicant is either to confirm that the PRA in the design certification bounds the site-specific design information and any design changes or departures, or to update the PRA to reflect the site-specific design information and any design changes or departures.

19.0.4 References

1. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," U.S. Nuclear Regulatory Commission, Rev. 0, June 2007.

2. SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs," U.S. Nuclear Regulatory Commission, Washington, DC, letter issued April 2, 1993 and Staff Requirements Memorandum issued July 21, 1993.

3. 10 CFR 50.34, "Contents of applications; technical information," U.S. Nuclear Regulatory Commission, June 2009.

4 10 CFR 52.47, "Contents of applications; technical information," U.S. Nuclear Regulatory Commission, June 2009.

5. "Severe Reactor Accidents Regarding Future Designs and Existing Plants," NRC Policy Statement 50 FR 32138, U.S. Nuclear Regulatory Commission, August 1985.

6. "Safety Goals for the Operations of Nuclear Power Plants," NRC Policy Statement 51 FR 28044, U.S. Nuclear Regulatory Commission, August 1986.

7. "Nuclear Power Plant Standardization," NRC Policy Statement 52 FR 34884, U.S. Nuclear Regulatory Commission, September 1987.

8. "Regulation of Advanced Nuclear Power Plants," NRC Policy Statement 59 FR 35461, U.S. Nuclear Regulatory Commission, July 1994.

9. "The Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," NRC Policy Statement 60 FR 42622, U.S. Nuclear Regulatory Commission, August 1995.

10. Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," Rev. 2, U.S. Nuclear Regulatory Commission, March 2009.

11. SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," U.S. Nuclear Regulatory Commission, Letter issued January 12, 1990 and Staff Requirements Memorandum issued June 26, 1990.

12. SECY-06-0220, "Final Rule to Update 10 CFR Part 52, 'Licenses, Certifications, and Approvals for Nuclear Power Plants' (RIN AG24)," U.S. Nuclear Regulatory Commission, Letter issued October 31, 2006.

13. NUREG-0800, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors," Section 19.0, Rev. 2, U.S. Nuclear Regulatory Commission, June 2007.

14. ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications" (Revision 1 RA-S-2002), American Society of Mechanical Engineers, April 2008.

15. ASME/ANS RA-Sa-2009, "Addenda to ASME/ANS RA-S-2008," American Society of Mechanical Engineers, February 2009.

16. SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," U.S. Nuclear Regulatory Commission, February 2012.

17. Order EA 12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," U.S. Nuclear Regulatory Commission, March 12, 2012.

18. Order EA 12-051, "Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," U.S. Nuclear Regulatory Commission, March 12, 2012.

19. "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," U.S. Nuclear Regulatory Commission, March 12, 2012.

20. 10 CFR 52.80, "Contents of applications; additional technical information," U.S. Nuclear Regulatory Commission, March 2009.

21. 10 CFR 50.54, “Conditions of licenses,” U.S. Nuclear Regulatory Commission, June 2013.

22. 10 CFR 50.150, “Aircraft impact assessment,” U.S. Nuclear Regulatory Commission, July 2009.

19.1 Probabilistic Risk Assessment

The scope of the APR1400 Probabilistic Risk Assessment (PRA) includes a Level 1 and Level 2 PRA for internal and external events (including internal flooding and internal fire) at full-power, as well as low power and shutdown (LPSD) conditions. The design changes resulting from the additional requirements established to manage and mitigate beyond design basis external events (BDBEEs) as a result of the Fukushima Dai-Ichi event described in Section 19.3 are not included.

The Level 1 and 2 evaluations of internal events at full-power conditions are based on the basic elements and approaches given in ASME/ANS RA-S-2008 and ASME/ANS RA-Sa-2009 (References 1 and 2), as endorsed by U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 1.200 (Reference 3), and using the methodological guidance of NUREG/CR-2300 (Reference 4) and NUREG-1150 (Reference 5).

Level 1 PRA evaluation is composed of the following technical elements:

a. Initiating event analysis

b. Accident sequence analysis

c. Success criteria analysis

d. System analysis (including system dependencies)

e. Data analysis and common cause analysis

f. Human reliability analysis (HRA)

g. Quantification

The Level 2 PRA results are produced in terms of large release frequency (LRF) for internal events at full power and the evaluation involves the following:

a. Plant damage state (PDS) analysis

b. Containment response analysis

c. Accident progression analysis

d. Quantification

The evaluation of a seismic external event is based on the seismic margin analysis (SMA) guidance in the ASME/ANS PRA Standard (Reference 2). The PRA-based SMA model is based on the internal events of the PRA model expanded to account for structural dependencies.

The evaluation of internal fire events is based on the basic methodology and approach given in NUREG/CR-6850 (Reference 6). A qualitative evaluation identifies fire compartments and susceptible components and a quantitative analysis evaluates initiating events and fire scenarios. The evaluation of internal flooding is based on the basic methodology and approach given in the ASME/ANS PRA Standard. A qualitative evaluation identifies flood areas and sources and a quantitative analysis evaluates initiating events and flood scenarios.

The Level 2 evaluation of the flooding and fire events at full-power conditions is based on the same approach as for internal events. Fault trees are modified to take into account flood/fire-induced failures of severe accident mitigation features and these fault trees are mapped into the internal events through the associated PDSs.

Other external events (i.e., high winds and tornadoes, external floods, transportation accidents, nearby facility accidents, etc.) are subject to screening criteria consistent with the ASME/ANS PRA Standard.

The evaluation of internal events, internal fire and internal flooding for low power and shutdown (LPSD) operations, uses the same basic methods as the evaluations for operations at power. A representative set of initiating events is chosen and modeled for a set of plant operational states (POSs).

The APR1400 PRA is developed from the available design information. If sufficient information is not available, then the information from the reference plants is used. The reference plants are Shin-Kori Units 3 and 4.

The PRA is documented in an extensive set of PRA notebooks, which are cross-referenced in the PRA Summary Report (Reference 7).

19.1.1 Uses and Applications of the PRA

19.1.1.1 Design Phase

The PRA is an integral part of the design process and is used to optimize the plant design with respect to safety. The PRA models and results influence the selection of design alternatives.

The APR1400 is designed to perform better than currently operating plants in the area of severe accident performance, since prevention and mitigation of severe accidents are evaluated during the design phase, taking advantage of PRA results and severe accident evaluations. The PRA results indicate that the APR1400 design results in a low level of risk and meets the core damage frequency (CDF), LRF, and containment performance goals for new-generation pressurized water reactors (PWRs).

At the design phase, the PRA results are used as information providing input to Technical Specifications (Chapter 16), reliability assurance program (RAP) (Section 17.4), human factors engineering (Section 18.6), severe accident evaluation (Section 19.2), and other design areas.

19.1.1.2 Combined License Application Phase

Uses of the PRA related to a specific combined license (COL) application are not addressed at this stage. A COL applicant that references the APR1400 design certification needs to describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the combined license application (COLA) phase.

19.1.1.3 Construction Phase

Uses of the PRA related to a specific COL application and associated construction activities are not addressed at this stage. A COLA that references the APR1400 design certification needs to describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the construction phase.

19.1.1.4 Operational Phase

Uses of the PRA related to the operating phase for the APR1400 are not addressed at this stage. A COLA that references the APR1400 design certification needs to describe the uses of PRA in support of licensee programs and identify and describe risk-informed applications being implemented during the operational phase.

19.1.2 Quality of PRA

This section identifies the attributes of the PRA that make it suitable for use in support of the design process and design certification. The provisions of 10 CFR 50, Appendix B, do not apply to the PRA for design certification. The PRA, however, is performed using the quality assurance attributes and methods to achieve and maintain an appropriate quality level. The quality methods include the following:

a. Use of qualified personnel: Qualified analysts perform each of the technical elements of the PRA. Analysts complete technical tasks in areas in which they are knowledgeable and understand the approach, methods, and limitations of the respective analyses.

b. Use of procedures to control documentation: Each element of the PRA is formally documented in a calculation prepared according to the procedures. Each PRA calculation is reviewed by a qualified staff. Any change or addition to a PRA calculation is also governed by procedure to control the configuration of the PRA. Each document revision requires review consistent with that performed for the original version. The PRA calculations are controlled documents and are maintained in archival form, including the regulatory submittal documents.

c. Use of procedures to control corrective actions: The conduct of the PRA is governed by the Corrective Action Program, which establishes requirements for promptly identifying and resolving errors or conditions that are adverse to quality. In addition to corrective action requirements, the design control process provides a mechanism for changes in design, assumptions, and supporting analyses to be reviewed by PRA personnel for potential impact on the PRA.

The above-listed items are essential steps to provide reasonable assurance of the technical quality of the PRA. With respect to producing a PRA adequate to meet the needs of the design certification process, Subsection 19.1.2.1 defines the scope of the PRA completed for the APR1400 design. Subsection 19.1.2.2 addresses the level of detail reflected in the models and other elements of the PRA. Subsection 19.1.2.3 describes the standards and other guidance that are used to provide a PRA that is technically adequate to support the applications described in Subsection 19.1.1. Subsection 19.1.2.4 outlines the steps that are taken to maintain the PRA as the design has evolved and to guide future updates to the PRA.

19.1.2.1 PRA Scope

The APR1400 PRA consists of a Level 1 and Level 2 PRA; an assessment of the potential for core damage, an assessment of the containment response to these accidents, and characterization of the magnitude and frequencies of radionuclide releases. The PRA includes applicable internal and external initiating events and all plant operating modes. Some initiating events are screened from detailed analysis based on their applicability to the design phase while others are treated qualitatively (e.g., other external events).

The approach used for risk evaluation of seismic events includes a PRA-based seismic margins assessment (SMA) rather than a seismic PRA. The PRA-based SMA is an acceptable methodology according to NRC guidance and SECY-93-087 (Reference 8). Although the PRA-based SMA does not result in the estimation of CDF or LRF, it does yield valuable information regarding the ruggedness of the seismic design with respect to severe accidents.

The scope is sufficient for the discussion of risk insights and results, and severe accident evaluation during the design phase.

19.1.2.2 PRA Level of Detail

To be effective in supporting the design process and to provide meaningful results with regard to judging the overall risk posed by the design, the PRA reflects a level of detail limited by the following:

a. The availability of certain design details, operating procedures, and other information

b. The level at which usable reliability data are available

At present, elements of the detailed design and other supporting information that are not available to support the PRA include the following:

a. The specific routing of piping – relevant to an assessment of internal flooding events

b. The routing of control and power cables – relevant to an assessment of internal fire events

c. The specific location of key equipment within the rooms – relevant to assessments of internal flooding and fire events

d. Emergency and other operating procedures – relevant to human reliability analysis

f. The conceptual design information (CDI), which is not finalized during the design phase

Analysis was performed that is consistent with the level of design detail available. In the case of internal fire events, the frequencies and the evaluation of equipment that could be affected reflect bounding assumptions. These assumptions have been refined, within the context of the available information, to avoid masking risk contributors from other sources due to overly conservative treatment.

A COL applicant that references the APR1400 design certification is required to review as-designed and as-built information and conduct walkdowns as necessary to confirm that the assumptions used in the PRA, including PRA inputs to RAP and severe accident mitigation design alternatives (SAMDA), remain valid with respect to internal events, internal flooding and fire events (routings and locations of pipe, cable and conduit), and HRA (i.e., development of normal operating procedures, emergency operating procedures and training), external events (including PRA-based SMA based upon high confidence, low probability of failure [HCLPF] seismic fragilities), and LPSD procedures.

The level of detail in the APR1400 PRA is commensurate with the guidance set forth in the ASME/ANS PRA Standard and NRC RG 1.200. Where detailed design information is not available, appropriate bounding assumptions are used consistent with the guidelines in the ASME/ANS PRA Standard and NRC RG 1.200.

19.1.2.3 PRA Technical Adequacy

The content of the PRA and the steps taken to provide for its technical quality are consistent with the guidance in the ASME/ANS PRA Standard and NRC RG 1.200. This PRA Standard presents high level requirements (HLRs) for various PRA technical elements and, for each HLR, a set of more detailed supporting requirements (SRs). The supporting requirements are related to the three capability categories addressed in the standard.

These requirements were formulated for application to operating nuclear power plants, and in some cases cannot be explicitly satisfied for a PRA performed in the design phase. Table 19.1-1 provides a summary of the degree to which the APR1400 PRA relates to the capability categories for the nine technical elements addressed in the ASME/ANS PRA Standard.

A COL applicant that references the APR1400 design certification should conduct a peer review of the PRA relative to the ASME/ANS PRA Standard prior to use of the PRA to support risk-informed applications or before fuel load. The findings and observations from this review should be dispositioned after the review to provide reasonable assurance that captured issues are addressed. Changes that are made to the PRA model and associated documentation as a result of this resolution process are to be conducted in a manner consistent with Subsection 19.1.2.4.

The ASME/ANS PRA Standard does not fully address LPSD modes of operation (the standard is still in draft form). For analyses in which the ASME/ANS PRA Standard does not directly apply, the APR1400 PRA has used the latest industry guidance available to perform assessments commensurate with the uses of the PRA. This additional guidance includes the following:

a. Internal fire analysis: The internal fire PRA uses the guidance provided in NUREG/CR-6850 and its supplement. This report documents the latest methodology available for practical assessment of internal fires in nuclear power plants. Limitations in applying this methodology because some design details are not yet available are addressed in Subsection 19.1.5.2.

b. LPSD analysis: The ASME/ANS PRA Standard and the associated NRC guidance on PRA adequacy apply only to accidents initiated from power operation. The APR1400 PRA also addresses LPSD modes. The LPSD PRA methodology and level of detail are consistent with industry practice. The LPSD methodology and modeling are state of the art and are designed to meet the requirements of the draft ANS/ASME LPSD PRA Standard (Reference 9).

c. PRA-based seismic margins assessment: The APR1400 PRA uses a PRA-based SMA approach to evaluate potential vulnerabilities to seismic events. The approach as implemented for the United States is consistent with guidance in SECY-93-087 and follows the general approach delineated in the ASME/ANS PRA Standard.

d. Other external events: The APR1400 PRA for design certification uses a screening method to address other external events that could represent challenges to safe operation. The screening approach follows guidance provided in the ASME/ANS PRA Standard.

19.1.2.4 PRA Maintenance and Upgrade

The objective of the PRA maintenance and upgrade program is to provide reasonable assurance that the PRA is maintained and upgraded so that its representation of the as-designed, as-to-be-built, and as-to-be-operated plant is sufficient to support the risk-informed applications for which the PRA is being used. PRA maintenance involves updating of PRA models to reflect plant changes such as modifications, procedure changes, or plant performance. A PRA upgrade involves the incorporation into the PRA model of new methodologies or significant changes in scope or capability.

The APR1400 PRA model and supporting documentation are to be maintained so that they continue to reflect the as-designed characteristics of the plant. Consistent with the ASME/ANS PRA Standard, and NRC RG 1.200, a process is in place to perform the following as applicable to the certified design:

a. Monitor PRA inputs and collect any new information relevant to the PRA.

b. Maintain and upgrade the PRA to be consistent with the design.

c. Consider cumulative impacts of pending changes when applying the PRA.

d. Consider impacts of changes for previously implemented risk-informed decisions that used the PRA (e.g., RAP).

e. Maintain configuration control of the computational methods used to support the PRA.

f. Document the PRA model and processes.

To meet the guidance of NRC RG 1.206 (Reference 10), the PRA should be maintained to provide reasonable assurance that it reasonably reflects as-designed, as-to-be-built, and as-to-be-operated conditions. A COL applicant that references the APR1400 design certification needs to describe the plant-specific PRA maintenance and upgrade program.

19.1.3 Special Design/Operational Features

Design and operational characteristics of the APR1400 that result in improved plant safety as compared to currently operating nuclear power plants, include the following:

a. An in-containment refueling water storage tank (IRWST)

b. A four-train safety injection system (SIS) that injects borated water directly into the reactor vessel (RV) through direct vessel injection (DVI) nozzles

c. Four pumps for component cooling water and essential service water systems (CCWS and ESWS)

d. An emergency containment spray backup system (ECSBS)

e. A cavity flooding system (CFS)

f. A hydrogen control system (HG)

The PRA has influenced the selection of design changes such as:

a. Four emergency diesel generators (EDGs)

b. The inclusion of an alternate ac source (AAC) gas turbine generator (GTG), which can be used as an independent ac source to cope with station blackout (SBO) scenarios following loss of offsite power (LOOP)

Table 19.1-2 provides a summary of the APR1400 systems. The table includes the system's key structures, systems, and components (SSCs) and the key functional descriptions with respect to the design features for preventing core damage, mitigating the consequences of core damage and preventing releases from containment, and mitigating the consequences of releases from containment.

19.1.3.1 Design/Operational Features for Preventing Core Damage

Key preventive features that are intended to minimize initiation of plant transients, mitigate the progression of plant transients, and prevent severe accidents include the following safety systems:

a. Safety Injection System (SIS)

The SIS consists of four independent trains. Each pump train takes its suction from the IRWST. The safety injection pumps (SIPs) inject borated water from the IRWST into the reactor coolant system (RCS) through DVI lines, which are shared with safety injection tanks (SITs). Two of the trains can also be aligned to inject water to the RCS hot legs through the shutdown cooling lines. The SITs are a subsystem within the SI system. The SITs are a self-actuating, passive system that injects borated water directly into the RV through DVI nozzles. A simplified diagram of the SIS is shown in Figure 19.1-1.

The function of the SIS is to inject borated water into the RCS to restore and maintain RCS inventory during accident conditions. This injection provides reasonable assurance of core decay heat removal, thereby preventing core damage in addition to maintaining RCS inventory.

The functions of the SIS are to:

1) Inject borated water into the RCS through DVI nozzles to flood and cool the core following a loss-of-coolant accident (LOCA), thus preventing significant cladding failures and subsequent releases of fission products into the containment, and maintaining the core subcritical.

2) Provide removal of heat from the core for extended periods of time following a LOCA.

3) Inject borated water into the RCS to increase shutdown margin following a rapid cooldown of the system due to a steam line break.

4) Provide supplementary emergency boration capabilities and prevent boron precipitation in the RCS during the long-term cooling mode of operation.

5) Provide water injection during the feed and bleed operation in conjunction with the POSRVs to remove decay heat.

The IRWST stores refueling water and provides a single source of water for SIPs, shutdown cooling pumps (SCPs) and containment spray pumps (CSPs), and serves as a heat sink for steam discharged from the pressurizer. The holdup volume tank (HVT) provides a low collection point in reactor containment to collect water released from pipe breaks and containment sprays during a design basis accident. The IRWST and HVT are considered to be integral parts of the reactor containment building internal structure.

During normal power operation, the IRWST provides storage of borated water for refueling. For refueling, water from the IRWST is transferred to the refueling pool using the SCPs and is cooled by the shutdown cooling heat exchanger. Following refueling, water is transferred from the refueling pool to the IRWST by diverting a portion of the SCP discharge downstream of the shutdown cooling (SC) heat exchanger to the IRWST. The remaining water in the refueling pool is drained down to the RV flange. Subsequent draining of the refueling pool is performed by using the spent fuel pool (SFP) cleanup pumps directly to the IRWST.

During accident conditions, the IRWST provides borated water for injection into the RCS by the SIS and for containment spray by the containment spray system

(CSS). The IRWST also provides storage of borated water for quenching the steam discharged from POSRVs. The IRWST is cooled by the containment spray heat exchangers during LOCA or secondary side pipe break. The containment spray pumps (CSPs) take suction from the IRWST and pump water to the containment spray heat exchangers where it is cooled and then sprayed through the spray nozzles into the containment atmosphere. Heat transfer from the containment atmosphere to the falling spray droplets provides containment decay heat removal. The water from the LOCA breaks and containment sprays is drained and collected in the HVT until the water level in the HVT reaches the main spillways, at which point, water flows back into the IRWST.

b. Shutdown Cooling System (SCS)

The SCS consists of two independent trains, each containing suction and discharge connections to the RCS. Each train contains a pump, a heat exchanger, a miniflow line with a heat exchanger, and associated valves and piping. A simplified diagram of the SCS is shown in Figure 19.1-2.

During a small break LOCA or a steam generator tube rupture (SGTR) event, borated water from the IRWST is injected into the reactor core by the SIPs. If these pumps are unavailable, the RCS can be depressurized rapidly and the SCPs can be used to inject the borated water. This operation is referred to as shutdown cooling system injection mode.

The SCS is used to cool the RCS during normal shutdowns or emergency shutdowns. During shutdown cooling operation, the SCPs take suction from the hot legs of the RCS and discharge the reactor coolant through the SC heat exchangers. The flow is then returned to the RCS through the DVI nozzles. The CSPs can be used to circulate the reactor coolant during shutdown cooling operation if the SCPs are not available. This operation is considered as a long-term decay heat removal.

During an accident condition, the steam generators (SGs) are used early in plant shutdown followed by the SCS as the preferred mode to remove decay heat. IRWST cooling is accomplished by circulating the water from the IRWST through the shutdown cooling heat exchangers and then back to the IRWST, during the feed and bleed operation using the pilot-operated safety relief valves (POSRVs) and SIPs.

c. Containment Spray System (CSS)

The CSS is designed to remove heat and fission products from the containment atmosphere in the event of a LOCA or MSLB inside the containment and thereby limit the leakage of airborne activity from the containment. The CSS takes borated water from the IRWST. A simplified diagram of CSS is shown in Figure 19.1-3.

The CSS consists of two trains. Each train includes a CSP, a containment spray heat exchanger, a containment spray minimum flow heat exchanger, a main spray header with nozzles, an auxiliary spray header with nozzles, and associated valves, piping and instrumentation. The CSPs are designed to be functionally interchangeable with the SCPs. The SCPs can be utilized as backup for the CSPs (or the CSPs as backup for the SCPs).

The functions of the CSS are to:

1) Reduce the containment atmosphere pressure and temperature below containment design limits with margin in the event of a postulated LOCA or MSLB inside containment, by removing heat from the containment atmosphere

2) Limit airborne iodine and particulate fission product inventory in the containment atmosphere in the event of an accident

3) Provide a backup to the SCS for decay heat removal and cooling of the IRWST during feed and bleed operations utilizing the SIS and the POSRVs

4) Provide an appropriate spray water chemical composition after an accident, which is required for hydrogen control, material compatibility, and long-term iodine control against re-evaporation

5) Provide long-term cooling of the IRWST to remove the decay heat if the containment spray operation through the spray header is not available to

protect the equipment located inside the containment for a long period of time following the accident

In addition, containment spray may be accomplished using the ECSBS. The function of the ECSBS is to provide sprays of water from external water sources to the dedicated ECSBS containment spray header for reducing containment pressure during emergency conditions when all CSPs are unavailable.

d. Pilot-Operated Safety Relief Valves (POSRVs)

The four POSRVs are a once-through depressurization system that has the capabilities to provide overpressure protection, and to depressurize the primary system. The four POSRVs act as the primary safety valves located on the top of the pressurizer.

In the event that and auxiliary feedwater and startup feedwater are unavailable to remove decay heat through the steam generators, the POSRVs are used to perform feed and bleed operation. To perform the depressurization of the primary system, the POSRVs are actuated by manually opening the normally closed double motor-operated pilot valves. The double motor-operated pilot valves consist of two motor-operated valves (MOVs) installed in series to allow each valve to be used as a backup in case that the other valve fails to close. The POSRVs are designed to be operated even when normal ac power is not available, whereas the MOVs are powered from an emergency dc power source with a battery backup. During feed and bleed operation, POSRVs discharge to the IRWST through underwater spargers, and the SIPs provide feed flow to the RCS. The POSRVs are considered to be a part of the RCS in the PRA. A simplified diagram of POSRVs and the discharge paths to IRWST is shown in Figure 19.1-4.

e. Auxiliary Feedwater System (AFWS)

The function of the AFWS is to provide an independent means of supplying makeup water to the SGs for removal of decay heat from the reactor core during an accident. The AFWS is a dedicated safety system that has no functions during normal operation.

The AFWS consists of two redundant trains. Each train consists of one auxiliary feedwater storage tank (AFWST), one motor-driven pump, one turbine-driven pump, and the associated valves, piping, instrumentation and controls (I&C). A simplified diagram of the AFWS is shown in Figure 19.1-5.

Each auxiliary feedwater pump takes suction from its associated AFWST and discharges to its own discharge path. Each discharge header contains a pump discharge check valve, modulating valve, isolation valve, and an SG isolation check valve. The motor-driven auxiliary feedwater pump line and the turbine-driven auxiliary feedwater pump line are joined together inside containment to feed the SG through a common header that connects to the SG downcomer feedwater line. Each common auxiliary feedwater header contains a cavitating venturi to restrict the maximum flow rate to each steam generator. The cavitating venturi restricts the magnitude of the two-pump flow as well as the magnitude of individual pump runout.

If the AFWS is unavailable to provide the decay removal, then the startup feedwater pump can be used. The startup feedwater pump takes its suction from the deaerator storage tank (DST), which is connected to the condensate system, condensate storage and transfer system, and condenser, where the steam is condensed from SGs through turbine bypass valves (TBVs).

f. Chemical and Volume Control System (CVCS)

The CVCS is a non-safety system (except for portions of the system that form part of the reactor coolant pressure boundary) consisting of a number of subsystems that, when operated together, function to control the RCS chemistry and volume against the established specifications. The CVCS maintains the required volume of water in the RCS together with the pressurizer level control system. The CVCS also maintains reactor coolant purity and chemical conditions by processing the coolant through filters and ion exchangers.

The CVCS consists of two centrifugal charging pumps (CCPs), one auxiliary charging pump (ACP), regenerative heat exchanger, letdown heat exchanger, ion exchangers, filters, pumps, tanks, and associated valves, piping and instrumentation. A simplified diagram of the CVCS is shown in Figure 19.1-6.

The CVCS provides four key functions for accident mitigation in the unlikely event of an accident. The first accident mitigation function is to support the auxiliary pressurizer spray function. This function is accomplished by the centrifugal charging pumps drawing suction from either the volume control tank (VCT) or boric acid storage tank (BAST) and discharging to the pressurizer spray nozzle via the auxiliary spray line. Successful delivery of the BAST contents to the charging pump suction is accomplished either via the boric acid makeup pumps (BAMPs) or via gravity drain.

The second accident mitigation function is the emergency boration that provides an independent means of supplying borated water to the RCS for reactivity control following an ATWS. This is done by delivering the contents of the BAST via the charging pumps to the RCS via the normal charging line.

The third accident mitigation function is to replenish the inventory in the IRWST. This is done by delivering the contents of the BAST to the IRWST using the BAMPs.

The fourth accident mitigation function is RCP seal cooling. RCP seal cooling is normally accomplished using the CVCS centrifugal charging pumps taking suction from the BAST via gravity drain and discharging to the individual RCP seal packages via the RCP seal injection filters.

The ACP is a positive displacement pump that is placed in parallel with the CVCS centrifugal charging pumps. The ACP is manually started and supplies injection water when RCP seal injection is not available through the two centrifugal charging pumps. The ACP takes suction from the VCT or the BAST and supplies seal injection water to the RCPs through the normal CVCS seal injection flow path. The ACP is considered as a diverse capability from the two centrifugal pumps.

g. Reactor Protection System (RPS)

The RPS is a part of the plant protection system (PPS). Nuclear steam supply system (NSSS) parameters and containment conditions are monitored by the PPS continuously. If monitored conditions approach specific safety limits, the PPS through the RPS rapidly shuts down the reactor to protect the fuel design limits and prevent a breach of the RCS pressure boundary. The PPS also communicates with the engineered safety features – component control system (ESF-CCS), which actuates mitigating systems.

The PPS is based on a digital I&C that includes plant parameter bistable comparator functions, coincidence logic functions, and initiation logic functions to actuate a reactor trip and operation of engineered safety features.

The coincidence trip signals are used in the initiation of the reactor trip switchgear system (RTSS) and the ESF-CCS. A coincidence of two-out-of-four like trip signals is required to generate a reactor trip signal.

A trip is generated when a coincidence of two like trip signals of the monitored plant parameters or containment conditions reach a preset safety limit. The RPS initiates a reactor trip for the following conditions:

1) Variable overpower trip signal (VOPT)

2) High logarithmic power level trip signal

3) High local power density (LPD) trip signal

4) Low departure from nucleate boiling ratio (DNBR) trip signal

5) High pressurizer pressure trip signal

6) Low pressurizer pressure trip signal

7) Low steam generator water level trip signal

8) High steam generator water level trip signal

9) Low steam generator pressure trip signal

10) High containment pressure trip signal

11) Low reactor coolant flow trip signal

12) Manual trip

The APR1400 design includes the diverse actuation system (DAS). The DAS consists of the diverse protection system (DPS), the diverse manual ESF actuation (DMA) switches, and the diverse indication system (DIS). The DPS provides additional trip capability to the RPS.

h. Engineered Safety Features Actuation System (ESFAS)

The engineered safety features (ESF) I&C consists of sensors, auxiliary process cabinet – safety (APC-S), the ESFAS portion of the PPS, and ESF-CCS.

The ESFAS monitors selected parameters to initiate the operation of necessary ESF systems to prevent damage to the core and the RCS components. It also provides reasonable assurance of containment integrity and prevents unacceptable levels of radioactivity release to the environment as well as protecting the control room operators during fuel handling accidents. The system uses bistable trip functions and coincidence logic in the PPS and component control logic in the ESF-CCS to generate actuation signals. The following actuation signals are generated by the ESFAS:

1) Safety injection actuation signal (SIAS)

2) Containment isolation actuation signal (CIAS)

3) Containment spray actuation signal (CSAS)

4) Main steam isolation signal (MSIS)

5) Auxiliary feedwater actuation signal (AFAS)

i. AC Power System

The ac power system comprises two qualified circuits from the offsite transmission network to the switchyard, two qualified circuits from the switchyard to the onsite Class 1E distribution system, four diesel generators (each capable of supplying one train of the onsite Class 1E ac distribution system, and automatic load sequencing for four trains of supported equipment that must be operable in Modes 1, 2, 3, and 4).

The non-Class 1E 13.8 kV power system consists of four non-safety switchgears. Each of two unit auxiliary transformers (UATs) normally supplies two of the 13.8 kV switchgears. The non-Class 1E 13.8 kV power system furnishes power to large motors such as the RCP motors, condensate pump motors, circulating water pump motors, and associated 480V load centers.

The Class 1E safety systems are divided into four redundant and independent distribution systems. Each distribution system can be powered from the following sources:

1) Unit auxiliary transformer (UAT)

2) Standby auxiliary transformer (SAT)

3) Emergency diesel generator (EDG)

4) Alternate AC (AAC)

If both the offsite power sources and the standby EDGs are unavailable, 4.16 kVac buses may be powered from the AAC power source. The AAC provides an independent and diverse power source, which is furnished with a battery and charger to provide power to its associated dc loads.

The unit has four independent 4.16 kV Class 1E auxiliary power systems (identified as safety trains A, B, C, and D), which normally receive power from the UATs. The incoming source breakers trip upon loss of normal power, and emergency power is provided to each of the redundant 4.16 kV Class 1E auxiliary power system trains by four EDGs.

All safety-related SSCs are powered from the Class 1E 4.16 kV power system, either directly or through transformers if a lower voltage is needed. The arrangement of EDGs, electrical distribution system, and supported loads is completely independent of each other. If power from both the UATs and SATs is lost, the normal power source to the Class 1E power system is also lost, and the

Class 1E buses are provided by the EDGs. In addition, the non-safety AAC power source is provided to cope with an SBO condition.

When the main generator is isolated from the transmission system due to an out-of-step condition, system disturbance, or operator action, the plant can be aligned for house load operation (HLO). During HLO, both the non-Class 1E and Class 1E power systems are fed from the main generator through the UATs if the main generator is not connected to the grid. The HLO is intended as a temporary measure when the transmission system is unavailable due to a short-duration system disturbance. Once the transmission system is restored, the main generator is resynchronized to the transmission system and normal operation is resumed.

j. Emergency Diesel Generators (EDGs)

Four redundant Class 1E EDGs are provided to supply onsite power to the Class 1E power system. Following the loss of voltage or prolonged degraded voltage condition on a Class 1E bus, the incoming breaker for the Class 1E switchgear is tripped, all the loads (except the 480V load center) are shed, including the non-Class 1E loads fed from the Class 1E bus, before the EDG is started. Once the EDG has reached rated voltage and speed, it is connected to the bus, restoring power in a sequence. Non-Class 1E loads fed from the Class 1E bus with isolation breakers may be reconnected manually, if sufficient spare capacity is available.

Each EDG has its own fuel oil transfer system to refill the day tanks as needed. Each system consists of a separate fuel oil storage tank and two redundant pumps.

k. Alternate AC (AAC) Source

The AAC source is a non-safety power source that can be used as an additional onsite emergency ac power source during SBO condition. The AAC gas turbine generator (GTG) is independent and diverse from the EDGs. The AAC GTG and supporting auxiliaries are non-safety related, and are provided as a packaged unit, mounted in a self-contained metal enclosure. The AAC facility is located within the plant protected area, outside the turbine missile impact zone.

The AAC can be physically connected to any one of four Class 1E 4.16 kVac buses, but the connection is administratively controlled to replace the EDG A or B only.

l. DC Power System

The dc power system provides dc power to various dc loads. The dc power system also provides power to selected emergency lighting circuits.

The dc power system is powered by the 480V power system through battery and battery chargers. The safety-related 125 Vdc system is an ungrounded Class 1E system consisting of four independent physically separated trains, each corresponding to one of the four reactor protection instrumentation channels. There are two safety-related dc trains per safety-related electrical division. Trains A and C correspond to Division I, while trains B and D correspond to Division II. Each Class 1E dc train consists of a battery, a battery charger, and a 125 Vdc control center. Each dc control center receives power from its respective battery and/or battery charger, depending on plant conditions. The safety-related 125 Vdc system provides power to the NSSS control and instrumentation systems, the vital bus inverters, solenoid valves, dc motor-operated valves, EDG field flashing, and miscellaneous balance-of-plant (BOP) control systems.

m. Condensate and Feedwater System

For the purposes of discussion with respect to the APR1400 PRA, there are six systems included under the system grouping referred to as the condensate and feedwater system:

1) Feedwater system

2) Condensate system

3) Condensate storage and transfer system

4) Turbine generator building closed cooling water system

5) Turbine generator building open cooling water system

6) Circulating water system

a) Feedwater System

The feedwater system supplies feedwater from the deaerator storage tanks (DSTs) to the SGs. A motor-driven startup feedwater pump provides feedwater to the SGs during startup, shutdown, and hot standby operation. The startup feedwater is also used if the auxiliary feedwater pumps are not available. A simplified diagram of the feedwater system is shown in Figure 19.1-7.

b) Condensate System and Condensate Storage and Transfer System

The condensate system consists of the condensers, condensate pumps, low pressure feedwater heaters, deaerators, DSTs, a gland seal water collection tank, overboard pump, associated piping, valves, and I&C. The condensate storage and transfer system consists of two condensate storage tanks (CSTs) and associated valves, piping, and I&C. The condensate system condenses steam in the condenser, collects condensate in the hotwell, and pumps it to the DSTs through condensate polishing demineralizers and three low pressure feedwater heaters and a deaerator, thus supplying condensate to the feedwater system. The CSTs provide a backup source of water for various plant systems, including the condenser hotwell and AFWS. A simplified diagram of the condensate and condensate storage and transfer system is shown in Figure 19.1-8.

The condensate system and condensate storage and transfer system discharge to the DST, which routes feedwater to the feedwater booster pumps or the startup feedwater pump.

c) Turbine Generator Building Closed Cooling Water System

The turbine generator building closed cooling water system is a closed-loop system that consists of two pumps, three heat exchangers, one surge tank, one chemical addition tank, valves, piping, and I&C. The turbine generator building closed cooling water system provides a continuous supply of cooling water to various turbine generator building equipment. The heated water is returned through the return header and then pumped through the turbine generator building closed cooling water heat exchangers, where the heat is dissipated to the turbine generator open cooling water system.

d) Turbine Generator Building Open Cooling Water System

The turbine generator open cooling water system consists of redundant strainers, three turbine generator building closed cooling water heat exchangers, valves, piping, and I&C. The turbine generator open cooling water system supplies cooling water to the cold side of the turbine generator building closed cooling water heat exchangers in the turbine generator building. The heated cooling water is discharged to the circulating water discharge conduit.

e) Circulating Water System

The circulating water system is a closed-loop cooling water system that uses the cooling tower as a heat sink. The system is designed to reject the waste heat from the main condenser to the circulating water and supply cooling water to the turbine generator open cooling water system during all modes of power operation.

n. Main Steam System (MSS)

The MSS delivers the steam generated in the SG to the high pressure turbine where the thermal energy of the steam is converted to mechanical energy to drive the main turbine generator. The MSS also provides steam to the turbine-driven auxiliary feedwater pumps.

The key components of the MSS are: main steam isolation valves (MSIVs), MSIV bypass valves (MSIVBVs), main steam atmospheric dump valves (MSADVs), main steam safety valves (MSSVs), and TBVs. A simplified diagram of the MSS is shown in Figure 19.1-9.

An MSADV is provided on each main steam line upstream of the MSSVs. Five spring-loaded MSSVs are provided for each individual main steam line for protection against overpressurization of the shell side of the SGs and the main steam line piping up to the inlet of the turbine stop valve.

Each main steam line is provided with an MSIV for steam line isolation. Each MSIV can be bypassed for warmup of the steam lines downstream of the isolation valves and for pressure equalization prior to admitting steam to the turbine. Downstream from the MSIVs, the four main steam lines are connected to an equalization header.

There are eight TBVs that originate from the main steam header. The TBVs are controlled by the steam bypass control system (SBCS). Steam can be bypassed through these valves to the condenser.

The SBCS, in conjunction with the reactor power cutback system (RPCS) and reactor regulating system (RRS), dissipates excess energy in the NSSS by regulating steam flow through the TBVs following the load rejection of any magnitude including a turbine trip from 100 percent power without a reactor trip or lifting the POSRVs or MSSVs.

The TBVs close automatically or are blocked from opening whenever the condenser is not available. If a load rejection occurs concurrently with condenser unavailability, the spring-loaded MSSVs sequentially open with increasing pressure and discharge the required amount of steam to the atmosphere to prevent system pressure from exceeding the maximum pressure of the main steam line.

For a main steam line break inside the containment, the faulted SG discharges directly into the containment. The unaffected SG discharges steam into the containment through the interconnected equalization header and broken line, unless the broken steam line is isolated. All MSIVs are signaled to close automatically upon receipt of a main steam isolation signal (MSIS).

o. Essential Service Water System (ESWS)

The ESWS is a once-through cooling water system that supplies filtered water for cooling the component cooling water (CCW) heat exchangers during all modes of plant operation.

The ESWS transfers heat from the component cooling water system (CCWS) to the ultimate heat sink (UHS) during all operation modes. The ESWS is safety-related and consists of two independent divisions. Each division consists of two pumps, one supply line, three debris filters, three CCW heat exchangers, and one discharge line. A simplified diagram of the ESWS is shown in Figure 19.1-10.

Each pump is equipped with a discharge check valve and a motor-operated discharge isolation valve. Two pumps of each division discharge to a common line, which then divides three lines, one line for each same train CCW heat exchanger. In each of the three lines is a manual isolation valve, a debris filter, a second manual isolation valve, a CCW heat exchanger, and an outlet manual isolation valve. The three lines in each train discharge into a common train discharge line and pass through a motor-operated flow control valve, which is locked in the throttled position. Each division discharges to a dedicated essential service water (ESW) cooling tower. A simplified diagram of the ESW cooling tower is shown in Figure 19.1-11.

The functions of the ESWS are to:

1) Be capable of removing heat from the CCWS through the CCW heat exchangers

2) Supply service water to two of three CCW heat exchangers of each division using a pump within the division during an accident condition

p. Component Cooling Water System (CCWS)

The CCWS is a closed-loop system that provides cooling water to remove heat released from plant SSCs, including both the safety-related and non-safety-related loads. Heat transferred by these SSCs to the CCWS is rejected to the ESWS through the CCW heat exchangers. A simplified diagram of the CCWS is shown in Figure 19.1-12.

The CCWS is capable of removing heat from safety-related components required for emergency shutdown of the plant and mitigation of the design basis events and the beyond design basis events. The CCWS provides an intermediate barrier between potentially radioactive systems and the ESWS to reduce any potential of radioactivity leakage to the environment.

The CCWS is a key accident mitigating support system, and the system is also assessed as a potential source of initiators. The CCWS consists of two independent divisions. Each division consists of two CCW pumps, one CCW surge tank, three CCW heat exchangers, and one discharge line.

q. Essential Chilled Water System (ECWS)

The ECSW is a closed-loop system that cools the cubicle coolers in specific plant rooms. The ECWS consists of two divisions, where each division consists of two chillers, two chilled water pumps, one air separator, one compression tank, one chemical additive tank, and one chilled water makeup pump. The ECWS provides a diverse means of providing room cooling, along with the heating, ventilation, and air conditioning (HVAC) systems. A simplified diagram of the ECWS is shown in Figure 19.1-13.

r. HVAC Systems

The HVAC systems include five subsystems: emergency diesel generator area HVAC, ESW building / CCW heat exchanger building HVAC, auxiliary building controlled area HVAC, auxiliary building clean area HVAC, and AAC GTG room HVAC. The HVAC systems provide a diverse room cooling capability, along with the ECWS.

s. Instrument Air System (IAS)

The IAS supplies clean, oil-free, dry air to all air-operated valves and instruments in the plant. The IAS is used during normal plant operation and after the plant is shut down. The IAS provides air to TBVs, AOVs in CVCS, and AOVs in the condensate system, which are modeled in PRA.

t. Reactor Coolant Gas Vent System (RCGVS)

The RCGVS provides a means of remotely venting non-condensable gases from the RV closure head and the pressurizer steam space during accident conditions when large quantities of non-condensable gases may collect in these high points. The RCVGS discharges to the IRWST.

Another function of the RCGVS is to provide a means of remotely removing steam from the pressurizer steam space or the RV for RCS pressure control in the event that pressurizer main spray and auxiliary spray are unavailable during accident conditions.

u. In-Containment Refueling Water Storage Tank (IRWST)

The IRWST is a steel-lined annular tank that resides entirely within containment. The functions of this system include:

1) Safety-grade water source for safety injection and containment spray

2) Heat sink for feed and bleed operation and rapid RCS depressurization

The IRWST eliminates the ECCS switch-over operation during LOCA, and minimizes contamination of the reactor containment building by scrubbing the released steam through the IRWST spargers. A simplified diagram of the IRWST and HVT is shown in Figure 19.1-14.

v. Digital Control Room

The APR1400 main control room (MCR) is a highly integrated control room. The control room includes:

1) Large display panel (LDP)

2) Integrated alarm system

3) Visual display unit (VDU) based information display

4) Computer-based procedures (CBPs)

5) Soft control

6) Safety console

x. Auxiliary Building

The auxiliary building is designed to provide a physical separation for the potential propagation of internal flooding. Floor drains in the auxiliary building are physically separated into quadrants (two in each division) and there are no common floor drain lines among quadrants.

The two EDGs located in the auxiliary building are spatially separated and located at opposite corners of the building. The auxiliary building also houses the MCR and supporting facilities. The remote shutdown room (RSR), located in a separate fire area from the MCR, contains all controls necessary to safely achieve cold shutdown.

19.1.3.2 Design/Operational Features for Mitigating the Consequences of Core Damage and Preventing Releases from Containment

The containment features, mitigating systems, and human actions that are provided to mitigate the consequences of a core damage event and to prevent containment failure are described in this subsection.

The following are key design features of the APR1400 containment and cavity region that reduce the potential for releases from containment:

a. The containment is a large prestressed concrete structure.

b. The containment inner surface is steel-lined to promote leak-tightness.

c. The reactor cavity is configured to promote retention of core debris during a severe accident. Corium retention in the core debris chamber virtually eliminates the potential for direct containment heating (DCH) challenges.

d. The cavity is designed to maximize the unobstructed floor area available to the spreading of corium debris. Uniform distribution of the corium debris within the reactor cavity results in a relatively shallow debris bed.

e. The cavity is designed with adequate distance between the floor elevation and the embedded portion of the containment steel liner to delay core debris contact with the liner in core melt scenarios.

The following systems are provided to mitigate the consequences of a core damage event and to prevent containment failure.

a. Containment Isolation System (CIS)

   The CIS provides the means of isolating fluid systems that pass through the containment penetrations in order to confine the release of any radioactivity from the containment following an accident.

   The components that provide containment isolation are part of the system that uses the penetration while the I&C that cause actuation of the isolation device (i.e., a valve) are part of the CIS. The containment penetrations include piping penetrations, personnel and equipment access hatches, and electrical penetrations. The containment penetrations and the structures and components that maintain containment integrity are designed to withstand post-accident conditions.

b. Containment Spray System

   The CSS is described in Subsection 19.1.3.1 with respect to its capabilities to mitigate core damage. The CSS is designed to reduce containment pressure and temperature during an accident and to remove iodine radionuclides and aerosols from the containment atmosphere.

   The CSS functions beneficial to the severe accident progression are containment heat removal and fission product scrubbing in the containment.

   The emergency containment spray backup system (ECSBS) is used to provide an independent means of supplying water to the dedicated spray header for reducing containment pressure during emergency conditions when the CSPs or the backup SCPs are not available.

c. Pilot-Operated Safety Relief Valves (POSRVs)

The POSRVs can rapidly depressurize the primary system to prevent high pressure core damage sequences that can result in severe-accident-induced failures of the hot leg / surge line or steam generator tubes, or high pressure melt ejection (HPME).

The POSRVs and associated discharge SSCs can be also used to control the hydrogen accumulation in the IRWST during RCS depressurization. In this case, two POSRVs and their three-way valves located in the POSRV discharge path are manually operated to redirect the steam release to the containment atmosphere via the SG compartment.

d. Containment Hydrogen Control System (HG)

The containment hydrogen control system (HG) is designed to control combustible gas (primarily hydrogen gas) inside the containment and IRWST within acceptable limits. The passive autocatalytic recombiners (PARs) and hydrogen igniters (HIs) are installed in the containment to remove hydrogen or limit hydrogen generation, which maintains hydrogen concentration in the containment below 10 percent by volume.

e. External Reactor Vessel Cooling (ERVC)

The ERVC function submerges the RV lower head to cool and retain the molten core in the RV. The ERVC is not credited in the Level 2 PRA.

f. Cavity Flooding System (CFS)

The function of the CFS is to flood the reactor cavity in the event of a severe accident to cover core debris in the reactor cavity with water. This facilitates the cooling and stabilization of the debris.

The CFS interconnects with the IRWST, HVT, and reactor cavity. The system is used in conjunction with the CSS to form a closed or recirculating water cooling system by providing a continuous cooling water supply to the corium debris in the reactor cavity. The quenching of the corium produces steam that is condensed by the containment spray flow. The CFS takes water from the IRWST and directs it to the reactor cavity. The water flows first into the HVT via the HVT flooding lines and then into the reactor cavity via the reactor cavity flooding lines.

19.1.3.3 Design/Operational Features for Mitigating the Consequences of Releases from Containment

Key mitigating features that are intended to minimize offsite doses/consequences include the following safety systems:

a. Containment Spray System

A fission product removal mechanism is provided so that in the event of containment leakage, the radiation dose at the site boundary due to airborne fission products is reduced. The spray solution, mixed with trisodium phosphate (TSP), minimizes the iodine radionuclides and fission product aerosols in the building atmosphere, removing them through the absorption of airborne fission products by the spray droplets.

b. In-Containment Refueling Water Storage Tank

The IRWST minimizes spread of radioactive contamination outside the containment building, where the potential contamination from circulated water through the piping located outside the containment is minimized.

The IRWST is also equipped with the underwater spargers to promote fission product scrubbing, where the fluids discharged through POSRVs are discharged through spargers.

19.1.3.4 Uses of the PRA in the Design Process

This subsection describes the uses of PRA in the design process to achieve the following objectives:

a. Identify features and requirements introduced to reduce or eliminate the known weakness/vulnerabilities in current reactor designs

b. Indicate the effect of new design features and operational strategies on plant risk

c. Identify PRA-based insights and assumptions used to develop design requirements

The basic design concept of the APR1400 is similar to current PWRs (specifically the Combustion Engineering System 80+ design). Additional design features are introduced to enhance plant safety. The design features are described in the previous Subsections 19.1.3.1 through 19.1.3.3.

The features and requirements introduced to reduce or eliminate the known weaknesses and vulnerabilities in current reactor designs are summarized in Table 19.1-3. The table also includes the effects of new design features found in the APR1400 on plant risk.

Design improvements to reduce or eliminate weaknesses in current plants were investigated for each categorized cause of core damage or large release. Major improved design features adopted in the APR1400 to reduce or eliminate weaknesses in previous plant designs are as follows:

a. Design change from two EDGs to four EDGs

b. Extension of 125 Vdc battery life to 16 hours from 8 hours

These changes are both related to mitigation of an SBO event, which is an important risk contributor.

19.1.4 Safety Insights from the Internal Events PRA for Operations at Power

The internal events PRA for operations at power, including its results, is described in this subsection. The Level 1 PRA is described in Subsection 19.1.4.1 and the Level 2 PRA is described in Subsection 19.1.4.2.

19.1.4.1 Level 1 Internal Events PRA for Operations at Power

A description of the Level 1 internal events PRA for operations at power, including results, is provided in the following subsections.

19.1.4.1.1 Description of Level 1 Internal Events PRA for Operations at Power

The Level 1 PRA uses a small event tree method supported by a linked fault tree approach. The major steps of the methodology are defined below:

a. Identification of potential accident-initiating events:

    1) Plant initiating events are identified based on previous industry experience, supplemented with a system failure modes and effects analysis (FMEA), which is focused on the identification of plant-specific initiators.

    2) Plant initiating events with similar accident mitigation requirements are grouped together.

    3) The annual frequency is estimated for each initiating event or initiating event group.

b. Accident sequence analysis:

    1) An evaluation of the plant response is developed for each type of initiating event, by identifying the key safety functions that are necessary to reach a safe and stable state and to prevent core damage.

    2) Systems and operator actions that affect the key safety functions are identified.

    3) Event trees are developed as a graphical representation of the potential core damage accident sequences for each initiating event. The top functional

events in these event trees reflect failures of the systems and of the operator actions required to mitigate these initiating events.

4) Success criteria are developed for each key safety function considered in the plant event trees. For each event tree top functional event, the minimum set of components/trains required in order for the system to adequately perform its accident mitigation function is identified.

c. System analysis:

1) For each system considered in the accident sequence event trees, a fault tree is constructed to allow for quantification of the system unavailability to perform the required accident mitigation function.

2) The system fault trees identify the various combinations of equipment failures that may result in failure of system function. Intra-system dependencies and common cause failures (CCFs) of components are considered.

3) Fault trees are constructed for the systems represented in the top functional events in the event trees (the front-line systems) and various systems needed to support these systems (support systems). The system dependencies are explicitly considered.

d. Data analysis:

1) Available generic data sources are compiled and reviewed to allow for selection of the failure parameters associated with components modeled in the system fault trees. The generic data are used to quantify the fault trees.

2) CCF parameters are also considered for groups of components with similar design, environmental, and service conditions. CCF factors, developed from generic data sources, are used to quantify the fault trees.

e. Human reliability analysis:

1) Human actions that, if not completed correctly, may impact the availability of equipment necessary to perform system functions modeled in the PRA are identified (pre-initiator HRA).

2) Human actions that are required for different accident sequences modeled in the PRA are identified (post-initiator HRA).

3) Human recovery actions are considered in the cases where it could be demonstrated that the action is plausible and feasible.

4) Acceptable methods are applied to estimate the probabilities of failure for the human actions. Estimates of probabilities of failure consider dependency on prior human failures in the scenario.

f. Quantification:

1) Fault trees and event trees are solved in an integrated manner to quantify CDF and LRF.

2) Quantification is performed by using the PRA software SAREX (Reference 24) and the FTREX code (Reference 25).

3) The quantification results are reviewed and significant contributors to CDF, such as initiating events, cutsets, basic events (SSC unavailabilities and human failure events) are identified.

4) Uncertainties in the results are identified and characterized. Key sources of modeling uncertainty derived from key assumptions are identified. Their potential impact on the results is assessed by performing a sensitivity analysis.

Each of these elements is described in greater detail in the sections to follow.

19.1.4.1.1.1 <u>Initiating Events</u>

An initiating event is defined as a disturbance that causes an upset condition of the plant, challenging systems and requiring operator performance of safety functions that are necessary and sufficient to prevent core damage. Such events result in challenges to plant safety functions, and postulated failures in the systems, equipment, and operator response could lead to an end state involving core damage and radionuclide release. Table 19.1-5 summarizes the impact on the key safety functions and plant systems by the initiating event types.

A thorough and systematic search is performed to define the spectrum of initiating events that could occur at an APR1400 plant. This list of accidents includes both design basis events (e.g., LOCAs, SGTR, and LOOP), as well as beyond design basis events (e.g., ATWS and SBO).

Potential initiating events are identified based on generic industry lists of initiating events, review of plant-specific system and design features, system interfaces, spatial interactions, and CCF potentials. For each of the potential initiating events identified, a qualitative evaluation is performed to assess the applicability of the event to the APR1400 design.

New initiators unique to the APR1400 design are also identified. Initiating events that are the result of support system failures or transients, called special initiators, are also considered through review of the existing design information.

The list of potential initiating events is grouped into similar functional categories to reduce the complexity of the PRA. The initiating event frequency for each of these groups is then quantified. The grouping is based either on the use of a bounding initiating event (i.e., an event whose impacts on the plant is more severe than those of the other initiating events in the group) or by the selection of a representative event (i.e., one that has essentially the same characteristics as the other events in the group). When selecting a bounding event for a given group of initiators, care is taken when grouping less severe events (with a higher frequency of occurrence) with an infrequently occurring, very severe event so that an appropriate overall initiating event frequency is used in the PRA. For example, a small break LOCA initiating event includes random small break LOCA, inadvertent opening of the POSRVs, and RCP seal catastrophic failure.

Potential initiating events can be screened from consideration if the frequency of occurrence of the event is sufficiently low. The ASME/ANS PRA Standard allows screening of initiating events that have a frequency less than 1×10^{-7} per reactor year and do not involve interfacing systems LOCA (ISLOCA), containment bypass, or RV rupture. No initiating events for the APR1400 PRA were screened based on frequency.

Once the initiating events are identified with preliminary definitions, the final initiating event groups are developed with the final group definitions.

As these initiating events are similar to those of existing nuclear power plants, the frequency for each initiating event is calculated based on generic estimates for current power plants from references such as NUREG/CR-6928 (Reference 11).

Initiating events identified by this process, along with the frequencies and uncertainties of the events, are shown in Table 19.1-6. Initiating event development for the internal flooding model is described in Subsection 19.1.5.3, and initiating event development during low power and shutdown (LPSD) states is identified and evaluated in Subsection 19.1.6.

19.1.4.1.1.2 Accident Sequence Analysis

The accident sequences that result from the initiating events are modeled in the form of event trees. The event trees are time sequences that show the response of the plant to a postulated disturbance. The response is depicted as nodes that represent the non-safety and safety systems potential response or use. The model includes support systems and operator actions that either respond to the initiating events or mitigate failure of other systems (note that this detail may also be reflected in the system or functional fault trees).

Accident sequence development involves, for each functional initiating event category, defining the safety functions and the systems and operator actions that potentially are available to support each safety function included in the event trees. Event trees are developed that trace the event sequences from initiating event to end states. The event trees are defined in a manner that captures the diversity of plant responses and severity. Table 19.1-7 provides the list of event trees used.

The success criteria for each event tree top event are defined in order to support the development of fault trees for the system functions and human reliability evaluations (for those top events that include operator actions); see Table 19.1-8.

An event sequence model structure is developed that facilitates identification of functional, physical, and human dependencies between the causes of initiating events and the causes of system and operator action failures that violate any of the event tree top event success criteria.

The event sequence development begins, from a plant response perspective, with all equipment available and operating normally, and then progresses to display critical and important failure paths in a logical progression. Event depictions are left to right decisions in the time order of plant response.

An event-tree-based sequence modeling approach is used with each event type based upon the initiator being developed in a unique tree. Safety functions necessary to achieve safe shutdown are modeled. Safety functions are derived from past PWR PRAs and from an evaluation of the plant response to the initiating event.

Event trees developed for each initiating event group are shown in Figures 19.1-15 through 19.1-39.

The results of the accident sequence analysis are the identification of the individual core damage sequences, and the analysis requirements for determining the timing and progression of each accident sequence. The timing information is required in order to evaluate the impact of the operator actions, and the time of occurrence of the automatic systems initiation signals.

The key safety functions are listed below:

a. Reactivity control

b. RCS pressure control

c. Preservation of RCS integrity

d. RCS inventory control

e. RCS heat removal

f. Containment heat removal

Each of these functions is described in further detail below:

a. Reactivity control – Directly influences the amount of heat being generated within the reactor core, which dictates the rate at which energy must be removed from the core and the RCS. Failure to control reactivity may cause core power generation to exceed the plant's capacity to remove it. Failure to limit core power may also challenge RCS integrity, depending on how well the other functions are performed.

b. RCS pressure control – This function is necessary to provide reasonable assurance that RCS design pressures are not exceeded during certain events (such as an ATWS or a loss of all secondary heat removal). RCS depressurization capability must also be provided to allow the use of the ECCS systems for non-LOCA events and to limit primary-to-secondary leakage after SGTR.

c. Preservation of RCS integrity – This function is closely related to the RCS pressure control function (i.e., if pressure control is not provided, then integrity cannot be maintained). Failure of the RCS integrity function can occur if the RCS pressure control features fail to reisolate the RCS after pressure relief was actuated following an initiating event. For example, if the POSRV failed to reseat following a demand, then RCS integrity would be compromised. RCS integrity will also be compromised if a LOCA occurs.

d. RCS inventory control – This function is crucial for maintaining core heat removal, since core damage is assumed to occur for any significant duration of core uncovery. Inventory control is of particular concern during LOCA events; however, inventory loss can also occur in other accident scenarios that result in an induced LOCA.

e. RCS heat removal – This function can be achieved by secondary heat removal to relieve steam and inject feedwater into the SGs. The feed and bleed operation may be able to perform this function.

f. Containment heat removal – This function is needed in those scenarios in which RCS heat is transferred to the containment, either due to a LOCA or due to use of the POSRVs.

For each initiating event, progression of potential scenarios leading to either a safe state or to core damage is modeled using an event tree. Functions required for mitigating the accident and for preventing core damage are included across the top of the event tree. Fault trees are used to quantify the probability of failure of each of the functions.

System and operator functional responses are ordered in the event trees sequentially based on the timing of the accident scenarios as they develop. In selected cases, events may be ordered differently to simplify the event tree structure while retaining the proper functional relationships.

Internal flooding, while considered to be an internal event, is described separately in Subsection 19.1.5.3.

Each Level 1 event tree sequence is assigned to an end state. The possible end states (for Level 1 analysis) are:

a. OK – The key safety functions have been performed successfully so that core damage is prevented during the mission time or a safe stable state is reached at a time beyond the 24-hour mission time;

b. CD – One or more key safety functions have failed in such a way that core damage will occur; or

c. TR – The accident progression has resulted in a transfer to another event tree that will define additional success requirements (e.g., a transient that results in a failure to scram the reactor will be transferred to the ATWS event tree).

Further classification of the core damage end states into specific plant damage states (PDSs) is performed in the Level 2 PRA analysis (see Subsection 19.1.4.2).

19.1.4.1.1.3 Success Criteria Analysis

The approach used in this success criteria analysis is based on the ASME/ANS PRA Standard requirements. The technical portions of the success criteria determination are based on the following:

a. The definition of core damage

Core damage is defined as the uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage involving a large fraction of the core is anticipated.

b. The specific plant parameter of core damage

The ASME/ANS PRA Standard defines core damage as the uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage are anticipated and involving enough of the core, if released, to result in offsite public health effects. For the purpose of the APR1400 PRA success criteria analysis, core damage commences at a peak clad temperature of 1,204.4 °C (2,200 °F) or greater. In the APR1400 success criteria analyses, a limit of 1,800 °F at the hottest core location was used to indicate the onset of core damage when calculated by MAAP. This value is deliberately less than the 10 CFR 50.46(b)(1) limit of 1,204.4 °C (2,200 °F) because the MAAP code used lumped core modeling, which compensates for some of the MAAP code simplifying assumptions, consistent with ASME/ANS PRA Standard requirement SC-A2. In all cases, core heat removal was either clearly lost or clearly maintained with respect to this 982.2 °C (1,800 °F) threshold.

Some success criteria calculations were performed using the RELAP code. Because the RELAP code has a detailed core model, these calculations used an acceptance criteria limit of 1,204.4 °C (2,200 °F) to identify the onset of core damage.

A containment failure could interfere with injection pathways to the point where the injection may be terminated. Containment failure is therefore considered to cause core damage.

c. The specification of core protection functions for core damage

Five safety functions are identified and specified for each initiating event. The general safety functions specified for meeting the success criteria are as follows:

1) Control of reactivity

2) Control of RCS pressure

3) Preservation of RCS integrity

4) Preservation of RCS inventory

5) Heat removal from the RCS and containment

Table 19.1-8 shows the relation of these plant safety functions and the initiating events.

d. The identification of mitigating systems and operator actions

Mitigating event tree nodes (composed from system fault tree top gates) and associated success criteria are summarized in Table 19.1-8. The key operator actions are as follows:

Nodes	Operator Action
ASC	Operators to perform aggressive secondary cooldown
BLEED	Operators to open POSRVs for feed and bleed operation
EBR	Operators to perform emergency boration
ECLDN	Operators to cool down primary early phase during SGTR
HIN	Operators to realign SIS for hot leg injection
ISOL	Operators to isolate secondary line break
LCLDN	Operators to cool down primary late phase during SGTR
RF	Operators to refill IRWST
SCSI	Operators to perform injection using SCS
SDC	Operators to align SDC operation

e. The specification of appropriate mission time

A mission time of 24 hours is specified for each success criterion. The 24-hour mission time provides sufficient time for the initiating event to either be successfully mitigated or for the event to progress to a core damage state. If a stable plant condition cannot be achieved within 24 hours for a specific sequence, additional evaluation of that sequence is performed to determine an appropriate end state, to extend the mission time, and/or to model additional system recovery.

f. The bases for features and operating procedures

The main bases for features and operating procedures are the APR1400 emergency operating guidelines (EOGs). The additional bases are very similar to those of the reference plants, which incorporate current existing PWR plant experience.

g. Plant thermal-hydraulic analysis for success criteria

Plant thermal-hydraulic analysis for PRA success criteria is performed. The minimum required thermal-hydraulic analysis for basic determination of success criteria and design support thermal-hydraulic analysis is conducted to specify the final success criteria.

h. The use of engineering judgment

In the design phase of the APR1400 design, many aspects of the detailed design have not been determined and the operational procedures have not been developed. Engineering judgment is used in areas where thermal-hydraulic analysis cannot be performed for success criteria determination.

i. The initiating events grouping and thermal-hydraulic analysis

An initiating event group for thermal-hydraulic analysis is determined for individual initiating events. The approach of the representative thermal-hydraulic analyses used to determine success criteria is to evaluate the most severe event among initiating events in a group and the available mitigating functions by considering minimum requirements for system functionality.

j. The analysis model and computer codes

The MAAP 4.0.8 code, the RELAP5 code, as well as analysis results described in Chapter 15 of this submittal are used to determine success criteria. It is recognized that the RELAP5 code modeling is more detailed than the MAAP code modeling. However, the MAAP code can be used to model certain phenomenology that RELAP 5 cannot. Engineering judgment is used to determine the appropriate code for the particular success criteria or scenario being examined.

k. The results of the thermal-hydraulic analysis

Representative results of the thermal-hydraulic analysis are given in Table 19.1-12 and Table 19.1-13.

l. Determination of success criteria

Final success criteria, shown in Table 19.1-8, are determined from the design, engineering judgment, and thermal-hydraulic analysis results in a manner that allows a margin for the uncertainties in the models of the thermal-hydraulic analyses and grouping of initiating events.

The success criteria were determined in terms of initiating events that are modeled for the APR1400. The initiating events that are considered in full-power Level 1 PRA are:

a. Large/medium/small break LOCA

b. SGTR

c. Large secondary steam line side break (LSSB)

d. General transients

e. Loss of main feedwater (LOFW)

f. Feedwater line break (FWLB)

g. Loss of condenser vacuum (LOCV)

h. Loss of instrument air (LOIA)

i. Loss of 125 Vdc (LODC)

j. Loss of component cooling water / essential service water (LOCCW/LOESW)

   1) Partial (PLOCCW/PLOESW)

   2) Total (TLOCCW/TLOESW)

k. LOOP (i.e., grid-related, weather-related, switchyard-centered, plant-centered)

l. Interfacing systems LOCA (ISLOCA)

The induced events considered in the internal events Level 1 PRA for operations at power are as follows:

a. Consequential LOOP (GRID-LOOP)

b. SBO and consequential SBO (GRID-SBO)

c. ATWS

d. Induced stuck-open POSRV (PR-A-SL)

19.1.4.1.1.4 Systems Analysis

The systems analysis provides for treatment of the causes of system failure and unavailability modes represented in the initiating events analysis and sequence definition.

The fault tree models include contributions due to the following:

a. Random component failures

b. Outages for maintenance and testing

c. Support systems

d. CCFs

e. Human errors involving failure to restore equipment to its operable state

f. Human errors involving failure to perform procedural actions

Fault trees are developed to the level of detail for which existing data can be applied. For active systems, passive failures that are potentially significant are included.

General assumptions and conditions applied to system analysis are summarized below.

a. General modeling conditions:

   1) Models reflect the design as-designed and as-to-be-built to the extent possible.

   2) Systems that participate in the necessary response to events or that provide critical support to such systems are modeled.

   3) Models reflect the success criteria for the systems to mitigate each identified accident sequence.

   4) Models capture the impact of dependencies, including support systems and harsh environmental impacts.

   5) Operator errors of commission are not included in the system model.

b. Conditions concerning level of detail

   1) The level of detail in the model matches one for one the simplified diagrams and includes key active components and potential misaligned components based upon data availability.

   2) Models include contributions due to random component failures, outages for maintenance and test, support systems, CCFs, human errors to restore equipment to its operable state, and human errors involving failure to perform procedural actions.

   3) Models include both failure modes of active and passive components that impact the function of the system.

   4) A thorough treatment of CCFs, intra-system dependencies, and selected intersystem dependencies is provided.

5) The fault tree is developed to the level of detail that existing data can support.

c. Failure modes of components modeled are as follows:

1) Reduced or single data value modeling is performed for systems that are best characterized from system failure data.

2) Valve plugging – For valves that are passive (normally open) components in standby, the spurious transfer closure failure mode applies. For components that are normally closed, plugging is not explicitly modeled. The origin of this assumption is NUREG/CR-1363 (Reference 12), which describes valve plugging as an event that would stop or limit flow through a normally open valve.

3) Plugging in flow lines is likely to occur in components such as valves and orifices, rather than in piping. Therefore, pipe plugging is not modeled.

4) Probabilities of failures that occur during standby states are evaluated from test and maintenance intervals. Test and maintenance intervals are assumed to be bounded by the Technical Specifications in Chapter 16.

5) Failure rate data include partial failures of components. For example, the data for a valve failing to open include failures where the valve opens, but not completely. If a basic event is true (failed), it may be completely failed, or it may be degraded. It is conservatively assumed that if a component fails, it fails in a manner that prevents it from performing its function. As such, if the fault tree reflects a train being successful, the train is available to perform its function at the normal (not degraded) level.

6) When components such as fuses, breakers, relays, etc. function to serve only one pump, valve, compressor, or diesel, etc. their failure is considered to be accommodated as part of the failure rates associated with the equipment they serve. Shared devices are explicitly modeled to account for inter-component dependencies.

7) Components or specific component failure modes may be screened from the PRA model according to the following criteria (SY-A15 in the ASME/ANS PRA Standard):

a) A component may be excluded from the system model if the total failure probability of the component failure modes resulting in the same effect on system operation is at least two orders of magnitude lower than the highest failure probability of the other components in the same system train that results in the same effect on system operation.

b) One or more failure modes for a component may be excluded from the systems model if the contribution of them to the total failure rate or probability is less than 1 percent of the total failure rate or probability for that component, when their effects on system operation are the same.

In implementing the requirements of SY-A15, the following generic criteria are used:

a) The probability of a passive failure of a manual valve is not included in the PRA model on the assumption that the manual valve failure probability is at least two orders of magnitude less than the failure probability of an active component.

b) When applying these screening criteria, special consideration must be given in cases where the valve failure would cause an initiating event or an interfacing systems LOCA, or where there are multiple manual valves (in series or parallel) lined up in such a way that the failure of any one valve would cause system failure (e.g., open manual valves in series that must remain open, or closed manual valves in parallel that must remain closed).

c) Passive failures (SY-A11) such as heat exchangers, piping, and tanks should be included where necessary; except when using the screening criteria in SY-A15.

d) Flow diversion (SY-A13) is considered a potential system failure if the flow diversion pathway occurs due to failures that do not meet the screening criteria of SY-A15 and can result in failure to meet the system success criteria. The flow diversion paths that are excluded are documented.

Dependency Analysis

The systems that are included in the systems analysis for internal events are provided in Table 19.1-9. Simplified diagrams of major systems are shown in Figures 19.1-1 through 19.1-14. Tables are provided to summarize the initiator-to-system dependencies.

a. Dependency between Initiating Events and Front Line Systems (Table 19.1-10)

b. Dependency between Initiating Events and Support Systems (Table 19.1-11)

19.1.4.1.1.5 Data Analysis

The purpose of the data analysis task is to tabulate estimates of the failure rates, demand failure probabilities, and unavailability data for basic events in the PRA model. The data developed during this task include:

a. Component unreliability data

b. Component unavailability data due to test and maintenance

c. CCF data

d. Special event data including recovery action failures

For each component type and failure mode identified in the system analysis, the failure rates are extracted from available generic data sources. Potential sources of generic failure data are:

a. NUREG/CR-6928, "Industry-Average Performance for Components and Initiating Events at U.S. Commercial Nuclear Power Plants," U.S. Nuclear Regulatory Commission, "Industry Average Parameter Estimates, 2010 Update."

b. NUREG/CR-5500, Vol. 10, "Reliability Study: Combustion Engineering Reactor Protection System, 1984-1998," U.S. Nuclear Regulatory Commission, November 2001 (Reference 13).

c. NUREG/CR-5485, “Guidelines on Modeling Common-Cause Failures in Probabilistic Risk Assessment,” U.S. Nuclear Regulatory Commission, November 1998 (Reference 14).

d. NUREG/CR-5497, “CCF Parameter Estimations, 2010 Update,” http://nrcoe.inl.gov/results/CCF/ParamEst2010/ccfparamest.htm, U.S. Nuclear Regulatory Commission, January 2012 (Reference 15).

e. NUREG/CR-6890, “Reevaluation of Station Blackout Risk at Nuclear Power Plants” (Vol. 1, Analysis of Offsite Power Events: 1986 – 2004), U.S. Nuclear Regulatory Commission, December 2005 (Reference 16).

f. EPRI Interim Technical Report, “Treatment of Loss of Offsite Power (LOOP) in Probabilistic Risk Assessments: Technical Basis and Guidelines,” Electric Power Research Institute, September 2009 (Reference 17).

A list of component types, failure modes, failure rates, and parametric uncertainty parameters is developed. Table 19.1-14 provides the component failure data for the APR1400 PRA. The majority of the failure data and unavailability data is taken from NUREG/CR-6928. When failure data are not available in NUREG/CR-6928, then the data are taken from other sources such as NUREG/CR-5500.

The component boundaries are consistent with corresponding basic event definitions. Component boundaries, given in Table 19.1-15, are defined by generic data sources, so that the boundaries of the basic events are set to be consistent with the component boundaries.

In the PRA, beta and gamma distributions are used for the random component failure data taken from NUREG/CR-6928. Unavailability due to test and maintenance is derived from NUREG/CR-6928. Other data set sources tend to use lognormal distributions.

Component Unreliability Data

The components that are modeled in the APR1400 range from small items such as transmitters and breakers to large equipment such as pumps and their motors. These components can fail due to random causes, related or CCFs, or being unavailable due to test and maintenance activities. The APR1400 plant-specific data are not yet available and the data used in this analysis are based upon generic sources.

Component Unavailability Data

Component unavailability means that a component is in an out-of-service state due to test and maintenance (T&M). In the APR1400 PRA, these T&M events are modeled in each system fault tree to account for the fact that certain components may be disabled due to maintenance (either preventive or corrective) or testing while the plant is in operation. While Technical Specifications allowed outage times, fuel cycles, and maintenance practices can vary significantly between plants and cause T&M events to be very plant-specific, the absence of plant data resulted in the use of generic component unavailability data (which are derived from NUREG/CR-6928).

Common Cause Analysis

The Alpha Factor methodology is applied to calculate the probability of common cause events. The Alpha Factor parameters are estimated by applying impact vectors based on generic industry data. To develop uncertainty distributions for the Alpha Factor parameters, a Bayesian framework in accordance with NUREG/CR-5485 is used.

The methodology for CCF analysis is based on NUREG/CR-4780 (Reference 18) and NUREG/CR-5485. Generic data for CCF reported in NUREG/CR-5497 and the latest CCF parameter updates from the NRC Reactor Operational Experience Results and Databases (Reference 19) are applied to evaluate the CCF parameters.

CCFs can result from various mechanisms. The causes of these events correspond to failure mechanisms that have been determined from analysis of nuclear plant service experience and fall into several broad categories such as the following:

a. Design/manufacturing/construction

b. Procedural error

c. Human actions / plant staff error

d. Maintenance and test

e. Abnormal environmental stress

Redundant and active components as well as groups of non-identical active components that have the potential for CCF mechanisms are prime candidates for the CCF analysis. The component types that are considered for common cause analysis include those for which there is documented evidence of common cause experience as well as those that have the characteristics of redundant active components. The components considered are as follows:

a. Electrical systems: Emergency power generators, circuit breakers, batteries, battery chargers, and inverters

b. Reactor trip system and ESF system: Bistables, reactor trip breakers, relays, shunt trip coils, sensors, logic modules, and control rods

c. HVAC systems: Chiller units (including compressors), dampers, air handling units, fans, and reactor containment fan cooler units

d. Mechanical systems: Pumps, MOVs, AOVs, check valves, relief valves, safety valves, heat exchangers, strainers, and traveling screens.

Common cause events for other component groups in a system may be defined if the event is an important contributor to system reliability and if the components in the group can be linked to conceivable CCFs such as those defined previously.

A set of components is defined as a common cause component group when they are of the same type (pumps, valves, etc.), and when they meet the following conditions:

a. Same initial conditions (such as normally open, normally closed, energized, and de-energized)

b. Same use or function (such as system isolation, flow modulation, parameter sensing, and motive force)

c. Same failure mode (such as failure to open on demand, and failure to start on demand)

d. Same minimal cutset (failure of multiple components that appear in the same cutset)

Treatment of intersystem CCFs is consistent with capability Category I and II of the ASME/ANS PRA Standard. CCFs across systems are not included in the CCF model, because they are quite different in terms of the environment, operation or service, design, and maintenance.

Some component dependencies are explicitly modeled as separate events in the fault trees to avoid double counting. Such dependencies are not included in the common cause analysis. Dependencies that are not considered in the common cause analysis are functional dependencies, human errors, maintenance and testing unavailability, and external events.

Once the common cause groups of components are defined, the fault tree is modified so that each fault tree basic event, representing the failure of a member of a common cause group, is expanded to include additional events that are combined under an "OR" gate.

Special Event Data

In developing the fault tree models, special events were developed to more accurately reflect potential plant scenarios. Special events may consist of adjusting or correction factors used to modify a specific basic event probability for particular accident sequence conditions. These events and their associated probabilities are listed in Table 19.1-16.

19.1.4.1.1.6 Human Reliability Analysis

The human reliability analysis (HRA) provides a structured approach to identify potential human failure events (HFEs) and to systematically estimate the probability of those events using data, models, or expert judgment. The HRA conforms to the ASME/ANS PRA Standard requirements, as clarified by NRC RG 1.200. This assessment evaluates both pre-initiator HFEs (errors that occur prior to the initiation of an accident, such as during maintenance) and post-initiator HFEs (errors committed during actions performed in response to an accident initiator).

Pre-Initiators

The assessment of HFEs is an important task in a comprehensive PRA. The overall approach to pre-initiator development in the HRA is consistent with the Accident Sequence Evaluation Program (ASEP) framework described in NUREG/CR-4772 (Reference 20). Pre-initiator HFEs constitute one of the four categories of HFEs:

a. Pre-Initiator Human Failure Events (Type A or Latent). These events take place prior to an initiating event, and leave a component or a system in an undesired state that does not manifest itself until an initiating event occurs. Miscalibration of instrumentation and misalignment of a manual valve on a standby system are examples of Type A HFEs.

b. Human-Induced Initiating Events. These events are human actions that contribute to the occurrence of an initiating event. Human-induced initiating events are implicitly included in the initiating eventsand are not considered in detail.

c. Initiating Event-Related HFEs (Type B). A failure to perform a Type B action results in the occurrence of an initiating event.

d. Post-Initiator HFEs (Type C or Dynamic). These events describe the response of operating staff to an initiating event or other plant upset event.

The pre-initiator HRA for the APR1400 PRA models the Type A, or latent, HFEs.

The general process for conducting the pre-initiator HRA is as follows:

a. Identify individual maintenance, test, and/or calibration activities that might cause a pre-initiator. An example is the identification of an activity that requires an alignment change or a calibration.

b. Screen activities that are determined to have a negligible impact on CDF due to a low probability of occurrence. Activities that affect redundant trains or diverse systems are not screened.

c. Define the HFEs from the resultant unscreened activities.

d. Quantify the human error probabilities (HEPs) using the ASEP methodology as a first pass.

e. Quantify HEPs using the THERP methodology for those events that have a Fussell-Vesely importance greater than 0.005 or a risk-achievement worth greater than 2.

The ASEP methodology (i.e., NUREG/CR-4772) is used to quantify the pre-initiator HRA using screening values. For significant HFEs, a detailed assessment is performed for the quantification of the pre-initiator HEP using THERP. Significant HFEs are defined according to NRC RG 1.200 as a basic event that has a Fussell-Vesely importance greater than 0.005 or a risk-achievement worth (RAW) greater than 2.

The ASEP methodology uses three levels to assess dependency between multiple human errors: complete dependence (CD), high dependence (HD), and zero dependence (ZD). The dependency calculations used in the ASEP methodology originated in NUREG/CR-1278 (Reference 21). However, Supporting Requirements HR-A3 and HR-B2 from the ASME/ANS PRA Standard state:

HR-A3 : IDENTIFY the work practices identified above (HR-A1, HR-A2) that involve a mechanism that simultaneously affects equipment either in different trains of a redundant system or in diverse systems (e.g., use of common calibration equipment by the same crew on the same shift, a maintenance or test activity that requires realignment of an entire system).

HR-B2 : DO NOT screen activities that could simultaneously have an impact on multiple trains of a redundant system or diverse systems.

There are cases of ZD assigned by the original ASEP methodology that, in effect, would screen activities that impact more than one system train. To address these conditions, the enhanced methodology used in the APR1400 PRA assigns low dependence (LD), rather than ZD. For example, to account for dependencies arising from miscalibrating multiple trains of equipment, such as using the same calibration equipment for multiple components, LD is applied instead of ZD. The enhanced method provides reasonable assurance that activities impacting more than one system train are not screened.

Post-Initiators

The scenarios analyzed in the APR1400 PRA include the potential for human errors related to detection, diagnosis, and decision-making for the event (cognitive errors), as well as errors related to performing the required actions (execution errors). For the scenarios considered in this PRA, operator actions occur as part of an overall response to mitigate plant events and aspects such as cue availability, procedural direction, timing, manpower limitations, and response prioritization; these all should be considered. The HRA modeling techniques used to quantify HEPs for each HFE should be able to account for these complexities. The operator actions considered for this PRA primarily involve in-control-room actions. Some ex-control-room activities may be directed from the control room based on procedurally directed requirements, such as: locally manipulating a valve, resetting equipment, or locating a source for a leak. It is also desired to use HRA methodologies that are commonly used in the nuclear industry.

Given these considerations, this PRA uses the cause-based decision tree methodology (CBDTM) (Reference 22), the human cognitive reliability / operator reliability experiment (HCR/ORE) methodology (Reference 22), or the annunciator response model (ARM) (Reference 21), depending on the particular scenario under analysis. The advantage of using these HRA methods is that they evaluate fundamental aspects and factors affecting human performance and are capable of addressing the detailed analyses needed for the scenarios considered. Alternate HRA methodologies that could be used are described in NUREG/CR-1842 (Reference 23). These other methods were not used because they either are simplified techniques that would likely result in overly conservative results or are inappropriate for the scenarios modeled.

The HCR/ORE methodology is used for immediate, memorized actions or time-critical actions and addresses event detection, diagnosis, and decision-making implicitly via time-reliability correlations to estimate the cognitive error component of the overall probability. Performance shaping factors (PSFs) are implicitly included within this technique. Time-critical actions are defined as those actions for which the time available for cognition is relatively short compared to the median crew response time. The crew nonresponse probability represents the probability than an operating crew, while making the correct decision, takes longer than the available time to respond. This contribution to the crew overall non-response is particularly important for situations where a relatively fast response to an initiator is required. The HCR/ORE correlation is a representation of the probability of crew non-response as a function of normalized time, a dimensionless unit that reflects the ratio of time available to crew median response time.

For simplicity and conservatism, the HFEs evaluated for the APR1400 PRA use the HCR/ORE methodology for those situations in which cognition must occur within a short time frame and for which the proposed scenarios are similar to the original scenarios, as proposed by the authors of the methodology.

For those HFEs in which cognition can occur at some time greater than 30 minutes, the CBDTM was chosen because the CBDTM more accurately represents the HEP for actions that are primarily procedurally directed or require transitions to another procedure. There is no guidance for using the method under time-limited conditions because the methodology was not intended to address such situations. The CBDTM is appropriately applied in situations where the operators characterize the event as they work through the procedures and must make a decision to initiate some process.

The ARM can be used to estimate the cognitive portion of the HEP for either pre-initiators or post-initiators. The ARM is suggested for those parts of an HRA in which the primary interest is in responding to the annunciators, without emphasis on interpretation. If the alarm occurs after an initiating event, then a sufficient amount of time must have passed so that a stable plant condition is considered to be re-established before the use of the ARM can be considered an appropriate methodology for the scenario. A stable plant condition is considered to be the point at which the operators have achieved a stable path toward plant shutdown and responses to annunciators that arose from the plant initiating event have been addressed.

To estimate the failure probability for the execution steps, the CBDTM, HCR/ORE, and ARM methodologies use the THERP methodology.

19.1.4.1.1.7 Quantification

This subsection summarizes the process used to quantify the frequency of core damage.

The frequencies of the core damage sequences are calculated by obtaining sequence level minimal cutsets. Post-processing of these cutsets is performed to account for factors that are not readily incorporated into the fault trees themselves. For example, this post-processing allows the identification of cutsets that contain more than one post-initiator HFE. The dependencies between multiple HFEs are assessed as appropriate, and included in the cutsets in post-processing. The event trees and fault trees were developed using the SAREX computer code and solved using the FTREX computer code. The SAREX model for the APR1400 constitutes a large, detailed set of event trees and fault trees. The model whose results are described in this report consists of the following:

- 25 event trees
- ~ 50 fault trees
- ~ 3,400 basic events

The model is quantified using a 1×10^{-13} truncation limit.

<u>Computer Codes Used</u>

<u>SAREX</u>

The PRA code package used for the creation of the Level 1 event and fault trees is SAREX (Reference 24). SAREX is an integrated PRA software package that provides the user with the ability to create and evaluate fault trees and event trees. The SAREX code provides tools for graphical fault tree and event tree constructions and editing, cutset generation and quantification, importance analysis, and uncertainty analysis.

<u>FTREX</u>

FTREX (Reference 25) is a computational engine that takes as input a reliability model in the form of a Boolean fault tree, including the supporting basic event probabilities and other options such as initiator events and house events.

<u>HRA Calculator</u>

The EPRI HRA Calculator (Reference 26) is used to calculate the HEPs.

RELAP5

RELAP5/MOD3 (Reference 27) is used to analyze the thermal-hydraulic behavior of the plant.

MAAP

The modular accident analysis program (MAAP) 4.0.8 (Reference 28) is used to evaluate the success criteria.

19.1.4.1.2 Results from Level 1 Internal Events PRA for Operations at Power

The results of the Level 1 internal events model are described in the following subsections. It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

19.1.4.1.2.1 Risk Metrics

Total CDF from internal events is 1.3×10^{-6}/year. This is well below the probabilistic safety goal of 1×10^{-4}/year. The initiating event contributions to CDF for Level 1 internal events at full power can be found in Figure 19.1-40.

19.1.4.1.2.2 Significant Initiating Events

The significant initiating events and their contributions to the internal CDF are given in Table 19.1-17. Only those initiating events that contribute more than 1 percent to the total internal events CDF are listed in the table. The LOOP initiating event strongly dominates the internal events CDF. In order to illustrate in more detail the total LOOP contribution to CDF, the LOOP sequences were divided into four categories.

a. LOOP events (no SBO, not grid centered) contribute approximately 20 percent to the total CDF.

b. SBO events (not grid centered) contribute 16 percent to the total CDF.

c. LOOP events (no SBO, grid centered) contribute approximately 1 percent to the total CDF.

d. SBO events (grid centered) contribute approximately 3 percent to the total CDF.

The next-largest contributors to plant risk are loss of cooling water events (TLOCCW and TLOESW).

a. TLOCCW/TLOESW contribution can be attributed to the loss of mitigating systems due to lack of component cooling as well as the induced RCP seal LOCA and the challenges that this configuration presents.

Medium break LOCA contribution is also significant.

19.1.4.1.2.3 Significant Sequences and Cutsets

The significant accident sequences are listed in Table 19.1-18. The accident sequences are dominated by loss of offsite power (LOOP), station blackout (SBO), loss of component cooling water (LOCCW), and loss of essential service water (LOESW). Only one accident sequence contributes over 10 percent of the CDF; this sequence involves the following elements:

a. LOOP

b. Success of reactor trip

c. No POSRV challenge

d. Success of one or more EDGs

e. Failure of secondary heat removal

f. Failure of bleed for feed and bleed operation

The significant cutsets for the internal events are illustrated in Table 19.1-19. The top 100 cutsets contribute approximately 39 percent of the total CDF. Cutset contribution to the internal events CDF is equally distributed. Only eight of the top cutsets contribute more than 1 percent to the total CDF. The number of cutsets that contribute to 95 percent of the

CDF is over 200,000. These results show that there are no significant outliers in the APR1400 internal events CDF.

19.1.4.1.2.4 Significant SSCs, Common Cause Events, and Operator Actions

Table 19.1-20 shows the risk-significant SSCs based on the RAW importance measure. The most important pieces of equipment are DC-MC01A/1B (Class 1E 125 Vdc bus 1A/1B) and CC-TK01B (component cooling water surge tank). Their high RAW rank can be explained by their high reliability and by a high consequence of their failures. The 125 Vdc bus 1A/1B is an electrical support for several key safety systems; failure would result in the inability to operate these systems. A failure (significant leak) in the component cooling water surge tank would disable component cooling water. Table 19.1-21 shows the significant SSCs based on the Fussell-Vesely (FV) importance measure.

Table 19.1-22 shows the significant common cause events based on RAW importance. The highest CCF events are the reactor trip circuit breakers and the 125 Vdc batteries. Table 19.1-23 shows the significant common cause events based on FV importance.

Table 19.1-24 shows the risk-significant operator actions based on the RAW importance. Table 19.1-25 shows the risk-significant operator actions based on the FV importance. The most important action is the failure to open the POSRVs for feed and bleed operation during the early phase.

19.1.4.1.2.5 Key Assumptions

Assumptions in the PRA development are divided into two groups:

a. Assumptions in response to key sources of uncertainty

b. Modeling assumptions made because of limitations in the PRA logic models or software

The important assumptions from these two groups are as follows:

a. The HRA is performed under assumptions that the operating procedures and guidelines will be prepared and that operator training will be similar to that at existing operating plants.

b. HEPs for different operator actions are estimated for the SBO conditions and non-SBO conditions. It is assumed that operators will have clear direction about the crosstie of buses and equipment during SBO conditions.

c. The CVCS is not credited for an injection function to make up the lost inventory.

d. RCP seal LOCA probability, given a total loss of seal cooling and the RCP trip, is assumed to be equal to 1×10^{-3} per pump.

e. The entire year is used for evaluation of the initiating event frequencies for operations at power. The plant capacity factor is assumed to be 0.95. This assumption needs to be verified when plant-specific shutdown information is available.

f. Consequential LOOP is modeled. It is assumed that the consequential LOOP probabilities as a result of plant trips and LOCA events are different.

g. A failure to trip the reactor during a small break LOCA or SGTR event is assumed to lead to core damage, and no further model development was made.

h. The digital I&C system model retains the current hardware model from the reference plant, except for the software events and the communication link models. The digital I&C model is retained as-is with a single event representing the software/communication links as a black-box event. The event probability in the fault tree model is based on engineering judgment. The dependency between hardware and software/communication links is not evaluated, but will be evaluated when design details are finalized.

19.1.4.1.2.6 Uncertainty Analysis

Uncertainty in the Level 1 internal events PRA results is quantified using SAREX. The results of parametric uncertainty for Level 1 internal events CDF are summarized below:

- 5 percent value: 4.5×10^{-7}/year
- Mean value: 1.9×10^{-6}/year
- 95 percent value: 3.8×10^{-6}/year

This 95th percentile CDF value is more than an order of magnitude below the NRC goal of 1×10^{-4}/year.

The results for parametric uncertainty, the mean value from Monte Carlo simulation, is larger than the point estimate. This is due to the "state of knowledge correlation" as defined in the ASME/ANS PRA Standards, which is important for cutsets that contain multiple basic events whose probabilities are based on the same data, particularly when the uncertainty of the parameter value is large. In the Monte Carlo sampling approach, the same value is used for each basic event probability, since the "state of knowledge" about the parameter value is the same for each event. This results in a mean value for the joint probability that is larger than the product of the mean values of the event probabilities.

Importance of the redundant equipment and the state-of-knowledge dependencies is limited for the equipment where CCFs dominate the results. The impact of the redundant equipment is more important in the case where equipment single failures are also significant contributors to the results.

More detailed discussion on parametric and modeling uncertainty is as follows:

Parametric uncertainty was quantified by selecting an uncertainty distribution for each input parameter. Distributions applied are lognormal, beta, and gamma, as described below for each type of parameter:

a. Initiating events: Uncertainty distributions were obtained from the same source as the mean values. For initiating events evaluated by fault trees, lognormal distribution was assumed.

b. Failure rates: Uncertainty distributions were obtained from the data source used.

c. Common cause parameters: Uncertainty parameters were obtained from the same source as CC factors.

d. LOOP-related basic events: Lognormal distribution was assumed.

e. Human error probabilities: For pre-accident HEPs, a lognormal distribution with an error factor of 10 was used, as recommended in the ASEP method. For post-accident HEPs, a constrained non-informative prior (beta) distribution was used, as recommended in the SPAR-H method (Reference 29).

f. Various parameters and undeveloped events: Constrained non-informative prior (beta) distribution was used to account for the limited state of knowledge.

g. Time-related parameters: For time-related parameters, like preventive maintenance duration (and corresponding unavailability), a lognormal distribution was used; an error factor was estimated from upper and lower bounds, corresponding to upper and lower time estimates.

Modeling uncertainty was also specifically treated, but limited to four cases selected to illustrate a specific lack of modeling design details. These cases are described below:

CASE 1: The case is based on the uncertainty of room cooling requirements for some of the electrical equipment rooms. It was assumed that the room cooling is not required even without the room cubicle coolers operating. Room heatup calculations need to be performed to provide reasonable assurance that the assumption is valid. A sensitivity analysis is to be performed with a room cooling requirement, assuming that electrical equipment will fail if the associated room cubicle coolers become unavailable.

CASE 2: The case is related to the hot leg injection (HLI) requirement; the base PRA model assumes that HLI is not needed for a medium break LOCA. HLI is used to prevent the boron precipitation from potentially plugging the core upper channels, and it is required for a large break LOCA. For a medium break LOCA at the upper break size, it was assumed that HLI is not needed. A sensitivity analysis is to be performed assuming that HLI is required for a medium break LOCA.

CASE 3: The case is related to the RCP seal LOCA model, which is currently modeled as a single basic event with the event probability based on engineering judgment. A sensitivity analysis is to be performed to characterize the sensitivity of this event that represents the RCP seal LOCA. The seal LOCA model complexity will depend on the RCP seal leakage rate.

CASE 4: The case is related to GSI-191 resolution, where the base model assumes that the downstream chemical effect in the core is negligible with the use of reflective metallic insulation (RMI) in the containment. The PRA model includes an event for the potential sump blockage due to the containment debris, but it does not include a potential blocking of the water pathway due to the downstream chemical effects. A sensitivity analysis is to be performed with an assumption that the chemical effects could cause a blockage.

19.1.4.1.2.7 Sensitivity Analysis

A sensitivity analysis was performed to evaluate the impact of a series of modeling assumptions, including the preceding assumptions, on the internal events CDF. Several insights can be drawn from the sensitivity cases analyzed.

a. TLOCCW/TLOESW Initiating Event Sensitivity Case: The initiating event frequencies for TLOCCW and TLOESW are based on the generic frequencies shown below. These support system initiating events were evaluated using fault trees, and the calculated initiating event frequencies were significantly lower than the generic frequencies. A decision was made to use the generic frequencies in the PRA model.

	Generic	SSIE FT	Factor
TLOCCW	2.34×10^{-4}	1.33×10^{-5}	17.5
TLOESW	2.34×10^{-4}	6.63×10^{-5}	3.5

A sensitivity case was evaluated using the initiating event frequencies calculated from the supporting system initiating event (SSIE) fault trees (FTs), and the result showed that CDF decreases by 13 percent to 1.1×10^{-6}/year.

b. RCP Seal LOCA Sensitivity Case: The base model assumes that the RCP seal LOCA probability to be 1×10^{-3} per RCP, based on engineering judgment, which is judged to be somewhat conservative. A sensitivity case was evaluated by setting the seal LOCA probability to zero, and the result showed that CDF decreases by 11 percent to 1.2×10^{-6}/year.

c. GSI-191 Sensitivity Case: The base model assumes that the probability associated with downstream chemical effects is zero based on the usage of RMI in the containment. A sensitivity case was performed by setting the chemical effect basic event to 1×10^{-3}, based on engineering judgment; and the result showed that the CDF increases by about 200 percent to 3.8×10^{-6}/year.

d. SBO Sensitivity Case: The base model does not credit any mobile equipment that may be available as a result of Fukushima accident action items. A sensitivity case was evaluated to examine the potential impact of crediting the mobile SSCs in the PRA model. This was accomplished by decreasing the operator action to connect an AAC power source by a factor of 10, and the result showed that there is only a minor decrease in CDF. This sensitivity case impacts only SBO sequences.

e. Hot Leg Injection Sensitivity Case: For medium break LOCA, a hot leg injection (HLI) is assumed not needed. A sensitivity case was performed that required HLI for a medium break LOCA, and the result showed the CDF increases by 10 percent to 1.4×10^{-6}/year.

19.1.4.1.2.8 Risk Insights

The APR1400 is an evolutionary PWR plant, and CDF is dominated by LOOP events (approximately 39 percent). Still, total LOOP CDF is small at less than 1.5×10^{-7}/year, which is a result of the high redundancy in trains and diversity in emergency power supplies.

Loss of cooling systems (CCWS and ESWS) and seal LOCA contributions to CDF are approximately 26 percent, which includes the total/partial losses of CCW or ESW. This relatively large contribution, which contributes to RCP seal LOCA, is a result of the lack of diversity in the redundant cooling trains.

The top cutsets show that the plant risk is strongly influenced by the performance of support systems (i.e., CCWS and ESWS). This is because the support systems are common dependencies of highly redundant safety systems.

19.1.4.2 Level 2 Internal Events PRA for Operations at Power

A description of the Level 2 internal events PRA for operations at-power, including the results of the analysis, is provided in the following subsections.

19.1.4.2.1 Description of Level 2 Internal Events PRA for Operations at Power

The PRA comprises two major areas of analysis: 1) identification of sequences of events that could lead to core damage and estimation of their frequencies of occurrence (the Level 1 analysis); and 2) evaluation of the potential response of the containment to these sequences, with emphasis on the possible modes of containment failure and the corresponding radionuclide source terms (the Level 2 analysis).

The Level 2 analysis begins with the end point of the Level 1 analysis (i.e., core damage). The Level 2 analysis uses both deterministic and probabilistic analysis tools to follow the progression of the core damage accidents. Computer analysis codes were used to simulate the meltdown of the core, failure of the RV due to contact with molten core materials, and transport and interactions of core debris in the containment. Because of the large uncertainties associated with the progression of a core damage accident, these deterministic calculations were supplemented with assessments that considered the potential for phenomena different from or more severe than those treated in the analysis codes. The results of this part of the analysis include an assessment of the potential for a variety of containment failure modes for each type of core damage sequence, and an estimate of the magnitude of the radionuclide release that would be associated with each.

It is impractical to evaluate the accident progression associated with each of the Level 1 core damage sequences. The binning of the sequences into plant damage states (PDSs) allows sequences exhibiting similar characteristics to be analyzed in detail in the Level 2 analysis, while keeping the total number of PDSs to be analyzed at a manageable level.

After the PDSs have been established, each is evaluated for probabilistic accident progression in the containment event tree (CET). The CET probabilistically evaluates the accident progression to calculate the likelihood of various end states ranging from an intact containment to small releases to large releases.

The PDS and CET quantitative solution tool is the SAREX code. The bridge event tree evaluation in SAREX is similar to the functions utilized in the Level 1 portion of the PRA. The Level 2 portion of the SAREX code was used to create the PDS binning diagram, CET, the CET's supporting decomposition event trees (DETs), and the release category binning diagram. MAAP is used for phenomenological evaluation of the accident progression and for calculation of source term releases from containment.

The following subsections describe the PDS and CET analyses.

19.1.4.2.1.1 Plant Damage State Analysis

At several stages in the PRA, elements of the accident sequences have been grouped according to similarities in characteristics. For example, many of the initiating events defined for the core damage sequences in the Level 1 analyses actually represent groups of different specific initiators that have similar effects on the systems required to respond to them. This grouping process is used primarily to make the overall analysis process more efficient and tractable by limiting the number of discrete events and scenarios that must be considered, while retaining the degree of discrimination needed to capture differences in potential accident sequences. The PDS binning approach follows the same philosophy.

The process of the PDS analysis is as follows:

a. Define the PDS characteristics to identify the physical characteristics and the accident sequence characteristics of the core damage sequences.

b. Develop the PDS event tree logic diagram.

c. Extend the Level 1 event trees to PDS event trees by questioning the status of functions that can affect containment integrity.

d. Group the extended core damage sequences (i.e., the end point of the PDS event trees) into the plant damage states by using a systematic logic diagram.

The PDSs are defined by developing possible combinations of the PDS parameters (core-melt bins and containment safeguard states), and in some cases conservatively combining some PDSs if the frequency is negligible. A PDS logic diagram is used to systematically bin core damage sequences into PDSs. This logic diagram is constructed with PDS grouping parameters as decision branches, to aid in the assembly of specific PDS characteristics from the matrix of possible combinations allowed by the grouping parameters.

Identifying the sequence characteristics necessary to delineate PDS bins requires a thorough understanding of the unique characteristics of the Level 2 systems of the containment itself, and of the accident progression phenomena to be considered. The PDS identification interfaces heavily with the CET analysis. The intent of PDS binning is to eliminate the need for additional system analysis in the progression of a specific PDS through the CET.

The nine sequence characteristics determined to be relevant to the APR1400 PDS bins are presented in Table 19.1-26 and described in detail in the text that follows in this section. A discussion of each follows, and the PDS binning diagram is presented graphically in Figure 19.1-41.

a. Containment Bypass (CONBYPASS)

The first parameter is "Containment Bypass." This parameter is used to divide the Level 1 core damage sequences into bypass and non-bypass groups. The containment bypass sequences are further subdivided into ISLOCAs and SGTR groups. Three branches are considered for this parameter:

1) NO BYPASS

2) ISLOCA

3) SGTR

The containment bypass sequences are distinctly different from the non-bypass sequences in that there is a direct flow pathway from the primary system to outside the containment boundary, bypassing the main containment region. Therefore, there is no holdup or attenuation of radionuclides (released from the core/primary system prior to vessel failure) by the natural processes and/or engineered safety systems in the containment. Consequently, bypass sequences can result in relatively large source term releases after the onset of core damage.

The ISLOCA and SGTR events are separated into different groups because the radionuclide release pathway for these sequences is different from those of non-bypass sequences.

For the SGTR sequences, the release pathway is from the RCS to the ruptured SG secondary side to the secondary steam line and safety/relief valves (i.e., MSSV and ADV). The SGTR sequences considered to be significant bypasses are those for which broken SG isolation is not achieved. If the SGTR event occurs and the ruptured SG is not isolated, it results in the large radionuclide releases regardless of severe accident phenomena inside the containment, so the CET may not be required for those sequences. For SGTR sequences, the CET considers the potential for fission product scrubbing if the ruptured tube is submerged in the SG.

In the APR1400 Level 2 PRA, the SGTR sequences are categorized as follows:

1) Spontaneous SGTR-initiated sequences

2) Transients leading to increased pressure differential across the tubes, including

    a) Secondary side depressurization sequences with induced tube ruptures

    b) Anticipated transient without scram (ATWS) sequences with-induced tube ruptures

3) Severe-accident-induced tube rupture (including pressure-induced SGTR and thermally induced SGTR)

In this parameter, the SGTR branch includes the first two sequences. All the unisolated SGTR sequences are assigned to PDS 1 and PDS 2. The third sequences are not considered in this parameter, but are considered based on the severe accident progression in the CET/DET analysis.

For the ISLOCA sequences, the pathway is from the RCS to the SC/CSS piping to the auxiliary building. Strictly speaking, a CET is not required for those sequences since containment phenomena are largely irrelevant. However, for ISLOCA sequences, a CET that considers important auxiliary building phenomena (such as whether the break location is submerged) may be necessary to assess the effectiveness of the auxiliary building in attenuating radionuclides. All ISLOCA sequences are assigned to PDS 3 and 4 by a rule-sorted option determined by the initiator.

b. Containment Isolation (CONISOL)

The second parameter is "Containment Isolation." This parameter is used to define three sequence groups based upon the status of containment building isolation at the time of core damage. If the containment is not isolated, early and relatively large releases of radionuclides from the plant are possible. Three branches are considered as follows:

1) NOT ISOLATED

2) ISOLATED

3) Rupture Before Core Melt (RBCM)

Containment isolation failure is not dependent on other systems considered in other PDS event trees. The containment isolation failure sequences could be evaluated using PDS event trees by the containment isolation (CI) system analysis. The extended core damage sequences with containment isolation failure are classified into NOT_ISOLATED. These sequences are assigned into PDSs 5 and 6. The most important consideration regarding additional systems (from the viewpoint of the radionuclide source term) is whether the containment spray systems function.

RBCM sequences can also result from long-term loss of containment heat removal even though core damage is initially prevented. These sequences require that injection into the RCS be successful and that containment heat removal be failed. The sequences with injection success and containment heat removal failure are classified into the RBCM group, and these sequences are assigned into PDS 7.

The sequences that are containment isolated and not in the RBCM group are classified into the ISOLATED state.

c. LOCA or Transient (LOCATRAN)

This parameter is "LOCA or TRANSIENT." The RCS leakage rate prior to vessel failure is important because it affects core melt timing, hydrogen generation and release rates, and fission product retention in the primary system. This parameter is strongly related to the next parameter, "RCS Pressure at the time of Core Damage." Five RCS leakage rates are considered:

1) Large LOCA (LL)
2) Medium LOCA (ML)
3) Small LOCA (SL)
4) RCP Seal LOCA (RSF)
5) Transient (TRAN)

The large break LOCA sequences result from a primary system break of greater than 15.24 cm (6 in) diameter. The large break LOCA sequences correspond to sequences that would result in RCS pressure in the low pressure range, less than 17.6 kg/cm^2 (250 psia).

The medium break LOCA sequences result from a primary system break of between 15.24 cm (6 in) diameter and 5.08 cm (2 in) diameter. The medium break LOCA sequences correspond to sequences that would result in RCS pressure in the medium pressure range, 17.6 kg/cm^2 (250 psia) to 84.4 kg/cm^2 (1,200 psia), at the time of core damage.

The small break LOCA sequences include break areas equivalent to those that would result from primary system breaks of less than 5.08 cm (2 in) diameter. This group also includes events initiated by one POSRV stuck open (fails to reclose). The small break LOCA sequences correspond to sequences that would result in RCS pressure in the high pressure range, greater than 84.4 kg/cm^2 (1,200 psia), at the time of core damage.

The RCP seal LOCA sequences include the event in which the mechanical failure of an RCP seal occurs. In terms of break size, the RCP seal LOCA sequence is similar to a small break LOCA. However, the accident progression of RCP seal

LOCA events is expected to be different from the small break LOCA. Following NUREG-1570 (Reference 30), the loss of a loop seal due to an RCP seal LOCA increases the potential for a TI-SGTR for high RCS pressure / dry secondary sequences, because it results in increasing the potential for a unidirectional convection flow between the degrading core and the relatively cool SG in the affected RCP loop. Hence, the small break LOCA and the RCP seal LOCA are considered separately in this parameter. The seal LOCA sequences correspond to sequences that would result in an RCS pressure of a high pressure range, greater than 84.4 kg/cm^2 (1,200 psia), at the time of core damage.

The transient sequences correspond to sequences having a cycling primary relief valve leakage rate (i.e., a rate with characteristic of a cycling POSRV). The RCS pressure in the transient sequences is maintained about the setpoint pressure of the POSRV, which is near 75.8 kg/cm^2 (2,500 psia).

d. RCS Pressure at the Time of Core Damage (PRCSCD)

This parameter is “RCS Pressure at the Time of Core Damage.” The RCS pressure during core damage can have a major impact on several potentially important containment events. This parameter segregates the extended core damage sequences into several groups, depending on the RCS pressure at the time of core damage. This parameter has three values:

1) High Pressure (HIGH, Pressure □≥□84.4 kg/cm^2 (1,200 psia))

2) Medium Pressure (MED, 17.6 kg/cm^2 (250 psia) ≤ Pressure < 84.4 kg/cm^2 (1,200 psia))

3) Low Pressure (LOW, Pressure < 17.6 kg/cm^2 (250 psia))

High pressure events are those events with an RCS pressure greater than approximately 84.4 kg/cm^2 (1,200 psia) at the time of core damage. High pressure sequences are the sequences that were assigned to be the TRAN, SL and RSF sequences in the former parameter, LOCATRAN. These sequences are the events with a small break LOCA leakage rate or a cycling primary relief valve leakage rate.

The high RCS pressure during core heatup and core damage facilitates natural circulation heat transfer from the core to the upper plenum, hot leg, surge line, and steam generators, which increases the potential for thermally induced hot leg, surge line, or steam generator tube creep failure. The high pressure events also have the potential for high pressure melt ejection (HPME) and direct containment heating (DCH), because elevated pressure at the time of RV rupture may result in entrainment of the core debris out of the reactor cavity, and may increase the potential for debris fragmentation and dispersal into the containment atmosphere, thus increasing the potential for DCH.

Medium pressure is defined to be a pressure between approximately 17.6 kg/cm^2 (250 psia) and 84.4 kg/cm^2 (1,200 psia) at the time of core damage. Medium pressure sequences are the sequences that were assigned to be the ML sequences in the former parameter, LOCATRAN. These sequences are the events with a medium break LOCA leakage rate. For medium pressure events, some potential for DCH is considered in CET analysis.

Low pressure is defined to be primary system pressure less than approximately 17.6 kg/cm^2 (250 psia) at the time of core damage. Events with a large break LOCA leakage rate would have low RCS pressure. For these events, DCH is considered to be very unlikely. The potential for steam explosion in the low pressure is greater than that of the high pressure. Low pressure sequences are the sequences that were assigned to be the LL sequences in the former parameter, LOCATRAN. These sequences are the events with a large break LOCA leakage rate or two more primary relief valves manually open.

e. Cavity Condition (CAVCOND)

The “Cavity Condition” parameter defines whether the cavity is flooded prior to vessel failure. The amount of water available in the cavity affects debris bed coolability, fission product production via core-concrete interaction (CCI), aerosol production rate, containment pressurization rate, potential for DCH, and mode of containment failure. If the cavity is flooded, the water in the cavity acts as an obstacle, and the amount of corium ejected out of the reactor cavity will decrease. This parameter has three values:

1) ERVC (only for sensitivity study)

2) WET

3) DRY

The cavity is defined to be WET if cavity flooding is manually initiated by operators, or if the initiating event is a vessel rupture with subsequent success of safety injection. For external RV cooling, if the outside of the reactor pressure vessel is flooded up to the bottom of the RCS loop piping, the cavity is defined as ERVC. All other cavity conditions are classified as DRY.

In this parameter, the WET sequences are the events in which the cavity is mainly flooded by the cavity flooding (CF) system operation. For the wet sequences, the potential for external RV cooling during severe accidents is not credited because the RV lower head is not submerged. The ERVC sequences are the events in which the cavity is flooded initially by one SCP injection, and the cavity water is maintained by operation of the boric acid makeup pumps (BAMPs). However, in-vessel retention by external RV cooling is not credited for the APR1400 PRA due to the uncertainty surrounding the phenomena. The ERVC branch in this parameter is included only for sensitivity study.

f. In-Vessel Injection (INVINJ)

The “In-Vessel Injection” parameter defines the status of in-vessel injection before the RV breach. Three branches are considered:

1) Success of in-vessel injection by operating SIS (ON)

2) In-vessel injection available but failure due to high RCS pressure (DEADHEADED)

3) In-vessel injection is not available (FAILED)

The status of in-vessel injection at the time of core damage is important for several reasons. If in-vessel injection is available during the period of core damage (ON), core damage may be limited and vessel failure prevented. If the RCS pressure is elevated above the SIP’s shutoff head and the SIS is available (DEADHEADED), then it could provide in-vessel injection if the RCS depressurizes prior to the RV breach (e.g., by an induced hot leg rupture). In addition, with the in-vessel injection operating, an additional source of cooling water is available to the cavity debris following RV failure.

g. Release Point (RELPOINT)

The "Release Point" parameter defines the path by which the reactor coolant fluid is released from the RCS prior to vessel failure. This parameter affects the hydrogen concentrations in the IRWST and the upper containment. For this analysis, two "Release Points" values are defined:

1) To containment (INC)

2) To IRWST (IRWST)

The first value is "Release to containment," and the reactor coolant may be released directly into the containment as typified by large or medium break LOCAs. In this case, the hydrogen produced in the vessel is released directly to the containment without passing through the IRWST (where it may be trapped). The first value also includes the events in which the rapid depressurization function is successful. The POSRVs and its discharge three-way valves can provide rapid depressurization after core damage. To do this, operators would open two out of four POSRVs and their related discharge three-way valves after severe accident initiation. This results in decreasing the RCS pressure rapidly and changing the release point from the IRWST to the containment atmosphere.

The second value is "Release to IRWST," and this release path is applicable to transients in which the reactor coolant is discharged to the IRWST via the POSRVs. In this case, the hydrogen generated in vessel is concentrically discharged to the IRWST area. This may lead to the buildup of flammable pockets of hydrogen in the IRWST area, and this increases the potential for burning or detonation of these pockets of hydrogen. The second value also includes releases both to the containment and to the IRWST. This type of release point is applicable to small break LOCAs in which some reactor coolant is discharged to the containment via the primary system break and some reactor coolant is discharged to the IRWST via the POSRVs. The hydrogen produced in the vessel is released both inside the IRWST and directly to the containment. In this analysis, however, this release type is classified into the IRWST category for simplicity and conservatism. The change of the assignment, as classified into INC, slightly affects CET quantification results.

h. Containment Heat Removal (CHR)

This parameter determines whether the containment heat removal by the CSS is available or not. Three branches are considered:

1) CSS operation (YES)

2) Failure of CSS (NO)

3) CSS recovered (RECOVERED)

The CSS, working in conjunction with the CCWS and ESWS, provides the active containment heat removal function. The containment spray flow is pumped from the IRWST, through the containment spray heat exchangers, and finally discharged into the containment atmosphere via the containment spray headers. The component cooling water cools the containment spray flow through the containment spray heat exchangers, thus removing the decay heat from containment. If the decay heat is not removed from containment, the containment pressure will gradually increase until the containment fails due to overpressurization. Thus, the status of containment heat removal is important with respect to determining the containment failure mode and timing. Containment heat removal is defined to be available if the flow from one containment spray pump is being delivered to containment via one containment spray header and the component cooling water and essential service water systems are cooling the containment spray flow in the containment heat exchanger.

In SBO sequences, if power is recovered, the containment heat removal may become available. These sequences are classified into RECOVERED.

Note that the ECSBS operation is not considered in this parameter. If the CSS is not available but ECSBS is available, the potential for containment overpressurization may be reduced significantly. However, the effectiveness of ECSBS is described in the CET analysis.

i. SG Feedwater Available (SG)

This parameter determines the status of feedwater from the core damage sequence. Two branches are considered:

1) SGs are wet at the time of core damage (WET)

2) SGs are dry at the time of core damage (DRY)

The availability of feedwater could influence the progression of the severe accident as described below.

First, the availability of feedwater to the SGs is important in determining the fission product retention in the RCS and the core melt timing. A transient or SLOCA event with a successful AFW system operation would result in relatively late core damage, but a transient or SLOCA event without the AFW system would result in relatively fast core damage.

Second, the availability of feedwater during accident progressions plays an important role in the significance of pressure-induced and thermally induced steam generator tube ruptures. A “wet” SG will prevent creep damage to the SG tubes, avoiding the conditions for a temperature induced SGTR (TI-SGTR) (i.e., TI-SGTR is not credible during severe accidents for the sequences in which feedwater is available to the SGs). A PI-SGTR could potentially occur in the presence of high RCS pressure (i.e., POSRV setpoint) coupled with a fully depressurized SG (i.e., atmospheric pressure). A fully (an unintentionally) depressurized SG can occur following an MSLB or transient with a stuck-open ADV or MSSV. If primary-secondary heat removal remains available following the blowdown, the RCS will continue to cool down. Thus, the high differential pressure (175.8 kg/cm^2-differential (2,500 psid)) necessary for a pressure-induced SGTR will not occur even if an SG is depressurized. The differential pressure across the SG tubes could increase to be as high as about 175.8 kg/cm^2-differential (2,500 psid) only after primary-secondary heat removal fails.

Third, if an SGTR event occurs, the availability of feedwater to the ruptured SG impacts the fission product release significantly. If the water level of the ruptured SG is maintained to be at the normal level above the top of U-tube sheet, a large amount of particulate fission products may be scrubbed. Following EPRI TR-101869 (Reference 31), if the point of release were submerged under a few meters of subcooled water, it could result in a reduction of at least of an order of magnitude in the fission product release.

As the Level 1 analysis only evaluates CDF, some containment systems relevant only to the Level 2 analysis must be added to the Level 1 sequences in order to generate the PDSs. These expanded event trees are called PDS event trees (also known as bridge trees). Linking of such system models is performed using the SAREX software in the same manner as is performed in the Level 1 analysis. By physically linking the Level 1 models with the Level 2 system models, system dependencies are explicitly captured by the software. The inclusion of additional systems for the Level 2 analysis is important to evaluate accident progression beyond core damage. For example, given core damage, the availability of containment sprays has the potential to maintain containment integrity, or at least scrub particulate fission product releases.

The top events added to Level 1 event trees to create the PDS event trees are as follows. Note that each discussion cites the inter-system dependencies of each.

a. CIS – Containment Isolation System. This event assesses the containment isolation system operation to isolate all of the containment penetrations to prevent fission product release. The success criterion of CIS is the isolation of all of the required containment penetrations. The containment isolation system fault tree model dependencies include CIAS actuation logic and 120 Vac for valves that need to change position other than check valves, and 480 Vac for some MOVs.

b. SDR – Rapid Depressurization Using the POSRVs. This event assesses the availability of the function of rapid RCS depressurization after core damage. The high pressure core damage sequences could be changed into the low pressure core damage sequences by operating the POSRVs. Operators can change the release point from the IRWST to the containment atmosphere by using the three-way valves downstream of the POSRVs. The success criterion of SDR is that greater than two out of four POSRVs and the associated three-way valves are manually opened after severe accident initiation.

c. INJ – Injection Status. This event assesses the injection of IRWST water into the RV by SIP trains. The success criterion of INJ is that at least one out of four SIPs injects the IRWST water into the RV. The event queries the status of safety injection (called as SIS or FEED), which is already considered in the Level 1 ETs. For some core damage sequences where the branch of SIS or FEED is not split in the Level 1 ETs, the branch of INJ is split in the PDS ETs.

d. ERVC – External Reactor Vessel Cooling. This event assesses the availability of ERVC function. After severe accident initiation, operators can flood the cavity by operating one SCP and maintain the water level by operating two BAMPs. However, in the baseline Level 2 model, the ERVC is not credited for the severe accident mitigation features due to uncertainty surrounding in-vessel retention by ex-vessel cooling. The impact of ERVC on the Level 2 PRA results is considered in a sensitivity study.

e. CFS – Cavity Flood System. This event assesses the availability of the CFS. The success criterion of CFS is that IRWST water flows into the reactor cavity via at least one spillway after severe accident initiation. The CFS relies on 120 Vac power for the signal to open the valves, and on Class 1E 125 Vdc power for MOV operation.

f. CSR1 – Containment Heat Removal. This event assesses the containment heat removal by the CSS. The success criterion of CSR1 is that at least either one CS pump or one SC pump provides the spray of water into the containment atmosphere. The event about containment heat removal (called CSR or LHR) is already considered in the Level 1 ETs. For some core damage sequences where the branch of CSR or LHR is not split in the Level 1 ETs, the branch of CSR1 is split in the PDS ETs. The CSS relies upon Class 1E 4.16 kVac power for pump operation, 125 Vdc power for control, 120 Vac for signaling, and pump room cooling.

g. SGISO – Ruptured Steam Generator Isolation. This event assesses the capability of isolation of a ruptured SG when SGTR occurs. If an unisolable path exists from the ruptured steam generator to the atmosphere, the ruptured generator could be at or near atmospheric pressure and there would be a direct path to the atmosphere for the release of radioactive material. The SG isolation components have dependency or partial dependency on instrument air, 125 Vdc power, and 120 Vac power.

However, prior to evaluating the isolation capability of a leak path, it is necessary to consider that the RCS pressure control is established before the ruptured SG is overfilled. If the RCS pressure is above the MSSV setpoint pressure and the ruptured SG is overfilled, the MSSVs will lift and pass water. In this analysis, if the MSSVs pass water, they are assumed to be stuck open and there is no means to isolate the ruptured SG. Thus, for the sequences in which the RCS pressure control is failed (called as ECLDN or SDR), the SG isolation is assumed to be failed, and those sequences are considered to be containment bypass sequences.

h. SHR1 – Feedwater Injection into Steam Generators. This event assesses the status of feedwater injection into SGs. The success criterion of FW is that at least either one motor-driven AFW pump or turbine-driven AFW pump provides the feedwater into the SGs, including steam removal. The secondary heat removal (SHR or SHR-TDP or ASC) is considered in the Level 1 ETs. For some core damage sequences where the secondary heat removal is not considered in the Level 1 ETs, the branch of FW is split in the PDS ETs.

i. RACV – Offsite ac Power Recovery before Battery Depletion. This event, RACV, assesses the probability of offsite ac power restored late before the 125 Vdc batteries run out. In the Level 2 PRA, it is assumed that there is no chance to recover the offsite power after battery depletion, since the battery depletion time is 16 hours.

j. PI-SGTR – Pressure-Induced SGTR May Occur in ATWS/MSLB/FWLB Events. This event assesses the conditional probability of pressure-induced SGTR due to the characteristics of some initiating events that result in high differential pressure between primary side and secondary side. In the MSLB and FWLB events, the secondary pressure in the broken loop would rapidly decrease to nearly atmospheric pressure, while the RCS pressure would increase and reach the setpoint pressure of POSRV cycling. If the POSRVs are not stuck open, the differential pressure between the primary and secondary side is approximately

175.8 kg/cm^2-differential (2,500 psid). This high differential pressure could result in a PI-SGTR.

k. RSF1 – RCP Seals Remain Intact. This event assesses whether the RCP seals remain intact given a loss of RCP seal cooling. The event about the RCP seal integrity (called RCPSEAL) is already considered in the Level 1 ETs. However, in some core damage sequences in which there is a loss of RCP seal cooling, the branch of RCPSEAL is not split in the Level 1 ETs. If the branch of RCPSEAL is not split in the Level 1 ETs, the branch of RSF1 is split in the PDS ETs.

l. FW-ISOL – FW Line Isolation during a FWLB Event. If a pressure-induced SGTR occurs in the FWLB events, the check valves in the feedwater line of the ruptured SG can prevent a fission product release to the environment. In the APR1400 plant, each steam generator has two downcomer feedwater line check valves, one economizer feedwater line valve, and two auxiliary feedwater line check valves. The success criterion of this event is that the feedwater line of the ruptured SG must be isolated by the check valves.

The dominant PDSs and the PDS event tree sequences largely contributing to them are presented in Table 19.1-27.

19.1.4.2.1.2 Containment Event Tree Analysis

19.1.4.2.1.2.1 CET Overview

Containment event trees (CETs) are developed to model the containment response during severe accident progressions. These CETs depict the various phenomenological progress, containment conditions, and containment failure modes that could occur under severe accident conditions.

To model containment responses for most accident sequences, a general CET is developed. Special CETs are developed for containment bypass and for containment isolation failure. These general and special CETs properly consider pertinent containment failure modes identified for the APR1400. The important phenomena that can affect the containment failure mode and source terms are also addressed in the CETs.

These CETs depict the various phenomenological processes, containment conditions, and containment failure modes that could occur under severe accident conditions. The purpose of the CET is to quantify the probabilities of containment failure modes and radionuclide releases. The various containment failure modes and the major phenomena that have a significant impact on the radionuclide release fractions are represented as top events on the CET. Detailed evaluation of phenomena that affect containment failure timing, fission product releases, or that may have an impact on downstream top events are treated through the use of decomposition event trees (DETs). The containment ultimate pressure capacity and severe accident phenomena analysis results are needed for quantification of the DETs. This CET/DET approach allows a relatively detailed treatment of the phenomena affecting containment performance while maintaining a relatively simple and easily understood CET. The CET sequences are grouped into a manageable number of distinct source term release categories for source term estimation.

The CETs use the plant damage states as input. The paths that a given PDS can take through the CETs depend on how the specific PDS is affected by the various events modeled in the CETs or DETs. Each PDS can contribute to more than one CET endpoint (containment status) with varying frequencies, and each CET endpoint can have more than one PDS contributing to its total frequency.

The potential severe accident progression for each PDS is unique and would be represented by a specific CET. For most PDSs, however, the potential severe accident progressions are very similar and can be represented by a general CET. For the rest of PDSs that pertain to containment bypass and isolation failure, special CETs represent their accident progression. The important phenomena that can affect the containment failure modes and the source term are also addressed as top events in the CETs.

The Level 2 analysis considers the possibility of the containment building failure under various accident scenarios. In order to be comprehensive, failures resulting from the spectrum of possible pressures must be considered. The NUREG-1150 study characterized containment failure using four parameters: a) likelihood of failure, the primary parameter of interest in the study, as a function of containment pressure; b) failure size, important because the larger the hole, the faster the release of radionuclides following an accident; c) location of failure, important because the retention of radioactive materials can be dependent on this parameter; and d) timing, since the longer the radioactive materials can be retained inside the containment before escaping, the larger the reduction in source term to the environment since the radionuclides are removed from the containment atmosphere by natural processes and ESFs. For a similar reason, timing is also important. These factors are considered in the CETs.

NUREG-1335 (Reference 32) gives a list of potential containment failure modes and mechanisms that should be considered in this report, and states that these failure modes and mechanisms were included in the NUREG-1150 analysis. The following describes how each of these items was evaluated in the APR1400 PRA.

a. Direct Bypass

Direct containment bypass is considered in the NUREG-1150 analysis and also in the APR1400 PRA. In each analysis, the bypass sequences include both V sequence (ISLOCA) and unisolated steam generator tube rupture (SGTR) sequences.

b. Containment Isolation Failure

NUREG/CR-4550 (Reference 33) describes failure to isolate containment. Since containment isolation failure can lead to direct release of radioactive material, it is of obvious importance. In NUREG/CR-4550, the probability of containment isolation failure was determined on the basis of analytical significance rather than fault tree analysis. A leak size greater than 9.29×10^{-3} m^2 (0.1 ft^2) is required to prevent containment overpressurization (from long-term steam generation).

The NUREG/CR-4550 analysis did not consider failure of containment isolation from a source term perspective. However, a leak in containment at the time of severe accident with the failure of the isolation paths to close may result in a significant release pathway, especially if the path is in direct contact with the containment atmosphere. The APR1400 PRA has considered this issue. A detailed screening analysis for containment isolation paths was performed and a fault tree was developed for the unscreened isolation paths. The effects of failure to isolate are considered in the CET.

c. Steam Explosion

NUREG-1150 considered steam explosions originating in the vessel (the classic Alpha mode failure) or ex-vessel, with Alpha mode failures considered by the Steam Explosion Review Group. The estimate for probability of Alpha mode containment failures is considered through a heading in the DET.

Ex-vessel steam explosions were dismissed for the Surry plant and the Zion plant in NUREG-1150 because steam explosions in the cavity would not directly contact structures that are both vulnerable and essential to the containment function. Nonetheless, ex-vessel steam explosions (as well as in-vessel steam explosions) were considered in the APR1400 PRA for model completeness.

d. Combustion Processes

The combustion of hydrogen prior to RV breach was treated in NUREG-1150 as an expert elicitation issue. However, it was decided that hydrogen combustion is of much greater concern for lower capacity containments, such as those at boiling water reactor (BWR) and PWR ice condenser plants, than it is for large, dry, high capacity containments such as the APR1400. In the words of NUREG-1150: "... the importance of early hydrogen combustion to the uncertainty in reactor risk for these plants is minor in comparison to that observed in the Grand Gulf and Sequoyah analyses."

Nonetheless, hydrogen combustion was considered for the Surry plant in NUREG-1150 accident progression analysis. Both early and late combustion were considered. Since the Surry and Zion containment buildings were found to be robust by the structural experts, the possibility of containment failure prior to RV failure is so remote as to be considered negligible and was not included in the NUREG/CR-4551 (Reference 34) containment building event analysis. The failure of containment due to a hydrogen burn at the time of RV failure was considered likely enough to be included. In the APR1400 PRA containment analyses, the impact of hydrogen combustion on containment overpressurization is considered at vessel failure and late in the accident sequence after vessel failure.

e. Steam Overpressurization

Gradual pressurization of the containment building would result from the protracted generation of steam or non-condensable gases from the interaction of molten core material with water on the containment floor or with the concrete basemat. This pressurization process could last from several hours to several days, depending upon accident-specific factors such as the availability of water in the containment and the operability of engineered safety features.

Gradual containment pressurization by steam production and from the non-condensable gases generated during debris concrete attack is considered explicitly in the APR1400 PRA.

f. Molten Core Concrete Interaction (Basemat Melt-Through)

After vessel failure, the core debris is discharged into containment. Once there, molten core-concrete interaction (MCCI) begins, leading to erosion of the concrete in the RV cavity. This threatens the integrity of the containment pressure boundary due to the possibility of melt-through of containment liners and the concrete basemat. Concrete ablation also generates combustible/non-condensable gases, which can lead to containment challenges due to pressurization and hydrogen burn. In order to prevent and mitigate the MCCI, the reactor cavity can be filled with water by using the CFS. This allows heat to be transferred from the corium pool into the overlying pool of water, eventually stopping MCCI. Therefore, for the wet cavity sequences, the probability of a severe MCCI and eventual melt-through of the containment basemat is expected to be very small.

g. Blowdown Forces (Vessel Thrust Force or Rocket Mode Failure)

Failure of the containment building as a result of gross displacement of the RV (above the shield wall) was considered in the NUREG/CR-4551 accident progression analysis. However, the assigned probability for this event was very small, making a negligible contribution to the probability of early containment failure.

h. Liner Melt-Through (Direct Contact of Containment Shell with Fuel Debris)

This issue is of primary concern to BWR plants because of the drywell design. For completeness of the PRA, this mode of failure was considered in the APR1400 PRA even though the pathways for debris transport out of the reactor cavity are to interior containment building compartments away from the containment wall. The probability of this failure mode was assigned a negligible value.

i. Failure of Containment Building Penetrations

Failure of containment building penetrations (electrical, fluid, equipment hatch, personnel hatch, etc.) was explicitly evaluated in the analysis of the containment overpressure capacity and found to be significantly less important than overpressure failure of the cylinder wall. Temperature-induced penetration failures were treated in the APR1400 PRA.

To model containment responses for most accident sequences, a general CET is developed. Special CETs were developed for the containment bypass, containment isolation failure, and containment failure before RV breach. These CETs properly considered all pertinent containment failure modes identified for the APR1400 containment. The important phenomena that can affect the containment failure modes and the source terms are also addressed in the CETs. The questions and important events that are used in significant references (e.g., NUREG-1150 and previous Level 2 PRAs for other plants) are reviewed and included in the APR1400 PRA CETs.

The containment event trees are shown in Figure 19.1-42 through Figure 19.1-46.

19.1.4.2.1.2.2 Containment Ultimate Pressure Capacity Analysis

In order to evaluate the likelihood of containment failure for various accident progression phenomena, it is necessary to determine a realistic pressure at which the containment would fail. In nuclear power plants, the containment design failure pressure is 2 to 3 times less than the realistic, as-built failure pressure. Therefore, a best-estimate assessment of the APR1400 containment was performed. This section summarizes the evaluation and results.

A plant-specific containment structural analysis was performed to determine the ultimate pressure capacity of the APR1400 containment building, and to identify the failure modes. Potential modes considered include:

a. Membrane failure

b. Cylindrical wall at the basemat

c. Failure of the basemat

d. Failure of the equipment hatch

e. Failure of the personnel access airlock

f. Failure of the personnel emergency exit airlock

g. Failure of the fuel transfer tube

In this analysis, the several failure modes that are identified in the containment structural analysis can be classified by their failure sizes into two groups, which are defined in NUREG-1150 and NUREG/CR-6906 (Reference 35).

a. A leak is defined as a containment breach that would arrest a gradual pressure buildup, but would not result in containment depressurization in less than 2 hours. The typical leak size is evaluated to be on the order of 9.29×10^{-3} m^2 (0.1 ft^2).

b. A rupture is defined as a containment breach that would arrest a gradual pressure buildup and would depressurize the containment within 2 hours. The typical rupture size is evaluated to be on the order of approximately 9.29×10^{-2} m^2 (1.0 ft^2).

The failure modes and their results are as presented in Table 19.1-28.

A probability density function was calculated for each potential failure mode, and summed together to estimate a total fragility curve. The results of this analysis are presented in Figure 19.1-47. These results were used in the Level 2 phenomenological evaluations for leak and rupture failure pressures of the containment.

19.1.4.2.1.2.3 CET Phenomenological Evaluations

The MAAP code was used to support many of the CET phenomenological evaluations. MAAP evaluations included evaluations of core melt, RCS failure, containment pressurization, ex-vessel core-concrete interactions, and releases from the containment. Containment failure due to overpressurization was considered using the results of the containment ultimate capacity evaluation. Many other calculations were performed to support the CET. Referring to the general CET presented in Figure 19.1-42, the following top events are described:

a. RCSFAIL – Mode of RCS Failure Before Vessel Breach

b. MELTSTOP – In-Vessel Core Melt Arrest

c. DCF – Dynamic Containment Failure

d. ECF – Early Containment Failure

e. CSLATE – Late Containment Heat Removal Recovery Failure

f. DBCOOL – Ex-Vessel Debris Coolability

g. LCF – Late Containment Failure

h. BMT – Basemat Melt-Through

1) RCSFAIL – Mode of RCS Failure Before Vessel Breach

The question posed in this DET is whether there is a severe accident-induced failure of the hot leg or steam generator tubes during severe accident progression. For high pressure core damage sequences, natural circulation of superheated gases can occur in the reactor coolant system after the core has uncovered. Natural circulation is a result of differences in gas density between the various regions of the reactor coolant system. Natural circulation of gases in the reactor coolant system during the severe accident is a significant phenomenon because it transports heat from the overheating core into the structure of the upper plenum, hot leg, surge line, and SG tubes. If the natural circulation flow of gases continues, it can cause failure of the hot leg, surge line, or SG tubes due to creep. However, if the SG tubes are cooled by water from the secondary side, the high temperature in the SG tubes will not occur. The induced SGTR event is possible only for dry and depressurized SG sequences.

The consequence of the induced primary system failures depends on the failure location. If the hot leg or surge line fails, the RCS is depressurized and many phenomena resulting from high RCS pressure at vessel breach, which threaten the containment integrity, are prevented. If the steam generator tubes fail, the direct release path of fission products from the RCS to the environment would be available. Note that these failure modes are mutually exclusive. Once failure occurs at any location, the resulting depressurization and reduction in stress on other components precludes subsequent failures. (That is, if the induced SGTR occurs, the induced hot leg or surge line failure will not occur. If the induced hot leg or surge line fails first, the induced STGR will not occur.) By considering the source term release consequences of each induced failure location, the induced SGTR is assumed to occur prior to hot leg or surge line failure in this analysis.

In terms of severe accident-induced SGTR, two unique induced tube rupture modes are possible during severe accident progression:

Pressure-induced SGTR (PI-SGTR): PI-SGTR results from a high differential pressure across the steam generator tubes occurring when RCS pressure is at the pressurizer relief valve (i.e., POSRV) setpoint and an SG is fully depressurized via a stuck-open ADV or MSSV. Note that core damage events that are expected to occur early in the sequence such as an MSLB or ATWS that involves induced SGTR are not included in this category. Such events were treated as bypass events previously in PDS analysis.

Thermally induced SGTR (TI-SGTR): TI-SGTR addresses the probability that high tube temperatures caused by the natural convection process after core damage, coupled with a significant RCS/SG pressure differential, will induce a rupture of SG tubes prior to hot leg and surge line failures.

2) MELTSTOP – In-Vessel Core Melt Arrest

This question determines whether the damaged core can be cooled in-vessel, thereby terminating the accident progression before RV rupture. Four possibilities are considered:

a) RV lower head failure prior to containment failure

b) Arrest of core melt progression before RV rupture

c) Containment failure before vessel rupture (leak)

d) Containment failure before vessel rupture (rupture)

The core melt can be arrested and the damaged core can be safely and continually cooled in the RV by the introduction of cooling water into the RV or the reactor cavity. There are two probable approaches for in-vessel core melt retention: Injection of a large amount of water (1) into the RV to completely submerge the damaged core or (2) into the reactor cavity to completely submerge the reactor lower head.

The safety injection system (SIS) can deliver sufficient water into the RV to cool the core when the intact core geometry is maintained or the core debris configuration is favorable for cooling. Once the core configuration becomes less favorable for cooling (e.g., after loss of original configuration and generation of obstacles in the core), substantially higher injection flow rates (several thousand gpm) may not be effective to cool the debris in-vessel because of low heat transfer rate from the core material.

There are two probable scenarios in which the core may be damaged in spite of injection being available. The first is a sequence in which the injection flow is insufficient to prevent core damage. The second is a sequence in which there is no coolant injection prior to core uncovery and incipient core damage, but some form of injection is recovered or initiated prior to vessel failure. In grouping the PDS ET sequences into PDSs, the safety injection flow is one of the grouping parameters.

If the RV lower head is submerged by water injected into the reactor cavity, the RV lower head can be maintained intact. The core can be cooled in the

RV by cooling of the outer wall of the RV. The severe accident phenomena that occurred outside the RV and threatened containment integrity would be prevented.

When the vessel failure is prevented by effectively cooling the core by in-vessel injection or external RV cooling, the containment may eventually fail due to steam-induced overpressurization if containment heat removal is lost.

If core melt is arrested before vessel failure and containment heat removal is available, only limited hydrogen production would be expected and containment overpressurization would be limited. DCH would not be a threat. As a result, containment failure is extremely unlikely. Furthermore, radionuclide release from the debris would be limited and long-term revaporization of radionuclides deposited on RCS surfaces would be largely avoided. Hence, because the containment does not fail and the radionuclide release is limited, the environmental source terms for core damage sequences that are successfully terminated in-vessel are expected to be very small. The sequences of this type are very similar to the accident at Three Mile Island Unit 2 (TMI-2).

3) DCF – Dynamic Containment Failure

This event determines whether the very energetic phenomenon only depending on the RCS pressure at vessel breach occurs and results in early containment failure at the time of vessel breach. This event can be included in the next event (Early Containment Failure). For convenience's sake, however, these phenomena are considered separately from Early Containment Failure. Two possibilities are considered:

a) No dynamic containment failure

b) Dynamic containment failure

In this top event, three energetic phenomena are considered:

a) In-vessel steam explosion ("Alpha-mode" containment failure)

b) Rocket-induced containment failure

c) High pressure melt ejection-induced containment failure by liner attack

In-vessel steam explosion: The in-vessel steam explosion or “Alpha” mode containment failure refers to the scenario whereby a large quantity of molten corium is relocated in-vessel from the core/lower support structure to a water pool in the RV lower plenum. The superheated corium is postulated to rapidly transfer its thermal energy into kinetic energy by creating a rapidly expanding steam region within a liquid pool. This rapidly accelerating bubble generates a shock wave in the liquid (steam explosion) that subsequently disassembles the RV and propels the upper head (as a blunt missile) against the containment upper dome. The consequences of an “Alpha” mode containment failure will be a large area containment failure in the containment upper dome. This containment failure mode was determined to have a negligible potential to fail the containment, but was conservatively given a small (0.001) probability of containment failure in low pressure sequences (zero in high pressure sequences).

Rocket-induced containment failure: The "rocket-induced containment failure" event addresses the potential for containment failure due to rocketing (lift-off) of the RV and damaging containment. A possible scenario consists of a gross failure of the RV bottom head with the gases inside at high or intermediate pressure. This results in a short duration (impulsive) pressure load on the RV, the load that is transmitted to the upper portion of the vessel and to the connective piping that supports the vessel. After several in of movement, the hot legs and the cold legs hit the cavity at the top nozzle cutout elevation. The piping walls, piping junctions, and restraints resist further upward movement of the vessel. If the upward impulsive load on the RV exceeds the restraining capability of the RCS piping, then a lift-off occurs. The ensuing projectile can collide with the missile shield, manipulator crane, or polar crane above the RV. The missile impact on the cranes could possibly tear the containment. This potential is considered to be negligible. However, the analysis conservatively assigned a small (0.001) probability of containment failure in high and medium pressure sequences (zero in low pressure sequences).

Containment failure by direct liner attack: This event addresses the potential for a containment failure due to the direct impact of corium particles ejected from the RCS at high pressure. This potential containment challenge results from a high pressure RV discharge of energetic corium debris interacting with the containment shell (concrete and steel liner). Direct containment shell attack by high temperature core debris requires that the debris be relocated from the RCS to the containment. An ex-vessel distribution of the debris leading to direct contact with the containment shell is a minimal requirement for the occurrence of this postulated failure mechanism. Low pressure vessel failure events will lead to the deposition of core debris entirely within the reactor cavity. This would preclude direct contact with the containment shell liner. Thus, only high pressure vessel failure events need to be assessed for direct shell attack. A high pressure vessel failure can lead to debris dispersal and potential ejection of a portion of the debris from the reactor cavity into adjacent containment shells.

For the APR1400, this issue was found to be negligible because even if the RV were to fail at high RCS pressure, the containment geometry of the APR1400 strongly inhibits the possibility of debris entrainment to the containment shell. However, the analysis conservatively assigned a small (0.001) probability of containment failure in high pressure sequences (zero in medium and low pressure sequences).

4) ECF – Early Containment Failure

This event determines whether a gross failure of containment occurs at or soon after RV failure. Four possibilities are considered:

a) No early containment failure without hydrogen burn

b) No early containment failure with hydrogen burn

c) Early containment failure (leak)

d) Early containment failure (rupture)

For sequences defined as early, it is assumed that insufficient core-concrete interaction can occur so that the hydrogen contribution due to CCI is small. This results in maximum hydrogen production during the core melt progression equivalent to 100 percent oxidation of the active cladding.

The phenomena that could potentially contribute to early containment failure are:

a) Hydrogen burn before RV failure

b) Direct containment heating (DCH)

c) Hydrogen burn after RV failure

d) Rapid ex-vessel steam generation (RSG) and ex-vessel steam explosion (EVSE)

Hydrogen burn before vessel failure: This issue considers the potential for a deflagration to occur in containment prior to vessel breach. Early in a severe accident sequence, hydrogen is primarily generated by the oxidation of zirconium. If only a small fraction of the available zirconium is oxidized early in the accident sequence, burnable concentrations of hydrogen would not be produced in the containment, even if the PARs or igniters are not available. After hydrogen concentration reaches a burnable level, hydrogen burns occurring at this phase of the accident are highly likely. The analysis assumes oxidation of 75 percent of the active core cladding inventory. This value is a reasonable upper bound for “in-vessel” hydrogen production prior to vessel breach and is used to establish the containment performance with a hydrogen burn occurring while the RV remains intact.

Early hydrogen burns prior to vessel breach (VB) can occur when (1) an ignition source is available, (2) appropriate burn conditions above the lower flammability limit of hydrogen are established, and (3) the ignition source successfully ignites the mixture.

The probability of containment failure due to pre-VB hydrogen burns was found to be negligible. If pre-VB hydrogen burns occur and containment failure does not occur, the pre-VB hydrogen burns decrease a threat of post-VB hydrogen burn due to a limited hydrogen amount being present. Therefore, in this analysis, pre-VB hydrogen burns are assumed NOT to occur, and all of the hydrogen generated prior to vessel breach is conservatively assumed to participate in post-VB hydrogen burns.

Post-vessel breach deflagration: Early hydrogen burns following vessel breach can occur when both an ignition source is available and appropriate burn conditions above the lower flammability limit of hydrogen are established. This event is also considered in the late containment failure section.

The probability of containment failure due to a hydrogen burn within a few hours after the RV failure is calculated by determining the potential containment pressure rise due to a hydrogen burn before vessel breach, and calculating the appropriate containment failure probability for that pressure using the containment fragility curve.

The failure potential for the post-VB hydrogen burn is quantified by assuming that the amount of hydrogen available for combustion is equivalent to the hydrogen produced following a 100 percent complete oxidation of the zircaloy cladding in the active core.

The post-VB "early" hydrogen burn is assumed to be suppressed if one of the following is true:

a) Containment sprays are not available regardless of release point into the containment

b) A burn event has already occurred in the containment. This includes:

- DCH event

- Pre-VB burn

- Continuous hydrogen removal by PARs

In this analysis, because pre-VB hydrogen burn is conservatively ignored, all the hydrogen generated prior to vessel breach always participates in post-VB hydrogen burns.

Post-vessel breach detonation: Detonations can develop from two sources: a DCH or a deflagration-to-detonation transition (DDT). DDT is defined to be a detonation resulting from a flame acceleration and subsequent shock development.

The possibility for a detonation to occur in containment is far more unlikely than a simple deflagration. This is a result of several factors:

a) The ignition source required to directly initiate hydrogen deflagration is over 10 orders of magnitude lower than that required for a direct initiation of a detonation.

b) Detonations are more likely for conditions of a highly reactive mixture and restricted geometry. The APR1400 potential hydrogen concentrations and geometry are not conducive to detonation formation.

c) Steam concentrations necessary to inert the containment to a hydrogen detonation are far lower than that required to inert the containment to deflagrations.

For the APR1400 Level 2 analysis, the potential for containment failure due to hydrogen deflagration or detonation was found to be negligible.

Direct containment heating: Direct containment heating is considered for sequences in which core damage is initiated while the primary system is at high pressure. It has been hypothesized that the corium would be ejected from the RV under high pressure and would be dispersed into the containment atmosphere as finely fragmented particles. The airborne particulate debris could then rapidly release chemical and thermal energy to the containment atmosphere. This would result in a rapid increase in containment pressure very soon after vessel failure. A more recent understanding of the DCH issue now suggests that the high pressure melt ejection (HPME) and fragmentation process provides little direct transfer of the heat generated in the corium-steam exothermic reactions or stored in the corium debris, to the containment atmosphere. Instead, the DCH process is one of hydrogen generation and combustion coupled with the RCS post-severe-accident steam/water blowdown to containment.

The DCH issue as related to the APR1400 has been evaluated. The APR1400 cavity has been configured to retain most of the core debris within the reactor cavity. It is estimated that even under the most adverse high pressure discharge, much of the ejected corium debris would be retained within the reactor cavity. For purposes of the PRA, the DCH loading was characterized by: 1) a combined HPME loading associated with introduction of RCS steam/water inventory into containment, 2) an unconditional hydrogen burn associated with the combined unburned hydrogen generated prior to and during the HPME process, and 3) a direct debris-containment heat transfer associated with the corium dispersal process. In the context of the APR1400 PRA, DCH loadings are associated with dry cavity HPME conditions only. HPME into a flooded the APR1400 reactor cavity is considered predominantly a containment threat associated with rapid steam generation.

Rapid steam generation and ex-vessel steam explosion: For sequences in which water is present in the cavity at the time of RV failure, the interaction of the corium with the water in the cavity can rapidly generate large amounts of steam. If the steam generation is sufficiently rapid to exceed the ability of the water to acoustically relieve the expansion, a shock wave will develop in the water. This process is referred to as a steam explosion. Steam explosion loads can be very large and are impulsive in nature. If an explosive interaction between the corium and the water does not result, the rapid steam generation may produce quasi-static pressure loads that can challenge containment integrity.

The relationships between the various factors that influence the potential for an early containment failure due to rapid steam generation are modeled. The issue of rapid steam generation has been divided into two related containment threats. These are the ex-vessel steam explosion-induced containment failure and the quasi-static steam pressurization containment failure event. It should be noted that the rapid steam generation containment failure mode presumes that the cavity is water filled so that DCH loadings are insignificant and that the steam atmosphere is sufficient to inert post-VB hydrogen burns.

In the APR1400 Level 2 analysis, the probability of containment failure due to the above phenomena was found to be negligible. Despite the negligible potential for any of these challenges to fail the APR1400 containment, a small probability was conservatively assigned to each phenomenon. These small probabilities do not adversely skew the results, but allow for sensitivity evaluations, which are performed in the results section.

5) CSLATE – Late Containment Heat Removal Recovery Failure

This event determines if containment heat removal is available late (after vessel breach) in the accident sequence. It is assumed that late overpressurization can be avoided if containment heat removal is available. In this analysis, the containment spray system and the emergency containment spray backup system (ECSBS) are considered to function for containment spray. The branches for this event are:

a) No late containment spray available

b) Late containment spray available

For containment heat removal to be available after vessel breach, the containment heat removal function should be available early in the accident scenario and the function maintained after vessel failure, or the early failed containment heat removal should be recovered. Failure of equipment inside containment is considered to be 100 percent non-recoverable. For cases where the containment heat removal was unavailable because the operator had failed to initiate containment spray, containment spray would be initiated before containment failure given the available time and indications. In cases in which ac power was unavailable, containment spray would be operated if power is recovered prior to containment failure.

6) DBCOOL – Ex-Vessel Debris Coolability

This event determines whether the core debris relocated into the reactor cavity is rapidly quenched by an overlying water pool. Though the APR1400 has been designed with a large cavity area and the cavity flooding system, in this analysis, it is considered that the corium may not be well cooled by an overlying water pool. Three possibilities are considered:

a) Ex-vessel debris not cooled without an overlying water pool

b) Ex-vessel debris not cooled with an overlying water pool

c) Ex-vessel debris cooled

The debris in the reactor cavity can be submerged by water if safety injection is operating after vessel failure or the reactor cavity flooding system operates. If the debris is cooled, its only subsequent challenge to the containment is steam overpressurization due to the continued addition of decay heat to the cooling water and hence to the containment.

Physically, the debris is not cooled if the debris surfaces that are exposed to the heat-removing medium are not large enough with respect to the heat generating volume to prevent high temperatures from being attained. High surface-to-volume ratios indicate that the debris is being spread thinly over a large surface area. The geometry of the cavity (floor area) is an important factor.

7) LCF – Late Containment Failure

This event determines whether a gross failure of containment due to overpressurization and/or overtemperature occurs late in the accident sequence. ("Late" is defined as being greater than after a few hours or a few days following RV failure.) This event is similar to the event for early containment failure, with the accident in progress for a significant amount of time as the obvious difference. Three possibilities are considered as follows:

a) No containment failure

b) Late containment failure (rupture)

c) Late containment failure (leak)

The phenomena that could potentially contribute to a late containment failure are:

a) Overpressurization caused by production of steam and/or non-condensable gases

b) Late hydrogen burn

c) Overtemperature failure of containment penetration sealants

The primary cause of failure of the containment is the steam overpressurization resulting from the loss of the containment heat removal. If the containment sprays (including ECSBS) are not available and the reactor cavity is flooded with water, the containment would finally fail due to steam overpressurization. The steam overpressurization process is slow and it takes a long time to reach the containment failure pressure. The containment pressurization may stop if a small leakage path exists.

The possibility of late containment failure due to a late hydrogen burn was evaluated with conservative assumptions that an ignition source is available when the maximum hydrogen concentration is reached. Pressure resulting from a late hydrogen burn through the adiabatic isochoric complete combustion (AICC) process was calculated using the MAAP code for various accident sequences. The probability of containment rupture, leak, or no containment failure was calculated based on the resultant pressure and the containment ultimate pressure capacity (UPC).

Overtemperature failure of containment seals is also considered, and was found to be negligible. However, the analysis conservatively assigned a small probability of containment failure in sequences with failed containment sprays and a dry cavity.

8) BMT – Basemat Melt-Through

This event determines whether the containment can fail due to basemat melt-through. Two branches are considered:

a) No basemat melt-through

b) Basemat melt-through

The containment can fail due to basemat melt-through (even if the cavity is filled with water) if the molten debris is not coolable. Note that if the containment heat removal function is not available and the reactor cavity is wet, it is assumed that overpressure failure occurs and basemat melt-through is neglected since the offsite consequences of basemat melt-through would be small compared with those of overpressure failure.

Successful cooling of the cavity debris bed implies that erosion-induced containment failure modes will not occur and that the radiological releases are attributable to either an alternate failure mode or containment leakage (assuming no other containment failure mode is identified).

19.1.4.2.1.3 Release Category Evaluations

The end points of the containment event tree (CET) represent the outcomes of possible accident progression sequences. These end points describe complete severe accident sequences from initiating event to release of radionuclides to the environment. The number of CET end points is large, and a detailed source term analysis for all of the end points is not feasible. In addition, such analyses for all accident sequences are not necessary because the amount and timing of the fission product release to the environment are similar for many of the accident sequences. Therefore, to reduce the source term evaluation effort, the CET accident sequences are grouped into a representative number of release categories that exhibit similar characteristics.

A particular release category consists of a group of CET end points that have similar source term governing characteristics. Once the release categories are determined, various accident sequences are allocated to each category. The APR1400-specific source terms are evaluated using the MAAP computer code for one sequence that best represents the release category. The MAAP cases are used to predict the source term characteristics, including the release fraction and the release timing.

The analysis for the source term categories (STCs), also called release categories (RCs), was performed through the following steps:

a. Define the STC grouping parameters (or headings)

b. Develop the source term category logic diagram

c. Quantify the logic diagram based on the results of the CET quantification

d. Discuss the frequency and the dominant sequences of each release category

e. Discuss the source term characteristics for each category using the MAAP code

The quantitative definition of a “large” release in the APR1400 Level 2 analysis is that the release fractions of the volatile/semi-volatile fission products (iodine, cesium, tellurium) are greater than 0.025 (2.5 percent). Of the 12 MAAP fission product groups, the highest of CsI, TeO_2, CsOH, and TE_2 is taken to represent the volatile/semi-volatile fission product release fraction for each STC.

The definition of an “early” release is one in which the large release occurs prior to effective evacuation of the surrounding public. In the Level 2 PRA, an effective evacuation is assumed to be evacuation of a 16 km (10 mile) radius surrounding the plant. The time for effective evacuation is assumed to be 4 hours after declaration of a general emergency. The criterion for the declaration is loss of two of three fission product barriers, with the potential loss of the third. As the emergency planning procedures have not yet been developed, the criteria for evaluation of the three fission product barriers, the best-estimate evaluations were taken from guidance in Nuclear Energy Institute (NEI) 99-01 (Reference 36).

In order to set up the release categories, binning parameters are selected. These parameters are defined on the basis of appropriate attributes that impact fission product release and accident consequences. The selected set of parameters is used as grouping criteria to define the release categories and the associated source term magnitude, composition, and timing. Although these parameters are plant- and containment type-specific, and there is no unique way to perform a binning process, recent PRA studies suggest a list of important binning parameters.

The containment sequence characteristics selected for use in definition of the source term release categories are:

a. Containment Bypass (CONBYPASS)

b. Containment Isolation Status (CONISOL)

c. In-Vessel Melt Retention (MELTSTOP)

d. Time of Containment Failure (TIMECF)

e. Mode of Containment Failure (MODECF)

f. Containment Spray System (CSS)

g. Cavity Condition (CAVCOND)

h. Fission Product Scrubbing for Bypass (SCRUB)

The STC binning diagram delineating these issues is presented in Figure 19.1-48. Each of the above parameters is directly based on the CET sequence characteristics from Figures 19.1-42 through 19.1-46.

A particular release category consists of a group of CET end points that have similar source term governing characteristics. Once the release categories are determined, various accident sequences are allocated to that category. Among these sequences, the APR1400 specific source terms are evaluated using the MAAP computer program for the one sequence that best represents the release category.

A source term category can be fully characterized by the following parameters:

a. The frequency of occurrence

b. The isotopic content and magnitude of the release (release fractions of the fission products)

c. The energy of the release to the environment

d. The time of the release to the environment

e. The duration of the release

f. The location of the release (release point of the release height)

Source term characteristics such as the isotopic content, magnitude, and the time of the release were calculated with the MAAP code for each release category. To select the representative sequence for the specific release category, the following process was used:

a. Select the PDS with the largest contribution to the release category's total frequency

b. Among the accident sequences corresponding to the PDS, choose the dominant sequence for the release category. This defines the initiating event and the status of the various plant systems.

c. The definitions of the CET sequence (i.e., accident progression sequence) are retrieved to determine if any special phenomenological conditions have to be specified.

d. A containment failure pressure, failure time, and failure condition are specified based on the release category definition.

By definition, a release category characterizes the unique source term characteristics for each of the release categories as mentioned above. Therefore, the representative sequences of the release categories for the APR1400-specific source term evaluation were determined based on the results of the internal events.

The release of the fission products can occur through the containment design leakage or a breach of the containment. The assumed pre-existing containment design leakage is a rate of 0.10 volume-percent per day at the design pressure and temperature. This design leakage was assumed to be from the containment to the environment. In this analysis, this design leakage was applied to all source term categories including those categories in which the containment does not fail.

The release categories from Figure 19.1-48 are summarized here:

RC 1 – This category is characterized as an SGTR bypass of containment without fission product scrubbing. In this release category, it is expected that the significant releases occur in the early time period (i.e., prior to effective evacuation).

RC 2 – This category is characterized as an SGTR bypass of containment with fission product scrubbing. In this release category, the fission products can be scrubbed with the overlying water pool in a ruptured SG.

RC 3 – This category represents ISLOCAs without successful scrubbing of fission product releases. In this release category, it is expected that the significant releases occur in the early time period (i.e., prior to effective evacuation).

RC 4 – This category represents ISLOCAs with successful scrubbing of fission product releases. If the break outside containment occurs in an area where there would be significant pooling of water to submerge the break, the fission product particles released to the environment would be scrubbed.

RC 5 – This category represents the containment isolation failure with successful containment spray. The largest penetrations that were modeled in the CI system fault tree are the CVCS IRWST boron recovery return line and non-condensable gas exhaust line excluding the entrance doors (personnel airlock) and the equipment hatch.

RC 6 – This category represents the containment isolation failure without containment spray. This category is very similar to RC 5, except that the containment spray system is not available.

RC 7 – This category represents the containment failure before core damage, and containment fails with leak failure size. The phenomenon of containment failure before reactor pressure vessel (RPV) breach (CFBRB) may occur when containment pressure keeps increasing due to the loss of containment sprays, while in-vessel injection is maintained during the accident.

RC 8 – This category represents the containment failure before core damage, and containment fails with rupture failure size. This category is very similar to RC 7, except for the failure size of the containment.

RC 9 – This category represents those sequences in which the core melt progression is stopped before RV failure. In this category, the integrity of the containment and the RV are maintained. Therefore, there is no significant release of ex-vessel fission products. The fission products are released from the containment to the environment at the design leak rate.

RC 10 – This category represents those sequences in which the containment does not fail after RV failure. In this category, there is a release of fission products after RV failure. However, the fission products are released from the containment to the environment at the design leak rate because containment integrity is maintained.

RC 11 – This category represents those sequences in which the containment fails late due to basemat melt-through. In this category, there are significant CCI and concrete erosion after RV failure. Since the containment failure occurs below the containment basemat, there is a very small release of airborne fission products to the environment, and the release characteristics of this category are expected to be as an underground water release. However, due to MAAP limitations for underground release evaluation, the basemat failures are conservatively treated as airborne releases at ground elevation. This conservatism does not significantly impact the source terms because the releases of this category are late and small.

RC 12 – This category represents those sequences in which the containment fails early with a leak failure size. However, no sequences are assigned to this release category based on the quantification results of the PDSs and CET/DETs.

RC 13 – This category represents those sequences in which the containment fails early with a rupture failure size. The release characteristics of this category are the same as those of RC 12 except for the failure size of the containment. The early containment failure modes include an early hydrogen detonation/deflagration failing containment, an ex-vessel steam explosion, a

DCH-induced containment failure, and several dynamic containment failures (i.e., alpha-mode containment failure, rocket mode containment failure, and the containment shell attack by HPME-induced corium particles). In this category, the containment would fail approximately at the time of RV failure. Therefore, the fission products were significantly released into the environment before successful evacuation.

RC 14 – This category represents those sequences in which the containment fails late with a leak failure size, the containment spray functions, and the cavity condition is dry. This represents the containment failure modes that include a late hydrogen detonation/deflagration failing containment. In this category, there may be significant fission product releases to the environment due to a dry cavity. However, these releases could be scrubbed by the containment sprays until the containment failure occurs.

RC 15 – This category represents those sequences in which the containment fails late with a leak failure size, the containment spray functions, and the cavity condition is wet. However, no sequences are assigned to this release category based on the quantification results of the PDSs and CET/DETs.

RC 16 – This category represents those sequences in which the containment fails late with a leak failure size, the containment spray does not function, and the cavity condition is dry. This represents the containment failure modes that include a containment seal failure due to overtemperature. In this category, there may be a significant fission product release to the environment due to a dry cavity and unavailable containment sprays.

RC 17 – This category represents those sequences in which the containment fails late with a leak failure size, the containment spray does not function, and the cavity condition is wet. This represents the containment failure modes that include a containment failure due to steam overpressurization. In this category, there is no significant fission product release to the environment due to a wet cavity. However, the releases are not scrubbed by the containment sprays.

RC 18 – This category represents those sequences in which the containment fails late with a rupture failure size, the containment spray functions and the cavity condition is dry. The release characteristics of this category are the same as those of RC 14, except for the failure size of the containment. This represents the containment failure modes that include a late hydrogen detonation/deflagration that fails the containment. In this category, there may be significant fission product releases to the environment due to a dry cavity. However, these releases can be scrubbed by the containment sprays until the containment failure occurs.

RC 19 – This category represents those sequences in which the containment fails late with a rupture failure size, the containment spray functions, and the cavity condition is wet. The release characteristics of this category are as same as those of RC 15, except for the failure size of the containment. This represents the containment failure modes that include a late hydrogen detonation/deflagration that fails the containment. In this category, there is no significant fission product release to the environment because the releases can be scrubbed by the containment sprays until the containment failure occurs and there is a wet cavity.

RC 20 – This category represents those sequences in which the containment fails late with a rupture failure size, the containment spray functions, and the cavity condition is dry. The release characteristics of this category are the same as those of RC 16, except for the containment failure size. This represents the containment failure modes that include a late hydrogen detonation/ deflagration that fails the containment. After the containment failure, the fission products are released into the environment through a containment failure location. In this category, there may be a significant fission product release to the environment due to a dry cavity and unavailable containment sprays.

RC 21 – This category represents those sequences in which the containment fails late with a rupture failure size, the containment spray does not function, and the cavity condition is wet. The release characteristics of this category are the same as those of RC 17, except for the failure size of the containment. This represents the containment failure modes that include a containment failure due to steam overpressurization. In this category, there is no significant fission product release to the environment due to a wet cavity. However, the releases are not scrubbed by the containment sprays.

The summary of the MAAP results (release magnitude and timing) and release categorization (i.e., large release, large early release, or not large release) is presented in Table 19.1-29 and Table 19.1-30.

19.1.4.2.2 Results from Level 2 Internal Events PRA for Operations at Power

It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

19.1.4.2.2.1 Risk Metrics

Total LRF from internal events is 1.1×10^{-7}/year. This is well below the NRC goal for LRF below 1×10^{-6}/year. Mean value and associated uncertainty distribution can be found in Subsection 19.1.4.2.2.7.

The conditional containment failure probability (CCFP) from all internal events (at power) in large release sequences is 8.4×10^{-2}. This meets the NRC goal of no more than approximately 0.1 for CCFP. This CCFP is the conditional probability of a large release (CPLR) for operations at power.

19.1.4.2.2.2 Internal Events Core Damage Release Category Results

The relative contributions of the release categories to the total STC frequency are shown in Figure 19.1-49. Figure 19.1-50 groups the categories further into no contailment failure, large release, and small release.

Approximately 49 percent of the LRF for internal events is from STC 1, which are unmitigated, unisolated SGTR releases (both SGTR initiating event and induced SGTR). The next-highest frequency STC is a late rupture with no containment sprays (27 percent), followed by containment failure (rupture) prior to core damage (12 percent), and containment failure (leak) prior to core damage (10 percent). Early containment rupture with no sprays contributes 1.6 percent to the LRF, and containment isolation failure with no spray contributes 1.1 percent. The remaining STCs have a negligible contribution to the LRF.

19.1.4.2.2.3 Significant Sequences and Cutsets

The significant LRF cutsets for the internal events Level 2 PRA are illustrated in Table 19.1-31. This table provides the top 100 LRF cutsets, and does not exclude any cutset that contributes over 0.1 percent to the total LRF.

Cutsets that contribute 1 percent or more to large release for internal events are described as follows.

The first six cutsets are all pressure-induced SGTRs. The first is an ATWS, in which the high RCS pressure induces the rupture. The next five are all main steam line break (downstream of MSIVs) with a failure to close the MSIVs, where the rapid decrease in secondary side pressure creates a large pressure differential across the tubes, inducing the break. The LSSB-D cutsets each have success of safety injection and rapid depressurization (SDR) in their event tree sequence logic, making them conservative in a classification as “large” releases.

LRF cutsets 7 and 8 are a total loss of ESW or CCW, a resulting RCP seal LOCA, and failure to run of the auxiliary charging pump. Containment sprays are unavailable because of the cooling water system failures, and late containment rupture results.

Cutsets 9 through 12 are similar to cutsets 2 through 6, with different CCFs of the MSIVs.

Cutset 13 involves containment failure prior to core damage. It is a medium break LOCA with failure of the containment sprays to provide containment heat removal. The eventual overpressurization of the containment causes the containment failure that is assumed to fail the systems that would prevent core damage (e.g., loss of NPSH for the SIPs).

19.1.4.2.2.4 Significant Core Damage End States, Initiating Events, Phenomena, and Basic Events

Table 19.1-32 and Figure 19.1-51 present the LRF contribution by internal initiating events. The largest contributor, with 27 percent, is a steam line break inside the containment (downstream of the MSIVs). This contribution arises because of the steam line break inside containment sequence described in Subsection 19.1.4.2.2.3. The second- and third-largest contributing initiating events are LOOP and SBO, each with failure of containment heat removal and a flooded cavity, leading to late containment overpressurization. The fourth-largest contributing initiating event is medium break LOCA, with the containment failure before core damage sequences. ATWS-induced SGTR is fifth in frequency.

Table 19.1-33 presents the significant plant damage states (PDSs) that contribute to LRF.

Table 19.1-34 presents the important basic events to LRF, ranked by RAW. Table 19.1-35 presents the same, ranked by FV. Table 19.1-36 presents the common cause event importance to LRF, ranked by RAW. Table 19.1-37 presents the same, ranked by FV. Table 19.1-38 presents the human action importance, accounting for both pre-initiators and post-initiators, ranked by RAW. Table 19.1-39 presents the same, ranked by FV.

19.1.4.2.2.5 Key Assumptions

a. If the MSSVs pass water in an SGTR, they are assumed to be stuck open and there is no means to isolate the ruptured SG. Thus, for the sequences in which RCS pressure control is failed (called ECLDN or SDR), the SG isolation is conservatively assumed to be failed and those sequences are directly considered as containment bypass sequences.

b. The conditional probability of PI-SGTR, given ATWS and MSLB/FWLB sequences without feedwater, is assumed to be 0.027 based on engineering judgment of applicable industry references for this probability.

c. For calculation of hydrogen mass generated in a severe accident in the first few hours after core damage, it is assumed that insufficient CCI can occur so that the hydrogen contribution due to CCI is small. This leads to a maximum hydrogen production during the time window concerned, equivalent to 100 percent oxidation of the active cladding.

d. For late hydrogen burns resulting in a "late" containment failure, the hydrogen burn pressures are assumed to result from the AICC process. Those hydrogen burn pressures for various conditions (such as the cavity condition, the operation of PARs, and so on) are estimated by using the MAAP code.

e. For the evaluation of hydrogen burns and detonations in an SBO, it is assumed that an ignition source is available when the burnable condition is established in containment.

f. In the evaluation of induced SGTR during a core melt at high RCS pressure and dry steam generators, the conditional probabilities of tube failure for moderately degraded SG tubes from NUREG-1570 are used. This is considered to be a conservative assumption.

g. In the induced SGTR modeling, it was assumed that any RCP seal LOCA failure under high RCS pressure with a dry SG would result in a cleared RCS loop seal. This is very conservative per the NUREG-1570 guidance and EPRI research, but the conservatism did not significantly impact the LRF.

h. External reactor vessel cooling is conservatively not credited in the baseline Level 2 analysis, but is evaluated in a sensitivity analysis.

i. It is assumed that the core can be recovered by early in-vessel injection before corium relocation.

j. The ECSBS is credited in the long term for preventing containment failure due to steam overpressurization, even though it does not provide decay heat removal and is only designed to operate for 24 to 72 hours after core damage. This is based on MAAP calculations that indicate that containment failure pressures would not be reached until long after the ECSBS stopped operating at 72 hours, at a point where it is assumed that failure to recover equipment would no longer be credible.

k. The quantitative definition of a "large" release in the Level 2 analysis is if the release fractions of the volatile/semi-volatile fission products (iodine, cesium, tellurium) are greater than 0.025 (2.5 percent). Of the 12 MAAP FP groups, the highest of CsI, TeO_2, CsOH, and Te_2 is taken to represent the volatile/semi-volatile fission product release fraction for each STC.

l. The definition of an "early" release is one in which the large release occurs prior to effective evacuation of the surrounding public. In the Level 2 PRA, an effective evacuation is assumed to be evacuation of a 16 km (10 mile) radius surrounding the plant. The time for effective evacuation is assumed to be 4 hours after declaration of a general emergency. The criterion for the declaration is loss of two of three fission product barriers, with the potential loss of the third. As the emergency planning procedures have not yet been developed, the criteria for evaluation of the three fission product barriers, the best-estimate evaluations were taken from guidance in NEI 99-01.

m. As applied to the MAAP analyses, the containment is assumed to be failed when the containment pressure reaches at 11.4 kg/cm^2g (162.7 psig). This is the median pressure of the containment ultimate pressure capacity. For those categories in which containment fails with a rupture mode, the release location is assumed to be near the midpoint of the containment cylindrical wall. For those categories in which containment fails with a leak mode, the release location is assumed to be near the equipment hatch.

n. If a pressure-induced SGTR occurs due to LSSB-D, LSSB-U, FWLB, and ATWS, it is assumed that the feedwater injection to the ruptured SG is unavailable.

o. In the analysis of severe accident-induced SGTR, the induced SGTR is assumed to occur prior to induced hot leg failure.

p. Once core damage occurs, fission products can be released at the design leakage rate, even when containment has not yet failed. The assumed pre-existing containment design leakage is a rate of 0.10 volume-percent per day at the design pressure and temperature. In this analysis, this design leakage was applied to all source term categories including those categories that were assessed as an intact containment release category.

q. In the Level 2 analysis, the model assumes that the ex-vessel core debris coolability for wet cavity condition is 0.5.

r. In the Level 2 analysis, the model assumes that the ignition source inside the containment always exists in both early phase and late phase.

s. In the Level 2 analysis, the model assumes that the probability of low heat transfer rate from ex-vessel core debris to water, which causes an ultimate basemat melt-through, is 0.01.

19.1.4.2.2.6 Sensitivity Analysis

In the containment performance analysis, several assumptions were made regarding the progression of severe accident phenomena. Sensitivity analyses were performed to assess the potential impact on the Level 2 results due to the potentially significant assumptions. Quantitative sensitivity studies can be performed where propagation of uncertainties is not practical or where the uncertain issues do not readily lend themselves to quantitative treatment.

These analyses assessed the impact of specified assumptions on the containment failure modes and the overall conditional containment failure probability. These analyses involved changing certain conditions or assumptions that are modeled in the CETs/DETs and then requantifying the Level 2 models to ascertain the impact.

These sensitivity analyses also provide significant insights into the dominant containment phenomena in terms of their contribution to LRF and the total containment failure frequency.

The following cases were analyzed for the Level 2 PRA:

Case R1 – Failure of ECSBS: For this case, the containment spray recovery (operation of ECSBS) was assumed to always fail (i.e., P(YES) = 0.0 for CSRECSBS branch in the CSLATE DET, MELTSTOP DET, and RBCM DET).

Case R2 – Failure of Cavity Flood System: The CFS was assumed to always be failed.

Case R3 – Failure of PARs: The PARs are assumed to always fail to control hydrogen.

Case R4 – Failure of Rapid Depressurization: Rapid depressurization is assumed to always fail.

Case R5 – Level 2 operator actions are always successful.

Case R6 – External RV cooling is credited to prevent RV failure.

Case R7 – Effects of Induced SGTR with "Pristine" SG Tubes: The baseline analysis assumed an average level of tube degradation (as may be the case after many years of operation). This sensitivity examined the effect of assuming the tubes are in a new or well-maintained condition.

Case R8 – No Induced Hot Leg or Surge Line Failure before Vessel Failure: No credit is given to induced hot leg or surge line failure before vessel failure.

The results of these sensitivity analyses are presented in Table 19.1-40. As can be seen in the table, the case demonstrating by far the greatest LRF sensitivity is Case R1. This demonstrates that the ECSBS credit in preventing containment overpressurization is very important to the LRF. If ECSBS were not credited for long-term containment pressure control, the LRF would increase from 8.4 percent of the CDF to 43.2 percent, and the total containment failure frequency would increase from 13.8 percent to 66.6 percent.

Case R2 demonstrates that the unavailability of the cavity flood system actually causes a slight drop in the LRF because it eliminates the steam overpressure failure, but the total containment failure frequency increases substantially, mainly due to basemat melt-through. If the cavity flood system were not credited, the LRF would decrease from 8.4 percent of the CDF to 6.2 percent, and the total containment failure frequency would increase from 13.8 percent to 60.1 percent.

Case R7 identifies that the conservative assumption that the SG tubes are in an "average" condition (which is used to define the conditional failure probabilities for induced SGTR) has a significant contribution to the baseline LRF. If credit were given to considering the tubes "pristine" and well maintained, the LRF would drop significantly. The LRF would decrease from 8.4 percent of the CDF to 5.8 percent and the total containment failure frequency would decrease from 13.8 percent to 11.4 percent.

The remaining sensitivity cases demonstrate that the remaining Level 2 phenomenological uncertainties have a relatively small or no impact on the LRF.

19.1.4.2.2.7 Uncertainty Analysis

The results of the uncertainty evaluation for the Level 2 internal events LRF are as follows:

5 percent value: 4.7×10^{-8}/year

Mean value: 1.6×10^{-7}/year

95 percent value: 2.9×10^{-7}/year

19.1.4.2.2.8 Risk Insights

The sensitivity analyses provide the best insights into the APR1400 Level 2 model. The analyses demonstrate that the LRF is very sensitive to the operation of the ECSBS to prevent long-term containment overpressurization. If ECSBS were not credited to prevent long-term overpressurization, the LRF would rise significantly.

The cavity flood system is important in maintaining an intact containment. Unavailability of the cavity flood system actually causes a slight drop in the LRF because it eliminates the steam overpressure failure, but the total containment failure frequency increases substantially, mainly due to basemat melt-through.

Finally, the conservative assumption that the SG tubes are in an "average" condition, which is used to define the conditional failure probabilities for induced SGTR, has a significant contribution to the baseline LRF. If credit were given to considering the tubes as being "pristine" and well maintained, the LRF would drop significantly.

19.1.5 Safety Insights from the External Events PRA for Operations at Power

This section addresses the following hazard groups:

a. Seismic

b. Internal fire

c. Internal flooding

d. Other external events (based upon those listed in the ASME/ANS PRA Standard)

A PRA-based seismic margin analysis (SMA) was performed to address the seismic hazard group (Subsection 19.1.5.1). Explicit quantitative PRA modeling was performed for internal fire and internal flooding hazard groups (Subsections 19.1.5.2 and 19.1.5.3). A screening evaluation is presented in Subsection 19.1.5.4 for the other external events listed for consideration in the ASME/ANS PRA Standard.

19.1.5.1 Seismic Risk Evaluation

This subsection describes the seismic risk evaluation including the results of the evaluation. The scope of this analysis is at-power operation. Low power and shutdown states are not considered.

19.1.5.1.1 Description of the Seismic Risk Evaluation

The seismic margin methodology was applied to estimate the seismic margin and accident sequences. The seismic margin for the APR1400 is evaluated by using PRA-based SMA. This methodology satisfies the recommendation of SECY-93-087 (Reference 8) approved by the NRC for a seismic risk evaluation. SMA identifies potential vulnerabilities and demonstrates seismic margins beyond the design basis safe shutdown earthquake (SSE). The capacity of components required to bring the plant to safe and stable conditions is assessed. The SSCs identified as important to seismic risk are addressed.

a. Selection of review level earthquake

The starting point to perform SMA is to select a review level earthquake (RLE). SMA demonstrates that sufficient margin in seismic design exists by showing the high confidence of low probability of failures (HCLPFs) of the plant and components are greater than the RLE. The RLE of the APR1400 is 0.5g.

b. Development of seismic equipment list

The seismic equipment list is provided from the internal events PRA model. Also, earthquake-specific SSCs such as passive components and structures related to a safety function, which are not addressed in the internal events PRA model, are included in the fragility analysis and system analysis.

c. Identification of seismic initiating event category

Initiating events due to a seismic event are identified from the internal events PRA. However, there are some major differences between seismic and internal events for the purpose of identifying the initiating event category, which are as follows: 1) seismic events may damage passive plant components and structures (e.g., steam generators, auxiliary building, etc.) that are not explicitly modeled in the internal events PRA; and 2) seismic events may simultaneously damage multiple SSCs in the plant.

d. Development of system models

The SMA system models are developed from the internal events PRA model to include the important accident sequences. This model also contains random failures and human errors from the internal events PRA. System models are modified to accommodate a seismic event. The model is used to estimate seismic margins and to identify vulnerabilities in the design.

e. Fragility analysis

At the design certification phase, specific design data such as material properties, analysis results, qualification test information, etc. are not available. Where available, information from the reference plant is used for the component fragility. The generic data are based on the fragilities provided by the Electric Power Research Institute (EPRI) Utility Requirements Document (Reference 37).

f. Evaluation for the plant seismic capacity

There are two acceptable approaches to evaluate the plant seismic margin as described in NUREG/CR-4482 (Reference 38).

1) "Min-max" method, in which HCLPF is assessed for accident sequences by taking the lower HCLPF value for components operating under OR logic and the highest HCLPF value for components operating under AND logic.

2) "Convolution" method, in which probabilities of non-seismic and operator failures are included in the calculation as well as the component fragilities. This is a fully quantitative approach in which the importance and contribution of seismic as well as non-seismic failures can be assessed quantitatively.

The "min-max" method is selected as the appropriate method at the design certification phase since detailed plant-specific data are unavailable. This method is accomplished by calculating HCLPFs for each seismic event tree top event that represents a safety-related system or function. HCLPFs of systems are calculated in conjunction with random failures and/or human actions.

g. Demonstration of seismic margin in the design

The objective is to demonstrate that there is sufficient seismic margin in the design. If the plant HCLPF earthquake is less than the RLE, modification of the design or the model is required.

19.1.5.1.1.1 <u>Development of Seismic Equipment List</u>

The seismic equipment list (SEL) provides a documented list of the plant structures, systems, and components (SSCs) that could be used to respond to an earthquake or mitigate potential reactor plant damage initiated by a seismic event. This design certification SEL then is used to develop the SMA systems logic model (i.e., event trees and fault trees).

While the objectives of the internal events PRA and SMA are similar, there are differences between the SSCs included in each of the models. As a result, not all SSCs included in the internal events PRA model are included in the SEL. For example, many balance-of-plant components, such as the feedwater system, are not considered in the SMA since they depend on offsite power, which is expected to be unavailable after a seismic event. Also, some SSCs are not modeled in the internal events PRA but must be considered in the SMA and, therefore, in the SEL. Examples include distribution systems such as piping, cable trays, ventilation ducts, and structural items such as masonry block walls that could fail and damage nearby safety equipment.

The first step in developing the SEL was to determine the potential initiating events that could occur as a result of a seismic event. Initiating events considered could occur either directly as a result of the earthquake or due to random or consequential events that occur subsequent to the earthquake. Identification of potential initiating events used the internal events PRA for guidance. The safety functions that would be required to respond to initiating events identified above were determined based on EPRI NP-6041 (Reference 39) and NUREG-1407 (Reference 40). These safety functions are:

a. Reactivity control

b. RCS pressure control

c. RCS inventory control

d. Decay heat removal

e. Containment integrity

The front-line systems used to meet the five safety functions were identified from the internal events PRA, including the additional required support systems. Unlike the internal events PRA, only systems that do not require offsite power were selected. Because the offsite power grid, switchyard insulators, and large transformers have relatively low seismic capacity, they cannot be relied on to provide power after a major earthquake. Only systems that can be supported by the onsite emergency ac power sources are considered.

The initial list of equipment for the SEL is then identified using the following data sources:

a. List of basic events from the internal events PRA

b. The internal events PRA systems notebooks

c. Piping and instrumentation diagrams (P&IDs)

d. Electrical diagrams (for offsite power and emergency power)

e. Plant arrangement drawings

f. Emergency Operating Guidelines (EOGs)

For the SMA, the initial list of equipment was identified beginning with the internal events PRA and reviewing the system P&IDs and electrical diagrams to provide reasonable assurance that all necessary components are on the SEL. For example, components needed to provide reasonable assurance of system integrity or electrical isolation were examined. These components were identified and added to the SEL when appropriate. Small, passive, in-line filters that are supported only by the piping or ducting, and instrumentation that is not required for mitigation of the seismic accident sequence are not included on the SEL (e.g., local instrumentation may be excluded, unless it is part of a plant procedure that would be implemented during a seismic event).

The following assumptions were used to develop the SEL:

a. The following components are considered to have seismically rugged capacity (i.e., having a HCLPF much greater than 0.5g) and are not included on the SEL:

   1) Piping and supports

   2) HVAC ducting, supports, and dampers

   3) Cable trays and supports, and electrical conduit

   4) Motor-operated valves

   5) Air-operated valves

   6) Solenoid-operated valves

   7) Pilot-operated safety relief valves

   8) Relief valves

   9) Manual valves

10) Check valves

11) Instrumentation such as resistance temperature detectors, pressure transmitters, etc.

12) Electrical components/relays/circuit breakers (not specifically analyzed in Table 19.1-42)

b. Since a formal evaluation of the EDG building has not been completed, it is assumed that the building fragility is greater than that of the diesel generators and associated equipment contained in the building.

19.1.5.1.1.2 Seismic Fragility Analysis

Seismic fragilities are calculated for component groups developed from the SEL. For the SMA, component fragility values from the reference plants are assumed to apply. The exception to the use of fragility information from the reference plants is when a component has a HCLPF of less than 0.5g. In such cases, it is assumed that the APR1400 design will be modified to increase the capacity of components to at least a 0.5g HCLPF.

A fragility evaluation is performed to obtain the seismic margin of components and structures that could have an effect on safe shutdown of the plant following a seismic event. In this evaluation, the seismic margin values of components and structures modeled in the accident sequences are obtained. The seismic margin is expressed in terms of HCLPF values.

$$\text{HCLPF} = A_m \times \exp(-1.65 \times (\beta_R + \beta_U))$$

or

$$\text{HCLPF} = A_m \times \exp(-2.33 \times \beta_C)$$

The equation for mean failure probability is:

$$= \text{Normal distribution of } \left[\frac{(\ln 1.0g) - (\ln A_m)}{\sqrt{(\beta_R^2 + \beta_U^2)}}\right]$$

A_m: median capacity

β_R: logarithmic standard deviation representing the randomness

β_U: logarithmic standard deviation representing the uncertainty

β_C: composite logarithmic standard deviation

The median capacities and HCLPFs are expressed in terms of the peak ground acceleration (PGA). An earthquake of 0.5g PGA is defined as the RLE for the APR1400.

The seismic fragilities (mean failure probabilities) for the component groups are calculated based on values of A_M, β_R, β_U for these components at an HCLPF value of 0.5g and a relative acceleration of 1.0g.

The major assumptions for the SMA model are as follows:

a. It is assumed that the seismic event would result in a LOOP, since offsite power equipment is not seismic Category I.

b. No credit is taken for non-safety-related systems, and they are assumed in the model to have failed or to be non-functional due to the seismic event.

c. In the SMA system fault trees, the operator actions in the random failure cutsets from the internal events PRA are assumed to apply, and the HEPs are reevaluated considering the seismic events.

d. As a conservative assumption, if one component fails due to the seismic event, other components of the same type in the system will also fail.

e. Failure of the reactor trip signal is not modeled since the breakers for motor generator sets would be de-energized following a LOOP due to a seismic event, thereby causing the release of control rods into the core even if the reactor trip function fails.

f. Failure of buildings that are not seismic Category I (e.g., turbine building and compound building) does not impact SSCs designed to be seismic Category I. Seismic spatial interactions between SSCs designed to be seismic Category I and any other buildings will be avoided by proper equipment layout and design. The following seismic Category I buildings and structures are identified as buildings and structures that involve safety-related SSCs to prevent core damage.

1) Reactor containment building

2) Auxiliary building

3) CCW heat exchanger building

4) ESW building

5) Emergency diesel generator building

g. Relay chatter does not occur or does not affect safety functions during and after the seismic event.

19.1.5.1.2 Results from the Seismic Risk Evaluation

19.1.5.1.2.1 Seismic Equipment List

The plant has a number of systems that are available for safe shutdown after a seismic event. In selecting the systems, the following potential seismic initiating event scenarios were considered:

a. Loss of offsite power (LOOP)

b. Small break LOCA

c. Large break LOCA

d. Loss of all I&C

e. Direct to core damage scenarios such as building collapse

f. Steam generator tube rupture (SGTR)

g. Anticipated transient without scram (ATWS)

h. Station blackout (SBO)

As with typical SMAs, the analysis considers equipment needed to supply offsite power to be of very low seismic capacity. If offsite power is available after an earthquake, then the earthquake was relatively mild and such events would cause very little damage. In particular, virtually all of the safety systems would be available for accident mitigation following such a mild event. Furthermore, it is expected that much of the balance-of-plant systems would also be undamaged.

The following scenarios are not considered further for the SEL:

a. Interfacing systems LOCA (ISLOCA) – The active ISLOCA-related valves are on the SEL, and the potential for relay chatter to cause an ISLOCA is included in the relay chatter analysis. Check valves have very high seismic capacity, and a potential ISLOCA from these valves following a seismic event is considered not significant.

b. Support system initiating events – Initiating events such as loss of dc power or loss of cooling water are not considered as seismically induced initiators. The seismic failure and random failure of this equipment is considered after a seismic event.

Table 19.1-41 lists the systems that were evaluated for the SMA with their associated plant designators. Note that only specific portions of these systems are included in the SEL and SMA models. Because the support systems provide support functions for multiple frontline systems, their availability after an earthquake is critical for successful mitigation of the seismic event.

As described in Subsection 19.1.5.1, the P&IDs and electrical single-line diagrams were used as the initial input to the SEL. The internal events PRA basic events were then reviewed to provide reasonable assurance that all appropriate equipment was included in the SEL.

The SELs are presented in Table 19.1-42, which includes approximately 350 components. The structures associated with the SEL equipment are listed in Subsection 19.1.5.1.1.2.

19.1.5.1.2.2 Seismic Fragility Analysis

The reference plant's fragility information is shown in Table 19.1-43. Components shown in Table 19.1-43 with an HCLPF of screened out (S/O) are assumed to be seismically rugged. Component groups that were not screened out, and have a mean failure probability calculated, are:

a. Safety injection tanks

b. Emergency diesel generators

c. ESF-CCS cabinet and load center

d. Plant protection system cabinet

e. 4.16 kv main control switchgear (MCSG)

f. Offsite power

g. Containment building exterior walls

h. Containment building internal structure

i. Auxiliary building

j. Emergency diesel generator building

The HCLPF for the APR1400 design is 0.5g. The dominant contributors to the plant HCLPF are provided in Table 19.1-44. The seismically induced failure probabilities are the mean failure probabilities calculated at 1.0g.

A COL applicant is to confirm that the PRA-based seismic margin assessment is bounding for their specific site, and update the SMA to include site-specific SSC and soil effects (including sliding, overturning, liquefaction, and slope failure).

19.1.5.1.2.3 Risk Insights

The following dominant sequences were identified for the seismic event.

a. The dominant contributor to the plant is failure of the ESF and RPS cabinets, which have an assumed HCLPF of 0.50g. Failure of these cabinets causes a loss of all I&C. Without indication and control available to the operators, core damage is assumed to occur.

b. The second most dominant contributor to the plant HCLPF is seismically induced failure of the 4.16 kV Class 1E buses. The 4.16 kV Class 1E buses have an assumed HCLPF of 0.50g. Loss of the electrical buses results in a station blackout and, therefore, a loss of all decay heat removal and RCS inventory control. Because the seismic event is assumed to have damaged the switchyard, offsite power cannot be recovered and core damage occurs.

c. Failure of the containment exterior, which is assumed to result directly in core damage, is the third-highest contributor. The HCLPF for containment exterior wall failure is estimated to be 0.66g. The failure of the containment would directly lead to core damage.

d. The auxiliary building has a HCLPF of 0.67g and is the fourth-highest contributor. As with the containment, failure of the auxiliary building is assumed to directly lead to core damage.

e. Operator alignment of shutdown cooling for long-term heat removal is needed because of the finite capacity of the AFW storage tanks. If seismic or random equipment failures occur, then this operator action is significant.

f. Seismically induced failure of the 120V instrumentation system, which is assumed to be a loss of all I&C, is the sixth-highest contributor. Failure of the 120V inverters along with their backup regulating transformers occurs.

g. In addition, there are cutsets with a seismically induced large LOCA and failure of two EDGs. These failures preclude adequate injection for the success criteria specified in the internal events PRA.

19.1.5.2 Internal Fire Risk Evaluation

The following subsections describe the internal fire risk evaluation and its results.

19.1.5.2.1 Description of the Internal Fire Risk Evaluation

The fire PRA methodology is based on NUREG/CR-6850 and NUREG/CR-6850, Supplement 1 (References 6 and 41). NUREG/CR-6850 provides a state-of-the-art methodology for fire PRAs. The fire PRA methodology is composed of 16 tasks, described below.

Task 1: Plant Boundary Definition and Partitioning – The purpose of this task is to define the global plant analysis boundary, and to divide the global plant analysis boundary into discrete physical analysis units (fire compartments).

Task 2: Fire PRA Component Selection – The purpose of the component selection task is to select the plant equipment that will be included and/or credited in the fire PRA. This task sets the analytical scope of the fire PRA model and provides input to Task 3, Cable Selection.

Task 3: Fire PRA Cable Selection – The purpose of this task is to identify the cables associated with all fire PRA components, and their physical routing throughout the plant. These data support the subsequent task of quantification for the fire PRA.

Task 4: Qualitative Screening – The objective of qualitative screening is to identify physical analysis units whose potential fire risk contribution can be judged negligible without quantitative analysis. Fire compartments are retained if they contain any fire PRA components or cables, or where it can be shown that a fire in the compartment might require a manual or automatic plant trip or a controlled manual shutdown based on plant Technical Specifications. All other fire compartments can be qualitatively screened.

Task 5: Plant Fire-Induced Risk Model – The purpose of this task is to create the fire PRA model that will be used in estimating the fire risk. The initiating events and system models from the internal events model are examined for applicability to fire events, and amended as required to include fire-induced initiators, fire-specific accident sequences, fire-induced failures and failure modes, and fire-related operator actions.

Task 6: Fire Ignition Frequency Development – The purpose of this task is to determine the fire ignition frequencies for fixed and transient ignition sources on a fire compartment basis.

The scope includes determining the compartment fire ignition frequencies using generic fire ignition frequencies, fixed ignition source counts, and transient combustible considerations such as room usage, cable loading, and other influencing factors.

Task 7: Quantitative Screening – The purpose of the quantitative screening task is to screen physical analysis units located within the global plant analysis boundary from further consideration based on preliminary conservative estimates of fire risk contribution using established quantitative screening criteria. The intent of the quantitative screening process is to limit the scope of detailed fire modeling and/or detailed circuit analysis by identifying the significant fire compartments. Quantitative screening does not eliminate the risk contribution for the screened-out compartments; the risk contribution of all screened-out fire compartments remains in the fire PRA.

Task 8: Scoping Fire Modeling – The purpose of this task is eliminate or reduce the frequency of those fixed ignition sources in a fire compartment that do not pose a threat to any fire PRA target. This task has two main objectives: 1) to screen out those fixed ignition sources that do not pose a threat to the fire PRA targets within a specific fire compartment, and 2) to assign severity factors to unscreened fixed ignition sources if possible. The goal of this task is to reduce the level of effort of the detailed analysis (Task 11).

Task 9: Detailed Circuit Failure Analysis – For risk-significant fire compartments, more detailed circuit analysis than performed in the Task 3 analysis is used to eliminate some of the cables in the compartments. The purpose of this task is to conduct a more detailed analysis of circuit operation and functionality to determine equipment responses to specific fire-induced cable failure modes. This information is then used to screen out cables that cannot prevent a component from completing its credited function.

Task 10: Circuit Failure Mode Likelihood Analysis – The purpose of this task is to quantify the probabilities for fire-induced hot short circuit failures that lead to component failure modes of interest. The failure mode probabilities are estimated for the cables of risk-significant components. The methodology used is provided in NUREG/CR-6850 (Reference 41), which is based on knowledge gained from recent cable fire tests.

Task 11: Detailed Fire Modeling – In prior tasks, the analyses assumed that a fire would have widespread impact within the fire compartment. In this task, for those fire compartments found to be potentially risk-significant (i.e., unscreened compartments), a detailed analysis approach is provided. As part of the detailed analysis, fire growth and propagation may be modeled. Furthermore, the possibility of fire suppression before damage to a specific target set is analyzed. This task is composed of the following three sub-tasks:

a. Detailed fire modeling of single fire compartments

   The purpose of this sub-task is to re-evaluate the risk-significant (unscreened) fire compartments in more detail. In this analysis, fire scenarios are defined in terms of ignition sources, target sets, fire growth, propagation pattern, and fire detection and suppression features.

b. MCR fire analysis

   Although simply another single fire compartment analysis, this sub-task is focused on fires occurring in the MCR, taking into consideration issues specific to the MCR, such as main control board fires, continuous manning of the MCR (and how that impacts manual suppression), MCR abandonment criteria, and the estimation of the probability of failure of alternate shutdown given MCR abandonment.

c. Multi-compartment fire analysis

   This sub-task analyzes all fire scenarios where it is postulated that a fire may spread from one compartment to another and damage target elements in multiple compartments. In this category of scenarios, damaging effects of a fire are assumed to spread beyond the compartment of fire origin.

   This analysis may use a set of screening criteria to reduce the scope of detailed multi-compartment analyses. The screening criteria include lack of additional fire PRA equipment in the adjacent fire compartment, low fire load in the exposing fire compartment, fire scenario frequency of occurrence, and finally CDF. Scenarios surviving the screening are analyzed using the same method as for the single fire compartment case.

Task 12: Post-Fire HRA – In this task, human failure events (HFEs) associated with the fire scenarios are identified, and associated human error probabilities (HEPs) are estimated. Operator actions after fire ignition are assumed to be affected by the fire unless it can be clearly shown otherwise.

Task 13: Seismic Fire Interactions – The main purpose of this task is to identify and correct any weaknesses in the fire protection systems and vulnerabilities in the ignition sources due to seismic events. This is the qualitative evaluation of the potential for: 1) seismically induced fires, 2) degradation of fire suppression systems and features, 3) spurious actuation of fire suppression and/or detection systems, and 4) degradation of manual firefighting effectiveness. No risks are computed.

Task 14: Fire Risk Quantification – In this task of the analysis process, the fire PRA model is quantified for each final fire scenario, the associated risk values (i.e., CDF and LRF) are computed, and risk contributors are identified.

Task 15: Uncertainty and Sensitivity Analyses – The purpose of this task is to determine, characterize, and assess the impact of uncertainty on the CDF and LRF estimates. In addition, sensitivity analyses are used to identify and understand the impact of risk-significant modeling assumptions.

Task 16: Fire PRA Documentation – The intent of this task is to provide reasonable assurance that the previous analyses are documented in a manner that facilitates review and update. Each task is documented in one or more notebooks that describe the purpose, methodology (including assumptions), and results of the analyses used to complete the associated task.

19.1.5.2.1.1 Deviations from the NUREG/CR-6850 Methodology

Note that not all of the tasks described above are required to perform a fire PRA. These tasks involve various types of screening to eliminate assessment of non-risk-significant fire scenarios. However, due to the plant being in the design stage, some specific plant details are not yet known, so some of these screening tasks cannot be applied with a high degree of certainty. These tasks include the following:

a. Task 4 has not been applied since it is currently not possible to verify that a fire in any one fire compartment will not result in a plant trip in accordance with the qualitative screening criteria identified for that task. The impact of not performing this screening is small since qualitatively screened fire compartments should have no PRA-credited components or cables; hence, even if the fire started in one of these compartments, there would be no additional damage to mitigation systems.

b. Task 8 has not been applied since specific relational location information between ignition sources and targets are either not known or cannot be confirmed via walkdown. The main unknown factors include intervening combustibles and conduit. Major plant equipment can be identified on plant general arrangement drawings, and cable tray locations and elevations can be identified on raceway drawings, but the distance between the potential ignition sources and the cable trays is not known. In addition, the location of conduits is not currently available, and walkdowns cannot be performed to identify intervening combustibles.

In addition, portions of Task 11, relating to fire growth and propagation modeling, have not been applied for the same reasons described for Task 8, above.

Regarding Task 12, the HRA was performed using the screening analysis described in NUREG-1921 (Reference 42). After the initial quantification, detailed HEP analysis was performed on the top 10 HFEs when ranked by Fussell-Vesely importance. These 10 HEPs were incorporated in the final quantification.

19.1.5.2.1.2 <u>Key Assumptions</u>

Various assumptions and engineering judgments provide a basis for the internal fire analysis. Key assumptions and engineering judgments used in this analysis are as follows:

a. All fire doors identified in the fire protection boundary drawings are assumed to be closed during normal operation. Failure of the doors (and other fire barriers) is modeled during the multi-compartment analysis (Task 11).

b. Only "credited" equipment is considered in this analysis. No exceptions were made. Credited equipment is defined as equipment required for safe shutdown following postulated fire initiators that has a known location including the location of necessary cables used to operate or maintain position of the component. Non-credited components are assumed to fail for any fire (Tasks 2 and 3).

c. For the purpose of cable selection, components are assumed to be in their normal expected position or condition at the onset of the fire (with the plant at-power operation). In cases where the status of a component is indeterminate or could change as a result of expected plant conditions, worst-case initial conditions are assumed (Tasks 3 and 9).

d. The plant is designed with properly sized and coordinated electrical protective devices (i.e., fuses, molded case circuit breakers, and load center breakers with solid state trip units) that function in accordance with their design tripping characteristics, thereby preventing loss of a common power supply or initiation of secondary fires through circuit faults created by the initiating fire (Tasks 3 and 9).

e. Fire damage to control cables is assumed to result in the worst-case failure mode for the affected component (e.g., failure to operate, or spurious operation, whichever is worse with respect to system function) (Tasks 3 and 9).

f. Fire damage to fiber-optic cables results in failure to operate the associated component, but does not cause a spurious operation, or prevent normally operating equipment from continuing to operate (Tasks 3 and 9).

g. If the power cables of a component are located in the same area as the cable identified as potentially causing a spurious operation, it is assumed that the spurious operation will occur before power is lost (Tasks 3 and 9).

h. Any fire included in this analysis is at least sufficient to trip the plant, resulting in a general transient. The trip may be automatic or may be the result of manual trip based on operators following procedures. The fire itself is the initiating event; however, "conditional" initiators (e.g., fire-induced loss of feedwater) are identified and analyzed for each fire scenario. The resultant accident sequence progression is the same regardless of whether the event starts due to random occurrences or it is fire induced. Fire-induced failures may fail a system, train, or component, but the impact on the accident sequence progression is no different than if the system, train, or component failed due to random events. Therefore, since the fire does not change the progression of the accident, the internal events event trees can be used for fire accident sequence progression (Task 5).

i. Fire-induced direct equipment failure is assumed to be non-recoverable within the time frame of the analysis. Fire-induced direct equipment failure refers to components directly impacted by a fire's sphere of influence. However, recovery by other means is acceptable, if possible. For example, manual opening of an alternative undamaged path may be used as a recovery for a fire-induced direct valve failure closed, or closing an undamaged redundant upstream or downstream valve may be used as a recovery for a fire-induced flow diversion due to direct valve failure open (Task 5).

j. Fire-induced indirect equipment failure is assumed to be recoverable under certain conditions. Fire-induced indirect equipment failure refers to components that are failed due to cable failures. If the component can be manually operated (e.g., an MOV with power cable damage can be manually operated by disengaging the clutch on the motor operator), then a recovery may be considered. One notable exception is fire-induced spurious operation. The spurious operation may prevent clutch disengagement, or may physically damage the valve (e.g., hot short bypasses torque and/or limit switches). Each spurious operation is evaluated individually to determine the impact on the component (Task 5).

k. Mechanical equipment that does not require a power source, such as manual valves, check valves, mechanical relief valves, safety valves, vacuum breakers, tanks, and pipes, is not impacted by the fire (Task 5).

l. It is assumed that every fire compartment in the scope of this analysis will, at a minimum, have an assigned transient ignition frequency. As there is industry evidence of failures to follow administrative control procedures, administrative controls impact the likelihood of transients but do not prevent their occurrence (Task 6).

m. Turbine building fire compartment (F000-TB) is very large and has a large amount of roof ventilation area where a formation of hot gas layers (and the propagation of the effects of the fire in the turbine building to other compartments as a result of the formation of that gas layer) is unlikely. Furthermore, equipment with large sources of lube oil has adequate curbing to prevent the spread of oil, and therefore limit the spread of oil fires. Therefore, fire spread to adjacent fire compartments from the turbine building is not considered credible. Likewise, hot gases entering the turbine building from an adjacent fire compartment via a failed barrier will be directed upwards and out the numerous roof vents; hence, fire spread to the turbine building is not considered credible (Task 11).

n. Due to the size of the containment building (F000-C01), any hot gas layer formed would be near the top of the dome. This is true regardless of whether the fire originated within containment, or entered containment via a failed barrier from the auxiliary building. The top of the dome is well over 45.7 m (150 ft) above the highest cable tray in containment and the highest penetrations to the auxiliary building. Therefore, any hot gas layer formation in the containment would not be located where it is credible to assume: 1) damage to cables within containment, and 2) spread into the auxiliary building. Therefore, potential fire spread scenarios from or to the containment building are not considered credible (Task 11).

o. It is assumed that automatic suppression systems are designed so that, if successfully activated, they will extinguish the fire prior to additional damage beyond the ignition source itself. Hence, if the ignition source is not a fire PRA-credited component, successful operation of the automatic suppression system will result in a general transient (likely a manual trip) with no PRA-credited equipment damaged. If the ignition source is a PRA-credited component, and the automatic suppression system successfully operates, the fire-induced initiator will be dependent upon the ignition source (e.g., fire in dc bus A will result in LODCA initiator), but will only involve the failure of the ignition source. Failure of an automatic suppression system is assumed to result in full room burnout and possible spread to adjacent compartments.

19.1.5.2.1.3 Analysis Details

Task 1, Plant Boundary and Partitioning, is conducted in two parts. The first activity involves definition of the global plant analysis boundary, which is defined to be the plant protected area and switchyard; however, it does not include all of the licensee-controlled areas. Notable facilities that are located within the licensee-controlled area but not in the global plant analysis boundary include the engineering building, wastewater treatment facility, and sanitary water treatment facility. Miscellaneous support structures and parking lots are also located throughout the licensee-controlled area, but not included in the global plant analysis boundary.

Meaningful fire analysis within the global plant analysis boundary requires establishment of realistic bounds that describe the expected extent of individual fires. The plant boundary and partitioning task establishes these analysis areas by dividing the global plant analysis boundary into discrete physical analysis units (PAU) or fire compartments. A fire compartment is a well-defined volume within the plant that is expected to substantially contain the effects of fire within the compartment. This volume is typically considered to be a room or clearly distinguishable area of the plant that is separated from other plant areas by substantial construction or other features that would contain the damaging effects of a fire within the compartment. Almost all fire compartments are completely enclosed by 3-hour fire barriers (or equivalent); however, a few fire compartments have one or more barriers that have only a 1- or 2-hour fire rating. A total of 391 fire compartments are identified (Table 19.1-45).

Task 2 identifies the components to be included in the fire PRA. Components are selected mainly based on a review of the internal events PRA, Fire Safe Shutdown Analysis, and the Post-Fire Human Reliability Analysis (Task 12), and included:

a. Equipment that if damaged as a result of fire will lead to a plant trip either directly or as a result of operator action

b. Equipment needed to respond to the initiating events identified

c. Equipment whose spurious operation as a result of fire will either cause a fire-induced initiating event or adversely affect the response of systems or operator actions required to respond to a fire

As part of Task 2, the internal events PRA model was reviewed to identify the accident sequences that should potentially be included in the fire PRA model. Some of the sequences included in the internal events PRA are eliminated from the fire PRA model. The elimination criteria of the sequences are as follows:

a. Sequences associated with initiating events involving a passive/mechanical failure that can be assumed not to occur as a direct result of a fire. Therefore, initiating events that are caused by primary or secondary side pipe breaks, vessel failure, and SGTRs can be eliminated from the PRA model.

b. Sequences associated with events that, while it is possible that a fire could cause the events, a low frequency of occurrence argument could be justified. For example, the ATWS sequence has not been treated in the fire PRA because fire-induced failures will almost certainly remove power from the control rods (resulting in a trip), rather than cause a "failure-to-scram" condition. Additionally, fire frequencies multiplied by the independent failure-to-scram probability can be seen as small contributors to fire risk.

As a result, the following accident sequences have been eliminated from the fire PRA model.

a. LOCAs (from pipe breaks)

b. Reactor vessel rupture

c. SGTR

d. Feedwater/main steam line break

e. ATWS

f. Spurious safety injection signal

The fire PRA credited components and their locations (i.e., fire compartments) within the plant are entered into a fire PRA database.

In Tasks 3 and 9, the cables associated with fire PRA components were identified, and failure modes for the associated equipment are assigned using Assumptions 2 to 7 above as guidance. All cables for fire PRA equipment are included in the fire PRA database, which also contains cable routing information on a fire compartment and raceway basis. The internal events PRA model has been edited as necessary to incorporate the additional components and failure modes unique to the fire PRA.

In the next step, Task 6, a fire ignition frequency is estimated for each identified ignition source and each fire compartment. This task is conducted in accordance with the methodology and information provided in Task 6 of NUREG/CR-6850 (Reference 6). Deviations from the methodology of NUREG/CR-6850 have been necessary as a result of further clarifications documented in Supplement 1 of NUREG/CR-6850 (Reference 41). Furthermore, the generic fire frequencies provided in NUREG/CR-6850 are not used in this analysis; rather, the updated generic fire frequencies from EPRI 1016735 (Reference 43) are used.

Task 7 screens fire compartments from further detailed analysis. There are no set screening criteria for fire-induced CDF or LRF. Rather, the criteria chosen are with the intent of achieving Capability Category II in accordance with Table 4-2.8-4(c) of the ASME/ANS PRA Standard, which suggests that the criteria should not screen the highest-risk fire areas, and the sum of the CDF and LRF contributors for all screened compartments is less than 10 percent of the total fire CDF and LRF. The process is iterative in that performing detailed analysis decreases the overall CDF and LRF, resulting in the need to perform detailed analysis on additional fire compartments.

Based on initial screening quantifications, detailed analysis was performed on 38 fire compartments, including the MCR, reactor containment building, and turbine building. The results of the fire compartment screening are listed in Table 19.1-45. Unscreened fire compartments are evaluated, resulting in the development of two or more unique fire scenarios. In total, there are 481 single compartment analysis (SCA) scenarios developed, of which 128 are the result of detailed analysis; the remaining 353 scenarios are the screened fire compartment full-room burnout scenarios. The CDF sum of all screened fire compartments is 1.6×10^{-7}/year, which is less than 10 percent of the total fire CDF of 1.9×10^{-6}/year (and 10 percent of the total single-compartment CDF of 1.6×10^{-6}/year). The LRF sum of all screened fire compartments is 1.1×10^{-8}/year, which is less than 10 percent of the total fire LRF of 1.7×10^{-7}/year (and less than 10 percent of the total single-compartment LRF of 1.5×10^{-7}/year). In addition, the highest unscreened CDF and LRF scenario (both are the complete room burnout of the AAC Building, FN-N00) resulted in about 0.6 percent (9.2×10^{-9}/year) of the total CDF, and about 0.7 percent (1.0×10^{-9}/year) of the total LRF. This indicates that the highest-risk fire areas are not screened.

No fire modeling is performed due to lack of sufficient data related to the relational location of the ignition sources and their targets (including intervening combustibles). Therefore, for single-compartment fire analyses, all unsuppressed fires are assumed to propagate throughout the entire compartment, damaging all PRA-credited equipment within. For multi-compartment scenarios, in addition to propagating throughout the exposing compartment (i.e., compartment in which the fire initiated), fire spread is assumed to propagate through barriers at the probabilities associated with the respective barriers under consideration. Generic barrier failure probabilities from NUREG/CR-6850 are used to calculate barrier failure probabilities between adjacent compartments.

Detailed analysis involved taking credit for installed automatic fire suppression systems, and manual suppression for continuously occupied areas (MCR only) and welding and cutting fires (due to the assumed presence of a fire watch during these activities).

Automatic suppression is only credited in fire compartments where it exists. Fixed or transient fires suppressed by an automatic suppression system are assumed to result in a plant trip with no damage to fire PRA-credited equipment or cables (e.g., general transient fire-induced event) unless the ignition source is a fixed ignition source that is a fire PRA-credited component. In that case, the damage state is dependent upon the impact of the failed component. Generic failure probabilities for automatic suppression systems including the impact of automatic detection, if required, are derived from NUREG/CR-6850.

Outside the MCR, prompt manual suppression is only credited for hotwork fires (i.e., either transient fires due to welding or cutting operations, or cable fires due to welding or cutting operations). From NUREG/CR-6850, Supplement 1, fire growth for transients assumes a t^2 growth reaching the peak heat release rate (HRR) at 8 minutes for common trash can fires to as low as 2 minutes for other common types of plant trash (e.g., paper, plastics, and other solid materials) that are contained in plastic trash bags but that are not contained within a plastic or metal receptacle. It is assumed that any of the fire compartments may contain either type (with the possible exception of the MCR, where transient combustibles are likely in the form of trash in a receptacle).

However, for the case of hotwork fires, there is at least one person (i.e., the person doing the hotwork), and usually a second person (e.g., a fire watch) at the fire scene at the start of the fire. Therefore, it is very likely that the fire will be detected in its incipient stage, prior to the fire growth stage. There is no industry guidance on the duration of the incipient stage; therefore, a reasonable total time of 10 minutes for the manual detection and extinguishment of hotwork fires prior to any damage to fire PRA-credited equipment and cables is assumed. This includes 5 minutes for the incipient fire stage, and 5 minutes for the fire growth stage (which is the average of the 2- and 8-minute fire growth times for the two types of transient fires described in the preceding paragraph).

Promptly suppressed hotwork fires are assumed to result in a plant trip with no damage to fire PRA-credited equipment or cables (e.g., general transient fire-induced event). The basis for this assumption is that due to the likelihood of manual detection of the fire during its incipient stage, it is unlikely to burn for a sufficient duration and HRR to damage nearby targets. Furthermore, during hotwork, any nearby equipment or transient combustibles are likely protected by welding blankets or other heat shielding.

For MCR fires, prompt manual suppression is credited if the fire can be extinguished in 8 minutes. The shorter 8-minute time frame is driven by MCR abandonment criteria, and was chosen based on the time for a common trash can fire to reach its peak HRR. Earlier testing on the effects of fires in enclosed rooms determined that the most significant impact on the test enclosure was dense smoke, which in all cases resulted in total obscuration within 6 to 15 minutes of fire ignition in NUREG/CR-4527 (Reference 44). The size of the test enclosure is about 55 percent of the volume of the APR1400 MCR volume. A larger volume would result in longer obscuration times, so the abandonment times of 8 minutes falls well within the range of this specific set of experiments, and is considered a reasonable average of abandonment times.

Manual suppression probabilities are derived from Chapter 14 of NUREG-CR/6850 Supplement 1.

Turbine generator fires are evaluated in accordance with Appendix O of NUREG/CR-6850.

Since the location of intervening combustibles is not known, unsuppressed fires, fixed or transient, are assumed to result in the “full room burnout” damage state.

Multiple compartment analysis (MCA) considers the potential for fire spread from one compartment to an adjacent compartment via a failed fire barrier. Screening was performed to eliminate non-minimal MCA scenarios, or scenarios deemed unlikely to happen due to lack of a credible fire spreading mechanism (e.g., hot gas layer, oil spill fire, etc.). Potential MCA compartments are screened if the exposed compartment has no PRA-credited equipment since the resulting cutsets will be non-minimal to the exposing single-compartment scenario. In addition, potential scenarios involving either the main turbine building (F000-TB) or the containment building (F000-C01) are screened due to the size and geometry, which preclude the formation of a hot gas layer or oil fire spread. In total, 1,055 unscreened MCA scenarios are identified and evaluated. MCA scenarios account for about 14 percent of the CDF and 13 percent of the LRF.

19.1.5.2.2 Results from the Internal Fire Risk Evaluation

The internal fire risk evaluation is performed using the design-specific fire protection features in Chapter 9, Appendix 9A and the internal events PRA model of Subsection 19.1.4.

The fire CDF and LRF for the APR1400 are as follows:

a. Fire CDF: 1.9×10^{-6}/year

   1) Single-compartment fire CDF: 1.6×10^{-6}/year

   2) Multi-compartment fire CDF: 2.6×10^{-7}/year

b. Fire LRF: 1.7×10^{-7}/year

   1) Single-compartment fire LRF: 1.5×10^{-7}/year

   2) Multi-compartment fire LRF: 2.2×10^{-8}/year

c. Conditional large release probability: 0.09

It should be noted that units for CDF and LRF are expressed in terms of “reactor calendar year” (shortened to “/year” when displayed in the text in this section).

19.1.5.2.2.1 Fire-Induced Initiating Events

Table 19.1-46 shows the percentages of fires resulting in each identified fire-induced internal event initiator, ranked highest to lowest. Table 19.1-47 and Table 19.1-48 present the CDF and LRF, respectively, for each fire-induced initiator ranked from highest to lowest. The results show that the vast majority of the plant fire frequencies result in general transients with the remaining initiators fairly evenly distributed. This demonstrates the effectiveness of the highly compartmentalized nature of the auxiliary building, wherein most fires will result in damage to only a few components.

Review of the fire-induced initiator impact on CDF and LRF reveals that the majority (about 60 percent) of all fire-induced CDF and LRF is from an MCR evacuation and loss of dc bus “B”; general transients and LOOPs make up the next significant impact, with about 30 percent of fire-induced CDF and LRF. The remaining fire-induced initiators are well distributed and not significant contributors. The MCR evacuation case’s impact is all from a single fire compartment (e.g., the MCR). This disproportionate amount can be partly explained by the lack of procedures governing safe shutdown during MCR evacuation at the plant design stage; hence, an estimate of 0.1 is used as a conditional core damage probability (CCDP). A conditional large release probability (CLRP) of 0.01 is used based on the CCDP estimate, 0.1, and the calculated overall conditional large release probability, 0.09.

19.1.5.2.2.2 Significant Fire Scenarios

The top 100 fire PRA CDF cutsets are presented in Table 19.1-49, and the top four dominant CDF fire scenarios are described below:

#1 – F 157-AMCR-4-4 Trans Fire, Supp. Fails, ASD

Scenario F157-AMCR-4-4 involves unsuppressed transient fires in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 8 minutes to extinguish a transient fire before visual obscuration results in the need to evacuate the MCR and shut down from the remote shutdown console (RSC). The 8-minute time frame is based on the estimated time to the peak heat release rate common trash can fires and a review of room effects testing published in NUREG/CR-4527. An estimated CCDP of 0.1 is assumed for alternate shutdown (ASD) from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#2– F157-AMCR-3-4 Safety Console Fire, Supp. Fails, ASD

Scenario F157-AMCR-3-4 involves an unsuppressed safety console (PM05) fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires, which have a 12-minute growth period with a t^2 growth profile, based on Appendix G of NUREG/CR-6850 (Reference 41) and a review of room effects testing published in NUREG/CR-4527 (Reference 44). An estimated CCDP of 0.1 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#3 – F157-AMCR-2-4 MCR Fire Control Panel Fire, Supp. Fails, ASD

Scenario F157-AMCR-2-4 involves an unsuppressed MCR fire control panel fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires, which have a 12-minute growth period with a t^2 growth profile, based on Appendix G of NUREG/CR-6850 and a review of room effects testing published in NUREG/CR-4527. An estimated CCDP of 0.1 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#4 – F157-AMCR-1-4 MCR CCTV Subconsole Fire, Supp. Fails, ASD

Scenario F157-AMCR-1-4 involves an unsuppressed MCR CCTV subconsole fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires, which have a 12-minute growth period with a t2 growth profile, based on Appendix G of NUREG/CR-6850 and a review of room effects testing published in NUREG/CR-4527. An estimated CCDP of 0.1 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

The top 100 fire PRA LRF cutsets are presented in Table 19.1-50, and the top four dominant LRF fire scenarios are described below:

#1 -F157-AMCR-4-4 Trans Fire, Supp. Fails, ASD

Scenario F157-AMCR-4-4 involves unsuppressed transient fires in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 8 minutes to extinguish a transient fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 8-minute time frame is based on the estimated time to the peak heat release rate from common trash can fires and a review of room effects testing published in NUREG/CR-4527. An estimated CLRP of 0.01 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#2 -F157-AMCR-3-4 Safety Console Fire, Supp. Fails, ASD

Scenario F157-AMCR-3-4 involves an unsuppressed safety console (PM05) fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires, which have a 12-minute growth period with a t^2 growth profile, based on Appendix G of NUREG/CR-6850 and a review of room effects testing published in NUREG/CR-4527. An estimated CLRP of 0.1 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#3 - F157-AMCR-1-4 MCR CCTV Subconsole Fire, Supp. Fails, ASD

Scenario F157-AMCR-1-4 involves an unsuppressed MCR closed-circuit television (CCTV) subconsole fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires, which have a 12-minute growth period with a t^2 growth profile, based on Appendix G of NUREG/CR-6850 and a review of room effects testing published in NUREG/CR-4527. An estimated CLRP of 0.01 is assumed for ASD from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

#4 - F157-AMCR-2-4 MCR Fire Control Panel Fire, Supp. Fails, ASD

Scenario F157-AMCR-2-4 involves an unsuppressed MCR fire control panel fire in fire compartment F157-AMCR, the MCR. The MCR analysis assumes the operators have approximately 10 minutes to extinguish the fire before visual obscuration results in the need to evacuate the MCR and perform shutdown from the RSC. The 10-minute time frame is based on the estimated time to reach about 70 percent peak heat release rate for cabinet fires which from Appendix G of NUREG/CR-6850 have a 12-minute growth period with a t^2 growth profile and a review of room effects testing published in NUREG/CR-4527. An estimated CLRP of 0.01 is assumed for alternate shutdown (ASD) from the RSC. Note that due to the lack of fire PRA-credited equipment in the MCR, and use of fiber-optic cable for almost all MCR controls, the resulting initiator is likely a simple transient as no PRA-credited equipment is directly damaged by the fire, and spurious operations resulting in more complicated initiators are unlikely.

19.1.5.2.2.3 Importance Analysis

The high importance basic events by RAW and FV for the CDF are presented in Table 19.1-51 and Table 19.1-52, respectively. The high importance CCF events by RAW and FV for the CDF are presented in Table 19.1-53 and Table 19.1-54, respectively. The high importance operator actions by RAW and FV for the CDF are presented in Table 19.1-55 and Table 19.1-56, respectively.

The high importance basic events by RAW and FV for the LRF are presented in Table 19.1-57 and Table 19.1-58, respectively. The high importance CCF events by RAW and FV for the LRF are presented in Table 19.1-59 and Table 19.1-60, respectively. The high importance operator actions by RAW and FV for the LRF are presented in Table 19.1-61 and Table 19.1-62, respectively.

Review of both the basic event and operator action FV importance demonstrates the importance of LOOP scenarios. Most of the events with high FV values (e.g., grid collapse, EDG failures, turbine-driven AFW pump failures, etc.) are directly associated with LOOP scenarios, or other partial loss of power scenarios.

The dominant basic event RAW values show high reliability equipment that supports multiple trains or systems. This includes water tanks and electric buses, although water tanks will generally not be impacted by fires. The results demonstrate the importance of protecting electrical buses from fire.

Regarding operator actions, the RAW values are relatively low due to the fact that screening values from NUREG/CR-1921 are used for the analysis, where the HEPs are quite high. The action to transfer the auxiliary feedwater source to an alternate source is dominant, which is expected since all fire-induced initiators credit AFWS.

19.1.5.2.2.4 Sensitivity Analyses

The results of the internal fire PRA show that internal fire events pose a low risk to the APR1400 design. The major contribution to internal fire risk is MCR evacuation, which uses an estimated CCDP and CLRP due to the lack of fire procedures. To better understand the impact of the MCR results, a sensitivity analysis was performed assuming the MCR cabinets had very early warning fire detection systems (VEWFDS). Following the procedure in NUREG/CR-6850 Supplement 1, the total CDF for all MCR cabinet fire cases drops from about 3×10^{-7}/year to about 6×10^{-9}/year. The overall CDF would drop to about 1.6×10^{-6}/year from 1.9×10^{-6}/year.

19.1.5.2.2.5 Risk Insights

The APR1400 design features that promote reduced fire risk are as follows.

a. The design has two divisions each consisting of two trains of safety systems. Each division is segregated with physical fire barriers to protect the safety function of safety systems from fires impacting the opposite division.

b. The auxiliary building is divided into four quadrants, two quadrants per division. Each quadrant contains the equipment for a safety train.

c. The design has a highly compartmentalized auxiliary building made up of many fire areas with 3-hour fire rating barriers to minimize the impact from any single fire in the auxiliary building.

d. The design uses fiber-optic cables between the MCR safety console, group controllers, and loop controllers, thereby minimizing the impact from fire-induced spurious hot shorts.

e. The AAC power source is a non-Class 1E power source that can be used as a common ac source to cope with SBO scenarios. This AAC power source is a gas turbine generator unit, which is independent and diverse from the Class 1E standby EDGs.

The fire PRA is used to identify potential design features and plant operational vulnerabilities, where a small number of failures could lead to core damage, containment failure, or large releases. Based on the analysis, the plant design has been changed as follows:

a. The cable routes connecting yard transformers to the switchgear within the turbine building had a high risk because the fire frequency of the turbine building is high and its fire severity is large. Therefore, the cable route has been designed to not pass through the turbine building, but rather enter the turbine building directly into the switchgear area (F073-T11). This routing minimizes the ignition sources in the turbine building that can impact offsite power.

b. Several cables have been identified as requiring fire protection features to prevent damage or spurious operation of related components.

19.1.5.3 Internal Flooding Risk Evaluation

This subsection describes the internal flooding risk evaluation including the results of the evaluation.

19.1.5.3.1 Description of the Internal Flooding Risk Evaluation

The objectives of the internal flooding PRA are to estimate the contribution of an internal flooding to CDF at the operations at power, to identify any design-specific vulnerability to flood-induced accidents, and to provide necessary information for design improvements.

The APR1400 design emphasizes the elimination and minimization of potential flood sources within safety-related areas as a means of flood protection, where internal flooding events should not be significant contributors to risk.

The design includes a number of design features that provide flood protection to safety-related SSCs. These flood protection measures are designed in accordance with NRC RG 1.102 (Reference 45).

Because sufficient plant information such as location of terminal boxes, valves, instruments, drain capacities and locations, and other flood mitigation devices like emergency overflow lines (EOLs), are not available during the design certification stage, the risk due to flooding originating in several buildings is estimated by using conservative assumptions and simple flood scenarios as described in following subsections.

The internal flooding analysis is performed in the following broad stages:

a. Identification of flood sources and target equipment

b. Definition of flood areas

c. Qualitative screening

d. Accident sequence definition

e. Initiating event analysis

f. Internal flooding human action development

g. Quantification of flooding sequences

19.1.5.3.1.1 Identification of Flood Sources and Target Equipment

The major flood sources are identified from the review of design calculations, system functional descriptions and general arrangement drawings. The potential flood sources in plant buildings are identified and the flood sources that cannot damage the equipment used for accident mitigation or lead to an initiating event are screened out from further consideration.

The internal flooding PRA considers any uncontrolled release of fluid from any plant system. From a practical point of view, release of fluid from some systems does not present a credible potential to damage equipment or result in a reactor shutdown. Such systems can be identified and screened from consideration as flood sources.

Systems and equipment used to mitigate accident sequences are determined in the internal events PRA; and those systems and equipment that were identified in the internal events PRA are reviewed to select the susceptible equipment by internal flooding. Major equipment, such as pumps, essential water chillers, diesel generators, electrical equipment, valves, and instruments are selected from reviewing the general arrangement drawings, P&IDs, and single-line diagrams.

19.1.5.3.1.2 Definition of Flood Areas

The development of the internal flood area definitions consists of the following steps:

a. Identify plant systems that could contribute to internal flooding: While the uncontrolled release of fluid from every system should be considered, in practice, some systems do not present a credible potential to damage equipment. Such systems can be identified and screened from consideration as flood sources.

b. Summarize and describe the areas considered for internal flooding: Include the boundaries for each area and how each area interfaces with adjoining areas. Summarize the penetrations and any associated barriers in each of the area boundaries and how the boundaries interface with adjoining areas. Identify the flood-susceptible, PRA-related equipment in each area. Identify flood sources in each area. Include the summary flood mitigation features in each area.

c. Assess and tabulate communication or propagation paths: Identify each normally open communication path leading from each area. Tabulate barriers to communication or propagation paths. Assess the ability of each barrier to withstand flooding events. Determine if water accumulation in the room could cause failure of the barrier. Determine if propagation following failure of a barrier could cause failure of PRA-related equipment in the adjoining room(s).

The following key assumptions are made during the development of flood area definitions:

a. Minor leakage under and around doors will not directly impact equipment on the opposite side unless otherwise noted.

b. All junction boxes are gasketed and not vulnerable to spray or splash unless otherwise noted.

c. Flood-induced failure of MOVs involves the valve operator’s loss of function, but does not involve the MOV changing position. The MOV is expected to remain in its original position.

d. Flood-induced failure of AOVs involves the valve operator’s loss of function and could also involve the AOV failing to its fail-safe position.

e. Sealed penetrations are assumed to pass no fluid provided flood levels remain within the design limits of the seals.

f. Cable insulation is not subject to failure from submergence or spray.

g. Walls and engineered barriers are assumed to remain intact throughout a flooding event.

19.1.5.3.1.3 Qualitative Screening

A screening process is developed to eliminate from further consideration flood areas that do not represent flooding risks. Screening criteria are developed using criteria from the ASME/ANS PRA Standard. Flood areas and flood sources are screened based on the following criteria:

a. The flood area contains no flood source and no flood source can propagate into the flood area either through normal pathways or through failure of barriers from other flood area.

b. Flooding of the flood area would not cause an initiating event or need for immediate plant shutdown and the flood area contains no mitigating equipment modeled in the PRA.

c. The flood area contains flooding mitigation systems (e.g., drains or sump pumps) capable of preventing unacceptable flood levels, and the nature of the flood does not cause equipment failure (e.g., through spray, immersion, or other applicable failure mechanisms).

d. The flood only affects the system that is the flood source, and the systems analysis addresses this event and it need not be treated as a separate internal flooding initiating event.

e. Human actions can mitigate the flooding event and therefore, the flood source may be screened as long as all the following can be shown:

   1) Flood indication is available in the control room;

   2) The flood source can be isolated; and

   3) The mitigating action can be performed with high reliability for the worst flood from that source. High reliability is established by demonstrating, for example, that the actions are procedurally directed, that adequate time is

available for response, that the area is accessible, and that there is sufficient manpower available to perform the actions.

19.1.5.3.1.4 Accident Sequence Definition

The analysis of the internal flooding accident sequences consists of the following steps:

a. Review information collected from the internal flooding design documentation review, including flood areas, possible flood sources, critical flood heights for equipment modeled in the PRA, drainage capacities and paths, flood detection instrumentation, interconnecting areas, and potential barriers (e.g., curbs, dikes, doors, etc.).

b. Extract the information needed to develop flooding scenarios. Such information includes: flood area identifier, possible flood sources and the flood hazard presented by each source, modeled PRA equipment in each area, critical flood heights for modeled PRA equipment, drainage paths and capacities, interconnecting areas, flood barriers, and flood detection instrumentation.

c. Collect other necessary information, including room dimensions and effective floor areas, as well as the identification of which system trains have piping in each flood area.

d. Determine the potential flood scenarios for each flood area, including damage within the area, flood egress from the area, damage to connecting areas and associated flood heights, detection of the flood, potential means of isolation, and potential for unisolated floods to fill multiple flood areas.

e. Calculate the timing associated with flood detection and isolation, based on break flow rate, location of detection instrumentation and PRA equipment, floor area or the associated areas, flood level alarm depths, and equipment critical flood heights.

Following development of the flood scenarios and corresponding accident progression, the accident sequence and system fault trees from the internal events PRA are then modified and requantified to evaluate the effects of flooding in each flood area in terms of the resulting accident sequence frequencies.

In addition to the assumptions for the flood area definition, the assumptions listed below are used in the flood source screening and accident scenario development.

a. Sump pumps have a flow capacity of 22.7 m^3/hr (100 gpm) or less.

b. Alarm response procedures will direct prompt operator action to investigate locally any room flooding alarm and isolate any leaks that are causing the flooding.

c. Where they exist, room flooding alarms will be actuated with water level in the affected room at 0.30 m (1 ft) or less.

d. Motor-operated valves are assumed to fail due to submergence when water level reaches 0.91 m (3 ft) in the room where the valve is located. Vertical pumps are assumed to fail due to submergence when water level reaches 0.91 m in the room where the pump is located. Horizontal pumps are assumed to fail due to submergence when water level reaches 0.46 m (18 in) in the room where the pump is located. This height is based on experience and is considered a minimum height. If this assumption becomes risk significant for a specific scenario, it can be examined on a case-by-case basis.

e. For areas with an EOL to a lower elevation, it is assumed that no PRA-related equipment will fail for flood levels below the design flood level for the EOL.

f. Leak-tight high energy line break (HELB) barriers are assumed to prevent flood propagation.

g. Where propagation exacerbates the accident scenario, door failure is assumed to occur at a differential water height of 0.30 m.

h. Batteries for the 125 Vdc systems are assumed to fail when the terminals become submerged. The height of terminals is assumed to be 0.91 m above the floor.

i. Any break of a pipe containing water at conditions that exceed atmospheric saturation conditions has the potential to cause a pressure transient in the room and challenge barriers to adjoining areas. Unless specific analyses of the pipe break are available, it is assumed that any significant break of a pipe containing fluid above saturated conditions will cause a pressure transient resulting in failure of all doors to the immediately adjoining areas. Other barriers, for example, sealed piping penetrations, are assumed to be capable of withstanding the steam pressure transient.

j. Unless explicitly analyzed, failure of a pipe containing water above saturated conditions is assumed to actuate all fire protection systems in the room in which the break occurs as well as in any room where significant propagation occurs.

k. Significant propagation of steam is assumed to occur only through failed doors, open passageways, open stairwells, HVAC ducting, and open floor grating. While some propagation of steam would occur through open pipe and cable penetrations or EOL lines, this propagation is not considered significant and fire protection system actuation is not considered.

l. Failure of auxiliary steam (AS) or steam generator blowdown (SD) system piping in the auxiliary building is assumed to be incapable of resulting in pipe whip or unique jet impingement failures.

m. Lines that are not normally pressurized or charged, such as drain lines or abandoned in-place systems, are not considered as credible flood or spray sources. For example, relief lines downstream of a relief valve are not normally pressurized and are not included.

19.1.5.3.1.5 Initiating Event Analysis

The flooding-induced initiating events are divided into three categories of causes:

a. Tank rupture events causing flooding

b. Maintenance-related events causing flooding

c. System pipe rupture events causing flooding

No tank ruptures are identified as causing unique effects or contributing to internal flooding events. Maintenance-induced flooding events are considered in the analysis, but a bounding analysis is performed to demonstrate that the maintenance-induced flooding event is a negligible contributor to the overall initiating event frequency.

A limited number of flood-vulnerable plant systems are identified for inclusion as potential flood sources, and are listed in below along with their corresponding rupture rate group as defined in EPRI 1021086 (Reference 46). Reasons for selecting these systems include:

a. The system has adequate inventory to present an obvious submergence threat.

b. The system piping is close to equipment that is important to accident mitigation.

c. The system itself is important to accident mitigation and could be made unavailable by a system pipe rupture.

d. A rupture of the system piping could result in the initiation of a system that could cause flooding.

All other plant systems are screened from consideration as flooding sources due to screening justifications listed below:

a. The system does not transport fluid (e.g., a compressed air system).

b. The system piping is normally dry and is a flooding source only during accident mitigation.

c. The system or piping is isolated during operation.

d. A rupture in the system piping would disable only that system and no reactor trip would result.

Calculation of system pipe break frequency values uses the methodology described in EPRI 1021086. For each internal flooding initiating event, the flood areas that include each system are identified in the accident sequence analysis and the length of pipe to be considered is identified. The pipe lengths used to develop the frequency values are primarily identified using plant isometric and piping arrangement drawings to develop overall pipe location drawings for each system.

The size groups in the analysis are designated as:

Size Group 1: 0 cm $\leq$ ID $\leq$ 5.08 cm (2.0 in)

Size Group 2: 5.08 cm (2.0 in) < ID ≤ 10.16 cm (4.0 in)

Size Group 3: 10.16 cm (4.0 in) < ID ≤ 15.24 cm (6.0 in)

Size Group 4: 15.24 cm (6.0 in) < ID ≤ 25.4 cm (10.0 in)

Size Group 5: 25.4 cm (10.0 in) < ID ≤ 60.96 cm (24.0 in)

Size Group 6: ID > 60.96 cm (24.0 in)

The categories and the values for the generic rupture rates used for the internal flooding PRA are based on EPRI 1021086 data as the basis for the initiating event frequency. Each flood frequency is a statistical estimate with an associated uncertainty, which is characterized by its error factor (EF). The error factors are identified as range factors (RF) in EPRI 1021086. The rupture frequency for each pipe segment has an associated error factor that is found by linear interpolation, at intermediate break sizes, from EPRI 1021086. Calculations that involve the difference in rupture frequencies, at different break sizes, may have two different error factors; in such a case, the larger error factor is used. Each initiating event consists of at least one (and frequently many) different pipe segments. The overall error factor for each initiating event is assumed to be the largest error factor for any segment with a contribution to that initiating event.

The following assumptions are used in the definition of internal flooding initiating event frequencies:

a. The fire protection (FP) and circulating water (CW) systems are assumed to have an infinite volume of water. All remaining systems that represent internal flooding sources are considered to have finite sources of water supply.

b. A minimum break size of 0.082 cm (0.032 in) is used when any break flow range does not include a lower limit.

c. Each pipe segment is evaluated against its minimum and maximum estimated break size (EBS) for consistency. If the nominal pipe size is too small to contribute to flooding at the minimum EBS rate for any segment, then the segment screens out.

d. Some systems are vulnerable to a double-ended guillotine break and can flood from both ends of a pipe. This vulnerability is assumed to exist for recirculating, closed-loop systems (e.g., component cooling water system), "ring header" systems (e.g., fire protection system), and systems with crosstied trains (e.g., main steam system). Although portions of double-ended guillotine break vulnerable system may branch off of the main header, all of the piping will be treated conservatively and consistently. For example, all of the fire protection piping from normally closed valves to the spray nozzles will be treated as double-ended guillotine break vulnerable.

e. A √2 factor is applied to account for the possibility of flow through both sides of a double-ended guillotine break. If [√2 × D] is larger than the minimum EBS, it is included in the calculations; the segment is screened out otherwise.

g. The EBS calculation is conservatively treated, in some cases, as a simplifying assumption. For example, if a 25.4 cm (10 in) pipe is analyzed for minimum and maximum break sizes between 10.16 cm (4 in) and 20.32 cm (8 in), the calculation is straightforward and the difference in relative frequencies is the best estimate. However, a 12.7 cm (5 in) diameter pipe may be analyzed for breaks between 10.16 cm and 20.32 cm, or any break larger than 10.16 cm, even though it can only have a maximum rupture size of √2 × 5 in, assuming the segment is double-ended guillotine break vulnerable. This approximation conservatively results in a slight overestimation of flood frequency for some segments.

h. The water density is assumed to be 999.6 kg/m^3 (62.4 lbm/ft^3) (using the ASME steam table value at standard temperature and pressure [STP] for most systems). This value is assumed to vary negligibly at all system conditions that can be potential flood contributors, with the following exceptions:

   1) Feedwater discharge: 829.8 kg/m^3 at 232.2 °C and 91.4 kg/cm^2g (51.8 lbm/ft^3 at 450 °F and 1,300 psig)

   2) Main steam and connected systems: 35.2 kg/m^3 at 69.3 kg/cm^2g (2.20 lbm/ft^3 at 985 psig)

i. Some segments of normally pressurized systems (e.g., drain lines downstream of an isolation valve) are normally isolated that are screened out.

j. Several fire protection system pipe segments are normally dry until a trip signal opens an upstream isolation valve, and these lines are screened out.

Table 19.1-63 lists all of the initiators and their associated frequencies. The adjusted initiating event frequency (“Adjusted IE Freq” column) is based upon an assumed 95 percent unit capacity factor.

19.1.5.3.1.6 Internal Flooding Human Action Development

The internal flooding HRA analysis consists of two separate analyses. The first portion of the analysis is the development of internal flooding operator action basic events for the isolation of flooding sources. The second portion of the analysis involves the modification of HEP values for operator actions in the initiating events model, which results in a different failure probability than for internal events.

The first portion of the analysis is carried forward with methods similar to those used for internal events (see Subsection 19.1.4.1.1.6). The second portion of the analysis is the analysis of non-flood mitigation HEPs when a flooding event is the initiator. Post-flood HFEs unrelated to flood mitigation are evaluated per ASME/ANS PRA Standard. Flooding events are segregated into two categories:

a) Operator actions performed outside the MCR

b) Operator actions performed within the MCR

If the action is entirely performed inside the MCR, the only possible effect on the operators from the flooding scenario is an increased level of stress. Credited operator actions performed from within the MCR are almost completely procedurally driven and are symptom based (not scenario based). This implies that the operators will respond in the same manner to mitigating functions failed by flooding as they would to those failed by random equipment failures or unavailabilities. Some the initiating events do not cause a plant trip but are modeled as initiators because they will require a controlled plant shutdown due to Technical Specification requirements or other operational considerations. In this case, the operators are actually under less stress than is implied by the baseline HEP values. Many of the credited operator actions with short scenario times (e.g., ATWS mitigation) already have a high stress level associated with them and the addition of a flood scenario results in a minimal increase in stress level.

Sufficient staffing is assumed to be present for the operating crew to investigate the cause of flooding symptoms and respond to events in the control room without compromising the ability to perform either function.

The effect of flooding on the HEP values for human actions performed within the MCR is considered to have a negligible effect on the overall HEP value. An examination of all credited human actions performed inside the MCR was performed and no outliers were found that warranted further analysis.

If a portion of the action is performed outside the MCR, limited or no credit should be taken for those flood scenarios in which the location of the action performance may be affected by the flooding effects. An analysis was performed to determine which human actions performed outside the control room should be failed as a result of flooding. The approach used is conservative in that, unless otherwise stated, a human action deemed to have a significantly degraded probability of success is modeled as being failed.

If the areas where a portion of the human actions are performed are subjected to spray or contain standing water as a result of direct deposition or propagation in a flood scenario, the human actions performed in that area are conservatively assumed to fail.

19.1.5.3.1.7 Quantification

For each postulated internal flooding scenario, the flooding initiating events and the flood-induced equipment failures are included in the logic models. Each internal flooding scenario is quantified a process similar to that used for the internal events PRA quantification to generate an estimated frequency of core damage.

19.1.5.3.2 Results from the Internal Flooding Evaluation

The total CDF from internal flooding events is 2.2×10^{-7}/year. Total LRF from internal flooding events is 1.7×10^{-8}/year. It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

19.1.5.3.2.1 Flooding Initiating Events

Significant flooding initiating events that contribute to the CDF and the LRF are shown in Table 19.1-64 and Table 19.1-65, respectively.

All of the significant events that contribute to CDF are flooding events in the auxiliary building. Furthermore, all the events that contribute to CDF are breaks that are larger than the design basis break. The vast majority of initiating events that contribute to internal flooding core damage risk are caused by breaks in the fire protection system.

The largest contributor to CDF is a large fire protection system break in Quadrant B. This event begins with a break that propagates to and causes failure of Train B electrical equipment. Accumulation of water causes failure of the door between Quadrants B and D and the subsequent surge of water causes loss of Train D electrical equipment. Failure of secondary cooling and failure of equipment needed to support feed and bleed cooling result in core damage.

The second largest contributor to CDF is a major beak of FP piping on the 100 ft elevation that propagates to Train A and Train C switchgear before operator action to isolate the break is successful. Otherwise, the accident progression for this event is similar to the progression described for the second event above.

The third-largest contributor to CDF is similar to the first, but the initiating event occurs in Quadrant A and propagates to Quadrant C.

The fourth-largest event contributing to CDF is a major break of FP piping on the 78 ft elevation that cannot be isolated before propagation causes failure of equipment. Although the specific equipment failures vary slightly, the accident progression for this event is similar to the first event described above.

The significant events and cutsets and sequences that contribute to LRF are the same as the significant contributors to CDF. This can be seen by comparing the dominant flooding events in Table 19.1-64 (CDF) with those in Table 19.1-65 (LRF), and by comparing the dominant flooding cutsets in Table 19.1-66 (CDF) with those in Table 19.1-67 (LRF).

19.1.5.3.2.2 Significant Flooding Scenarios

The top 100 internal flooding CDF cutsets are shown in Table 19.1-66, and the top 100 LRF cutsets are shown in Table 19.1-67. Although the specific initiating event and hardware failures vary slightly between cutsets, the overall accident progression is the same. That is, a flooding event occurs and cannot be isolated before barriers to adjoining areas are challenged. Propagation causes flood-induced failure of two trains of electrical power. The resulting hardware failures result in a general transient or require an immediate reactor shutdown per Technical Specifications. Random hardware failures then preclude operation of secondary cooling and feed and bleed cooling for decay heat removal.

19.1.5.3.2.3 Importance Analysis

Importance measures for basic events, CCF events, and human actions for the internal flooding analysis with respect to CDF are contained in Table 19.1-68 through Table 19.1-73. Importance measures for basic events, CCF events, and human actions for the internal flooding analysis with respect to LRF are contained in Table 19.1-74 through Table 19.1-79.

Because nearly all internal flooding events result in a general transient, the important basic events with respect to FV and RAW are related to maintaining decay heat removal. The important events are related to loss of electrical power to the safety-related buses, equipment failures in the AFWS, and support system equipment failures (such as chilled water).

19.1.5.3.2.4 Risk Insights

The results of the internal flood PRA show that internal flooding events pose a low risk to the design. The low risk from internal flooding events is due to physical separation provided by the plant layout and the design features implemented for the APR1400. The results of the quantification show that beyond design basis flooding events in the auxiliary building represent nearly all of the risk for internal flooding accident sequences. The primary contribution to auxiliary building flooding risk is from failure of the fire protection piping. Flooding caused by other systems is of finite volume or low flow rate and does not present a significant potential for propagating across quadrants. Flooding in other buildings is an insignificant contribution to overall risk.

The major contributors to internal flooding risk are beyond design basis breaks of the fire protection system. Such breaks, which contribute to over 90 percent of the internal flooding CDF, are significant because fire protection is the only system in the auxiliary building with sufficient volume to result in inter-quadrant propagation and damage to equipment needed for accident mitigation. Because of the large volume that could be released from the fire protection system, operator actions to identify and isolate any fire protection system break are credited in the analysis. Because of the holdup capacity of the lower elevation in the auxiliary building, significant time is available for operators to isolate these breaks in most scenarios. Clear and compelling cues from quadrant sump alarms, quadrant flooding alarms, and fire pump running alarms provide reasonable assurance that the actions are initiated promptly.

The design includes a number of features that provide flood protection to safety-related SSCs. These features influence the low overall risk significance of internal flooding, as shown below:

a. Divisional Separation

   In the auxiliary building, flood barriers have been integrated into the design to provide further flood protection while minimizing the impact on maintenance accessibility. The primary means of flood control in the auxiliary building is provided by the structural wall, which serves as a barrier between redundant divisions of safe shutdown systems and components. At the lowest elevation, this structural wall contains no doors or passages, and the limited penetrations through the wall will be sealed. These design features confine floodwater to one division on the lowest elevation. Thus, one division will be unaffected by flooding originating in the other division.

b. Quadrant Separation

   In the auxiliary building, each half of the division is compartmentalized into separate redundant safe shutdown components to the practical extent, while maintaining accessibility requirements. The bottom of the auxiliary building, which houses the front-line safety systems, is compartmentalized into quadrants, with two quadrants on either side of the divisional structure wall. Flood barriers with a flood door provide separation between the quadrants. This design confines flood water to one quadrant up to an elevation of 78 ft. As shown in preliminary calculations in the deterministic design for the flood protection volumes, the potential flood sources are less than the free volume for each quadrant. Therefore, the volume of water contained in one quadrant of these systems would not rise above the lowest elevation. Thus, the equipment in the adjacent quadrants will be unaffected by the flood. The flood door installed between the quadrants in a division will be provided with open and close sensors and alarmed in the control room. A flood door will be designed to withstand the static pressure from the maximum flood elevation as determined in the design.

c. Control Complex

The APR1400 control complex is protected from flooding by having no water lines routed above and through the control room or computer room. Water lines routed to HVAC air handling units around the control room are contained in the rooms with curbs, which prevents any potential water leakage from entering the control room or computer room.

d. Safety-Related Electrical Equipment

At higher elevations, electrical equipment is elevated above the floors so that flooding events will not affect the components. Additional barriers (curbs, ramps, sealed penetrations, etc.) are provided to mitigate the effects of the postulated pipe ruptures. Elevated equipment pads also prevent equipment from being inundated in the event of flooding.

e. Cooling Water System

The AFWS, CCWS, ECWS, ESWS, etc., are separated by division with no open cross-connections; thus, a single pipe break resulting from a division of those systems does not affect the other division.

f. Piping Routing

Lengths of high energy and moderate energy piping are minimized by equipment location. Equipment is located in quadrants around the bottom of the auxiliary building to minimize the lengths of piping runs. This arrangement provides proximity of equipment to reduce piping runs from containment.

g. Floor Drainage Systems

Flood protection is also integrated into the floor drainage systems. The floor drainage systems are separated by quadrant and use valves that prevent the backflow of water to areas containing safety-related equipment. Each quadrant contains its own separate sump equipped with redundant sump pumps and associated instrumentation. These pumps are also powered from the diesel generator in the event of loss of offsite power. The auxiliary building also has its own quadrant-separated drainage system, having no common drain lines between quadrants. Floors are gently sloping to allow good drainage to the quadrant sumps. Floor drains are routed to the lowest elevation to prevent flooding of the upper elevations. The lower elevation in each quadrant has adequate volume to collect water from a break in any system without flooding the other quadrant. In addition, potential discharges of fixed fire suppression systems and fire hoses are considered in the sizing of floor drains to preclude flooding of areas should the fire protection systems be initiated.

h. Emergency Flow Paths

In some flood areas of the auxiliary building, normal floor drains would not have sufficient capacity to accommodate design basis flooding. In such cases, emergency drain paths are provided; emergency drain paths from upper to lower elevations within a quadrant are routed to the section of the radioactive drain sump area dedicated to that quadrant. In the bottom of the auxiliary building, overflow provisions between the safety-related area and non-safety-related area in each quadrant are provided to hold the maximum flood source within each quadrant. In the turbine building, appropriately sized openings are designed to accommodate design basis flooding.

i. CC Heat Exchanger Building and SX Building

Flood protection is incorporated into the CC heat exchanger building and essential service water system (SX) building. SX pumps and CC heat exchangers are located outside the auxiliary building. These structures are divisionally separated by walls so that a flood in one division cannot propagate to the other division.

j. Condenser Circulating Water

The circulating water system piping is confined to the turbine building. Therefore, this unlimited flood source in the turbine building is not permitted to flow into the auxiliary building.

k. Flood Protection Features between Auxiliary Building and Turbine Building

Doors between the auxiliary building and turbine building are located above the maximum turbine building flood elevation.

The major reasons for the low risk from flooding are as follows:

a. The flood protection design effectively eliminates the possibility that a turbine building flood can propagate to other buildings and damage equipment.

b. Equipment needed to mitigate internal flooding sequences is not located in the turbine building.

c. Potential flood sources in the auxiliary building are of finite volume such that the potential for propagation between flood areas is minimized or the potential flow rate from a system is limited, thereby providing time for operator action to terminate a flood.

d. The auxiliary building is separated into quadrants with flood barriers between quadrants. This separation minimizes the potential for propagation resulting from a flood to impact multiple trains of equipment used to mitigate accident scenarios.

e. The design uses emergency overflow lines (EOLs) to provide reasonable assurance that fluid released on the upper elevations of the auxiliary building is directed to the lowest elevation within the quadrant. This feature minimizes the potential for accumulation and propagation to impact equipment in the auxiliary building.

f. The lowest flood areas in each quadrant of the auxiliary building are designed to contain over 2,271 m^3 (600,000 gal) of water without impacting equipment in adjoining quadrants. Watertight barriers, designed to withstand at least 9 ft of accumulation, are provided between quadrants on the lowest elevation of the auxiliary building.

19.1.5.4 Other External Events Risk Evaluation

External events considered are those whose cause is external to all systems associated with normal and emergency operations situations, with the exception of internal fires and floods. Some external events may not pose a significant threat of a severe accident. Some external events are considered at the design stage and have a sufficiently low contribution to plant risk.

The set of external events was taken from the ASME/ANS PRA Standard and represents a consensus listing of external events for nuclear power plant. Table 19.1-80 presents the screening analysis of these external events (based upon recommendations in the ASME/ANS PRA Standard). Those events that are not screened or subsumed within other hazard categories need to be addressed in a site-specific PRA.

Chapter 2 contains site-specific parameters for the following attributes.

a. Nearby industrial, transportation, and military facilities

b. Meteorology

c. Hydrologic engineering

d. Geology, seismology, and geotechnical engineering

Evaluation of potential accidents for the nearby industrial, transportation, and military facilities in Chapter 2 is a probabilistic and predictive approach that is to be followed and documented in the COLA to verify that a 1×10^{-7}/year occurrence rate has been demonstrated. For low probability events, where data may not be available, a 1×10^{-6}/year occurrence rate can be utilized when combined with reasonable qualitative arguments. Otherwise, a PRA may need to be performed to comply with the guidance of the ASME/ANS PRA Standard. The screening criteria for other external events need to be determined at the COL phase, with confirmation that the screening criteria are below the plant-specific risk target.

19.1.6 Safety Insights from the PRA for Other Modes of Operation

This section summarizes Level 1 and 2 internal events, internal flooding, and internal fire PRAs for the low power and shutdown (LPSD) operations, including results and risk insights.

19.1.6.1 Level 1 Internal Events PRA for Low Power and Shutdown Operations

A description of the Level 1 internal events PRA for LPSD operations, including the results from the PRA, is provided in the following subsections.

19.1.6.1.1 Description of Level 1 Internal Events PRA for Low Power and Shutdown Operations

19.1.6.1.1.1 Methodology

The scope of this analysis included quantitative evaluation of internal events for the LPSD operations. The development of the LPSD PRA includes the following nine major technical tasks.

a. Plant Operating State Development

b. Initiating Events Analysis

c. Accident Sequence Analysis

d. Success Criteria Analysis

e. Systems Analysis

f. Data Analysis

g. Human Reliability Analysis

h. Analysis of Large Early Release

i. Quantification

The draft ANS/ASME LPSD PRA Standard (Reference 9) is used as a guideline for the requirements for these technical tasks. Although the LPSD PRA Standard is still in draft form and has not been endorsed by the NRC, it still provides the best available guideline for identifying potential shutdown concerns. The draft standard was developed to support the analysis of operating reactors and, therefore, some of the specific requirements cannot be met in a design phase PRA. For example, the draft standard requires the review and incorporation of plant-specific operating experience into the PRA, interviews with plant operations and other personnel, plant walkdowns, etc., which cannot be performed for a plant in the design stage.

19.1.6.1.1.2 <u>Plant Operating State Definition</u>

The first step in evaluating core damage sequence(s) is the determination of plant operating states (POS). A systematic search was performed to define the spectrum of potential POS for the design. Although the scope of LPSD PRAs for current generation PWRs is limited, the available studies were reviewed to identify potential applicable shutdown states.

The identification of plant operating states benefits from the fact that the U.S. industry has significant experience with outage evolutions. These evolutions include planned shutdown refueling as well as unplanned shutdowns for maintenance and other causes. As a result, the scope of potential plant operating states has already been established. The development of the LPSD PRA, therefore, is focused on the the characterization of the POS for the LPSD PRA.

The APR1400 design is similar to existing PWR designs and a review of information from existing plants is appropriate. NUREG/CR-6144 (Reference 47) documented a shutdown PRA for Surry Unit 1 in 1994. It included a comprehensive set of POS that correlate well with those selected for the next-generation plants. The DCDs for the next-generation reactors were also reviewed to determine whether the POS definition is reasonable.

The POS defined for the APR1400 are summarized in Table 19.1-81. The POS for the APR1400 are defined in a manner that is consistent with the draft LPSD PRA Standard.

19.1.6.1.1.3 Initiating Events

The identification of potential initiating events considers generic information sources, information from similar plants, and a systematic review of the APR1400 design to identify unique initiating events. A detailed failure modes and effects analysis (FMEA) was performed to identify potential initiating events. The potential initiating events are grouped into similar functional categories to reduce the complexity of the PRA. The initiating event frequency for each of these groups is then quantified.

Once the initiating events are identified with preliminary definitions, the final initiating event groups are developed with the final group definitions. Since these initiating events are similar to those of existing nuclear power plants, the frequency for each initiating event is based on generic estimates for the operating power plants. When generic estimates are not available or the APR1400 design indicates that a different frequency is more appropriate, engineering judgment is used to estimate the initiating event frequency.

Based upon this review of shutdown PRAs for PWRs, the following shutdown initiating events are selected:

S1 – Recoverable loss of shutdown cooling system

S2 – Unrecoverable loss of shutdown cooling system

SO – Overdrainage during reduced inventory operation

SL – Failure to maintain water level during reduced inventory operation

SL – Small break LOCA

SL1 – Small break LOCA during reduced inventory operation

SL2 – Small break LOCA above reduced inventory operation

SG – Steam generator tube rupture

JL – Unrecoverable LOCA (i.e., CVCS letdown line)

PL – POSRV fails to reclose

RL – LTOP safety valve fails to reclose

LX – Station blackout

LP – Loss of offsite power

CC/ES – Partial loss of component cooling/essential service water

TC/TS – Total loss of component cooling/essential service water

KV – Loss of 4 kV emergency bus (i.e., SCS power supply)

DC – Loss of 125 Vdc bus

LLOCA – Large break LOCA in transition mode

MLOCA – Medium break LOCA in transition mode

SLOCA – Small break LOCA in transition mode

The results of LPSD initiating event analyses for the above initiators are contained in Table 19.1-82 through Table 19.1-87.

19.1.6.1.1.4 Accident Sequence

The accident sequence (AS) analysis has been developed after an initial review of corresponding sequences for other PWRs for current and next-generation plant designs. Although the scope of shutdown PRAs for current-generation plants is limited, the available studies were reviewed to identify the major elements of accident progression.

With the exception of the transition modes, shutdown conditions are characterized by low temperatures, low or depressurized conditions, and decreasing decay heat. The plant configuration, including primary coolant inventory, primary system temperature and pressure, and status (i.e., whether the primary system is intact or not), and mitigation system availability, can differ significantly from one POS to the next. The reactor core vulnerability to inventory boil-off and subsequent fuel uncovery can differ as well.

The time between boiling inception and fuel uncovery is a strong function of the decay heat level and the primary system inventory. Thus, the potential accident sequences are highly dependent upon the plant configuration and timing, as characterized for each POS.

The important safety functions for LPSD are inventory control and decay heat removal, including the support systems. A core damage sequence typically will occur following the failure of at least one of these functions. Conversely, core protection is maintained by ensuring that both of these functions are established for long-term operation. A safety function may be accomplished by more than one system. For example, decay heat removal in the transition and shutdown modes may be accomplished by the shutdown cooling system, or by safety injection system for feed and bleed.

The accident sequence progression reflects the phenomenological response that is unique to each operating state.

Due to differences in mitigation system availability and plant conditions at each POS, different event trees are developed for some states for the same initiating events.

The LPSD core damage sequences are summarized in Table 19.1-88. This table does not include the large, medium, and small break LOCA, SGTR, and dc bus failure sequences, which are already described for the at-power analysis.

The LPSD event trees for POS 5, which occurs during mid-loop operation, are contained in Figure 19.1-52 through Figure 19.1-63.

19.1.6.1.1.5 Success Criteria Analysis

Plant conditions evaluated in the LPSD PRA are characterized by low temperatures, low RCS pressure or depressurized RCS conditions, and decreasing decay heat. Plant configuration changes during an outage are conducted in a controlled and deliberate manner according to outage plans. In the transition modes, e.g., Technical Specification (TS)

Modes 2 and 3, plant conditions more closely resemble at-power conditions. This section addresses success criteria for all shutdown POS, including transition modes.

Development of success criteria makes use of the standard computer codes (e.g., RELAP5/MOD3) and the APR1400-specific models. The success criteria are intended to be realistic and developed within the capabilities of computer codes and models. The development considers uncertainty associated with the models if that uncertainty could influence conclusions.

The ASME/ANS PRA Standard defines core damage as the uncovery and heatup of the reactor core to the point at which prolonged oxidation and severe fuel damage are anticipated and involving enough of the core, if released, to result in offsite public health effects. For the purpose of the at-power PRA success criteria analysis, core damage is defined to commence at a peak clad temperature of 1,204 °C (2,200 °F) or greater. For LPSD PRAs, NUREG/CR-6144 uses 1,340 °F as the definition of core damage based on phenomena of clad oxidation and ballooning. Furthermore, Inspection Manual Chapter 0609 (Reference 48) specifies a definition of core damage of 726.7 °C (1,340 °F) for LPSD PRAs, confirming that the core damage definition used for at-power PRAs is not appropriate for LPSD PRAs. Therefore, the LPSD PRA uses 704.4 °C (1,300 °F) clad temperature as the definition of core damage, which is slightly conservative compared to the inspection manual value.

Success criteria are dependent upon the initiating event, POS, equipment response, and operator actions that can occur in response to an event. In order to determine the success criteria for a given initiating event and POS, system-level success criteria are considered. Success criteria for the LPSD PRA consider the time available to actuate equipment needed to mitigate an event in conjunction with the time that cues would be generated to alert the operators. Timing can vary significantly in different POS and is considered in the success criteria development.

For the LPSD model, each accident sequence must achieve and maintain a safe stable state, which is defined in the ASME/ANS PRA Standard as “a plant condition, following an initiating event, in which RCS conditions are controllable at or near desired values.” The ASME/ANS PRA Standard further specifies that accident sequences should be evaluated for a minimum mission time of 24 hours. A 24-hour mission time is used for the LPSD PRA. In some circumstances, core damage may not occur within the initial 24-hour period after the initiating event but, without additional actions, core damage would be expected at a later time. In such a case, the scenario is not considered to have reached a safe and stable end state and additional equipment or actions are included in the success criteria. Where mission times differing from 24 hours are appropriate for specific success criteria, these are identified in the discussion below.

Success criteria for the LPSD PRA are based on thermal-hydraulic analysis performed to evaluate the specific conditions specified in the accident sequence analysis. For events analyzed as occurring in the transition modes (POS 1, 2, 14, and 15), these criteria are based on the criteria developed for the at-power PRA. For the remaining POS, success criteria are analyzed using the RELAP5/MOD3 code (Reference 27), where the thermal-hydraulic analyses consider the initiating event, limiting plant conditions for each POS, and equipment availability specified for each accident sequence. Evaluation of containment performance is performed using the MAAP code (Reference 28).

Plant conditions in the transition modes, i.e., POS 1, POS 2, POS 14, and POS 15, are similar to those considered in the at-power internal events PRA. Furthermore, the accident sequence progression developed for each initiating event analyzed in the transition modes is based on an event initiated from full power. Therefore, the success criteria for front-line systems in transition modes are the same criteria as specified for the at-power internal events PRA.

The following are general assumptions and notes applicable to the success criteria development:

a. Success criteria for systems considered in the accident sequence development for POS 1, POS 2, POS 14, and POS 15 are assumed to be the same as for the at-power internal events PRA. Decay heat levels would be lower for an event initiated in these POS than for an event occurring at full power; therefore, this assumption is conservative. Since the time spent in transition modes is small, this assumption is considered acceptable.

b. Failure to begin secondary cooling before RCS pressure reaches the LTOP relief valve lift setpoint is assumed to result in failure of secondary cooling.

c. Failure to begin secondary cooling before RCS level drops below the top of the hot leg is assumed to result in failure of secondary cooling.

d. One SG is assumed to be rendered unavailable by planned outage activities when the plant enters POS 4A.

e. The success criteria and time available for operator actions and events occurring in POS 3B is assumed to be the same as for events that occur in POS 3A. Since RCS temperature is lower in POS 3B, the timing for events is expected to take longer and, therefore, this assumption is conservative.

f. If feed and bleed cooling is used in POS 3A, containment design pressure would be exceeded after 24 hours. Although containment ultimate pressure capability will not be exceeded within 24 hours, operator action to begin IRWST cooling is assumed to be required to provide reasonable assurance safe, stable conditions.

g. Success criteria for unrecoverable LOCA (JL) events are analyzed assuming that the maximum break is the 34.1 m^3/hr (150 gpm) flow rate of the CVCS letdown line that occurs at-power.

h. Success criteria for LTOP safety valve fails to reclose (RL) events are based on the relief capacity of one LTOP relief valve.

Tables for the success criteria for LPSD various initiating event categories and operating states are shown in Table 19.1-89 through Table 19.1-92.

19.1.6.1.1.6 Human Reliability Analysis

The human reliability analysis (HRA) for the LPSD PRA is performed using the same methods as the at-power PRA described in Subsection 19.1.4.1.1.7.

Operator actions that respond to events that occur in Technical Specification Mode 2 or Mode 3 are assumed to be the same as the responses to events that occur at-power. Although the time available for response to an event in Mode 2 or Mode 3 is expected to be longer, thereby resulting in a lower HEP, this conservatism is considered to be negligible to overall risk because the time spent in these modes is short.

Operator actions for responses to events that occur in TS Modes 4, 5, or 6 are summarized in the following groups:

a. Actions to restore SCS

b. Actions to provide reasonable assurance of secondary cooling

c. Actions to initiate feed and bleed cooling

d. Actions to isolate RCS leakage and restore inventory

e. Actions to align the AAC power source

The time available to perform each of these categories of actions varies with POS. As a result, the HEPs for each event also vary with POS. Some actions are not applicable to all initiators and timing can be affected by specific initiating events. For example, actions to isolate RCS leakage and restore inventory are not applicable to loss of SCS initiating events.

19.1.6.1.1.7 Systems Analysis

The following summarizes differences in LPSD PRA system models versus at-power PRA modeling:

a. Safety Injection System

   1) The SITs are isolated in the late POS 2 (TS Mode 3) and below. They are considered unavailable during all of POS 3 through POS 13.

   2) Manual actuation of the SIPs is assumed to be required in Mode 4 (POS 3) and below. Automatic actuation is not credited.

b. Shutdown Cooling System

   1) The system is modeled as aligned for shutdown with one train in operation and one train on standby.

   2) No maintenance is performed on the SCS when operation of the system is required.

3) Although the containment spray pump could be aligned and used as a backup for the SC pump in the same division, no credit is taken for use of the CS pump if the SC pump fails

c. Containment Spray System

1) This system is assumed to be unavailable in TS Mode 5 and below when operability is not required. The unavailability is assumed because it is expected that foreign material exclusion (FME) covers are installed over the trash racks on the inlet to the holdup volume tank (HVT) during refueling outages.

2) There are no system changes to this system's configuration in the transition modes and, therefore, the LPSD model uses the at-power model in the transition modes.

d. Pilot-Operated Safety Relief Valves

The success criterion for feed and bleed cooling in TS Mode 2 or Mode 3 (POS 1, 2, 14, or 15) is the same as for the at-power internal events PRA model, i.e., two of four POSRVs are required to open. When in TS Mode 4 or lower with RCS intact (POS 3A, 4A, 12B through 13), the success criterion for feed and bleed cooling is that one of four POSRVs must open.

e. Chemical and Volume Control System

There are no CVCS model changes required for LPSD analysis.

f. Auxiliary Feedwater System

1) Automatic AF actuation is credited in Modes 1-3 but the AF system must be initiated manually if used in TS Mode 4. Secondary heat removal is not credited in the shutdown modes after the primary system is vented. Therefore, AF flow is not required if the RCS is vented.

2) The turbine-driven AF pumps are not credited in POS 3A to POS 13 due to reduced secondary steam pressure.

3) One AF train is assumed to be unavailable for maintenance when in POS 4 through POS 12.

g. Feedwater System

The feedwater system is modeled as a makeup source for the steam generators in POS 1, 2, 14, and 15 only. There are no changes to this system's configuration in the transition modes and thus the LPSD model uses the at-power model in the transition mode.

h. Main Steam System

1) MS is the preferred system for heat removal in POS 1, 2, 14, and 15. There are no changes to the at-power PRA model for use in those POS.

2) In TS Mode 5, the MSS is used for heat removal if the RCS is intact. However, the ADVs are the only steam removal pathway because the MSIVs are closed and SG pressure is well below the lift pressure of the MSSVs. Also, one SG is assumed to be unavailable in POS 4A and all SGs are assumed to be unavailable in POS 4B through POS 12B.

3) MS is unavailable in POS 4B-12B because the primary system is open and unable to transfer heat to the secondary system.

i. Electrical Distribution System

1) Because the main generator is not operating, the failure of the main generator breaker to open is eliminated from the model.

2) During the refueling outage, no maintenance is performed on EDG A and B, which provide emergency power to the SCS.

j. Component Cooling Water System

No changes to the at-power CC system model are needed for POS 1, 2, 14, or 15. In POS 3A through 13, the CC valves to the SC heat exchangers are open and the fail-to-open failure mode is not applicable. CC system maintenance can be performed during outages. Maintenance is avoided when the CC system is required by TS or needed to support use of the SCS for decay heat removal. Therefore, it is assumed that all CC trains are available in POS 1-6 and 10-15.

k. Essential Service Water System

1) The LPSD model reflects the alignment to three CC heat exchangers during the transition modes. Although three heat exchangers may be placed in service, two heat exchangers, by design, are capable of meeting the decay heat removal requirements. Therefore, the model assumes, conservatively, that the third CC heat exchanger is in standby.

2) No changes to the at-power SX system model are needed for the LPSD PRA. SX system maintenance can be performed during outages. Maintenance is avoided when the SX system is required by TS or needed to support use of the SCS for decay heat removal. Therefore, it is assumed that all SX trains are available in POS 1-6 and 10-15.

l. Essential Chilled Water System (WO)

No changes to the at-power WO system model are needed for POS 1, 2, 14, or 15. The WO system maintenance can be performed during outages. Maintenance is avoided when the WO system is required by TS or needed to support use of the SCS for decay heat removal. Therefore, it is assumed that all WO trains will be available in POS 1-6 and 10-15. Maintenance is assumed to render Train A unavailable in POS 7-8. Maintenance is assumed to render Train B unavailable in POS 8-9 after Train A is returned to service

m. Heating, Ventilation, and Air Conditioning System

No changes to the at-power HVAC system models are required for use in the LPSD PRA.

n. Instrument Air System

No changes to the at-power instrument air system (IAS) models are required for use in the LPSD PRA.

19.1.6.1.1.8 Data Analysis

The approach to assigning failure rate data for components unique to the shutdown model is the same as that used in the at-power Level 1 internal events model (see Subsection 19.1.4.1.1.6). The approach for constructing component unavailability data is the same as that for the at-power Level 1 internal events model as well.

19.1.6.1.1.9 Quantification

Quantification refers to the solution of the Level 1 LPSD PRA accident sequences to generate an estimated frequency of core damage. The Level 1 LPSD PRA quantification process is similar to that used for the Level 1 internal events PRA for operations at power.

19.1.6.1.2 Results from the Level 1 Internal Events PRA for Low Power and Shutdown Operations

It should be noted that units for CDF and LRF are expressed in terms of “reactor calendar year” (shortened to “/year” when displayed in the text in this section).

19.1.6.1.2.1 Risk Metrics

The total CDF from internal events LPSD PRA is 2.6×10^{-6}/year.

19.1.6.1.2.2 Significant Initiating Events

The CDF contributions by each initiating event are presented in Table 19.1-93. The top LPSD CDF contributor is an overdrain event at about 57 percent. A level control failure at reduced inventory contributes about 10 percent, and unrecoverable LOCA contributes about 8 percent. Loss of offsite power and SBO events together also contribute about 8 percent. The overdrain and level control failure events thus contribute a combined 67 percent of the total Level 1 internal events LPSD risk.

LOCA events, including a letdown line LOCA and POSRV fail-open faults, contribute about 12 percent to the LPSD CDF.

The CDF contributions by initiating events for the reduced inventory POS are presented in Table 19.1-94. The CDF contributions by POS are presented in Table 19.1-95.

19.1.6.1.2.3 Top Cutsets

The top 100 cutsets for the low power and shutdown events are illustrated in Table 19.1-96, contributing more than 90 percent of the total CDF. The top three cutsets contribute more than 50 percent of the total CDF.

Table 19.1-97 lists the top 100 cutsets in the reduced inventory states, which are the highest contributors to the CDF. The 100 cutsets listed in Table 19.1-97 contribute 99 percent of the CDF in POS 5 and 11.

19.1.6.1.2.4 Importance Anlaysis

Table 19.1-98 and Table 19.1-99 list the risk-significant basic events, based upon RAW, for all POS and for the reduced inventory. The all-POS results are dominated by IRWST sump plugging and failures of the electrical components. The reduced inventory results are dominated by various controller and safety injection check valve failures. Table 19.1-100 and Table 19.1-101 list the risk-significant basic events, based on FV, for the all POS and for the reduced inventory.

Table 19.1-102 lists the risk-significant CCFs by RAW for the LPSD PRA. Table 19.1-103 lists the significant CCFs by FV. Table 19.1-104 and Table 19.1-105 list the risk-significant operator actions for the LPSD PRA. The results consist of failures to recover shutdown cooling, establish makeup, or perform a feed and bleed following an overdrain or a reduced inventory level control failure; all of these events occur in the reduced inventory operating states.

19.1.6.1.2.5 Key Assumptions

General modeling assumptions are similar to those used in the at-power PRA. Additional shutdown assumptions are listed below.

a. The decay heat load is assumed to be constant during each state. The decrease in decay heat over time is conservatively neglected. Thus, the calculated time to boil off coolant is conservatively underestimated.

b. IRWST cooling is not required when the RV head is removed, but makeup for boil-off is assumed to be required when heat removal is lost. More than 3 days are required to deplete the IRWST if steam is not condensed in the containment and returned to the IRWST. This conservative treatment provides the basis for neglecting IRWST cooling when the RV head is removed.

c. Possible transient LOCA events through the RV and pressurizer (PZR) vents are not considered. The pressurizer vent is normally open during shutdown. The RV vent is open during reduced inventory operation and plant startup after refueling. Given RCS temperatures and pressures, a loss of inventory as steam is evaluated after a loss of RHR cooling. The pressurizer vent contains a flow restrictor, which significantly limits the flow to well below the makeup capacity of the CVCS. The RV vent is a 1 in line, and it would take a long time to uncover the core by venting steam through this line. The risk from this event is not considered significant because the operators have more than enough time to isolate the vent or to provide makeup to the RCS, and these events are screened out as potential initiating events.

d. It is assumed that a transient-induced LOCA response requires feed and bleed cooling success, using the pressurizer relief valves, because the LOCA size may not be large enough to provide sufficient bleed flow.

e. The probability of IRWST suction strainer plugging is not increased relative to the power operation PRA model. The IRWST design characteristics (e.g., large, separation between suction lines, debris filtering capability) and plant procedures (e.g., foreign material control) are expected to provide reasonable assurance that this probability is low.

f. Risk with a water-solid pressurizer is not considered. The inadvertent start of an RCP or an SIP could cause an overpressure event when the pressurizer is solid. The SCS relief valves will protect the system from overpressure during this period and the exposure time is small. Thus, overfill events that could lead to a low temperature overpressure event have been screened out as potential initiating.

19.1.6.1.2.6 Sensitivity Analyses

Sensitivity analyses using full model requantification can identify effects that might not be captured by the importance analysis, due to truncated cutsets. However, the extremely low LPSD truncation level (1×10^{-13}), more than seven orders of magnitude below the LPSD CDF, means that it is highly unlikely that any such effects might be present. No additional LPSD sensitivity analyses have been performed.

19.1.6.1.2.7 Uncertainty Analyses

The uncertainty results for Level 1 internal events CDF for LPSD operations are summarized below:

5 percent value: 9.4×10^{-7}/year

Mean value: 2.6×10^{-6}/year

95 percent value: 6.0×10^{-6}/year

Uncertainty in the Level 1 shutdown PRA results is quantified with a process similar to that described for internal events in Subsection 19.1.4.1.2.6. Parametric uncertainty was represented by selecting an uncertainty distribution for each parameter type, as described in Subsection 19.1.4.1.2.6. Modeling uncertainty is not represented in the shutdown model.

19.1.6.1.2.8 Risk Insights

The following insights are drawn from the Level 1 internal events LPSD PRA:

a. Many systems are manually started or aligned during shutdown modes. Training is especially important for shutdown evolutions because operator error is often a significant risk contributor in shutdown sequences.

b. Successful SCS operation is the preferred end-state for all shutdown sequences. The operation and maintenance personnel must have procedures, training, and spare parts to restore SC in a timely manner. The ability of the operator to align the SCS for makeup and feed and bleed operation is an important risk contributor.

c. Configuration control is necessary because significant plant risk can occur during adverse configurations. If configurations are managed so that critical, high risk configurations do not occur or occur infrequently, then their associated risks will be reduced. The COL applicant should limit planned maintenance that can potentially impair one or both SC trains during the shutdown modes. During plant shutdown, risk can be minimized by appropriate outage management, administrative controls, procedures, and operator knowledge of the plant configuration.

d. If one train of the SCS is unavailable for any reason during shutdown, the shutdown cooling function is dependent upon the remaining train and its support systems. The COL applicant should develop procedures and a configuration management strategy to address the period of time when one SC train is unexpectedly unavailable (including the termination of any testing or maintenance that can affect the remaining train and restoration of equipment restored to its nominal availability).

19.1.6.2 Level 2 Internal Events PRA for Low Power and Shutdown Operations

Section 19.1.6.1 presented the description and results of Level 1 internal events PRA for low power and shutdown operations. This section presents the description and results of the Level 2 internal events PRA for low power and shutdown operations.

19.1.6.2.1 Description of Level 2 Internal Events PRA for Low Power and Shutdown Operations

19.1.6.2.1.1 Methodology

The primary objective of the Level 2 PRA for LPSD operations is to provide insights into potential plant vulnerabilities with regard to accident progression.

The scope of this analysis includes quantitative evaluation of the large release frequency (LRF) for internal events during LPSD operations. Some lower CDF POS are evaluated conservatively, with a more detailed evaluation being performed for the more significant contributors to the LPSD CDF. Performing a more detailed evaluation on the higher CDF LPSD contributors provides reasonable assurance that significant risk insights are captured.

Many of the LPSD Level 2 phenomenological considerations are the same as in the at-power analysis. Examples include containment isolation (without credit for automatic SI signals, which are not functional in some POS) and containment overpressurization. Some at-power phenomena are not relevant in some POS. However, some LPSD POS present accident progression challenges are unique to LPSD and therefore require evaluation. For example, in some POS, the containment equipment hatch can be open, which must be considered as a potential release path. When the hatch is closed (as is the case in many POS), it is secured with fewer bolts than in at-power conditions, meaning a lower containment ultimate pressure can be tolerated. In addition, a severe accident in POS with the RCS open results in hydrogen releases from the RCS that differ from at-power, so consideration must be given to the potential for hydrogen "pocketing." The most significant differences between the at-power and the LPSD Level 2 analysis occur in those POS in which the RCS is open, so the Level 2 analysis evaluates these in more detail, with additional consideration given to the POS in which the containment equipment hatch may be open.

The approach to the LPSD Level 2 is similar to the at-power Level 2 analysis in Subsection 19.1.4.2. The following subsections present material that differs from the at-power analysis. References to the at-power analysis are often made in the description of the LPSD Level 2 approach.

Unlike the at-power Level 2 analysis, the LPSD Level 2 does not group Level 1 sequences into PDSs. Relevant Level 1 sequence characteristics and system evaluations are considered directly in the LPSD containment event tree (CET). The top logic fault tree is used for the CET quantification, allowing Level 2 system fault trees and the CETs to be directly linked to the Level 1 system models without the need for the creation of PDSs.

A single CET model is developed for evaluation of POS 4B, 5, 6, 10, 11, and 12A. Since, for each of these POS, the containment is closed per Technical Specifications and the pressurizer manway open, the accident progressions considered are similar and can be assessed with a single CET. Differences in timing are evaluated for HEPs, but these are evaluated at the fault tree level and do not alter the CET structure.

For POS 1, 2, 3A, 13, 14, and 15, the containment integrity is required by Technical Specifications, and the RCS is intact. Therefore, the accident progression of these POS can conservatively be estimated using the at-power conditional probability of a large release (CPLR). From Subsection 19.1.4.2.2.1, the at-power CPLR is $8.4x10^{-2}$. Use of this CPLR is conservative because decay heat levels and the initial RCS pressure are both lower, yielding both greater times for response actions and an accident progression that involves lower energy levels.

For POS 3B and 4A, the RCS is closed, but for portions of each POS, the containment equipment hatch may be open. In the LPSD Level 2 analysis, it is conservatively assumed that the hatch is open for the entire duration of these POS. Should an accident occur, credit is given to closing containment to allow mitigation of the accident progression. Failure to close the containment is assumed to result in a large release. Successful closure is addressed in the same manner as in POS 1-3A and 13-15.

Table 19.1-132 summarizes the approach to calculating LRF for POS 1-15.

19.1.6.2.1.2 <u>Containment Equipment Hatch and Containment Integrity in LPSD</u>

A key item to consider in LPSD analysis is that the containment, which is kept intact for at-power operation, is open during portions of LPSD conditions. If the containment is open at the time of core damage in a severe accident, then the releases are assumed to be large and unmitigated. While the releases would actually be into the auxiliary building, no credit is taken for fission product retention and/or holdup, and it is conservatively assumed that a large release directly to the environment results.

The containment integrity is intact in POS 1, 2, 3A, 4B, 5, 6, 10, 11, 12A, 13, 14, and 15. POS 7-9 can have the containment open, but the risk for these POS is negligible and not quantitatively evaluated in the Level 1 model (see Subsection 19.1.6.1). In POS 3B and 4A, the containment equipment hatch is open for a portion of the time, and the Level 2 analysis assumes that it is open for the entire POS duration. However, should shutdown cooling (SDC) be lost, operators would act to restore containment integrity. This action is credited in the Level 2 analysis for POS 3B and 4A.

Credit for closing the containment equipment hatch requires consideration of several factors.

a. The time at which the action to close the hatch is initiated. This is taken to be the event initiation, the loss of SDC, which is alarmed in the control room.

b. The time by which the hatch must be closed. There are concerns about attempting to close the hatch after the onset of steaming, which include high temperature conditions, high steam velocity exiting the containment and providing force against the hatch, as well as visibility. Although a large containment like the APR1400 has would delay the time after the onset of boiling before some of these issues became significant, the Level 2 analysis assumes that hatch closure must occur prior to the onset of boiling. In POS 3B, after a loss of SDC, there is an estimated 280 minutes until boiling begins in the RCS. In POS 4A, there is an estimated 179 minutes.

c. The time required to close the containment equipment hatch. With ac power available (offsite or onsite), the containment equipment hatch can be closed and at least four bolts engaged in 1 hour. If no ac power is available (SBO), the Level 2 analysis does not credit hatch closure.

The HEP for failing to close the containment equipment hatch was calculated to be 5.1×10^{-2} for both POS 3B and 4A. Failure to close the hatch before RCS boiling is assumed to yield a large release.

During at-power operation, the containment equipment hatch is secured with 40 bolts. When closed as described here, the hatch can be sealed with a minimum complement of four bolts, which is sufficient to secure the hatch so that no visible gap can be seen between the seals and the sealing surface. The failure pressure of the hatch is lower when fewer bolts are engaged, though the hatch is pressure-seated, meaning that an increase in containment pressure tightens the hatch seal.

The at-power containment ultimate failure pressure was modeled as 162.7 psig (see Subsection 19.1.4.2.2.5). For modeling purposes, the LPSD analysis assumes that because of the smaller number of bolts securing the equipment hatch, the failure pressure will be less than half of the at-power ultimate capacity. A failure pressure of 80 psia (65.3 psig) is assumed. This has little effect on most of the LPSD Level 2 analysis; for slow overpressurization, if containment heat removal (CHR) is available, containment pressure is maintained far below this level. If CHR is unavailable and there is significant steaming, then overpressure failure will occur at some point, regardless of what failure pressure is chosen. The key areas in which the failure pressure affects the analysis are in the ability to withstand a hydrogen detonation or burn, and the ability to remain intact long enough for the ECSBS to be credited. These are evaluated in Subsection 19.1.6.3.1.3.

With the exception of the containment equipment hatch and the normal containment isolation pathways (which are considered in the CET), it is assumed that no other breaches of containment exist. This includes removal of penetration seals, simultaneous opening of both containment personnel airlock doors, and other breaches of containment. If one of these breaches occurs, it is assumed they would be readily sealed (i.e., the containment equipment hatch is assumed to be limiting).

19.1.6.2.1.3 Containment Event Tree Analysis

A containment event tree (CET) is developed to model the containment response during severe accident progressions. The CET depicts the various phenomenological progressions, containment conditions, and containment failure modes that could occur under severe accident conditions. Level 2 system availability is evaluated directly within the CET and supporting decomposition event tree (DET) models using fault tree logic.

A single CET model is developed for evaluation of all the POS 4B, 5, 6, 10, 11, and 12A. Since the containment is closed per Technical Specifications and the pressurizer manway is open for these POS, the accident progressions considered are similar and can be assessed with a single CET. Differences in time for human error probabilities, offsite power recovery, etc. are evaluated directly at the fault tree and cutset recovery file level.

The LPSD CET is less detailed than the at-power CETs (see Figures 19.1-42 through 19.1-46) as a result of making some simplifying assumptions. For example, the at-power CET considered the probability of containment rupture versus leakage on many branches. In the LPSD model, all such containment failures are assumed to be rupture because of uncertainty in the containment equipment hatch failure pressure. In addition, SGTR (both induced and as an initiating event), is a significant contributor in the at-power PRA, but is not credible in the LPSD POS with the RCS open. Therefore, at-power modeling related to SGTR is not present in the LPSD CET.

The LPSD CET is presented in Figure 19.1-64. The top events are:

CDF – Entry from LPSD Level 1 POS 4B-6 and 10-12A

BYPASS – Containment not bypassed (JL initiating event)

CISO – Containment isolation is successful

MELTSTOP – The core melt is arrested in-vessel

DCF – No dynamic containment failure

ECF – No early containment failure

CSLATE – Late containment heat removal availability

DBCOOL – Molten core debris is cooled ex-vessel

LCF – No late containment rupture

BMT – No basemat melt-through

A summary of each of these top events is described below:

a. BYPASS – Containment Not Bypassed (JL AND CHR failed)

   The failure branch of this node considers the CVCS purification line ISLOCA (initiating event JL). The pathway that fission products would take from the RCS to outside containment is convoluted, with significant flow resistance. Because the pressurizer manway is open in POS 4, 5, 6, 10, 11, and 12A, releases from the purification line break are assumed to be very small compared to what is released into containment, as long as containment pressure is not high. Therefore, as long as containment heat removal (via containment spray) is successful, this is not considered a large release path, as almost all fission products would release into the containment. However, if CHR fails, the rise in containment pressure would force more fission products through the purification line rupture. It is assumed that this would result in a large release from the CVCS path.

b. CISO – Containment Isolation Successful

Isolation of containment penetrations is assumed to be identical to the containment isolation modeling in the at-power Level 2 model. For LPSD conditions, the automatic actuation is failed for POS in which the SI signals are turned off, and this effect is captured in the analysis. Note that for POS 3B and 4A, failure to close the containment hatch is considered (see Subsection 19.1.6.2.1.2), but this does not apply to the POS analyzed in the CET.

c. MELTSTOP – Accident Progression Terminated In-Vessel

When core damage occurs, there are two options to arrest core melt and to retain corium in the RV. One is to inject water into the RV to cool the corium. The other is to inject water into the reactor cavity to cool the external wall of the RV to the extent that heat transfer through the wall cools the corium inside, and a stable state is reached. The latter is referred to as external RV cooling (ERVC) or in-vessel retention (IVR) in this analysis.

Safety Injection

The APR1400 has developed Severe Accident Mitigation Guidelines (SAMGs) for LPSD operation. The SAMGs state that when core exit thermocouple temperatures reach 1,200 °F, the operators should attempt to initiate safety injection (SI).

In the LPSD Level 1 event trees, SI is questioned on each sequence that leads to core damage. In the POS modeled explicitly in the LPSD Level 2 analysis, all core damage sequences include failure of SI.

The benefit of crediting SAMG SI initiation is limited to an opportunity to recognize the need to initiate SI when core exit thermocouples reach 1,200 °F, given failure to recognize the need earlier in the sequence. If the early failure of SI was due to hardware failures, then no credit is given to recovery.

In the at-power Level 2 analysis (Subsection 19.1.4.2.1.2.3), credit for in-vessel retention was taken for recovery of SI after core damage but before induced primary system failure. In the LPSD analysis, the pressurizer manway is open for POS 4B-12A, so induced primary system failure is not relevant. There is some point after core damage but before vessel failure in which recovery of SI prevents vessel failure; there is uncertainty as to the exact criteria to define this point, so conservatism is applied in this instance.

For the LPSD analysis, successful initiation of SI to prevent vessel failure is assumed until the time of core damage. This allows some conservatism to account for uncertainties in the thermal-hydraulic analysis, which provides sufficient realism to credit the SAMG action. The time to reach 1,200 °F and the time to core damage were developed using the MAAP code for a mid-loop scenario with loss of SDC and no SI.

External Reactor Vessel Cooling (ERVC)

When the core exit thermocouple temperature of 1,200 °F is reached, another SAMG action is initiation of the cavity flooding system (CFS). This is credited if there is a mechanical failure of SI, but if there is an operator failure to initiate SI by the SAMG action, then complete dependence is assumed, and no credit is given to cavity flooding by SAMG action. In addition, the ERVC system provides a means to flood the containment cavity in an attempt to prevent vessel failure by cooling the molten core from outside the vessel. Consistent with the at-power Level 2 PRA, ERVC is not credited in the baseline LPSD analysis.

d. DCF – No Dynamic Containment Failure

Given that the RV has failed (failure of the MELTSTOP top event), the LPSD CET then questions whether the containment fails dynamically at vessel breach. This event is similar to the at-power Level 2 CET event DCF, except that in the LPSD model for POS 4B-12A, the RCS pressure will always be “low” at vessel breach (due to the open pressurizer manway). The evaluation of “low” pressure vessel failure from the at-power Level 2 analysis presents a $1x10^{-3}$ probability of dynamic containment failure due to Alpha-mode containment failure. The same value is conservatively used for the LPSD Level 2.

e. ECF – No Early Containment Failure

The next event in the LPSD CET is ECF, which questions whether the containment fails early due to a hydrogen burn, direct containment heating (DCH), or an ex-vessel steam explosion. This event is similar to the at-power DET ECF, except that the RCS pressure is considered low in all sequences of POS 4B-12A. The LPSD DET is identical to the at-power model except for the following:

1) The RCSPRESS branches of medium and high pressure have been removed (since pressure is low).

2) The release point from the RCS in POS 4B-12A is always assumed to be through the pressurizer manway.

3) DCH failures are not credible for low pressure sequences.

4) The branches in which the containment fails as a small leak are deleted. All containment failures due to ECF are assumed to be rupture.

5) The conditional probability of containment rupture due to hydrogen detonation when hydrogen control is unavailable is increased to 0.1 to account for reduced containment pressure capacity with less than 40 bolts secured on the containment equipment hatch. The conditional probability of containment rupture is also set to 0.1 for hydrogen burns when steam is quenched by containment sprays and hydrogen control fails.

f. CSLATE – Containment Spray Status

This top event considers the availability of containment sprays for CHR late (after vessel breach) in the accident sequence. The event is essentially identical to the at-power CET event CSLATE, except that the supporting fault trees consider an increased probability of containment sump plugging. For POS in which there is substantial work being performed inside the containment, there could potentially be a larger amount of debris presented to the sump. The APR1400 containment design includes the holdup volume tank (HVT), which would reduce the potential for sump plugging. Nonetheless, the LPSD analysis conservatively uses higher generic probabilities of sump plugging. From NUREG/CR-6144, Vol. 2, a Level 2 sump plugging probability of 0.1 should be considered for LPSD. In the APR1400 Level 2 analysis, the probability of 0.1 is used for POS up to 6. For POS 10 and higher, it is assumed that most transient equipment and personnel would be removed from containment, and the at-power sump plugging probability of 0.01 is used.

In order to confirm that the ECSBS can be credited in shutdown (with a lower containment ultimate failure pressure at the equipment hatch), MAAP analyses were performed at mid-loop and also with larger cavity water volumes to allow greater steaming. As in the at-power PRA, the ECSBS is assumed not to be available until 24 hours into the event, so the containment pressure must be below failure pressure at 24 hours to allow success. The LPSD analysis assumes the containment failure pressure will be 80 psia (65.3 psig) with four bolts engaged on the containment equipment hatch, but there is uncertainty in this value. However, in the MAAP analysis, the highest containment pressure 24 hours into the event is less than 30 psia (15.3 psig). Therefore, even if a much lower containment failure pressure is considered, the ECSBS can still be credited for the LPSD Level 2.

g. DBCOOL – Core Debris is Cooled Ex-Vessel

The at-power CET event DBCOOL is simplified for the LPSD Level 2 analysis. Offsite power recovery is not credited because of uncertainties in the containment ultimate failure pressure. In-vessel injection credit is limited to the SAMG initiation of SI (see event MELTSTOP), since all of the LPSD core damage sequences modeled explicitly in the LPSD Level 2 analysis include SI failure in the Level 1 analysis.

The conditional probabilities of debris coolability are assumed to be the same in LPSD as in the at-power Level 2. This assumption is conservative because the decay heat levels in the debris are significantly lower in LPSD operation.

h. LCF – No Late Containment Failure

The next event in the LPSD CET is LCF, which questions whether the containment fails late due to overpressurization, hydrogen detonation, or hydrogen burn. This event is similar to the at-power DET LCF except for the following:

1) The branches in which the containment fails as a small leak are deleted. All containment failures due to ECF are assumed to be ruptures.

2) An ignition source is assumed to always be available for a hydrogen burn, so the LATEH2IG top event is deleted.

3) Spray of the containment is successful and is accomplished early in the scenario by containment sprays, and late in the scenario (given failure of early spray), by success of ECSBS.

4) LATE cavity flooding (dead-headed in-vessel injection recovered after vessel failure) is not relevant to the LPSD Level 2, since RCS pressures are low in the POS explicitly modeled in the LPSD Level 2.

5) Because of the lower containment ultimate failure pressure at the equipment hatch in POS 4B-12A, the probability of containment rupture due to hydrogen detonation or burn is significantly increased. The conditional probability of rupture due to detonation is increased to 0.1. The conditional probability of rupture due to hydrogen burn is increased to either 0.1 or 0.01.

i. BMT – No Basemat Melt-Through

This is modeled consistent with the at-power Level 2 CET event BMT.

19.1.6.3.1.4 Release Category Evaluations

The end points of the CET represent the outcomes of possible accident progression sequences. These end points describe complete severe accident sequences from initiating event to release of radionuclides to the environment. The at-power Level 2 release category evaluation was described in Subsection 19.1.4.2.1.3, and presents the Level 2 definitions of large, small, early and late releases. The LPSD Level 2 evaluation uses the same definitions.

The at-power evaluation delineated 21 release categories. The LPSD release category evaluation is less detailed. The more simplified and conservative LPSD release category evaluation created four release categories. They are:

RC-1-LPSD – The containment is intact and there are no significant releases. Consistent with the at-power Level 2 release categories 9 and 10, releases are modeled as the containment design leakage rate.

RC-2-LPSD – The containment ruptures with large and early releases. The main contributors to this category are containment bypass, CET sequence 31, or failure to close the containment equipment hatch (POS 3B/4A, not shown in the CET diagram). Other contributors are early hydrogen detonation or burn, or ex-vessel steam explosion.

RC-3-LPSD – The containment ruptures with large and late releases. The main contributors are steam overpressurization (CHR failure) and late hydrogen detonation or burn.

RC-4-LPSD – This category represents those sequences in which the containment fails late due to basemat melt-through. In this category, there are significant corium-concrete interaction (CCI) and concrete erosion after RV failure. Since the containment failure occurs below the containment basemat, there is a very small release of airborne fission products to the environment, and the release characteristics of this category are expected to be as an underground water release. The releases of this category are late and small.

The large release frequency (LRF) is the combined frequencies of RC-2-LPSD and RC-3-LPSD.

The summary of the MAAP results (release magnitude and timing) and release categorization (i.e., large release, large early release, or not large release) is presented in Table 19.1-133.

19.1.6.2.2 Results from the Level 2 Internal Events PRA for Low Power and Shutdown Operations

19.1.6.2.2.1 Risk Metrics

Total LRF from LPSD internal events is 1.2×10^{-7}/year. This is well below the NRC goal for LRF below 1×10^{-6}/year. It should be noted that units for CDF and LRF are expressed in terms of “reactor calendar year” (shortened to “/year” when displayed in the text in this section).

The CCFP from all LPSD internal events large release sequences is 0.044. This meets the NRC goal of having a CCFP of approximately 0.1 or lower.

19.1.6.2.2.2 LPSD Internal Events Large Release Frequency Results

The relative contribution to LRF from each POS is presented in Table 19.1-134. Approximately 45 percent of the LPSD LRF results from POS 5 and 11 (the mid-loop POS). These POS dominate the LPSD CDF (approximately 74 percent of the CDF), but the LRF percentage is lower because of credit given to SAMG initiation of SI. Much of the CDF in the mid-loop POS is due to operator failure to initiate SI before core damage, but the credit taken in CET event MELTSTOP successfully mitigates much of the frequency.

The next two highest POS contributors to LRF are POS 3A and 3B. POS 3A contributes 13 percent to the total LPSD LRF. As described in the LPSD Level 2 modeling sections previously, POS 3A is evaluated using the at-power CPLR, so there is some conservatism in this frequency. POS 3B LPSD LRF is composed of 11 percent from containment bypass (JL) and another 11 percent from other Level 1 event trees. These other event trees also use the at-power CPLR, along with the potential for failure to close the containment equipment hatch.

19.1.6.2.2.3 Significant Cutsets

As described in Subsection 19.1.6.2.1, POS 1-4A and 13-15 LRF is estimated conservatively using the at-power CPLR. Since the RCS is intact in these POS, the accident progression is similar to the at-power accident progression, except with lower energy levels. Since the CPLR was applied to the entire CDF of each of these POS (except as described in Subsection 19.1.6.2.1 for failure to close the containment equipment hatch and for containment bypass), no new insights would be gained by performing LPSD LRF importance analyses or other results evaluation. The CDF importance and results provide sufficient insights into the key contributors to these POS, and LRF insights with an intact RCS are achieved by the at-power Level 2 analysis (Subsection 19.1.4.2.2).

Therefore, the LRF cutset, importance analyses, and other results evaluations in this and the following sections are limited to the POS with the RCS open (i.e., POS 4B, 5, 6, 10, 11, and 12A).

The top 100 LRF cutsets for all the POS quantified are presented in Table 19.1.135. The top six cutsets are all stem from POS 5, and involve a combination of combination of initiating events with either purification line rupture (JL sequences), or containment rupture due to overpressurization or hydrogen detonation.

The top 100 LRF cutsets for the reduced inventory POS are presented in Table 19.1-136.

19.1.6.2.2.4 Importance Analysis

The significant LPSD internal events LRF initiating events are presented in Table 19.1-137. The significant LPSD internal events LRF initiating events for the reduced inventory POS are presented in Table 19.1-138. The most significant initiating events in both tabulations are the overdrain and LOCA events in reduced inventory.

An importance analysis of the LPSD key basic events with respect to LRF sorted by RAW is presented in Table 19.1-139. The same list sorted by RAW for reduced inventory POS is presented in Table 19.1-140.

An importance analysis of the LPSD key basic events with respect to LRF sorted by Fussell-Vesely is presented in Table 19.1-141. The same list sorted by Fussell-Vesely for reduced inventory POS is presented in Table 19.1-142.

An importance analysis of the LPSD key CCF basic events with respect to LRF sorted by RAW is presented in Table 19.1-143. The same list sorted by Fussell-Vesely is presented in Table 19.1-144.

An importance analysis of the LPSD key operator action basic events with respect to LRF sorted by RAW is presented in Table 19.1-145. The same list sorted by Fussell-Vesely is presented in Table 19.1-146.

The source term category contributors to the internal events LPSD LRF are presented in Table 19.1-147.

19.1.6.2.2.5 Key Assumptions

A. The LPSD internal events Level 1 analysis did not credit offsite power recovery for LOOP sequences that did not result in SBO (offsite power recovery was credited for the SBO sequences). In the Level 1 analysis, the impact on CDF was not large, but it had a greater impact on LRF. Therefore, the Level 2 analysis did credit offsite power recovery in non-SBO LOOP sequences in order to present a more realistic LRF.

B. Failure of hydrogen control from PARs and/or igniters is assumed to yield a conditional probability of containment rupture due to hydrogen detonation of 0.1, plus another conditional probability of containment rupture due to hydrogen burn of 0.1 or 0.01. These probabilities are believed to be conservative, but additional calculations are needed for confirmaton.

C. No credit was taken for the external reactor vessel cooling (ERVC) system. This is conservative, especially for LPSD, since RCS pressure would be low at the time of core damage and the decay heat levels are low. Crediting ERVC system would reduce the LPSD LRF.

D. The containment equipment hatch can be secured in LPSD POS with four bolts, but this provides a lower containment ultimate pressure capacity than is credited in the at-power Level 2 analysis. The LPSD analysis assumed that the LPSD hatch configuration can withstand a containment pressure of 80 psia (65.3 psig). In MAAP calculations to determine if ECSBS could be credited, the containment pressure only reached 30 psia before ECSBS was initiated, so the impact of the assumption is not as significant.

E. ECSBS was credited for containment heat removal in the LPSD analysis, which is consistent with the at-power Level 2 analysis and the LPSD-specific MAAP analyses.

F. Many severe accident phenomenological probability estimates from the at-power Level 2 analysis were used in the LPSD Level 2. This is conservative because of lower decay heat levels and RCS pressure in LPSD sequences.

19.1.6.2.2.6 Uncertainty Analysis

This section presents the parametric uncertainty analyses performed on the internal events LRF cutsets for LPSD operations. The resultant uncertainty parameters are:

5 percent value: 1.6×10^{-8}/year

Mean value: 6.8×10^{-8}/year

95 percent value: 1.8×10^{-7}/year

The uncertainty analysis was performed using a Monte Carlo sampling, with a sample size of 10,000.

19.1.6.2.2.7 Risk Insights

The LPSD CDF is dominated by overdrain events while in mid-loop operation. For cutsets in which the failure of SI is caused by operator error, the LPSD Level 2 analysis credits a second cue for SI initiation. This SAMG action mitigates a large portion of the mid-loop operation CDF. The action also mitigates other LPSD POS and initiating events, and its importance is seen in the associated basic event's Fussell-Vesely LRF importance of approximately 5.0×10^{-1}.

Offsite power recovery for LOOP sequences that did not result in SBO has a significant impact on the LRF. The Level 2 analysis credits offsite power recovery in non-SBO LOOP sequences to estimate a more realistic LRF.

The ability to close the containment equipment hatch in POS 3B and 4A is significant. Without credit for hatch closure, these POS would yield an LRF of 9.6×10^{-8}/year, which would nearly double the LPSD internal events LRF. However, with credit for hatch closure, these two POS contribute 2.5×10^{-8}/year to the LRF (21 percent).

19.1.6.3 Internal Fire PRA for Low Power and Shutdown Operations

The following subsections describe the development of the internal fires risk evaluation during low power and shutdown conditions, and the analysis results.

19.1.6.3.1 Description of Internal Fire PRA for Low Power and Shutdown Operations

The low power and shutdown (LPSD) fire PRA (FPRA) methodology for the APR1400 is based on NUREG/CR-7114 (Reference 52) and NUREG/CR-6850 (Reference 6). NUREG/CR-7114 provides a framework for quantitative analysis of fire risk during LPSD conditions. NUREG/CR-6850 provides a state-of-the-art methodology for fire PRAs. The steps in the LPSD fire PRA methodology are the same as those used in the full-power internal fire PRA (FP-FPRA) (see Subsection 19.1.5.2.1) with the exception that they are applied to the LPSD internal events model (see Subsection 19.1.6.1). The exceptions to the at-power FPRA methodology used in the development of the LPSD FPRA are described below. It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

19.1.6.3.1.1 Deviations from the Industry Methodology

All of the tasks described in Subsection 19.1.5.2.1 are required to perform a LPSD FPRA. These tasks involve various types of screening to eliminate assessment of non-risk-significant fire scenarios. Since the plant is in the design stage, some specific plant details are not yet known, so some of these screening tasks cannot be applied with a high degree of certainty. These tasks include the following:

a. Task 4 has not been performed. Instead, all fire compartments are included in the analysis, and those that do not result in an LPSD initiator simply have a CDF of zero (since the initiating event frequency is zero). It should be noted that all compartments are later considered for multi-compartment analysis (MCA) impacts.

Hence, even the impact of compartments that do not result in an LPSD initiating event are evaluated for MCA, since the combination of potential equipment damage in both compartments may result in a fire-induced initiating event. There is no impact for not performing this screening, since qualitatively screened fire compartments should have no PRA-credited components or cables.

b. Task 7 has not been formally applied. Instead, due to the short durations of LPSD POS resulting in a small CDF for most fire compartment fire scenarios, no formal quantitative screening was performed to identify risk-significant compartments; rather, risk-significant fire compartments were identified by inspection. This inspection resulted in identifying only the main turbine building area fire compartment (F000-TB) as risk significant, and therefore requiring detailed analysis. In addition, the MCR was identified as requiring detailed analysis in accordance with Task 11.

c. Task 8 has not been applied since specific relational location information between ignition sources and targets are either not known or cannot be confirmed via walkdown. The main unknown factors include intervening combustibles and conduit. Major plant equipment can be identified on plant general arrangement drawings, and cable tray locations and elevations can be identified on raceway drawings, but the distance between the potential ignition sources and the cable trays is not known. In addition, the location of conduits is not currently available, and walkdowns cannot be performed to identify intervening combustibles. The impact of this is that all ignition sources in each fire compartment is conservatively assumed to result in a full room burnout scenario.

d. Detailed circuit analysis has not been performed as part of Task 9. As described in Subsections 19.1.6.3.1.2 and 19.1.6.3.1.3, conservative key assumptions are made regarding the impact of cable damage.

e. In addition, portions of Task 11, relating to fire growth and propagation modeling, have not been applied for the same reasons described for Task 8.

f. Task 13 from the FP-FPRA is assumed to be applicable to LPSD FPRA, and therefore, a unique seismic-fire interactions analysis for LPSD was not performed.

19.1.6.3.1.2 Key Assumptions

Key assumptions and engineering judgments used in the LPSD FPRA analysis are as follows (note that references to NUREG-6850 tasks associated with the assumptions are included in some of the entries):

a. PAUs and boundaries from the full-power internal fire PRA (FP-FPRA) will be used. There is no information suggesting fire barriers and associated PAU boundaries will change during LPSD POS. All PAUs in the auxiliary building identified in the FP-FPRA have solid barriers, and none are defined based on separation or partial barriers. Evaluation of the potential for barriers to be breached is evaluated in the MCA (Task 1).

b. The removable walls/floor slabs in the auxiliary building are only removed for major equipment (large pump or motor) replacement; they remain intact at all other times. Major equipment replacement is expected to be performed very infrequently (multiple decade replacement for normal wear). When major equipment replacement is underway that requires opening of the removable barriers, the portion of the evolution where the barriers are removed will be performed during defueled conditions (POS 8). Since fire risk is considered to be negligible during POS 8, and is screened from this analysis, opening of the barriers will have no impact on LPSD fire risk (Task 1).

c. Only LPSD-credited equipment is considered in this analysis. No exceptions were made. LPSD-credited equipment is defined as equipment required for safe shutdown following postulated LPSD fire initiators that has a known location including the location of necessary cables used to operate or maintain the position of the component. Non-credited components are assumed to fail for any fire (Tasks 2 and 3).

d. For the purpose of cable selection, components are assumed to be in their normal position or condition at the onset of the fire. In cases where the status of a component is indeterminate or could change as a result of plant conditions, worst-case initial conditions are assumed (Tasks 3 and 9).

e. The plant is designed with properly sized and coordinated electrical protective devices (i.e., fuses, molded case circuit breakers, and load center breakers with solid state trip units) that function in accordance with their design tripping characteristics, thereby preventing loss of a common power supply or initiation of secondary fires through circuit faults created by the initiating fire (Tasks 3 and 9).

f. Fire damage to 3-phase power cables is assumed to fail the equipment, if operating, or prevent the start of standby equipment; however, spurious operation is not considered, since it would require a 3-phase proper polarity hot short (Tasks 3 and 9).

g. Since detailed circuit analysis was not performed, fire damage to control cables is assumed to result in the worst-case failure mode for the affected component (Tasks 3 and 9).

h. Fire damage to fiber-optic cables is assumed not to cause spurious operations, or prevent normally operating equipment from continuing to operate. However, since detailed circuit analysis was not performed, any fire damage to fiber-optic cables is assumed to result in failure to operate the associated component (i.e., fire damage prevents operation of the component control circuitry) (Tasks 3 and 9).

i. If the power cables of a component are located in the same area as the cable identified as potentially causing a spurious operation, it is assumed that the spurious operation will occur before power is lost if the impact of the spurious operation is more severe than the impact of failure to operate (Tasks 3 and 9).

j. Beneficial failures are not credited; spurious actuations resulting in placing components in their desired condition (e.g., pump running, isolation valve closed, etc.) are not modeled (Task 5).

k. Any fire in any fire compartment included in this analysis is at least sufficient to result in a potential LPSD initiator based on the equipment and cables located in the fire compartment. The fire itself is the initiating event; however, “conditional” initiators (e.g., fire-induced loss of shutdown cooling) are identified and analyzed for each fire scenario. The resultant accident sequence progression is the same regardless of whether the event starts due to random occurrences or it is fire-induced. Since the fire does not change the progression of the accident, the internal events event trees can be used for fire accident sequence progression (Task 5).

l. Fire-induced direct equipment failure is assumed to be non-recoverable within the time frame of the analysis. Fire-induced direct equipment failure refers to components directly impacted by a fire's sphere of influence. Credit for recovery by other means is acceptable, if possible. For example, manual opening of an alternative undamaged path may be used as a recovery for a fire-induced direct valve failure closed (Task 5).

m. Fire-induced indirect equipment failure is assumed to be recoverable under certain conditions. Fire-induced indirect equipment failure refers to components that are failed due to cable failures. If the component can be manually operated, then a recovery may be considered. Each spurious operation must be evaluated individually to determine the impact on the component (Task 5).

n. Mechanical equipment that does not require a power source (such as manual valves, check valves, mechanical relief valves, safety valves, vacuum breakers, tanks, and pipes) are assumed not to be impacted by the fire. However, stuck-open relief valves following spurious pump operation is considered credible (Task 5).

o. POS 1, 2, 14, and 15 are screened from the LPSD FPRA. These POS are considered to be subsumed by the FP-FPRA, and given the fraction of time in these POS results in LPSD fire CDF < 1 percent of full-power fire CDF. In addition, the applicable fire initiators are a subset of the full-power fire initiators, further reducing the impact from this POS (Task 5).

p. From the internal events LPSD model, POS 12B was screened based on thermal-hydraulic analysis, which shows that the time to core damage is greater than 24 hours after a loss of shutdown cooling (due to the low decay heat and high water level during this POS). Similarly, POS 7 and 9 are screened as the cavity is flooded and the anticipated time to core damage is greater than 24 hours. In a fire scenario, the potential for spurious flow diversion exists. However, based on the high water levels in the RCS in POS 12, the cavity in POS 7 and 9, and the flow limitations in the letdown line (2 in line with flow restrictions under low pressures), the draindown times would be expected to be very long (several hours), providing the operators adequate time to identify and isolate the leak prior to any potential damage (Task 5).

q. Consistent with the internal events LPSD model, POS 8 is screened as there is no fuel in the core (Task 5).

r. The S1 initiator (recoverable loss of shutdown cooling system) is screened from the LPSD FPRA model. Fire-induced failure of the shutdown cooling system is assumed to result in an unrecoverable loss of shutdown cooling (S2); fire damage resulting in a loss of the operating shutdown cooling train is modeled as an S2 event (Task 5).

s. Consistent with assumption n), large, medium, and small LOCAs from pipe breaks are screened out of the LPSD FPRA model as it is assumed that fire damage cannot result in pipe break failures. Similarly, fire-induced SGTR is screened as it is assumed to be non-credible (Task 5).

t. The PL initiator (POSRV fails to reclose) is screened from the LPSD FPRA model, since the POSRV cables are protected in such a way that a fire-induced spurious open signal is not possible, and the random initiator is already modeled in the internal events LPSD model (Task 5).

u. Since the only impact on the LPSD model of a loss an SX (essential service water) system train is the loss of the corresponding CC (component cooling water) system train, initiator ES (partial loss of essential service water) is subsumed in initiator CC (partial loss of component cooling). Fires that result in failure of the running SX or CC train result in the partial loss of component cooling initiating event (Task 5).

v. Initiators TC and TS (total loss of component cooling and total loss of essential service water) were screened from the LPSD FPRA; it was determined that there were no credible fire scenarios that could cause these initiators (Task 5).

w. There were no fire scenarios identified that failed offsite power and all four EDGs; hence, there is no fire-induced station blackout (SBO). A combination of fire-induced and random failures can result in an event that is similar to an SBO; these scenarios are captured in the loss of offsite power (LP) initiator (Task 5).

x. The internal events LPSD model used an assumed shutdown schedule that stipulated which trains are operating, and which are in standby (and potentially out of service for testing and/or maintenance) for each POS. The LPSD FPRA uses this same schedule (Task 5).

y. Since the APR1400 is in the design phase, the generic fire frequencies from Table 2 of NUREG/CR-7114 (Reference 52) are applicable (Task 6).

z. Table 2 of NUREG/CR-7114 does not consider the updated classification of Bins 15 and 16 into Bins 15.1, 15.2, 16.1, and 16.2 as described in EPRI TR-1016735 (Reference 43) (also see NUREG/CR-6850, Supplement 1, Reference 41). However, Table 1 of NUREG/CR-7114 states that these bins are not unique to LPSD, implying that the full-power and LPSD frequencies are identical. This is supported by the fact that the original NUREG/CR-6850 and NUREG/CR-7114 both have 4.5×10^{-2} for bin 15 and 1.5×10^{-3} for bin 16. This implies that there is no significant difference in the frequencies between online and LPSD for these bins. It is assumed that the values for bins 15.1, 15.2, 16.1, and 16.2 from full power are applicable to LPSD (Task 6).

aa. The ignition sources identified in the FP-FPRA are not dependent upon the operating mode; hence, no ignition sources were added or removed for the LPSD FPRA (Task 6).

bb. The impacts of increased and redistributed transient initiators during LPSD are incorporated into the LPSD FPRA in two ways. The increase in frequency is incorporated directly via the use of the NUREG/CR-7114 generic data. The redistribution of transients is incorporated via adjustment of transient influencing factors. Since the transient influencing factors will be unique during each outage, the impact and location of increased transient influencing factors is estimated, and assumed applicable to an "average outage." The transient influencing factors were increased in the reactor containment, containment spray HX room, spent fuel pool cooling HX rooms, CVCS access areas, the 55 ft elevation pipe chase and valve rooms, hot tool crib, and the general access areas on all major plant elevations (Task 6).

cc. All potential spurious operations are conservatively assumed to occur with a probability of 1.0 (Task 10).

dd. It is assumed that APR1400 automatic suppression systems are designed in such way that, if successfully activated, they will extinguish the fire prior to additional damage beyond the ignition source itself. Hence, if the ignition source is not a fire PRA-credited component that can cause a fire-induced LPSD initiating event, successful operation of the automatic suppression system will not result in a fire-induced LPSD initiating event, and there is no impact to LPSD fire risk. If the ignition source is a PRA-credited component that can cause a fire-induced LPSD initiating event and the automatic suppression system successfully operates, the fire-induced initiator will be dependent upon the ignition source. Note that automatic suppression is only credited in F000-TB; based on inspection of the equipment and cables in this compartment, the only potential LPSD fire-induced initiating event is loss of offsite power (LP). Therefore, fires that could potentially damage the offsite power cables in F000-TB that are successfully suppressed are assumed to have no LPSD fire risk impact; non-suppressed fires are assumed to result in an LP event (Task 11 – SCA).

ee. Cable tray drawings in the turbine building were not available during the LPSD FPRA; however, based on the reference plant, the offsite power cables are assumed to be routed along the east wall of the turbine building (i.e., wall between the turbine building and the auxiliary building). Due to the geometry of the main turbine building fire compartment, F000-TB, which consists of a large open building with areas of open grid deck plate, and numerous roof vents, it is assumed that most fires do not result in the formation of a hot gas layer, and therefore, fire damage to offsite power cables must result from being in the flame or plume, or from radiative damage. It is assumed that any fire within 30 ft of the east wall of the turbine building has the potential to damage the offsite power cables. In addition, turbine/generator exciter or hydrogen fires classified as “catastrophic” in Appendix O of NUREG/CR-6850, turbine/generator oil fires classified as “severe” or “catastrophic” in Appendix O of NUREG/CR-6850, and miscellaneous hydrogen fires are all assumed to result in an LP event (Task 11 – SCA).

ff. Even though the main turbine building areas will likely be continuously populated during most LPSD POS, manual suppression of fires in F000-TB is only considered for fires caused by welding and cutting operations, since it is assumed that these activities will require a fire watch. All suppression timing is based on 10-minute curves from Table 14-1 of NUREC/CR-6850, Supplement 1. The probability of non-suppression for welding fires within 10 minutes is 0.153 (Task 11 – SCA).

gg. The ignition sources within the MCR remain the same as those in the FP-FPRA; however, the frequency or fires and the distribution of transient fires are as defined in Task 6 of the LPSD FPRA (Task 11 – MCR).

hh. All assumptions related to the FP-FPRA MCR evacuation analysis are assumed to be applicable to the LPSD MCR evacuation analysis. All suppression timing is based on Table 14-1 of NUREC/CR-6850, Supplement 1. The probability of non-suppression for MCR fires within 10 minutes is 0.036 and within 8 minutes is 0.070 (Task 11 – MCR).

ii. The failure of alternate shutdown (ASD) (i.e., CCDP for alternate shutdown scenarios) following fire-induced MCR evacuation is assumed to be either 0.1 or 0.5 depending upon the timing available for subsequent ex-MCR operator actions. (Task 11 – MCR).

jj. Due to the size of the containment building, F000-C01, any hot gas layer formed would be near the top of the dome. This is true regardless of whether the fire originated within containment or entered containment via a failed barrier from the auxiliary building. The top of the dome is well over 45.7 m (150 ft) above the highest cable tray in containment and the highest penetrations to the auxiliary building. Any hot gas layer formation in the containment would not be located where it is credible to assume: 1) damage to cables within containment, and 2) spread into the auxiliary building. Therefore, potential fire spread scenarios from or to F000-C01 are not considered credible (Task 11 – MCA).

kk. The main turbine building fire compartment (F000-TB) is large, and has a large amount of roof ventilation, so the formation of hot gas layers is not considered credible. Furthermore, equipment with large sources of lube oil has adequate curbing to prevent the spread of oil, and therefore limit the spread of oil fires. Therefore, fire spread to adjacent fire compartments from the turbine building is not considered credible. Hot gases entering the turbine building from an adjacent fire compartment via a failed barrier will be directed upwards and out the numerous roof vents; hence, fire spread to F000-TB is not considered credible (Task 11 – MCA).

ll. All fire doors identified in the fire protection boundary drawings are assumed to be closed during normal operation. Failure of the doors (and other fire barriers) is modeled during the multi-compartment analysis (Task 11 – MCA).

mm. When not in use, fire doors and dampers are expected to be in their closed, or otherwise operable, positions. This is consistent with normal power operations; hence, there is no impact on the barrier failure probabilities due to general LPSD conditions. During maintenance, fire doors and dampers may be propped open to facilitate the passage of temporary hoses for air, water, etc., or temporary power lines. It is assumed that the fire barrier management procedures used during LPSD will include directions to provide reasonable assurance that breached risk-significant fire barriers can be closed in sufficient time to prevent the spread of fire across the barrier. These directions will include the use of a fire watch whose duties are commensurate with the risk associated with the barrier. Since it is expected that fire barriers will be treated in a similar manner during online conditions, it is assumed that the barrier failure probabilities used in the FP-PRA are sufficient to model barrier failures during LPSD conditions (Task 11 – MCA).

nn. Piping and cable penetrations may be breached for maintenance/replacement; however, this can occur both during online and LPSD conditions. During the breach of these barriers, it is assumed that the fire barrier management procedures will provide reasonable assurance that a fire watch is designated both during online or LPSD conditions. Therefore, it is assumed that the failure probabilities used for cable or piping penetrations for the FP-PRA are applicable to the LPSD POS (Task 11 – MCA).

oo. It is assumed that, for all fires, there is damage to at least some of the instrumentation necessary for operator cues in diagnosing plant conditions; however, this damage is limited to the division in which the fire occurred, and it is assumed that the operators will be trained to rely on undamaged instrumentation once the location of the fire is known. The potential for uncleared hot shorts impacting operator diagnosis is modeled. The probability for uncleared hot shorts is derived from Table 6-3 of NUREG/CR-7150, Volume 2 (Reference 53) (Task 12).

19.1.6.3.1.3 Analysis Details

For Task 1, plant boundary and partitioning, the PAUs and boundaries from the FP-FPRA are used in the LPSD FPRA as they encompass all LPSD equipment, and contain all fire hazards that may induce a LPSD initiating event. A total of 391 fire compartments have been identified (Table 19.1-45).

Task 2, component selection, identifies the components to be included in the LPSD FPRA. Components are selected based on a review of the FP-FPRA, and the internal events LPSD PRA. This task is performed by comparing the internal events LPSD model and the FP-FPRA model to identify any equipment unique to LPSD that must be added to the fire equipment list, and have its cables identified and routed. In addition, any equipment identified in Task 5 during the development of systemic initiator fault trees is added to the fire equipment list.

For Tasks 3 and 9, cable selection and circuit analysis, cables and routing for the LPSD unique equipment identified in Task 2 have been added to the LPSD FPRA model. This includes determining the appropriate failure modes for each cable, selecting the appropriate basic events associated with the failure modes, and editing the PRA model input files to provide reasonable assurance that the associated basic events are failed. Conservative assumptions regarding the assignment of equipment failures based on cable damage are described in Subsection 19.1.6.3.1.2.

For Task 5, fire-induced risk model, the initiating events and system models from the LPSD internal events model are examined for applicability to fire events, and amended as required to include fire-induced initiators, fire-specific accident sequences, fire-induced failures and failure modes, as well as fire-impacted operator actions.

A review of potential LPSD initiators from the internal events LPSD PRA, as well as fire unique impacts, was performed to identify those potential initiators that could be induced via fire damage. Based on that review, eight potential fire-induced initiators are identified:

S2 – Unrecoverable loss of the operating shutdown cooling train

SL – Loss of level control (POS 5 and 11 only)

SO – Overdrain events (POS 5 and 11 only)

JL – CVCS letdown line diversion LOCA

CC – Loss of operating component cooling train

KV – Loss of 4 kV bus on operating shutdown cooling train

LP – Loss of offsite power impacting operating shutdown cooling train

AS – Fire-induced main control room evacuation (alternate shutdown)

LPSD initiator fault tree models have been created for all systemic initiators, and any new equipment added to support these initiator fault trees has been included in Task 2. The flag files used during quantification to fail fire-damaged equipment in each fire compartment were updated to include any new equipment identified in Task 2 (included events added for LPSD initiator fault tree models), and any new cables added in Task 3.

During the development of the systemic initiator fault trees, it was identified that the spurious operations that could cause an SL event are the same that could cause an SO event. These two initiators are only applicable to POS 5 and 11, and are functionally the same initiator for fire scenarios since: 1) the flow diversion pathway is the same, 2) the mitigation scheme is identical, and 3) operator action timing is the same. For this analysis, the SL event is used to represent these failures.

Based on the potential for equipment damage in each fire compartment, a list of potential fire-induced initiating events in each fire compartment has been developed. For each fire compartment, a single initiator is chosen based on the most likely fire, or engineering judgment. If there is the potential for more than one fire-induced initiator solely due to fire damage, engineering judgment is used to determine the representative initiator. A hierarchy was established wherein perceived worst-case initiators were given preference over lesser initiators. The hierarchy used is:

AS > SL > LP > KV > S2 or CC > JL

Note that AS is only applicable to fires involving the MCR and SL is only applicable to POS 5 and 11. Also, note that S2 and CC are functionally equivalent, since CC's only modeled function during LPSD is cooling the shutdown cooling heat exchangers, and direct fire-induced loss of shutdown cooling is functionally the same as fire-induced loss of CC (or SX).

Task 6, fire ignition frequency development, was accomplished in a two-step process. Step 1 involved updating the fire ignition frequency spreadsheet used in the FP-FPRA with the LPSD generic frequencies from Table 2 of NUREG/CR-7114. Step 2 involved updating the maintenance, occupancy, and storage transient fire influencing factors, using engineering judgment to identify fire compartments where these influencing factors will likely increase during the outage. The result of these two steps is a recalculation of the fire compartment initiating event frequencies for LPSD conditions. All assumptions or deviations from the NUREG/CR-6850 methodology for determining fire ignition frequencies taken in the FP-FPRA (see Subsection 19.1.5.2.1.3) are assumed applicable to the LPSD FPRA.

Task 7 screens fire compartments from further detailed analysis. Risk-significant fire compartments have been identified by inspection of preliminary CDF calculations, and resulted in the main turbine building area, fire compartment F000-TB, being the only fire compartment chosen for detailed analysis. Note that the MCR, fire compartment F157-AMCR analysis is performed in accordance with the NUREG/CR-6850, Task 11 methodology.

The Task 10 failure mode likelihood analysis conservatively sets all potential spurious operations have assumed to occur.

Task 8 fire scoping modeling and Task 11 detailed fire modeling have not been performed due to lack of sufficient data related to the relational location of the ignition sources and their targets (including intervening combustibles). Therefore, for single-compartment fire analyses, all unsuppressed fires are assumed to propagate throughout the entire compartment (damaging all PRA-credited equipment within the compartment). For multi-compartment scenarios, in addition to propagating throughout the exposing compartment (i.e., compartment in which the fire initiated), fire spread is assumed to propagate through barriers at the probabilities associated with the respective barriers under consideration. Generic barrier failure probabilities from NUREG/CR-6850 were used to calculate barrier failure probabilities between adjacent compartments.

The Task 11 detailed analysis credited the following:

a. Installed automatic fire suppression systems in F000-TB

b. Manual suppression for continuously occupied areas (MCR only)

c. Welding and cutting fires (due to the assumed presence of a fire watch during these activities in F000-TB and the MCR)

No credit for either automatic or manual suppression was taken for any other fire compartment in the LPSD FPRA at this time.

In F000-TB, automatic suppression is only credited in locations and elevations where it exists, and can be applicable to both fixed and transient ignition sources. Since the only potential LPSD fire-induced initiator is loss of offsite power due to the potential for fire damage to offsite power cables, any fixed or transient fires suppressed by an automatic suppression system are assumed to result in only local damage, but no CDF impact (i.e., the offsite power cables are not damaged, and there is no initiating event). Generic failure probabilities for automatic suppression systems, including the impact of automatic detection, if required, are derived from NUREG/CR-6850 (also see Key Assumption dd) in Subsection 19.1.6.3.1.2).

Prompt manual suppression in F000-TB is only credited for hotwork fires (i.e., either transient fires due to welding or cutting operations, or cable fires due to welding or cutting operations). From NUREG/CR-6850, Supplement 1, fire growth for transients assumes a t2 growth reaching the peak heat release rate (HRR) at 8 minutes for common trash can fires to as low as 2 minutes for other common types of plant trash (paper, plastics, and other solid materials) that are contained in plastic trash bags but that are not contained within a plastic or metal receptacle. It is assumed that any of the fire compartments may contain either type (with the possible exception of the MCR, where transient combustibles are likely in the form of trash in a receptacle).

However, for the case of hot-work fires, there is at least one person (the person doing the hotwork), and usually a second person (a fire watch) at the fire scene at the start of the fire. Therefore, it is very likely that the fire will be detected in its incipient stage (which is prior to the fire growth stage). There is no industry guidance on the duration of the incipient stage; therefore, a reasonable total time of 10 minutes for the manual detection and extinguishment of hotwork fires prior to any damage to fire PRA-credited equipment and cables is assumed (5 minutes for the incipient fire stage and 5 minutes for the fire growth stage).

As with auto-suppression systems, prompt manually suppressed hotwork fires in F000-TB are assumed to result in only local damage. The basis for this assumption is the likelihood of manual detection of the fire during its incipient stage; it is unlikely to burn for a sufficient duration and HRR to damage nearby targets. Furthermore, during hotwork, any nearby equipment or transient combustibles are likely protected by welding blankets or other heat shielding.

In the MCR, a prompt manual suppression time of 10 minutes is allowed for fixed sources. All fixed sources in the MCR are electrical cabinets. Appendix G of NUREG/CR-6850 provides guidance for the HRR growth of electrical cabinet fires and this guidance was followed in the analysis.

Additionally in the MCR, prompt manual suppression of transient fires is credited if the fire can be extinguished in 8 minutes. The 8-minute time frame was chosen based on the time for a common trash can fire to reach its peak HRR.

Earlier testing on the effects of fires in enclosed rooms has determined that the most significant impact on the test enclosure is dense smoke that, in all cases, resulted in total obscuration within 6 to 15 minutes of fire ignition in NUREG/CR-4527 (Reference 44). The size of the test enclosure in that study is about 55 percent of the volume of the APR1400 MCR volume. A larger volume would result in longer obscuration times, so the abandonment times of 8 and 10 minutes fall well within the range of this specific set of experiments, and are considered reasonable average abandonment times. Manual suppression probabilities for these MCR fires were derived from Chapter 14 of NUREG-CR/6850, Supplement 1 using suppression times of 8 and 10 minutes.

Turbine generator (T/G) fires, including excitor, hydrogen, and oil fires, were evaluated in accordance with Appendix O of NUREG/CR-6850.

Multiple compartment analysis (MCA) considers the potential for fire propagation from one fire compartment to an adjacent compartment via a failed fire barrier. Screening was performed to eliminate non-minimal MCA scenarios or scenarios deemed unlikely to occur due to lack of a credible fire spreading mechanism. Potential MCA compartments were screened if:

a. The exposed compartment has no PRA-credited equipment, since the resulting cutsets will be non-minimal to the exposing single-compartment scenario, or

b. When the exposing compartment is at a higher elevation than the exposed compartment, and there are no doors, dampers, or penetration seals in the barrier between the two compartments, and there are no oil fires in the exposing compartment since the potential for the hot gas layer descending below the fire source through a solid rated fire barrier is considered incredible. Note that oil fires are explicitly excluded in this screening process, since the potential to spread the fire via draindown to the lower elevation compartment is potentially credible and cannot be excluded without further detailed analysis.

c. In addition, potential scenarios involving either the main turbine building (fire compartment F000-TB) or the containment building (fire compartment F000-C01) were screened due to the size and geometry of the compartment, which preclude the formation of a hot gas layer or oil fire spread (see Key Assumptions in Subsection 19.1.6.3.1.2).

The potential for failure of barriers was evaluated in accordance with the methodology in NUREC/CR-6850, and considering Key Assumptions in Subsection 19.1.6.3.1.2). Risk-significant barriers can be identified by reviewing the importance analysis for the basic events associated with the barrier failures. Specifically, the RAW value of the barrier failure basic event enumerates the risk impact of the failed barrier, and helps identify which barriers are important to fire risk.

The LPSD Fire Level 2 analysis follows a similar approach as described for the LPSD internal events (Subsection 19.1.6.4.1), with some differences noted here. POS 1-4A and 13-15 are treated similar to the internal events LPSD Level 2.

For POS 4B-12A, as for the internal events LPSD Level 2, the single-compartment Level 1 fire scenarios are evaluated in detail for contribution to LRF. The only exception is the

MCR fires. For these scenarios, consistent with the at-power fire PRA, a CPLR of 0.1 is applied to the CDF to determine LRF.

For the MCA, low CDF scenarios are not evaluated in detail. There are over 6,000 MCA scenarios developed in the LPSD Level 1 fire analysis, with a total CDF of $6.2x10^{-8}$/year. However, only 67 of these have a CDF of $1x10^{-10}$/year or greater, with a combined CDF of $5.1x10^{-8}$/year. Of these, 22 are scenarios that occur in POS 3A, 3B, or 13, and one is an MCR scenario. Therefore, of the greater than 6,000 MCA scenarios, a detailed LRF is only performed on the 44 non-MCR scenarios (combined CDF of $3.3x10^{-8}$/year) that are in POS 4B-12A and have a CDF greater than $1x10^{-10}$/year. The remaining greater than 6,000 MCA sequences have a combined CDF of $1.1x10^{-8}$/year. These are conservatively assigned a CPLR of 1.0 and not evaluated in detail.

19.1.6.3.2 Results from Internal Fire PRA for Low Power and Shutdown Operations

The LPSD fire risk evaluation was performed using the LPSD FPRA model described in Subsection 19.1.6.3.1. Quantification of the CAFTA (Reference 51) top logic fault tree was performed using the FTREX (Reference 25) quantification engine.

It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

The LPSD fire CDF for the APR1400 is as follows:

Total LPSD fire CDF:	1.7×10^{-6}/year
Single-compartment fire CDF:	1.5×10^{-6}/year
Multi-compartment fire CDF:	2.3×10^{-7}/year

Table 19.1-119 contains a complete listing of the LPSD fire CDF contribution for each POS.

The LPSD FPRA CDF for reduced inventory POS (i.e., POS 5 and 11) is 8.2×10^{-7}/year or about 47 percent of the total CDF.

The LPSD fire LRF for the APR1400 is as follows:

Total LPSD fire LRF:	1.3×10^{-7}/year
Single-compartment fire LRF:	1.2×10^{-7}/year
Multi-compartment fire LRF:	8.0×10^{-9}/year

Table 19.1-148 contains a complete listing of the LPSD FPRA LRF contribution for each POS.

The LPSD FPRA LRF for reduced inventory POS (i.e., POS 5 and 11) is 2.4×10^{-8}/year or approximately 19 percent of the total LRF.

19.1.6.3.2.1 LPSD Fire-Induced Initiators

Table 19.1-120 shows the CDF and CDF percent contribution of the fire-induced initiators ranked highest to lowest when all modeled POS are considered. Table 19.1-121 shows the same information when only reduced inventory POS are considered.

Tables 19.1-153 and 19.1-154 present the initiator rankings by LRF for all POS and the reduced inventory POS, respectively.

Review of these results reveals that with the exception of "C" and "D" EDG rooms, and some general access areas, the LPSD fire CDF risk is well distributed. This demonstrates the effectiveness of the highly compartmentalized nature of the APR1400 auxiliary building wherein most fires will result in damage to only a few components.

19.1.6.3.2.2 LPSD Fire Scenarios

The top 100 LPSD FPRA CDF cutsets are presented in Table 19.1-122. Table 19.1-149 presents the same for the LRF cutsets.

The most striking feature of these cutsets is that they are dominated by operator action. Within the top 100 cutsets, most contain only operator action failures, and very few contain random equipment failures. This result is reasonable, since there are no automatic safety system actuations, and therefore, each mitigation strategy employed for each fire-induced initiator requires operator actions. Top cutsets are dominated by reduced inventory POS 5.

This result is expected due to the low water levels, and relatively high decay heat levels during this POS, which lead to short operator action times.

Other high contribution cutsets involve other POS that have short operator action times including POS 4B, 6, 10, and 12A.

Table 19.1-123 presents the top 100 LPSD FPRA CDF cutsets when only the reduced inventory POS (5 and 11) are considered. Table 19.1-152 presents the same for the LRF cutsets.

19.1.6.3.2.3 Importance Analysis

The high importance equipment basic events for LPSD CDF, sorted by RAW, are presented in Table 19.1-124 for all POS, and Table 19.1-125 for reduced inventory POS. Tables 19.1-153 and 19.1-154 present the rankings for LRF.

The RAW importance ranking mainly demonstrates that maintaining the availability of highly reliable equipment is important. However, one key item to note is that of the many fire barriers modeled in the MCA, only two fire barriers resulted in a RAW of greater than 2; the fire barrier between F120-AGAC and F120-AGAD, which has a RAW of approximately 15, and the fire barrier between F078-AGAC and F078-AGAD, which has a RAW of approximately 8. These high RAW values signify the importance of maintaining the operability of these two fire barriers during LPSD conditions. The RAW of these two fire barriers actually decreases when only reduced inventory scenarios are considered. This implies that the impact of these fire barriers is significant with respect to all POS, and are not only significant with respect to reduced inventory POS.

The high importance equipment basic events for LPSD CDF (as defined by FV) are presented in Table 19.1-126 for all POS, and Table 19.1-127 for reduced inventory POS. Tables 19.1-155 and 19.1-156 present the rankings by LRF.

Due to the relative importance of operator actions, there are very few components that contribute to LPSD fire CDF with any significance. The barriers between F078-AGAC and F078-AGAD, and between F120-AGAC and F120-AGAD, contribute approximately 7 percent and 2 percent, respectively; the AAC contributes approximately 3 percent, and EDG A and B contribute about 2 percent and 1 percent, respectively.

The high importance CCF events for LPSD CDF sorted by RAW and FV are presented in Table 19.1-128 and Table 19.1-129, respectively. Tables 19.1-157 and 19.1-158 present the rankings by LRF.

The dominant CCF RAW values all fail feed and bleed by failing the safety injection system. Feed and bleed is used a recovery strategy for fire scenarios that results in the failure of the preferred shutdown cooling method. Furthermore, review of the CCF FV values indicates that like the single equipment failures, individual CCFs have little impact on CDF and none contributes more than 0.2 percent.

The high importance human actions for LPSD CDF sorted by RAW and FV are presented in Table 19.1-130 and Table 19.1-131, respectively. Tables 19.1-159 and 19.1-160 present the rankings by LRF.

When sorted by RAW, nine of the top ten operator actions involve feed and bleed during different POS to mitigate different fire-induced initiators. These nine operator actions all involve reduced inventory POS, or other POS with short time to boil upon loss of shutdown cooling, with the top three involving POS 5. Due to the short "time to boil" in the reduced inventory POS, the likelihood of successfully re-establishing the opposite train of shutdown cooling is very small; the relatively long duration feed and bleed operator actions are significant with respect to preventing core damage.

Conversely, when reviewing the FV importance of operator actions, in addition to the feed and bleed actions, the operator action to restore the opposite shutdown cooling train are identified as important.

The LPSD FPRA LRF frequency by source term category is presented in Table 19.1-163.

19.1.6.3.2.4 Uncertainty and Sensitivity Analyses

The LPSD fire PRA was performed in a conservative manner. No credit was taken for the various automatic fire protection systems in the auxiliary or EDG buildings (see Subsection

19.1.6.3.1.2). In addition, as described in Subsection 19.1.6.4.1.3, conservative assumptions are made regarding the impact of cable damage. The results of the LPSD fire PRA show that fire events pose a low risk during shutdown operations.

Insights with respect to the importance analysis are described in the importance section (Subsection 19.1.6.3.2.3).

The parametric uncertainty results for Level 1 internal fire CDF during LPSD are summarized below:

5 percent value: 8.7×10^{-7}/year

Mean value: 1.7×10^{-6}/year

95 percent value: 3.6×10^{-6}/year

The parametric uncertainty results for Level 2 internal fire LRF during LPSD are summarized below:

LPSD Fire Events LRF Uncertainty Analysis

5 percent value: 2.5×10^{-8}/year

Mean value: 7.1×10^{-8}/year

95 percent value: 1.7×10^{-7}/year

Parametric uncertainty was represented by selecting an uncertainty distribution for each parameter type. Modeling uncertainty was not represented in the shutdown model.

19.1.6.3.2.5 Risk Insights

The APR1400 design features that promote reduced LPSD fire risk are as follows:

a. The design has two divisions, each consisting of two trains of safety systems. Each division is segregated with physical fire barriers, protecting the safety function of safety systems from fires impacting the opposite division. No fires were identified that can fail both divisions of safety equipment without the conditional failure of a fire barrier.

b. The design has a highly compartmentalized auxiliary building comprising many fire areas with 3-hour fire rating barriers; this minimizes the impact from any single fire in the auxiliary building. This design feature tends to compartmentalize fires, and significantly decreases the impact from multi-compartment fires.

c. The design uses fiber-optic cables between the MCR safety console, the group controllers, and loop controllers, thereby minimizing the impact from fire-induced spurious hot shorts.

d. The alternate ac (AAC) power source is a non-Class 1E power source that can be used as a common ac source to cope with SBO scenarios. This standby gas turbine generator unit is independent and diverse from the Class 1E standby EDGs. The presence of this alternative onsite power source reduces the contribution from loss of offsite power and station blackout scenarios.

e. The control cables inside the containment that could lead to loss of the operating shutdown cooling train are routed in individual conduits so that containment fires do not result in spurious operation of these valves, thereby eliminating the potential for the fire-induced initiator.

f. During plant shutdown operation, the integrity of fire and flood barriers between areas in the same division, such as quadrants where systems making up the alternate shutdown capability are located should be maintained. A configuration control program should require that, during Modes 4, 5, and 6, the watertight flood doors and fire doors be maintained closed in at least one quadrant (containing either an SC or CS pump) to help prevent common mode failures from internal floods or fires. The SC or CS pump in this quadrant shall be operable. If the flood or fire doors to this quadrant must be opened for reasons other than normal ingress/egress, a flood/fire watch should be established for the affected door.

The LPSD FPRA was used to identify potential design features and plant operational vulnerabilities, where a small number of failures could lead to core damage. In addition to the cables identified during the at-power FPRA, several additional cables have been identified during the LPSD FPRA as requiring fire protection features to prevent damage or spurious operation of related components.

19.1.6.4 Internal Flooding PRA for Low Power and Shutdown Operations

19.1.6.4.1 Description of Internal Flooding PRA for Low Power and Shutdown Operations

19.1.6.4.1.1 Methodology

The low power and shutdown (LPSD) flooding analysis evaluates the risk due to internal flooding with the shutdown cooling system (SCS) in service as the front-line system for decay heat removal. Therefore, the only LPSD initiating event considered for the application of flooding initiators is a failure of the running train of shutdown cooling system.

Plant Operating States 1 and 15 (low power and hot subcritical operation), and States 2 and 14 (cooldown/heatup with secondary steam in service), are screened from further consideration. The basis for their screening is the fact that the SCS is not in service, and also that these POS have relatively short durations.

The LPSD risk analysis assumes that the flood-induced failure of the running SC pump is unrecoverable. If possible, it evaluates whether the standby train can be used to restore the shutdown cooling function. If this function remains unavailable, the operators will attempt to establish decay heat removal via feed and bleed.

In POS 3A (cooldown from 350 °F to 212 °F), decay heat remains relatively high and the analysis credits the availability of containment cooling (CC). In all subsequent POS, decay heat is assumed to be sufficiently low that a failure of containment cooling would pose no challenge to fuel integrity.

The analysis specifically included the list of equipment that is expected to be unavailable, due to maintenance or testing, in each POS.

19.1.6.4.1.2 Initiating Events

The at-power flood analysis was reviewed to identify all floods that can submerge either of the SC pumps or their power supplies. In some cases, floods are identified that could submerge both pumps.

The flooding initiating events are verified to determine that the representative flow rates from the at-power model remained applicable for LPSD analysis. When necessary, some flow rates are adjusted (e.g., by expanding to include a wider range of potential flow rates). In addition, very low flood flow rates in the SC pump rooms are considered, in order to include potential spray vulnerability for the pump motors.

The volume of water necessary to cause submergence failure of the SC pumps was calculated and found to be different than the volume of water required to cause a reactor trip during power operations. This submergence volume is used to screen flooding sources that contained insufficient volume to damage the SC pumps. Additionally, this new volume is used to calculate a minimum flow rate required to result in submergence failure of the SC pumps within a time period in which the operators are expected to always be able to successfully isolate the break. A number of initiators are requantified using this new minimum flow rate.

Ruptures of the heat sinks for the SCS (component cooling and service water) are subsumed into general failures of the SCS and are not reanalyzed. Some CC system ruptures are retained because they could potentially fail a power supply and thus posed a broader threat than the loss of an SC train.

19.1.6.4.1.3 Accident Sequence

The AS development for LPSD flooding uses the loss of shutdown cooling sequences in the LPSD internal events analysis. While there are many initiating events (i.e., many floods that can fail one or both trains of SC), each unique IE use the same, basic loss of shutdown cooling (LOSC) event tree for the subsequent accident analysis.

Since the initiating events are failures of the running train of shutdown cooling, the sequences include the same potential recovery actions. First, the operators would attempt to recover the SCS via the standby train, if it is available. If this action is not successful, the operators must proceed to feed and bleed cooling.

19.1.6.4.1.4 Success Criteria

No changes to the success criteria are made for the internal flooding analysis, relative to the LPSD internal events PRA model. The same criteria for shutdown cooling (including supporting heat sinks), feed and bleed (including supporting heat sinks), and containment cooling are used throughout the evaluation.

19.1.6.4.1.5 Operator Actions

No changes are made to the LPSD internal events human error probabilities (HEPs) for the LPSD flood analysis. The operator actions for isolating LPSD pipe breaks involve similar timing and required similar actions as those operator actions for isolating at-power pipe breaks, so no new HEPs for LPSD are introduced.

19.1.6.4.1.6 Systems Analysis

No new systems are modeled for LPSD flooding, nor are any existing models expanded or revised for the LPSD flood analysis.

19.1.6.4.2 Results from Internal Flooding PRA for Low Power and Shutdown Operations

19.1.6.4.2.1 Risk Metrics

The CDF for LPSD flooding is 1.8×10^{-8}/year. This figure will be approximately two orders of magnitude less than LPSD internal events and internal fire, both of which are in the low 1×10^{-6}/year range for LPSD CDF. The LPSD flooding large release frequency (LRF) is not quantified. As an upper bound, it is assumed to be less than 1.8×10^{-8}/year. It should be noted that units for CDF and LRF are expressed in terms of "reactor calendar year" (shortened to "/year" when displayed in the text in this section).

19.1.6.4.2.2 Initiating Events

The LPSD internal flooding PRA CDF contributions by for all initiating events in all POS is shown in Table 19.1-106 and in the reduced inventory states in Table 19.1-107.

A major fire protection system flood originating in room 78-A44B contributes 72 percent to the LPSD flooding CDF. A large FP flood in room 100-A37B contributes an additional 20 percent. These two initiating events alone contribute 92 percent of the total LPSD flooding CDF. No other LPSD flood initiator contributes more than 2.4 percent. These two major floods both submerge both trains of the SCS, so that there is no option for opposite train recovery. Instead, the operators must go directly to feed and bleed to provide core cooling, which requires manual action for success.

19.1.6.4.2.3 Top Cutsets

Table 19.1-109 and Table 19.1-110 contain the top 100 LPSD internal flooding CDF cutsets for all POS and reduced inventory POS, repectively.

The top five cutsets are due to floods originating in room 78-A44B and make up 45 percent of the total LRF. The top ten cutsets contribute 62 percent and the top 20 contribute 76 percent. These reflect the dominance of the top two floods identified in the initiating events discussion in Subsection 19.1.6.4.2.2.

Since these floods fail both trains of shutdown cooling, the only available accident response is feed and bleed, which is dominated by operator failure. Given the initiating event, the operator failure leads directly to core damage.

The results are similar in the reduced inventory POS.

19.1.6.4.2.4 Importance Analysis

The following tables show the RAW and FV risk metrics for various classes of PRA model basic events in the LPSD internal flooding CDF model.

Table 19.1-111: Basic events sorted by RAW for all POS

Table 19.1-112: Basic events sorted by RAW for reduced inventory POS

Table 19.1-113: Basic events sorted by FV for all POS

Table 19.1-114: Basic events sorted by FV for reduced inventory POS

Table 19.1-115: CCF events sorted by RAW for all POS

Table 19.1-116: CCF events sorted by FV for all POS

Table 19.1-117: Operator actions sorted by RAW for all POS

Table 19.1-118: Operator actions sorted by FV for all POS

The most significant component failures, as measured by their RAW, are failures of the dc buses that provide control power. The next group of components includes various single-train failures of the injection pumps used for feed and bleed, or the valves on the associated injection lines.

There are 15 single failure basic events that contribute 0.5 percent of total plant risk or more, as measured by the FV. Most of these components fail a train of injection that is used in a feed-and-bleed recovery.

Due to the absence of automatic mitigation functions at shutdown, operator action is highly risk significant. Since most risk-significant floods fail both SC pumps, no recovery with the opposite train is possible in those cases; thus, the operators must attempt feed and bleed to restore shutdown cooling. Risk-significant operator actions, as measured by their RAW, are operator failures to perform the feed and bleed evolution in each of the plant operating states. There is a single operator action to implement secondary cooling with auxiliary feedwater, in POS 3A, which is also risk significant. Due to the dominance of floods that fail both trains of shutdown cooling, operator action to recover the SC function with the opposite train is not risk significant.

The list of risk-significant operator actions, as measured by the FV, includes two different events for operator failure to isolate fire protection system ruptures, one in less than 20 minutes and another for isolation between 20-40 minutes.

As expected, CCFs can be significant risk contributors when they occur. More than 50 CCFs have risk achievement worths (RAWs) in excess of 20; these are primarily failures of various valves in the redundant injection lines used for feed and bleed.

Due to their low probability, common cause events are relatively low contributors to average plant risk; there are no CCF events that have an FV value in excess of 0.5 percent.

19.1.6.4.2.5 Sensitivity Analysis

No sensitivity analyses have been performed for LPSD flooding, because its contribution to total LPSD and plant risk is very low.

19.1.6.4.2.6 Uncertainty Analysis

The LPSD flooding CDF is sufficiently low that no uncertainty analysis was performed. Even a relatively large uncertainty band on the ~1×10^{-8}/year frequency would result in a very low upper bound on the shutdown flooding risk.

19.1.6.4.2.7 Risk Insights

The general risk insight from the LPSD flooding analysis is that the APR1400 has been effectively designed to establish flood protection at shutdown. Specific insights are described below:

a. The overall LPSD internal flooding CDF is extremely low. This low frequency may be attributed primarily to the following factors: (1) low initiating event frequencies; (2) effective separation of divisions, for the SC pumps and their power supplies, via flood barriers; and (3) the large emergency overflow lines (EOLs), which serve as high capacity drains.

b. The dominant initiating event is a fire protection flood in room 78-A44B. This flood has a higher frequency than all other floods by approximately an order of magnitude. It also submerges both trains of the SC pumps as well as one power supply. This IE is the dominant risk contributor at 72 percent of the total internal flooding CDF.

c. Fire protection (FP) ruptures contribute over 99 percent of total LPSD flood risk. This is a result of the FP system rupture frequencies being high (with respect to other flooding scenarios) and the potential flooding flow rates also being high.

d. Operator actions are significant contributors to LPSD flooding risk, because there are no automatic actions for any mitigation function. Operator isolation of various FP floods is highly risk significant. Isolation failures with isolation times greater than 20 minutes are also risk significant.

e. Manual feed and bleed failure is also highly risk significant. For example, a feed and bleed failure in POS 10 alone contributes 21 percent of the total LPSD CDF; therefore, almost all POS 10 CDF (22 percent) includes this HEP. The same HEP is also a significant contributor to all other POS.

f. Containment cooling is assumed to remain a requirement in POS 3A (SC cooldown from 350 °F to 212 °F) because decay heat is still relatively high. In all later POS, decay heat is sufficiently low that containment cooling is not "asked" in the LPSD flooding PRA. As a result of this potential failure mode, the risk results from POS 3A are relatively high.

g. During plant shutdown operation, the integrity of fire and flood barriers between areas in the same division, such as quadrants, where systems making up the alternate shutdown capability are located, should be maintained. A configuration control program should require that, during Modes 4, 5, and 6, the watertight flood doors and fire doors be maintained closed on at least one quadrant (containing either an SC or CS pump) to prevent common mode failures from internal floods or fires; the SC or CS pump in this quadrant shall be operable. If the flood or fire doors to this quadrant must be opened for reasons other than normal ingress/egress, a flood/fire watch should be established for the affected door.

19.1.7 PRA-Related Input to Other Programs and Processes

The APR1400 is expected to perform better than current operating plants in the area of severe accident safety performance, since prevention and mitigation of severe accidents, as shown in Table 19.1-2 and Table 19.1-3, have been addressed during the design stage, taking advantage of PRA results and severe accident analysis. The PRA results indicate that the APR1400 design has a low level of risk and meets the CDF, LRF, and containment performance goals for new-generation PWRs.

19.1.7.1 PRA Input to Design Programs and Processes

The APR1400 PRA is an integral part of the design process and has been used to optimize the plant design with respect to safety. The PRA models and results have influenced the selection of design features such as four EDGs and battery depletion time extension.

19.1.7.2 PRA Input to the Maintenance Rule Implementation

PRA input is provided as required to develop the Maintenance Rule, described in Chapter 17, Section 17.6.

The PRA is not used to support Maintenance Rule implementation at the design certification stage. As stated in Subsection 19.1.1.4, the COL applicant is responsible for describing the uses of PRA in support of licensee programs, such as Maintenance Rule implementation, during the operational phase.

19.1.7.3 PRA Input to the Reactor Oversight Process

Ultimately, the site-specific PRA models and results in the COLA phase are used to support elements of the reactor oversight process including the mitigating systems performance index and the significance determination process.

At the design certification stage, the PRA is not used to support the reactor oversight process. As stated in Subsection 19.1.1.4, the COL applicant is responsible for describing the uses of PRA in support of licensee programs such as the reactor oversight process during the operational phase.

19.1.7.4 PRA Input to the Reliability Assurance Program

Risk-significant SSCs are identified for the RAP (Section 17.4). Key risk-significant SSCs are organized by an FV importance greater than 0.005, RAW greater than 2.0 for independent events, and RAW greater than 20 for CCF events in accordance with

NUMARC 93-01 (Reference 49). These thresholds are consistent with NEI 00-04 (Reference 50). In addition, risk-significant information based on the LPSD PRA and external PRA, SSC-related initiating events, and key assumptions are identified. PRA input is provided as required to develop the RAP, described in Subsection 17.4.

The PRA is used to provide input to the RAP. Specifically, the PRA is used to identify SSCs that are potentially risk significant, and therefore should be considered by the RAP expert panel as candidate SSCs under the RAP program. The probabilistic approach to determining SSC risk significance is based on assessment of PRA importance measures. The PRA importance measures do not provide the only insight to SSC risk significance determination. In addition to the PRA importance measures, the expert panel also considers deterministic safety analysis insights and appropriate operating experience when making the final determination of the RAP scope. Refer to Section 17.4 for a description of the Reliability Assurance Program. As stated in Subsection 19.1.1.4, the COL applicant is responsible for describing the uses of PRA in support of licensee programs such as RAP implementation during the operational phase.

19.1.7.5 PRA Input to the Regulatory Treatment of Non-Safety-Related Systems Program

The APR1400 design is an evolutionary ALWR, and the RTNSS is not applicable to this design.

19.1.8 Conclusions and Findings

The APR1400 design has evolved from current PWR technology that incorporates features intended to make the plant safer and easier to operate as compared to currently operating plants. The PRA results and risk insghts should confirm that the design incorporates features to reduce overall risk compared to operating plants. The phrase “risk insights” refers to the results and findings that come from PRA. Specifically, risk insights include information about:

a. Design features that are the highly effective in reducing risk with respect to operating plants

b. Major contributors to risk, including equipment failures and operator actions

c. Major contributors to the uncertainty associated with the risk results

Risk insights from each hazard evaluated for different operational modes are described in the subsections shown below:

19.1.4.1.2.8 – Level 1 Internal Events PRA for Operations at Power

19.1.4.2.2.8 – Level 2 Internal Events PRA for Operations at Power

19.1.5.1.2.3 – Seismic Risk Evaluation

19.1.5.2.2.5 – Internal Fire Risk Evaluation

19.1.5.3.2.4 – Internal Flooding Risk Evaluation

19.1.6.1.2.8 – Level 1 Internal Events PRA for LPSD Operations

19.1.6.2.2.7 – Level 2 Internal Events PRA for LPSD Operations

19.1.5.3.2.5 – Internal Fire PRA for LPSD Operations

19.1.5.4.2.7 – Internal Flooding PRA for LPSD Operations

Table 19.1-4 is a list of significant PRA insights and assumptions regarding how the design and operational features affect the plant risk, and how uncertainties affect the PRA models in representing the plant risk. To provide reasonable assurance that this information is incorporated into the design process, the PRA insights and assumptions are categorized as follows:

a. Design Requirement: A design feature that requires specific design details be preserved to maintain its validity. If a future design change affects a design requirement, the PRA model needs to be reanalyzed to determine the significance of the change. Each design requirement is referenced to applicable subsection(s) in the DCD.

b. Operational Program: An operational feature that requires specific operational programs, such as procedures or training, to be preserved to maintain its validity. Development of operating and maintenance procedures is the responsibility of the COL applicant in accordance with COL Items 13.5(4), 13.5(5), and 13.5(6). Other operational programs that address PRA insights and assumptions are the Maintenance Rule, Technical Specifications, and development of the baseline PRA model. Each operational program is referenced to applicable COL item(s).

c. PRA Model Insight: An assumption that provides significant information about the PRA model or its results, but does not require design details or operational programs to maintain its applicability. PRA model insights should be maintained in the Baseline PRA model development and should be considered when making risk-informed decisions.

The APR1400 PRA, as demonstrated through the preceding subsections, has been used to achieve the following:

a. Identify and address potential design and operational vulnerabilities (i.e., failures or combinations of failures that are significant risk contributors that could drive the risk to unacceptable levels with respect to NRC safety goals: Subsections 19.1.4, 19.1.5, and 19.1.6).

b. Reduce or eliminate known weaknesses of existing operating plants that are applicable to the new design, by introducing appropriate features and requirements: Subsection 19.1.3.

c. Select among alternative features, operational strategies, and design options: Subsection 19.1.3.

d. Develop an in-depth understanding of the design's robustness and tolerance of severe accidents initiated by either internal or external events: Subsections 19.1.4, 19.1.5, and 19.1.6.

e. Examine the risk significance of specific human errors associated with the design, and characterize the significant human errors in preparation for better training and more refined procedures: Subsections 19.1.4, 19.1.5, and 19.1.6.

f. Determine how the risk associated with the design compares against the NRC safety goals of less than 1×10^{-4}/year for core damage frequency (CDF) and less than 1×10^{-6}/year for large release frequency (LRF): Subsections 19.1.4, 19.1.5, and 19.1.6.

g. Determine containment performance against the NRC containment performance goal, which includes a deterministic goal that containment integrity be maintained for approximately 24 hours following the onset of core damage for the more likely severe accident challenges and a probabilistic goal that the conditional containment failure probability (CCFP) be less than approximately 0.1 for the composite of core damage sequences assessed in the PRA: Subsection 19.1.4.

h. Assess the balance of preventive and mitigate features of the design, including consistency with guidance in SECY-93-087 and the associated staff requirements memoranda: Subsection 19.1.3.

i. Demonstrate that the plant design represents a reduction in risk compared to existing operating plants: Subsection 19.1.3.

j. Demonstrate that the design addresses known issues related to the reliability of core and containment heat removal systems at some operating plants: Subsection 19.1.3.

k. Support regulatory oversight processes and programs that are associated with plant operations (e.g., Technical Specifications, reliability assurance, Maintenance Rule, etc.): Subsection 19.1.7.

l. Identify and support the development of design requirements, such as inspection, tests, analysis, and acceptance criteria (ITAAC), reliability assurance program (RAP), Technical Specifications, and combined license (COL) action items and interface requirements: Subsections 19.1.7 and 19.1.9.

19.1.9 Combined License Information

COL 19.1(1) The COL applicant is to describe the uses of PRA in support of licensee programs, and to identify and describe risk-informed applications being implemented during the combined license application phase. See Subsection 19.1.1.2.

COL 19.1(2) The COL applicant is to describe the uses of PRA in support of licensee programs, and identify and describe risk-informed applications being implemented during the construction phase. See Subsection 19.1.1.3.

COL 19.1(3) The COL applicant is to describe the uses of PRA in support of licensee programs, and identify and describe risk-informed applications being implemented during the operational phase. See Subsection 19.1.1.4.

COL 19.1(4) The COL applicant is to review as-designed and as-built information and conduct walkdowns as necessary to confirm that the assumptions used in the PRA (including PRA inputs to RAP and SAMDA) remain valid with respect to internal events, internal flood and fire events (routings and locations of pipe, cable, and conduit), and HRA analyses (development of operating procedures, emergency operating procedures, and severe accident management guidelines and training), external events including PRA-based seismic margins and HCLPF fragilities, and LPSD procedures. See Subsection 19.1.2.2.

COL 19.1(5) The COL applicant is to conduct a peer review of the PRA relative to the industry PRA Standard prior to use of the PRA to support risk-informed applications, as applicable. See Subsection 19.1.2.3.

COL 19.1(6) The COL applicant is to describe the PRA maintenance and upgrade program. See Subsection 19.1.2.4.

COL 19.1(7) The COL applicant is to confirm that the PRA-based seismic margin assessment is bounding for the selected site, and to update the assessment to include site-specific SSC and soil effects (including sliding, overturning liquefaction, and slope failure). The COL applicant is to confirm that the as-built plant has adequate seismic margin. See Subsection 19.1.5.1.2.

COL 19.1(8) The COL applicant is address following issues with a site-specific risk assessment, as applicable:

- Dam failure
- External flooding
- Extreme winds and tornadoes
- Industrial or military facility

- Pipeline accident
- Release of chemicals from onsite storage
- River diversion
- Sandstorm
- Toxic gas
- Transportation accidents

See Subsection 19.1.5.4.

COL 19.1(9) The COL applicant is to describe the uses of PRA in support of licensee programs such as Maintenance Rule implementation during the operational phase. See Subsection 19.1.7.2.

COL 19.1(10) The COL applicant is to describe the uses of PRA in support of licensee programs such as the reactor oversight process during the operational phase. See Subsection 19.1.7.3.

COL 19.1(11) The COL applicant is to develop the fire barrier management procedures that direct the appropriate use of a fire watch and use of the isolation devices with a quick-disconnect mechanism for hose and cables that bleach a fire barrier. See Subsection 19.1.6.3.

COL 19.1(12) The COL applicant is to develop procedures and operator training for reliance (during fire response) on undamaged instrumentation (when the location of the fire is known). See Subsection 19.1.6.3.

COL 19.1(13) The COL applicant is to develop procedures specifying that a fire watch be present when hot work is being performed. See Subsection 19.1.6.3.

COL 19.1(14) The COL applicant is to establish procedures for closing the containment hatch (after being opened during during LPSD operations) to promptly re-establish the containment as a barrier to fission product release. This guidance must include steps that allow for sealing of the hatch with four bolts (versus the 40 bolts used to secure the hatch during at-power operation); four bolts are sufficient to secure the hatch so that no visible gap can be seen between the seals and the sealing surface. See Subsection 19.1.6.2.

COL 19.1(15) The COL applicant is to develop a configuration control program requiring that, during Modes 4, 5, and 6, the watertight flood doors and fire doors be maintained closed in at least one quadrant. Furthermore, the COL applicant is to incorporate, as part of the aforementioned configuration control program, a provision that if the flood or fire doors to this designated quadrant must be opened for reasons other than normal ingress/egress, a flood or fire watch must be established for the affected doors.

COL 19.1(15) The COL applicant is to develop outage management procedures that limit planned maintenance that can potentially impair one or both SC trains during the shutdown modes.

COL 19.1(16) The COL applicant is to develop procedures and a configuration management strategy to address the period of time when one SC train is unexpectedly unavailable (including the termination of any testing or maintenance that can affect the remaining train and restoration of all equipment to its nominal availability).

19.1.10 References

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Table 19.1-1 (1 of 3)

Characterization of PRA Relative to Supporting Requirements in ASME PRA Standard

Technical Area	APR1400 PRA Characteristics
Initiating Events Analysis (IE)	Comprehensive, systematic search made for initiating events. Most aspects of the IE analysis satisfy Capability Category II or greater. Elements of the PRA that cannot meet at least Category II until later stages of design, construction, and operation include the following: • Plant-specific operating experience is not available for review, although experience of current plants was considered (IE-A3, IE-A7). • Operators are not yet available to be interviewed (IE-A6). • Initiating event frequencies reflect generic data (IE-C1). • The ability to capture plant-specific information in the assessment of recovery actions is limited (IE-C9).
Accident Sequence Analysis (AS)	Response to the initiating events was first delineated via the use of event sequence diagrams (ESDs), and these were used to define core damage sequences via the construction of event trees. Most aspects of the accident sequence analysis satisfy Capability Category II. Elements of the PRA that cannot meet at least Category II until later stages of design, construction, and operation include the following: • The functions and structure of the accident-sequence models reflect expectations of plant-specific operating practices, based on those of current plants (AS-A5).
Success Criteria (SC)	Success criteria reflect design-specific calculations performed using the MAAP4 and RELAP5 computer codes. These calculations are equivalent to the requirements for Capability Category II. An exception is as follows: • Plant-specific operating philosophy and procedures are not available to confirm the bases for success criteria (SC-A6).

Table 19.1-1 (2 of 3)

Technical Area	APR1400 PRA Characteristics
Systems Analysis (SY)	The systems analyses were accomplished via the construction of detailed fault trees. These fault trees reflect the design details available. Aspects that do not meet at least Capability Category II because of the state of the design include the following: • Since the plant has not yet been constructed, it is not possible to collect information on the as-built, as-operated systems (SY-A2). • Although it is reasonable to infer testing and maintenance practices and system operating procedures from operating plants, these elements do not yet exist (SY-A3). • Plant walkdowns cannot be conducted until the plant is constructed (SYA4). • The ability to address spatial and environmental hazards is limited for a plant in the design phase (SY-B8). • There is not yet operating procedures or actual system operating experience that can be documented (SY-C2).
Human Reliability Analysis (HRA)	HRA necessarily relies on significant plant-specific information that is not yet available. The nature of the human reliability analysis and the areas in which compensatory steps are addressed is summarized in Subsection 19.1.2.
Data Analysis (DA)	Parameter estimates necessarily reflect generic data. These data were obtained from available relevant sources. Specific requirements for which the data analysis does not meet at least Capability Category II include the following: • The lack of plant-specific operating experience precludes the development and use of a plant-specific database or of specialization of generic data based on plant experience via Bayesian analysis (DA-C2 through DA-C13; DA-D1 and DA-D4).

Table 19.1-1 (3 of 3)

Technical Area	APR1400 PRA Characteristics
Internal Flooding (IF)	Some aspects of the internal flooding analysis are limited by the lack of plant-specific details. Specific areas in which the internal flooding analysis does not meet at least Category II include the following: • Plant information reflecting as-built, as-operated conditions does not yet exist (IF-A3). • Walkdowns cannot be conducted until the plant is constructed (IF-A4, IFB3a). • Some sources of flooding will account for plant/site-specific features not yet available (IF-B1). • Conservative assumptions were made with respect to propagation pathways and areas that could be affected (IF-C1 and IF-C
Quantification (QU)	The quantification was performed by solving the overall core damage model using the linked fault-tree approach. The quantification satisfies at least Category II for each of the supporting requirements.
LERF (LE)	A detailed assessment of containment response and release frequency was conducted. The assessment satisfies at least Capability Category II for the supporting requirements, except for such aspects as system failure analysis and human reliabA detailed assessment of containment response and release frequency was conducted. The assessment satisfies at least Capability Category II for the supporting requirements, except for such aspects as system failure analysis and human reliabalysis and human reliability analysis, as addressed for technical areas SY, HF, and DA above.

Table 19.1-2 (1 of 10)

Key Design Features in APR1400

System	SSC Configuration	Key Functional Description	Design Features
Safety Injection Tank	• Four independent passive trains • Equipped with a fluidic device	• Rapid reflooding of the core following large break LOCA • RCS inventory makeup during rapid cooldown in small break LOCA	• Prevent core damage
In-Containment Refueling Water Storage Tank (IRWST)	• Located in the containment • Equipped with holdup volume tank (HVT) • Two independent ECCS sump strainers	• Single source of water for ECCS, CSS, and refueling • Primary heat sink to condense the steam discharged during feed and bleed operation • Fission product scrubbing • Eliminates ECCS and CSS recirculation operation • Screens out containment debris	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Safety Injection System	• Four independent trains with direct vessel injection (DVI) nozzles • Two independent hot leg injection paths (1 path per 2 trains) • Two independent return lines to IRWST (1 path per 2 trains)	• RCS inventory makeup • RCS heat removal (long-term cooling) • Feed and bleed operation	• Prevent core damage • Mitigate core damage consequences • Prevent containment release

Table 19.1-2 (2 of 10)

System	SSC Configuration	Key Functional Description	Design Features
Shutdown Cooling System	• Two independent trains • Two independent heat exchangers (1 per train)	• RCS inventory makeup • RCS heat removal (long-term cooling and IRWST cooling) • Backup for containment spray pump	• Prevent core damage • Mitigate core damage consequences • Prevent containment release
Containment Spray System	• Two independent divisions • Two independent heat exchangers (1 per division) • Two independent containment spray nozzle rings	• Containment heat removal • Containment pressure control • Fission product scrubbing • Backup for SC pump	• Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Emergency Containment Spray Backup System	• Single independent division with external water source • Dedicated ECSBS spray nozzle ring	• Diverse containment pressure control	• Prevent containment release
Chemical and Volume Control System	• Two charging pumps and two boric acid makeup pumps with suction from boric acid storage tank	• Emergency boration • RCP seal cooling • IRWST inventory makeup	• Prevent core damage • Mitigate core damage consequences

Table 19.1-2 (3 of 10)

System	SSC Configuration	Key Functional Description	Design Features
Auxiliary Feedwater	• One motor-driven pump train and one turbine-driven pump train per SG • One AFW storage tank per SG • Alternative water sources for AFW pumps	• RCS secondary heat removal • RCS depressurization with MSADV • Fission product scrubbing during SGTR	• Prevent core damage • Mitigate core damage consequences • Mitigate release consequences
Startup Feedwater	• One non-safety pump train with suction from deaerator storage tanks (DSTs) from condensate system	• Diverse RCS secondary heat removal	• Prevent core damage
Main Steam	• Two main steam lines per SG • One MSIV per main steam line with MSIVBV • One MSADV and five MSSVs per main steam line • Eight non-safety TBVs	• RCS secondary heat removal • RCS depressurization • Secondary side pressure relief • Mitigate RCS pressure transient • SG isolation during SGTR and secondary side pipe breaks	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Reactor Protection System	• Four independent channels • Two-out-of-four coincidence logic • Two sets of four reactor trip switchgears (RTSGs)	• Provides redundant and diverse reactor trip signals	• Prevent core damage

Table 19.1-2 (4 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Diverse Protection System	• Non-safety four channels • Two-out-of-four coincidence logic	• Provides diverse means for reactor trip signal, turbine trip, SIAS, and AFAS • Diverse ATWS mitigation system	• Prevent core damage • Mitigate core damage consequences
ESFAS	• Four independent channels • Two-out-of-four coincidence logic	• Provides redundant signals to SIAS, CSAS, CIAS, MSIS, and AFAS	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Reactor Coolant System – POSRV subsystem	• Four POSRVs • POSRV discharge lines to IRWST • Spargers in IRWST • Two three-way valves for POSRV discharge lines to IRWST	• RCS overpressure protection • Provides bleed capability for feed and bleed operation • Discharge from POSRVs is routed to the IRWST – eliminates potential for containment debris entrainment to clog sump strainers during feed and bleed operation • Provides rapid depressurization capability • Prevents severe accident-induced SGTR • Mitigates potential high hydrogen concentration buildup in IRWST during severe accidents to prevent potential hydrogen explosion • Fission product scrubbing	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-2 (5 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Reactor Coolant Gas Vent System (RCGVS)	• Single vent path with two valve lines from reactor pressure vessel head • Single vent path with two valve lines from pressurizer	• Vents non-condensable gases from RCS • Discharges to IRWST for safety functions or to reactor drain tank (RDT) for startup/shutdown operation • RCS pressure control	• Prevent core damage • Mitigate core damage consequences
Hydrogen Mitigation System	• 30 PARs and 8 igniters	• Hydrogen control	• Prevent containment release
Cavity Flooding System	• Two independent divisions with suction from IRWST via HVT	• Pre-flooding of reactor cavity • Mitigates MCCI progression • Fission product scrubbing	• Prevent containment release • Mitigate release consequences
Essential Service Water System	• Two independent divisions with two pumps per division • Two separate cooling towers • Located in ESW building	• Provides ultimate heat sink • Provides cooling water to CCW heat exchangers to remove heat released by SSCs	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-2 (6 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Component Cooling Water System	• Two independent divisions with two pumps per division • Three heat exchangers per division located in CCW building	• Provides cooling water to the safety-related and non-safety-related loads • Division I provides cooling water to RCP seals	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Essential Chilled Water System	• Two independent divisions with two pumps/chillers per division	• Provides chilled water to safety-related cooling coils of air handling units (AHUs) and cubicle coolers	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Class 1E ac Power System	• Four independent Class 1E 4.16 kV switchgears • Powered from offsite power via two unit auxiliary transformers (UATs) or standby auxiliary transformers (SATs) • UATs are powered from the main generator or offsite power	• Provides power to the loads for safe shutdown • Provides house load operation (HLO) capability • Provides a fast transfer from the UAT supply to the SAT supply	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-2 (7 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Emergency Diesel Generator	• Four independent EDGs • One 7-day fuel oil capacity storage tank per EDG	• Each EDG supplies emergency onsite power to respective Class 1E 4.16 kV bus	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Alternative ac Power	• One non-Class 1E train of AAC gas turbine generator with independent room cooling system and independent dc power supply	• Provides diverse onsite emergency power to Class 1E SWGR during SBO • Eliminates the potential of CCFs between AAC and EDGs	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
125 Vdc power system	• Four Class 1E dc batteries with two battery chargers per dc bus • 4-hour capacity for trains A and B • 16-hour capacity for trains C and D	• Provide control dc power for operation of safety-related equipment or equipment important to safety • Provides extended time for recovery of offsite power following a SBO	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-2 (8 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
120 Vac Power System	• Four Class 1E ac trains with associated inverter or regulating transformer per train	• Provide uninterruptible control ac power for operation of safety-related equipment or equipment important to safety	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Instrument Air	• Three compressors, three air receivers, and two dryer packages	• Provides instrument air to key SSCs	• Prevent core damage • Mitigate core damage consequences
HVAC Systems	• Emergency diesel generator area HVAC system • ESW building / CCW heat exchanger building HVAC system • Auxiliary building controlled area HVAC system • Auxiliary building clean area HVAC system	• Provide room and equipment cooling capability	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-2 (9 of 10)

System	SSC Configuration	Key Functional Description	Design Feature
Auxiliary Building	• Four physical quadrant design • System layout and design using the principles of physical separation • Emergency overflow lines (EOLs) and flood barriers	• Limits impacts from internal and external hazards to the relevant quadrant • Minimizes impact of aircraft crash	• Prevent core damage • Mitigate core damage consequences
Reactor Containment Building	• Post-tensioned cylindrical concrete wall with a steel liner, and reinforced concrete internal structuresContainment isolation • Large reactor cavity floor area • Reactor cavity with core debris chamber and a convoluted vent path	• Minimizes containment overpressure failure • Minimizes fission products release • Enhances ex-vessel core debris coolability • Minimizes impact of direct containment heating • Minimizes impact of aircraft crash	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Fire Protection System	• Fire detection system • Water supply system including fire tank, pump, and yard fire main and distribution system • Automatic fire fighting systems • Manual firefighting systems	• Prevents fires from starting • Rapidly detects, controls, and extinguishes fires • Provides protection for SSCs important to safety from fires • Minimizes adverse impact of inadvertent operation from fires	• Prevent core damage • Mitigate core damage consequences

Table 19.1-2 (10 of 10)

System	SSC Configuration	Key Functional Description	Design Features
Main Control Room	• Highly integrated control room (HICR) design • Digitalized I&C with soft controls and displays • Safety console with diverse manual ESF actuation (DMA) switches and diverse indication system (DIS)	Complies with GDC 19: • Provides an indication and control function for the safe and reliable operation of the plant • Provides a diverse indication and control function for safe shutdown and accident mitigation • Provides an indication and control for safety functions during and following a seismic event • Provides reasonable assurance of an adequate human-system interface (HSI)	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Remote Shutdown Room (RSR)	• Remote shutdown console (RSC) with soft controls and displays	• Allows emergency shutdown from outside the MCR	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences
Remote Control Center (RCC)	• Panel with channelized Class 1E control and associated signals, and non-Class 1E signals routed from hardwired switches to the P-CCS loop controller and the motor control center (MCC) • Located separately from the MCR and RSR	• Maintains the reactor for 24 hours to accomplish hot standby plant condition against aircraft impact	• Prevent core damage • Mitigate core damage consequences • Prevent containment release • Mitigate release consequences

Table 19.1-3 (1 of 5)

Design Features Addressing Potential Risk Challenges

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Preventing Core Damage	
Loss of offsite power (LOOP) / Station blackout (SBO): • LOOP event occurrence • Onsite emergency power capability • RCP seal cooling	• House load operation (HLO) minimizes reactor trip during LOOP event • Improvements on the onsite emergency power capability - Four EDGs with large fuel storage capacity - A diverse AAC using combustion gas turbine - Extended battery life to 16 hours - Mobile EDGs - Mobile battery chargers and batteries • Improvements on RCP seal challenges - Advanced seal design - Improved seal injection cooling system - Auxiliary charging pump in addition to two charging pumps
LOCA: • ECCS recirculation for long-term operation • RCS inventory makeup for LOCAs • Challenges associated with long-term cooling • Containment heat removal and pressure control	• Elimination of ECCS recirculation phase - IRWST integrated into containment with a continual makeup via holdup tank • Improvements to deal with any sizes of LOCAs - Four redundant SIP trains - Improved SIT design with fluidic device (FD) • Improvements made for long-term cooling - SC pumps capable of long-term injection or SDC operation

Table 19.1-3 (2 of 5)

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Preventing Core Damage (cont.)	
LOCA (cont.)	• Improvements made for containment heat removal - IRWST cooling by SCS - Containment spraying by CSS - SC pumps designed to backup CS pumps • Improvements made for containment pressure control - Diverse independent ECSBS
Transients: • Secondary heat removal capability • Initial pressure transients mitigation	• Improvements to deal with secondary heat removal - Two divisions with a motor-driven AFW pump and a turbine-driven AFW pump per division - Large capacity of AFW storage tanks - Alternative sources for AFW pumps - Advanced POSRV design to enhance the feed and bleed operation - Independent startup feedwater operation • Improvements to deal with initial pressure transients - Additional pressure relief capabilities using MSSVs, TBVs, and MSADVs
SGTR:	• Addition of main steam line and associated SSCs per steam generator provides additional pressure relief and steam removal capabilities • POSRVs provide a rapid RCS depressurization capability that prevents severe accident-induced SGTR

Table 19.1-3 (3 of 5)

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Preventing Core Damage (cont.)	
Internal Flooding: • Flooding in auxiliary building • Flooding in turbine building	• Improvements to deal with auxiliary building flooding - Four physically separated quadrant design - Elimination of a large water source into auxiliary building - Installation of emergency overflow line (EOL) to redirect flood water to lowest level of auxiliary building • Improvements to deal with turbine building flooding - Relocation of all SSCs with safety functions away from turbine building
Internal Fire: • Fire in auxiliary building • Fire in turbine building	• Improvements to deal with fires in auxiliary building - Four physically separated quadrant design - Separation of key SSCs into four quadrants - Cable separation at the division level - Highly compartmentalized where many fire areas have 3-hour fire rating barriers - Employ fiber-optic cables between the MCR safety console, the group controllers, and loop controllers, thereby minimizing the impact from fire-induced spurious hot shorts • Improvements to deal with fires in turbine building - Relocation of all SSCs with safety functions away from turbine building

Table 19.1-3 (4 of 5)

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Mitigating the Consequences of Core Damage and Preventing Releases from Containment	
High Pressure Melt Ejection	• Improvements to deal with high pressure melt ejection - Rapid RCS depressurization by POSRVs - Reactor cavity with core debris chamber and a convoluted vent path - Reactor cavity with adequate distance between the floor elevation and the embedded portion of the containment steel liner to delay core debris contact with the liner
Ex-Vessel Debris Cooling and MCCI	• Improvements to deal with debris cooling in reactor cavity - Addition of cavity flooding system to pre-flood reactor cavity - Large reactor cavity floor area
Hydrogen Accumulation	• Addition of passive autocatalytic recombiners (PARs) to limit hydrogen concentration in the containment • Igniters to supplement PARs for accidents where rapid hydrogen release rates are expected • Large volume of the containment • Prevention of hydrogen accumulation in the IRWST by operating POSRV’s three-way valve

Table 19.1-3 (5 of 5)

Potential Risk Challenges	Design Features and Operational Strategies
Design Features for Mitigating the Consequences of Core Damage and Preventing Releases from Containment (cont.)	
Containment Overpressure	• Large and robust containment • Containment heat removal to prevent containment overpressure - SCPs designed to back up CSPs - Addition of ECSBS provides a diverse and independent means to control containment pressure
Design Features for Mitigating the Consequences of Releases from Containment	
Radionuclide Release Reduction	• Improvements to reduce radionuclide releases - Additional fission product scrubbing in IRWST via POSRV spargers - Additional fission product scrubbing in cavity flooding system that pre-floods reactor cavity

Table 19.1-4 (1 of 25)

Risk Insights and Key Assumptions

No.	Insight	Disposition
	PRA Key Assumptions	
1	The RCP seal LOCA probability is based on engineering judgment and the seal LOCA model is represented with a single basic event with one flow rate that occurs given failure of the RCP seals. A detailed seal LOCA model will be developed when the RCP seal LOCA technical bases, including the seal LOCA probabilities, become available.	Subsection 19.1.4.2.5 Subsection 5.4.1
2	The insulation used inside the containment is reflective metallic insulation (RMI), which minimizes the chemical effects in the core. The downstream chemical effects are assumed to be negligible, and, therefore, chemical effects during recirculation are not included in the PRA model.	Subsection 5.2.3.2.3 Table 15.0-12
3	Loss of essential chilled water (LOECW) is assumed to not result in initiating event. The basis for this assumption is that the ECWS is normally in standby with the rooms cooled by the normal HVAC (even with a limited amount of cooling) when ECW is lost. Following a LOECW, there will be ample time to shut down the unit per Technical Specifications while using normal HVAC for cooling.	Subsection 19.1.4.1.1.3 Table 19.1-11 Subsection 16.3.7.10
4	Emergency HVAC use in the auxiliary building is assumed in the PRA as a diverse room cooling to ECW room cooling coils. It is assumed that there is a sufficient capacity using the emergency HVAC system to remove the heat from the affected ECCS rooms during accident conditions with a LOECW.	Subsection 19.1.4.2 Subsection 9.4.5.2

Table 19.1-4 (2 of 25)

No.	Insight	Disposition
PRA Key Assumptions		
5	Room cooling is assumed not to be needed for the following rooms. The room heatup calculations to be supplied are expected to show that room cooling is not required. This assumption applies to each room when both the emergency HVAC and ECW are lost. 125 Vdc battery/battery charger rooms 120 Vdc/120 Vac distribution areas 1E ESF 480V load center rooms 1E ESF 480V MCC rooms Electrical equipment rooms (i.e., loop controllers, group controllers) AF turbine-driven pump rooms	Subsection 19.1.4.1.2
	The following rooms are assumed to require at least one room cooling source, either emergency HVAC or ECW. 1E ESF 4.16 kV switchgear rooms	Subsection 19A
6	ESW pump room cooling is assumed to require two-exhaust-fan configuration based on the conceptual design.	Subsection 9.4.5 COL 9.4(3)

Table 19.1-4 (3 of 25)

No.	Insight	Disposition
PRA Key Assumptions		
7	Digital I&C system model retains the current hardware model from the reference plant, except for the software events and the communication link models. The digital I&C model is retained as-is with a single event representing the software/communication links as a black-box event. The event probability in the fault tree model is based on engineering judgment. The dependency between hardware and software/communication links is not evaluated, which will be evaluated when design details are finalized.	PRA basic assumption Subsection 19.1.4.1.2.5
8	The RCS pressure transient following a reactor trip is assumed not to challenge POSRVs as long as either TBVs or MSSVs successfully operate to relieve the pressure on the secondary side. This assumption does not apply to LOCV and LODC events.	Subsection 19.1.3.4 Table 19.1-3 Subsection 19.1.4.1.1.4 Table 19.1-8
9	ATWS UET is based on the equilibrium core, where the UET value is 0.16, which is based on the reference in Subsection 15.8.2.	Subsection 15.8.2
10	All SSCs are assumed to be in staggered testing mode, except for those cases that are specifically identified and documented. The COL applicant is to provide a program for developing operating procedures, including procedures that provide reasonable assurance that the assumed staggered testing mode remains valid for the as-designed, as-built, and as-operated plant conforms to the assumptions in the PRA.	 COL 13.5(4)

Table 19.1-4 (4 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
11	The following are important aspects of pilot-operated safety relief valves (POSRVs) as represented in the PRA:	
	The POSRVs, located on the top of the pressurizer, have two functions: overpressure protection and rapid depressurization (RD). When long-term decay heat removal is not available through the steam generators, the rapid depressurization (or bleed) function provides a means of rapidly depressurizing the RCS manually from the control room so that the SIS can inject to the RCS, enabling a "feed and bleed" cooling capability.	Subsection 5.2.2.1 Subsection 5.4.14.2
	Another function of the RD is to provide the capability to depressurize the RCS during a severe accident to minimize the potential for high pressure melt ejection (HPME).	Subsection 19.2.3 Subsection 6.8.4.4
	The POSRV discharge line is immersed into the IRWST water through the sparger, the discharging load dissipation device. When POSRVs actuate, the discharged RCS fluid is scrubbed in the IRWST, reducing the fission product releases.	Subsection 5.2.2.10 Subsection 5.2.5.1.2.1
	The COL applicant is to provide a program for developing and implementing emergency operating procedures, including the procedures for use of the RD for "feed and bleed" cooling.	COL 13.5(5)

Table 19.1-4 (5 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
12	The in-containment refueling water storage tank (IRWST) is an important design feature that helps reduce the risk with respect to currently operating reactor designs. Important characteristics are: Located inside containment CSS and/or SCS can be aligned to cool the IRWST contents using the CSS or SCS heat exchangers, respectively No valve changeover is required for the recirculation mode of emergency core cooling; IRWST inventory can be made up from the BAST. In conjunction with remote manual valve operation, IRWST provides source of water for flooding the reactor cavity in severe accidents.	Subsection 6.8.2.2
13	The following are some important aspects of the SIS as represented in the PRA: Four redundant trains are arranged and are completely physically and electrically separated from each other. Each SIP has an independent suction line connection from the IRWST. A passive flow regulating device, the fluidic device (FD), is installed in safety injection tank (SIT) to regulate the discharge flow rate from SIT during large break LOCA. By the adoption of the FD, the need for large-capacity low pressure SIPs was eliminated. Safety injection for "feed and bleed" is an important backup decay heat removal method during an accident condition or shutdown operation.	 Subsection 6.3.2.1 Subsection 6.3.2.1 Subsection 6.3.1.4 COL 13.5(4), COL 13.5(5)

Table 19.1-4 (6 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
14	The following are some important aspects of the shutdown cooling system (SCS) as represented in the PRA:	
	The SCS has two separate and redundant trains, each with the heat removal capacity to cool the RCS to cold shutdown conditions. The SC and CS pumps are designed to be independent, but identical and functionally interchangeable. Either pump in a division can provide flow to either the CSS header or the SCS heat exchanger.	Subsection 5.4.7.1
	The SC pumps can be aligned to take suction from the IRWST, and can also be aligned to discharge to the IRWST via the SCS heat exchangers. The SCS can be aligned to provide IRWST cooling. This backs up the CSS capability for providing IRWST cooling. With the SC pumps aligned to the IRWST, the pump's NPSH is adequate to prevent pump cavitation and failure even if the IRWST inventory is saturated.	Subsection 5.4.7.4
	During plant shutdown operations, the SCS can be aligned to the IRWST to provide RCS inventory makeup.	Subsection 5.4.7.1

Table 19.1-4 (7 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
15	The following are important aspects of the containment spray system (CSS) as represented in the PRA:	
	Containment heat removal: The CSS is designed so that the CS pumps and the SC pumps are functionally interchangeable when not required to perform their requisite design basis function, assuming a loss of offsite power and single failure. The SC pumps are designed to be aligned from the MCR to provide the containment spray. Containment pressure control: Following a LOCA or MSLB, the containment pressure is reduced to near the atmospheric pressure with the CSS operation. Fission product scrubbing: The CSS is a safety-grade system designed to remove fission products from the containment atmosphere following a DBA. Backup for SC pump: The CSS is designed to provide a backup to the SCS for residual heat removal and for cooling of the IRWST during post-accident feed and bleed operations using the SIS and pressurizer POSRVs.	Subsection 6.5.2.1
	In addition to its design basis capabilities, the CSS provides the capability to cool the IRWST during accidents requiring "feed and bleed" operation.	Subsection 6.2.2.2
	The CS pump's NPSH is adequate to prevent pump cavitation and failure if the IRWST inventory is saturated.	Subsection 6.2.2.3
16	The charging pumps provide the RCP seal cooling and are used for emergency boration operation during an unlikely ATWS event. Divisional separation exists between redundant charging pumps and their power and instrument air supplies.	Subsection 9.4.3.2 Subsection 15.4.6.2

Table 19.1-4 (8 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
17	A diverse RCP seal injection capability is provided using a positive displacement pump that is diverse from the CVCS and can be powered from either the EDG or the AAC.	Subsection 9.3.4.3
18	The following are important aspects of the auxiliary feedwater system (AFWS) as represented in the PRA: The AFWS is a dedicated safety system that has two separate and redundant divisions. Each division has two diverse 100% capacity AFW pumps, one motor operated and one turbine driven. Redundancy, diversity, and separation between divisions are important features improving the reliability of the secondary side heat removal. The turbine-driven AFW pump in each division is supplied steam from the SG in its division via a pipe connection located upstream of the MSIV. For SBO sequences that do not credit the alternate ac source, the turbine-driven AFW pumps are the only safety system available for removing decay heat. Their operation, however, requires dc power supplied by batteries. Each auxiliary feedwater storage tank (AFWST) can be supplied by gravity flow from either the condensate water storage tank (CST) or the raw water storage tank, thereby providing long-term cooling.	 Subsection 10.4.9.2 Subsection 10.4.9.2 Subsection 10.4.9.3 Subsection 10.4.9.2

Table 19.1-4 (9 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
19	The following are important aspects of the main steam system (MSS) as represented in the PRA: The key components of the MSS are: main steam isolation valves (MSIVs), MSIV bypass valves (MSIVBVs), main steam atmospheric dump valves (MSADVs), main steam safety valves (MSSVs), and turbine bypass valves (TBVs). One MSADV that can be used for manual control of SG pressure is provided on each main steam line upstream of the MSSVs. Five spring-loaded MSSVs are provided for each individual main steam line for protection against overpressurization of the shell side of the SGs and the main steam line piping up to the inlet of the turbine stop valve. Each main steam line is provided with an MSIV for steam line isolation. There are eight TBVs that originate from the main steam header downstream of the MSIVs. The TBVs are controlled by the steam bypass control system (SBCS). Steam can be bypassed through these valves to the condenser. The redundancy and diversity of steam release pathways provide reasonable assurance of high reliability of secondary cooling and also limit primary pressure transients following reactor trip.	Subsection 10.3.2

Table 19.1-4 (10 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
20	The following are important aspects of the essential service water system (ESWS), which is the ultimate heat sink (UHS) as represented in the PRA: The ESWS has two redundant and separate safety-related divisions, each with capacity to achieve and maintain safe shutdown. Each division has two pumps. The two CCW heat exchanger structures (one per division) and the two ESW buildings are seismic Category I. The supply and return lines in one division of the ESWS are completely separated from the supply and return lines of the other division. ESW cooling tower configuration is based on a two-basin design. During normal operation, one ESW pump in each division is running with the second pump in standby mode. The standby pump will automatically start if the running pump in that division trips. This configuration improves availability of the ESWS.	Subsection 9.2.1.2

Table 19.1-4 (11 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
21	The following are important aspects of the component cooling water system (CCWS) as represented in the PRA:	
	The CCWS has two redundant and separate safety-related divisions, each with capacity to achieve and maintain safe shutdown. Each division has two pumps. The two CCW heat exchanger structures (one per division) are seismic Category I.	Subsection 9.2.2.2
	The CCWS has a crosstie between two divisions, which can be used if one division is not available, to prevent a potential initiating event or to mitigate the accident consequences. When the division crosstie is used, both pumps on the operating division need to run.	
	During normal operation, one CCW pump in each division is running with the second pump in standby mode. The standby pump will automatically start if the running pump in that division trips. This configuration improves availability of the CCWS. The nonessential headers are isolated automatically on a safety injection actuation signal (SIAS) or a low-low surge tank level signal.	Subsection 9.2.2.2.1
	The COL applicant is to provide a program for developing and implementing emergency operating procedures, including the procedures for use of the divisional crosstie when needed.	COL 13.5(5)

Table 19.1-4 (12 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
22	The following are important aspects of the essential chilled water (ECW) system as represented in the PRA: The ECWS provides chilled water for cooling to all safety-related equipment room cooling coils. The ECWS consists of two independent, redundant, closed-loop, safety-related divisions. The divisions are separated both mechanically and electrically. Each division consists of two chillers, two chilled water pumps, a chilled water makeup pump, a compression tank, an air separator, a chemical additive tank, piping, valves, and I&C. Cooling water for each chiller condenser is supplied from the component cooling water (CCW) system. There is a direct dependency between ECW system and CCW system at the division level, where loss of a CCW division will result in loss of the ECW division in the same division.	Subsection 9.2.7.2.1
23	The onsite power system consists of the Class 1E power system and the non-Class 1E power system. The onsite power system is normally powered from two unit auxiliary transformers (UATs). In case power is unavailable from the UATs, the power source for the connected onsite power system Class 1E and non-Class 1E buses is automatically transferred to the standby auxiliary transformers (SATs). The system includes standby power sources, distribution systems, and auxiliary supporting systems that are provided to supply power to safety-related equipment or equipment important to safety for all normal operating and accident conditions. There are four Class 1E emergency diesel generators (EDGs) and one non-Class 1E gas turbine generator (GTG). The Class 1E ac electric power distribution system consists of two independent, redundant divisions, where each division consists of two independent trains.	Subsection 8.3.1.1

Table 19.1-4 (13 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
24	The Class 1E onsite power system has four trains with two trains per division. Each train is connected to one EDG. The two EDGs of a single division (i.e., Trains A and C, or Trains B and D) are sufficient to meet the emergency load requirements for a safe shutdown during a LOOP. Each EDG train and its associated auxiliaries are installed in a separate room within physically separate seismic Category I structures that provide protection against tornadoes, hurricanes, external missiles and seismic phenomena, and are electrically isolated from the circuits of other EDG trains and non-Class 1E circuits. Each EDG room is a separate fire area with 3-hour fire-rated walls, floors, and ceilings. Each EDG room is provided with its own independent ventilation system that automatically maintains the design room temperature for proper equipment operation and personnel access. The EDG room HVAC system and other EDG support auxiliaries are powered from the same electrical train as the EDG. Per the Technical Specifications, two EDGs on the same division (i.e., EDG A and C, or EDG B and D) can be out-of-service (OOS) together during an online maintenance. This allows two EDG maintenance cases to be retained in the PRA results, as compared to allowing only one EDG maintenance case.	Subsection 8.3.1.1.3 Subsection 16.3.8.1
25	The onsite Class 1E 125 Vdc power system is composed of four independent subsystems (Trains A, B, C, and D) and supplies reliable power to the plant safety system dc loads and essential I&C system loads. Each dc power subsystem consists of a battery, two battery chargers (normal and standby), a dc control center, and distribution panels. The station batteries A and B will last up to 2 hours without dc load shedding and 8 hours with load shedding. The station batteries C and D will last up to 16 hours without dc loading. The operator action to perform the load shedding is included in the PRA model.	Subsection 8.3.2.1.2 Subsection 8.3.2.1.2

Table 19.1-4 (14 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
26	The Class 1E 120 Vac I&C power system supplies continuous, reliable, and regulated ac power to the safety-related plant instruments, control equipment, and engineered safety features – component control system (ESF-CCS). The Class 1E 120 Vac I&C power system consists of four separate and independent 120 Vac power systems. Each Class 1E 120 Vac I&C power system has an inverter, regulating transformer, distribution panel, manual and automatic transfer switch, and distribution panel.	Subsection 8.3.2.1.2.2
27	The 4.16 kV non-Class 1E AAC generator is provided as an AAC source to mitigate the SBO condition. The AAC generator has sufficient capacity to operate the system necessary for coping with the SBO for the time required to bring and maintain the plant in a safe shutdown condition. The AAC generator is manually connected to the designated Class 1E 4.16 kV switchgears (Train A or Train B) by the operator within 10 minutes from the beginning of the SBO event. To minimize the potential for CCFs with Class 1E EDGs, the AAC generator is provided with a gas turbine engine with a diverse starting and cooling system. The COL applicant is to develop detailed procedures for manually aligning the alternate ac power supply when two (Trains A and B) of the four diesel generators are unavailable during a loss of offsite power event.	Subsection 8.4.1.3 COL 8.4(2)
28	The transmission network design includes at least two preferred power supplies and each one has sufficient capacity and capability to supply power to the safety-related and non-safety-related systems during all design modes to provide reliable offsite ac power. The COL applicant is to identify the circuits from the transmission network to the onsite electrical distribution system that are supplied by two physically independent circuits.	Subsection 8.2.1.1 COL 8.2(1)

Table 19.1-4 (15 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
29	To provide sufficient diversity and defense in depth to mitigate all postulated accidents, even assuming a CCF within the plant protection system (PPS) and ESF-CCS, the following features included: The diverse protection system (DPS) automatically initiates diverse protective functions to mitigate postulated accidents with CCF between PPS and ESF-CCS. The safety console also provides diverse manual ESF actuation (DMA) switches to actuate components to manage critical safety functions and to actuate components that will place the plant in safe shutdown condition. The DPS and DMA switches are diverse from the PPS and ESF-CCS so that these systems are not simultaneously subjected to CCF due to errors in PPS and ESF-CCS.	Subsection 7.8.1.1 Subsection 7.8.1.2 Subsection 7.8.2.2
30	The auxiliary building clean area HVAC system consists of two divisionally separated auxiliary building clean area HVAC subsystems, main steam valve room HVAC subsystem, main steam enclosure HVAC subsystem, and auxiliary building smoke removal HVAC subsystem. Provision of separate HVAC subsystems for each division eliminates the possibility of smoke, hot gases, and fire suppressants migrating from one division to another, which reduces risk from fire.	Subsection 9.4.3.2 Subsection 9.4.3.3

Table 19.1-4 (16 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
31	The following are features of the main control room (MCR) design that were assumed to minimize risk from fires in the control room: Low energy circuits (switch contact and lamps) are used to the maximum extent practical. Fire-retardant non-metallic materials meeting UL-94 rating or equivalent are used throughout the MCR operator consoles, LDP, safety console, and RSC enclosures. Fire-resistant insulation material for MCR operator consoles, safety console, and RSC wiring meets the applicable requirements of IEEE Std 383. Electrical independence of channelized circuits is maintained throughout the MCR operator consoles and safety console enclosures. The enclosures are equipped with smoke detectors. The control room has its own dedicated ventilation system. The design eliminates the possibility of migration of smoke, hot gases, and fire suppressants, originating in areas outside the MCR, via the ventilation system to the control room.	Subsection 7.7.1.2 Subsection 6.4.2.4
32	In the unlikely event that the MCR becomes uninhabitable, sufficient indications and controls are provided outside the MCR to: a) Achieve hot standby of the reactor b) Maintain the unit in a safe condition during hot shutdown c) Achieve cold shutdown of the reactor through the use of operating procedures For safe shutdown in the remote shutdown room (RSR), controls and indications are available through the soft controls and displays on the information flat panel display on the remote shutdown console (RSC). The shutdown overview display panel (SODP) at the RSC provides the information that the operator requires for assessing the plant status.	Subsection 7.4.1.1

Table 19.1-4 (17 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
33	The containment pressure boundary is made up of the containment shell and mechanical and electrical containment penetrations. The penetrations include one equipment hatch; two personnel airlocks; containment piping penetration assemblies to provide for the passage of process, service, sampling, and instrumentation pipelines into the containment; electrical penetrations for power, control, and instrumentation; and a fuel transfer tube. All large penetrations are explicitly considered in the containment shell ultimate pressure capacity analyses. Smaller penetrations are sufficiently strong that they do not prematurely compromise the integrity of the containment shell.	Subsection 19.2.3.1
34	The low pressure systems that interface with the RCS are protected against ISLOCA by a combination of factors: The piping outside containment has a minimum design pressure of 900 psig, which is higher than currently operating designs. Pressure sensors and MCR alarms are provided to indicate leakage of pressure isolation valves.	Subsection 5A
35	There only system that is a large flood source in the auxiliary building is the fire protection system. The interface between the CCWS and the ultimate heat sink through the ESW system is located in a separate structure outside the auxiliary building. Elimination of the ESW piping from the auxiliary building reduces the potential for significant flooding events The seals for the underground pipe chase (contains CCW piping) between the auxiliary building and the CCW heat exchanger building are capable of withstanding an internal flood from a pipe break in the CCW heat exchanger building (e.g., service water piping).	Subsection 9.2.2.2.1 Subsection 3.4.1.3 COL 3.4(1) COL 3.4(2)

Table 19.1-4 (18 of 25)

No.	Insight	Disposition
Risk Insights from Key Design Features		
36	Flood protection is integrated into the auxiliary building floor drainage systems. The flood drainage systems are separated by quadrants with no common drain lines between the quadrants. The floor drainage systems are separated by division and Safety Class 3, seismic Category I valves that prevent backflow of water to areas containing safety-related equipment. Each quadrant contains its own separate sump equipped with redundant Safety Class 3, seismic Category I sump pumps and associated instrumentation.	Subsection 3.4.1.3 Subsection 9.3.3.1 Subsection 9.3.3.2
37	The potential for consequential flooding of safety-related SSCs due to flooding in the turbine building is prevented by the following design features: (a) no openings to safety-related structures exist below grade, (b) openings to safety-related structures above the maximum design basis flood level for the turbine building are sealed, (c) very large openings to allow flow out of the turbine building once level exceeds plant grade, and (d) site grade moves water away from structures where safety-related equipment is located.	Subsection 10.4.1.3
38	No water lines are routed above or through the MCR and the computer room. HVAC water lines contained in rooms around the MCR are located in rooms with raised curbs to prevent leakage from entering the MCR.	Subsection 3.4.1.5.2
39	All fire barriers that provide separation between the two divisions are rated for at least 3 hours.	Subsection 9.5.1.1

Table 19.1-4 (19 of 25)

No.	Insight	Disposition
Risk Insights from Severe Accident Design Features		
40	The emergency containment spray backup subsystem (ECSBS) for severe accident management is provided. The ECSBS is used as an alternate means of providing containment spray in the event of a beyond design basis accident in which all CSPs/SCPs or the IRWST are unavailable. The ECSBS is to be placed in service 24 hours after a severe accident to prevent a catastrophic failure of the containment. The fire engine truck as ECSBS pumping device is used to deliver water from external water sources to the ECSBS containment spray header after the initiation of a severe accident.	Subsection 6.2.2.2
	The operating procedure(s) for use of the ECSBS is to be developed by the COL applicant.	COL 19.2(2)
41	The reactor cavity is configured to promote retention of and heat removal from the postulated core debris during a severe accident, thus serving roles in accident mitigation.	Subsection 19.2.3.3
	The cavity flooding system consists of two independent divisions and is supplied, via gravity, from the IRWST via the HVT.	Subsection 6.8.3.1
	Procedures for use of the cavity flood system during a severe accident are to be developed by the COL applicant as part of its plant-specific severe accident management guidelines (SAMG).	COL 19.2(2)

Table 19.1-4 (20 of 25)

No.	Insight	Disposition
Risk Insights from Severe Accident Design Features		
42	In-vessel retention of core debris as result of external RV cooling is a potential means to mitigate a severe accident. The goal of external cooling is to retain the molten core debris in the RV lower plenum and thus prevent vessel failure. In-vessel retention precludes the possible ex-vessel physical phenomena related to debris relocation such as steam explosions and molten core-concrete interaction (MCCI). The plant is designed to allow operators to fill the reactor cavity with water and thereby submerge the RV in coolant. This can achieve ex-vessel cooling and in-vessel retention. However, in-vessel retention is not credited as a mitigation feature due to uncertainty surrounding the associated phenomena along with the need for operators to take additional manual actions.	Subsection 19.2.3.3.1
43	The hydrogen mitigation system (HMS) consists of igniters and passive autocatalytic recombiners (PARs) to control hydrogen concentration during a severe accident. HMS consists of eight igniters and 30 passive autocatalytic recombiners (PARs), which are strategically located inside the containment. The SAMG will address use of the HMS.	Subsection 6.2.5.1 Subsection 6.2.5.2 COL 19.2(2)

Table 19.1-4 (21 of 25)

No.	Insight	Disposition
Risk Insights from PRA Models		
44	During shutdown and startup, a motor-driven startup feedwater pump provides feedwater from the deaerator storage tank to the SGs. The startup feedwater pump can provide secondary heat removal via SGs, if the auxiliary feedwater system is unavailable.	Subsection 10.4.7.2 COL 13.5(4), COL 13.5(7)
45	The turbine bypass system (TBS) provides the capability to direct main steam from the SGs to the main condenser, bypassing the main turbine by controlling to dissipate heat and to minimize transient effects on the RCS. The TBS consists of the steam bypass control system (SBCS), the turbine bypass valves (TBVs), and associated piping and instrumentation. The TBS discharges steam from the main steam line upstream of the turbine stop valves to the condenser. The TBS consists of eight TBVs located in two lines (four bypass valves per line) branching from the main steam header and connecting to the condensers.	Subsection 10.4.4.2
	The TBVs are important in PRA to minimize initial pressure transient in the RCS following a reactor trip, thereby minimizing any potential challenge to the POSRVs.	Subsection 19.1.3.1
46	Aggressive secondary cooldown (ASC), which involves cooling of the RCS by opening the MSADVs and ensuring that AFW is being delivered to both SGs given failure of safety injection, has a significant impact on the CDF contribution for small LOCA and SGTR. Given a small LOCA or SGTR with failure of SIS, the SCS can be aligned to provide core injection if the RCS is depressurized to the SC pump shutoff head.	Subsection 19.1.3.1
	The COL applicant is to provide a program for developing and implementing emergency operating procedures, including the use of the AFWS, and the TBVs or MSADVs for ASC and alignment of the SCS for core injection operation.	COL 13.5(5)
47	The COL applicant is to consider the information on risk-significant operator actions from the PRA in developing and implementing procedures, training, and other human reliability related programs.	Subsection 19.1.8 Subsection 18.6.2 COL 13.2(5), COL 13.5(4)

Table 19.1-4 (22 of 25)

No.	Insight	Disposition
Risk Insights from PRA Models		
48	The COL applicant is to ensure that the safety-significant SSCs are included in the RAP, in developing and implementing procedures, to monitor these SSCs.	COL 17.4(1) COL 17.4(2)
49	The COL applicant is to address organization, training, qualification of personnel, implementation of fire protection program elements such as establishment of the fire brigade, implementation of a combustible and ignition source control program, firefighting procedures, development of inspection and test procedures and pre-fire plans, and quality assurance. In addition, the operators will be trained to rely on undamaged instrumentation once the location of the fire is known.	Subsection 9.5.1 Subsection 19.1.6.3 COL 9.5(1)
50	Integrity of divisional separation between redundant safety-related equipment is a key design feature in the fire and flood PRAs. This divisional separation, which extends also to the service water and component cooling water system structures, minimizes the potential for fires and floods propagating from one division to the other. There are no doors or passageways connecting the divisions of safety-related equipment up to elevation 68 ft in the auxiliary building.	Subsection 3.4.1.3 Subsection 9.5.1.1 Subsection 9.5.1.2.1 Subsection 9.5.1.1
51	The risk from internal flooding in the auxiliary building is minimized by the emergency overflow lines (EOLs) and floor drains that are designed to provide a flow path from upper elevations to the basement. This flow path, coupled with the large volume in the basement of each quadrant and drain sump alarms, provides time for operator action to detect and isolate any internal flood before equipment credited in the PRA could fail. The COL is to develop procedures to respond to sump alarms, investigate, and isolate pipe breaks, particularly fire protection system pipe breaks.	

Table 19.1-4 (23 of 25)

No.	Insight	Disposition
Risk Insights from PRA Models		
52	The auxiliary building is divided into many rooms housing the various equipment and systems. This segmentation prevents a pipe break in one room from spraying equipment in another room, thereby minimizing the risk from internal flooding.	
53	During plant shutdown operation, risk can be minimized by appropriate outage management, administrative controls, procedures, and operator knowledge of plant configuration. For example, the removable walls and slabs between areas in a division for equipment replacement must remain intact during plant shutdown operation. Any SSC maintenance that requires these removable walls and slabs to be removed must be performed during the defueled condition. Also, the foreign material exclusion (FME) program should direct that the covers be installed over the trash racks on the inlet to the holdup volume tank (HVT) during refueling outages. The COL applicant is to develop an appropriate shutdown safety management program to manage the shutdown risk that encompasses the FME program and the configuration control program. A configuration control program during an outage should require that the watertight flood doors and fire doors be maintained closed in at least one quadrant to help prevent common mode failures from internal floods or fires, where the SC or CS pump in the protected quadrant is operable. If the flood or fire doors (including the removable walls and slabs) to the protected quadrant must be opened for reasons other than normal ingress/egress, a flood or fire watch is to be established for the affected doors.	Subsection 19.1.6.1.1.7 COL 13.5(7)

Table 19.1-4 (24 of 25)

No.	Insight	Disposition
Risk Insights from PRA Models		
54	For a severe accident in LPSD conditions when the containment equipment hatch is open, the COL applicant should provide reasonable assurance that the hatch can be closed in 1 hour from the time of loss of SC. The closure should be accomplished under SBO or non-SBO conditions. Closure of the containment equipment hatch in LPSD conditions is important, where a sufficient number of hatch bolts should be engaged to provide reasonable assurance containment integrity as the containment pressurizes.	Subsection 5.4.7 COL 13.5(4), COL 13.5(7), Subsection 19.1.6.1
55	Passive autocatalytic recombiners (PARs) and igniters are normally placed to cope with at-power accidents, but hydrogen control should also be considered for LPSD configurations. The COL applicant should provide reasonable assurance that there is sufficient hydrogen control during a severe accident condition when the RCS is open (e.g., pressurizer manway, etc.).	 COL 13.5(7)
56	Solid state switching devices and electro-mechanical relays resistant to relay chatter are used in the safety I&C platforms. Use of these devices and relays either eliminates or minimizes the mechanical discontinuities associated with mechanical relays at operating reactors.	Subsection 7.4.2.5
57	The COL applicant is to perform a seismic walkdown to provide reasonable assurance that the as-designed and as-built plant conforms to the assumptions in the PRA-based seismic margins analysis and that seismic spatial systems interactions do not exist. Details of the seismic walkdown are to be developed by the COL applicant.	COL 19.1(4)

Table 19.1-4 (25 of 25)

No.	Insight	Disposition
Risk Insights from PRA Models		
58	The fire PRA assumes that the fire barrier management procedures used during LPSD will include directions to provide reasonable assurance that breached risk-significant fire barriers can be closed in sufficient time to prevent the spread of fire across the barrier. The procedural direction is to include the use of a fire watch whose duties are commensurate with the risk associated with the barrier. For example, for fire barriers that separate two fire compartments that both contain no equipment or cables necessary to prevent core damage or large early release during LPSD conditions, or have been demonstrated to have low risk significance, there will at least be a roving fire watch to check the barrier during rounds. For fire barriers separating fire compartments that contain equipment or cables necessary to prevent core damage or large early release during LPSD conditions, and have been demonstrated to be risk significant with respect to fire, a permanent fire watch will be established until the barrier is reclosed. In the latter case, the fire barrier management procedure is to direct that hoses or cables that pass through a fire barrier use isolation devices on both sides of a quick-disconnect mechanism that allow for reclosure of the barrier in a timely fashion to re-establish the barrier prior to fire spread across the barrier.	Subsection 19.1.6.3.1.2 COL 19.1(11)

Table 19.1-5 (1 of 2)

Relation of the Plant Safety Functions and the Initiating Events

Initiator Type	Impact on Core Performance Functions				Impact on Plant System Performance	Level 2 Analysis Considerations
	Reactivity Control	RCS Pressure Control	RCS Inventory Control	RCS Heat Removal		
LOCAs	None; LOCAs followed by reactor protection system (RPS) failure are grouped under the ATWS category.	None; the LOCA will depressurize the RCS eliminating potential to exceed upper RCS design pressure limit. RCS inventory control response will provide necessary lower limit pressure control.	Major impact. LOCA break size dictates the amount of RCS makeup required to ensure that the reactor core is covered.	Potential Major impact, depending on the break size and the occurrence of transient induced LOCAs. For medium and large LOCAs, the systems used to provide RCS inventory control are also used for RCS heat removal.	Potential major impact, depending on the location of the LOCA. LOCAs in SI or SC injection piping will partially fail these systems. ISLOCAs may fail plant systems due to dynamic effects (e.g., pipe whip) or steam flooding.	LOCAs are subdivided according to their ability to bypass the containment: • No bypass • Bypass - ISLOCAs - SGTRs

Table 19.1-5 (2 of 2)

Initiator Type	Impact on Core Performance Functions: Reactivity Control	RCS Pressure Control	RCS Inventory Control	RCS Heat Removal	Impact on Plant System Performance	Level 2 Analysis Considerations
Secondary Piping Break	Steam/feed line breaks followed by RPS failure are treated separately in the secondary pipe break accident sequence analysis.	Feed line break and isolation may require pressure control.	RCS inventory control is required. RCS integrity impacted if POSRVs fail to reclose.	Steam/feed line break will isolate steam and feedwater flow and actuate ECCS. The systems used to provide RCS inventory control are also used for RCS heat removal.	Potential major impact, depending on the location of the steam/feed line break. High energy line breaks (HELBs) may fail plant systems due to dynamic effects (e.g., pipe whip) or steam flooding.	No specific effects. HELBs that fail plant systems designed to prevent core damage may also fail containment systems.
Transients (including Special Initiators)	None; Transients followed by RPS failure are grouped under the ATWS category.	Potential major impact, depending on the specific initiator involved (e.g., LOOP).	None. Transient induced LOCAs (e.g., RCP seal LOCAs and safety relief valve LOCAs) are grouped under the LOCA category.	Potential major impact, depending on the specific initiator involved (e.g., loss of MFW).	Potential major impact, depending on the specific initiator involved. Special initiators are defined, in part, by their impact on post-trip plant system operation.	No specific effects. Special initiators that fail plant systems designed to prevent core damage may also fail containment systems.
ATWS	ATWS represents failure of the RPS.	Major impact since RCS pressure should be maintained below design limit.	Major impact if the peak pressure exceeds the RCS design limit.	Potential major impact, depending on the specific initiator involved (e.g., LOFW).	No specific effects. Plant system impacts related to transients, secondary breaks, and LOCAs apply to ATWS as well.	No specific effects. Level 2 considerations related to transients, secondary breaks, and LOCAs apply to ATWS as well.

Table 19.1-6 (1 of 2)

Internal Events PRA Initiating Event Frequencies

Designator	Initiating Event Description	Mean Frequency (Per Rx Critical Year)(1)	Mean Frequency (Per Rx Calendar Year)(2)	Error Factor
LLOCA(3)	Large LOCA (Rupture greater than 15.24 cm dia.)	1.33E-06	1.26E-06	10.7
MLOCA(3)	Medium LOCA (Rupture of 5.08 cm to 15.24 cm dia.)	5.10E-04	4.85E-04	10.0
SLOCA(3)	Small LOCA (Rupture of 5.08 cm dia. or less) (Total of SLOCA + RCP Seal LOCA + IOSRV Frequencies)	2.09E-03	1.99E-03	8.4
SGTR	Steam Generator Leakage/Tube Rupture	2.07E-03	1.97E-03	2.5
LSSB-U	Large Secondary Side Breaks Upstream of MSIV	3.67E-04	3.49E-04	8.4
LSSB-D	Large Secondary Side Breaks downstream of MSIV	7.70E-03	7.32E-03	1.6
LODCA	Loss of Class 1E 125V DC A	7.37E-04	7.00E-04	3.3
LODCB	Loss of Class 1E 125V DC B	7.37E-04	7.00E-04	3.3
GTRN	General Transient	6.90E-01	6.56E-01	1.7
LOFW	Loss of Main Feedwater	6.89E-02	6.55E-02	2.7
FWLB	Main Feedwater Line Break	1.83E-03	1.74E-03	2.5
LOCV	Loss of Condenser Vacuum	5.86E-02	5.57E-02	2.2
ATWS	Anticipated Transient without SCRAM	Transferred from each Event Tree (including RT)		N/A
LOOP	Loss of Offsite Power:	-		-
LOOP-PL	Plant-centered	1.93E-03	1.83E-03	2.5
LOOP-SW	Switchyard-centered	1.04E-02	9.88E-03	1.5
LOOP-GR	Grid-related	1.22E-02	1.16E-02	11.6

Table 19.1-6 (2 of 2)

Designator	Initiating Event Description	Mean Frequency (Per Rx Critical Year)[(1)]	Mean Frequency (Per Rx Calendar Year)[(2)]	Error Factor
LOOP-WE	Weather-related	3.91E-03	3.71E-03	1.7
SBO	Station Blackout	Transferred from LOOP Event Tree		1.7
LOIA[(3)]	Loss of Instrument Air System	2.48E-02	2.69E-02	2.1
TLOCCW[(3)]	Total Loss of Component Cooling Water System	2.46E-04	2.34E-04	8.4
PLOCCW[(3)]	Partial Loss of Component Cooling Water System	4.59E-03	4.36E-03	2.0
TLOESW[(3)]	Total Loss of Essential Service Water System	2.46E-04	2.34E-04	8.4
PLOESW[(3)]	Partial Loss of Essential Service Water System	1.72E-3	2.52E-03	2.6
RVR[(4)]	Reactor Vessel Rupture	3.22E-08	3.06E-08	67.5
ISLOCA[(5)]	Interfacing System Loss of Coolant Accident	1.24E-10	1.18E-10	10.0

(1) The mean frequencies for these initiating events are values presented in Reference 11 in units of per reactor critical year (rcry). (Excludes frequencies for ISLOCA, and reactor vessel rupture, which a separately calculated.)

(2) The mean frequencies for these initiating events were adjusted to an APR1400 specific per reactor calendar year (rcy). Converting to APR1400 specific reactor calendar year (rcy), it was assumed the reactor is critical 95% of the year.
Converting to rcy, the result is:
(Mean Initiating Event Frequency/rcry) × (0.95 rcry/rcy) = Mean Initiating Event Frequency/rcy

(3) APR1400 LOCA break size from generic industry data. These LOCA initiating event frequencies are used as an estimate for APR1400 LOCA frequencies.
Support system initiating event frequencies (/rcry) for LOIA, TLOCCW, PLOCCW, TLOESW, and PLOESW are calculated using fault trees in the initiating event analysis for information purposes. However, industry values for these parameters are utilized in the quantified PRA model.

(4) Reactor Vessel Rupture frequency (2.90E-08/rcy) was taken from NUREG-1829, Volume 1, Table 7.19, for break sizes > 31 inches (Reference 52). This value was treated similarly to other LOCA frequencies, converting to per reactor critical year by multiplying by 1 rcy/0.9 rcry.

(5) The ISLOCA initiating event frequency (/rcy) is taken from calculation. No Error Factor (EF) is calculated for this initiating event frequency and thus an EF of 10 is assumed.

Table 19.1-7 (1 of 2)

Level 1 Internal Events PRA Event Tree List

Initiator Group	Event Tree Name
1. Large Break Loss of Coolant Accident	LLOCA
2. Medium Break Loss of Coolant Accident	MLOCA
3. Small Break Loss of Coolant Accident	SLOCA
4. Stuck Open POSRV	PR-SL
5. Steam Generator Tube Rupture	SGTR
6. Interfacing System LOCA	ISLOCA
7. Reactor Vessel Rupture	RVR
8. General Transient	GTRN
9. Loss of Condenser Vacuum	LOCV
10. Loss of 125V DC - Bus A	LODCA
11. Loss of 125V DC - Bus B	LODCB
12. Loss of Main Feedwater	LOFW
13. Loss of Instrument Air	LOIA
14. Large Secondary Steam Line Break Upstream of MSIV	LSSB-U
15. Large Secondary Steam Line Break Downstream of MSIV	LSSB-D
16. Feedwater Line Break	FWLB

Table 19.1-7 (2 of 2)

Initiator Group	Event Tree Name
17. Loss of Offsite Power (Grid-related, plant-centered, switchyard-centered, weather-related)	LOOP
18. Consequential LOOP	GRID-LOOP
19. Station Blackout	SBO
20. Consequential SBO	GRID-SBO
21. Partial Loss of Component Cooling Water System	PLOCCW
22. Total Loss of Component Cooling Water System	TLOCCW
23. Partial Loss of Essential Service Water System	PLOESW
24. Total Loss of Essential Service Water System	TLOESW
25. Anticipated Without Scram	ATWS

Table 19.1-8 (1 of 6)

Event Tree Top Events and Success Criteria

Top Event	Top Event Description	Success Criteria	Event Trees
Reactivity Control			
RT	Reactor scram	All CEAs except the most reactive element are fully inserted into the core	FWLB, GTRN, LOCV, LODCA, LODCB, LOFW, LOIA, LOOP, LSSB-D, LSSB-U, MLOCA, SGTR, SLOCA
	Reactor scram and RCP trip	All CEAs except the most reactive element are fully inserted into the core and operators trip RCP manually	PLOCCW, PLOESW, TLOCCW, TLOESW
MTC	Sufficient negative moderator temperature coefficient (MTC) during ATWS	Negative MTC provides reactivity feedback to reduce power such that the primary system does not rupture on high pressure	ATWS
EBR	Emergency boration for long-term reactivity control during ATWS	1 of 2 charging pumps provides emergency boration	ATWS
RCS Pressure Control			
PFO	RCS pressure relief during ATWS	All four POSRVs must open	ATWS
BLEED	RCS bleed using POSRV for feed and bleed decay heat removal	2 of 4 POSRVs need to open	FWLB, GRID-LOOP, GTRN, LOCV, LOFW, LOIA, LOOP, LSSB-D, LSSB-U, PLOCCW, PLOESW, SBO, SGTR, SLOCA
		2 of 2 POSRVs need to open	LODCA, LODCB
		At least 2 POSRVs need to open	PR-SL

Table 19.1-8 (2 of 6)

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Pressure Control			
ASC	RCS is rapidly depressurized by aggressive secondary cooldown to enable shutdown cooling injection	• 1 of 2 AF pumps provides AFW to the intact SG, and • RCS is rapidly depressurized using 1 of 2 MSADVs on associated SG on associated SG to enable shutdown cooling injection	SGTR
		• 1 of 4 AF pumps provides AFW to 1 of 2 SGs, • 1 of 4 SITs injects borated water into RCS, and • RCS is rapidly depressurized using 1 of 2 MSADVs on associated SG on associated SG to enable shutdown cooling injection	SLOCA
ECLDN	RCS is depressurized to stop primary-to-secondary leakage before ruptured SG overfill occurs.	• RCS is depressurized to less than the MSSV lift pressure using 1 of 2 MSADVs on intact SG, • RCS pressure is controlled using auxiliary spray or RCGVS, and • AF pumps are throttled to prevent SG overfill in ruptured SG	LSSB-D, SGTR
LCLDN	RCS is depressurized after ruptured SG overfill occurs.	RCS is depressurized to less than SCS initiation limit using 1 of 2 MSADVs on intact SG	LSSB-D, SGTR

Table 19.1-8 (3 of 6)

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Integrity			
PRC	RCS integrity after challenge to POSRVs (No challenge to POSRVs, or if challenged, all POSRVs reclose after reducing RCS pressure)	All POSRVs must reclose	ATWS
		Primary pressure transient limited by steam relief using one MSSV or one TBV to below POSRV lift setting or all opened POSRV must reclose.	GTRN, LOFW
		All POSRVs must reclose	LOCV, LODCA, LODCB, LSSB-D, LSSB-U
		Primary pressure transient limited by steam relief using one MSSV to below POSRV lift setting or all opened POSRV must reclose.	LOIA, LOOP
PISGTR	SGTR due to pressure difference between primary and secondary side	Pressure difference between primary and secondary side does not result in SGTR	ATWS, FWLB, LSSB-D, LSSB-U
RCPSEAL	RCP seal integrity	RCP seal remains intact given RCP seal injection or auxiliary charging pump provides seal cooling	GRID-SBO, PLOCCW, PLOESW, SBO, TLOCCW, TLOESW
ISLOCA	Interfacing system LOCA	N/A	ISLOCA
RVR	RCS breaks which cannot be mitigated by ECCS	N/A	RVR

Table 19.1-8 (4 of 6)

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Heat Removal			
SIT	Safety Injection Tanks inject borated water	2 of 4 SITs inject borated water	LLOCA
SIS	SI pumps provides high pressure injection to make up lost RCS inventory	1 of 4 SI pumps provides DVI injection	FWLB, LSSB-D, LSSB-U, MLOCA, SGTR, SLOCA, PR-SL
		1 of 2 SI pumps provide DVI injection	PLOCCW, PLOESW
		3 of 4 SI pumps provide DVI injection	LLOCA
SCSI	SC pump injection to RCS	1 of 2 SCS pumps provides injection from IRWST	SGTR, SLOCA
RF	IRWST refill during SGTR	Refill IRWST with borated water using CVCS	LSSB-D, SGTR
	SI pump injection for feed and feed decay heat removal	1 of 4 SI pumps provides DVI injection	FWLB, GRID-LOOP, GTRN, LOCV, LOFW, LOIA, LSSB-D, LSSB-U LOOP, SBO, PLOCCW, PLOESW
		1 of 3 SI pumps provides DVI injection	LODCA, LODCB
HIN	Hot leg injection to prevent boron precipitation	1 of 2 SI pumps provides hot leg injection	LLOCA
SDC	Shutdown cooling for long-term heat removal	1 of 2 SCS pumps provides injection from hot leg	LSSB-D, SGTR

Table 19.1-8 (5 of 6)

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Heat Removal			
SHR	Auxiliary feedwater provides adequate flow to the steam generator to remove decay heat	1 of 4 AF pumps or Startup feedwater pump to associated SG, and 1 MSADV or 1 MSSV on associated SG or 1 TBV	GTRN
		1 of 4 AF pumps or Startup feedwater pump to 1 of 2 SGs, and 1 MSADV or 1 MSSV on associated SG	LOIA
		1 of 4 AF pumps to 1 of 2 SGs, and 1 MSADV or 1 MSSV on associated SG	LOCV, LOFW, LOOP, PR-SL, SLOCA
		1 of 2 AF TDPs or 1 AF MDP (only Division I AF MDP is lost) or Startup feedwater pump to associated SG, and 1 MSADV or 1 MSSV on associated SG or 1 TBV	PLOCCW, PLOESW
		1 of 2 AF TDPs or 1 AF MDP (only Division I AF MDP is lost) and 1 MSADV or 1 MSSV on associated	LODCA, LODCB
		1 of 2 AF TDPs or Startup feedwater pump to associated SG, and 1 MSADV or 1 MSSV on associated SG or 1 TBV	TLOESW, TLOCCW
		1 AF TDPs or 1 AF MDP with AAC to associated SG, and 1 MSADV or 1 MSSV on associated SG	SBO, GRID-SBO
		1 of 2 AF pumps to 2 of 2 SGs, and 1 MSSV or 1 ADV per SG	ATWS

Table 19.1-8 (6 of 6)

Top Event	Top Event Description	Success Criteria	Event Trees
RCS Heat Removal			
SHR1	Auxiliary feedwater provides adequate flow to the steam generator to remove decay heat with onsite emergency power supplied by EDGs	1 of 4 AF pumps to 1 of 2 SGs, and 1 MSADV or 1 MSSV on associated SG	GRID-LOOP
SHR-RAC	Auxiliary feedwater provides adequate flow to the steam generator to remove decay heat with offsite power recovered	1 of 4 AF pumps to 1 of 2 SGs, and 1 MSADV or 1 MSSV on associated SG	GRID-SBO, SBO
Containment Heat Removal			
CSR	Containment heat removal – long-term cooling of containment via CS heat exchangers	1 of 2 CS pumps provides long-term heat removal in recirculation mode	LLOCA, MLOCA
LHR	Long-term RCS cooling	1 of 2 CS pumps provides containment cooling or 1 of 2 SC pumps provides IRWST cooling	FWLB, GRID-LOOP, GTRN, LOCV, LOFW, PR-SL, SBO, SGTR, SLOCA, LOIA, LOOP, LSSB-D, LSSB-U
		1 of 2 CS pump provides containment cooling or 1 of 1 SC pump provides IRWST cooling	LODCA, LODCB
		1 of 1 CS pump provides containment cooling or 1 of 1 SC pump provides IRWST cooling	PLOCCW, PLOESW
General			
AAC	AAC power source	AAC power source aligned to one Class 1E 4.16 kV ac bus	GRID-SBO, SBO
DG	Standby emergency diesel generators provide AC power	1 of 4 EDGs provides ac power to Class 1E 4.16 kV ac bus	GRID-LOOP, LOOP
GRID	Offsite power available after reactor trip	Offsite power remains available after reactor trip	GTRN, LOCV, LODCA, LODCB, LOFW, LOIA, TLOCCW, TLOESW
ISOL	Steam generator isolation following secondary break	Both steam lines on at least one SG isolated by closing the MSIVs	FWLB, LSSB-D, LSSB-U
RAC-16HR	Offsite power recovery	Offsite power restored within 16 hours following an LOOP event	GRID-SBO, SBO

Table 19.1-9 (1 of 3)

PRA Modeled Systems

System Code	System Description/Title
AF	auxiliary feedwater system
AP	auxiliary power system
AT	auxiliary feedwater pump turbine system
AT	auxiliary feedwater pump turbine system
AX	auxiliary feedwater storage and transfer system
CC	component cooling water system
CD	condensate system
CS	containment spray system
CT	condensate storage and transfer system
CV	chemical and volume control system
CW	circulating water system
DA	AAC diesel generator
DC	DC distribution system
DG	emergency diesel generator system
DO	diesel fuel oil transfer system
DP	diverse protection system
EF	engineering safety features actuation system
FW	feedwater system
GW	gaseous radwaste system
HG	containment hydrogen control system
IA	instrument air system
IP	instrument power system
IW	in-containment water storage system

Table 19.1-9 (2 of 3)

System Code	System Description/Title
MP	main power system
MS	main steam system
NB	4.16 kV Non Class-1E System
NG	480 V load center non Class-1E system
NH	480 V MCC & low voltage non Class-1E system
NP	13.8 kV power system
NR	ex-core neutron flux monitoring system
PA	I&C equipment room and computer room panels and cabinets
PC	containment isolation system
PE	ESF-component control system
PF	4.16 kV Class-1E system
PG	480 V load center Class-1E system
PH	480 V mcc & low voltage Class-1E system
PO	process-component control system
RC	reactor coolant system
RG	reactor coolant gas vent system
RP	reactor protection system
SD	steam generator blowdown system
SI	safety injection/shutdown cooling system
SX	essential service water system

Table 19.1-9 (3 of 3)

System Code	System Description/Title
VC	control room HVAC
VD	emergency diesel generator area HVAC
VE	electrical and I&C equipment areas HVAC
VG	ESW building/CCW Hx building HVAC
VH	CW pump house HVAC
VK	auxiliary building controlled area HVAC
VO	auxiliary building clean area HVAC
VP	reactor containment building HVAC
VQ	reactor containment building purge
VU	miscellaneous building HVAC
WH	turbine generator building open cooling water system
WI	plant chilled water system
WL	raw water system
WM	makeup demineralizer system
WO	essential chilled water system
WT	turbine generator building closed cooling water system

Table 19.1-10 (1 of 2)

Dependency between Initiating Events and Front Line Systems

Initiator		LLOCA			MLOCA	SLOCA	SGTR	LSSB-U	LSSB-D	LOFW	FWLB	LOCV	LOIA	PLOCCW	TLOCCW	PLOESW	TLOESW	LODCA	LODCB	LOOP	SBO	GTRN	ATWS
System	SSC	C.L	H.L	DVI	C.L	C.L	SG2	SG2	SG2	-	SG2	-	-	A/C	A/B/C/D	A/C	A/B/C/D	MC01A	MC01B	-	-	-	-
RP	Shutdown rod																					P	T
RCS	Cold Leg (C.L)	T/X			T	T																P	
	Hot Leg (H.L2)		T/X																			P	
	DVI (1B)			T/X																		P	
SG	SG1 (MS line)	*	*	*	*	*																P	
	SG2 (MS line)	*	*	*	*	*	T/X	T/X	T		T/X											P	
SI	PP02A (SIT A)													X	X	X	X	X		E	X	P	
	PP02B (SIT B)														X		X		X	E	X	P	
	PP02C (SIT C)													X	X	X	X			E	X	P	
	PP02D (SIT D)		X	X											X		X			E	X	P	
SC	Train A													X	X	X	X	X		E	X	P	
	Train B														X		X		X	E	X	P	
CS	Train A													X	X	X	X			E	X	P	
	Train B														X		X			E	X	P	
RC	POSRV200	*	*	*	*													X		E	B	P	
	POSRV201	*	*	*	*														X	E	B	P	
	POSRV202	*	*	*	*													X		E	B	P	
	POSRV203	*	*	*	*														X	E	B	P	

Table 19.1-10 (2 of 2)

Initiator		LLOCA			MLOCA	SLOCA	SGTR	LSSB-U	LSSB-D	LOFW	FWLB	LOCV	LOIA	PLOCCW	TLOCCW	PLOESW	TLOESW	LODCA	LODCB	LOOP	SBO	GTRN	ATWS
System	SSC	C.L	H.L	DVI	C.L	C.L	SG2	SG2	SG2	-	SG2	-	-	A/C	A/B/C/D	A/C	A/B/C/D	MC01A	MC01B	-	-	-	-
AF	TDP01A	*	*	*	*															E	B	P	
	MDP02A	*	*	*	*									X	X	X	X	X		E	B	P	
	TDP01B	*	*	*	*		X	X	I		X									E	B	P	
	MDP02B	*	*	*	*		X	X	I		X				X		X		X	E	B	P	
MF	PP07	*	*	*	*	X		X	X	X	X	X						X	X	X	X	P	X
MS	MSADV101	*	*	*	*														X	E	B	P	
	MSADV102	*	*	*	*													X		E	B	P	
	MSADV103	*	*	*	*		I	X	I		X								X	E	B	P	
	MSADV104	*	*	*	*		I	X	I		X							X		E	B	P	
	TBVs	*	*	*	*	X		X	X		X	X	X							X	X	P	X
	MSSVs	*	*	*	*																	P	
CV	PP01A	*	*	*	*	*		*	*	*	*	*	*	X	X	X	X	*	*	*	X	P	
	PP01B	*	*	*	*	*		*	*	*	*	*	*	*	X	*	X	*	*	*	X	P	
	PP03	*	*	*	*	*	*	*	*	*	*	*	*					*	*	*	X	P	*
	PP05	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	
	PP06	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	P	

T - Loss of SSC(s) will cause an initiating event.

P - A partial loss of SSC(s) may cause transient.

X - Unavailable during the onset of accident condition.

B - Limited availability due to the battery capacity during SBO condition with AAC available.

E - Emergency power supplied from the each dedicated EDG.

I - Availability depends on the successful isolation of impacted SG.

* - Not considered in the event tree top events.

Table 19.1-11 (1 of 2)

Dependency between Initiating Events and Support Systems

Initiator		LLOCA			MLOCA	SLOCA	SGTR	LSSB-U	LSSB-D	LOFW	FWLB	LOCV	LOIA	PLOCCW	TLOCCW	PLOESW	TLOESW	LODCA	LODCB	LOOP	SBO	GTRN	ATWS
System	SSC	C.L	H.L	DVI	C.L	C.L	SG2	SG2	SG2	-	SG2	-	-	A/C	A/B/C/D	A/C	A/B/C/D	MC01A	MC01B	-	-	-	-
NP	Offsite power																			T/X		P	
DG	DG01A													X	X	X	X	X			T/X	P	
	DG01B														X		X		X		T/X	P	
	DG01C													X	X	X	X				T/X	P	
	DG01D														X		X				T/X	P	
PF	SW01A																			E	B	P	
	SW01B																			E	B	P	
	SW01C																			E	B	P	
	SW01D																			E	B	P	
DC	MC01A																	T/X		E	B	P	
	MC01B																		T/X	E	B	P	
	MC01C																			E	B	P	
	MC01D																			E	B	P	
SX	Train A													X	X	X	X	X		E	B	P	
	Train B														X		X		X	E	B	P	
	Train C													X	X	X	X			E	B	P	
	Train D														X		X			E	B	P	
CC	Train A													X	X	X	X	X		E	B	P	
	Train B														X		X		X	E	B	P	
	Train C													X	X	X	X			E	B	P	
	Train D														X		X			E	B	P	
WO	PP01A/CH01A													X	X	X	X	X		E	B	P	
	PP01B/CH01B														X		X		X	E	B	P	
	PP02A/CH02A													X	X	X	X			E	B	P	
	PP02B/CH02B														X		X			E	B	P	
VD	HV12/13A													X	X	X	X	X		E	B	P	
	HV12/13B														X		X		X	E	B	P	
	HV12/13C													X	X	X	X			E	B	P	
	HV12/13D														X		X			E	B	P	

Table 19.1-11 (2 of 2)

Initiator		LLOCA			MLOCA	SLOCA	SGTR	LSSB-U	LSSB-D	LOFW	FWLB	LOCV	LOIA	PLOCCW	TLOCCW	PLOESW	TLOESW	LODCA	LODCB	LOOP	SBO	GTRN	ATWS
System	SSC	C.L	H.L	DVI	C.L	C.L	SG2	SG2	SG2	-	SG2	-	-	A/C	A/B/C/D	A/C	A/B/C/D	MC01A	MC01B	-	-	-	-
VG	AH01/2A													X	X	X	X	X		E	B	P	
	AH01/2B														X		X		X	E	B	P	
	AH01/2C													X	X	X	X			E	B	P	
	AH01/2D														X		X			E	B	P	
VK	CC: HV13/14A													X	X	X	X	X		E	B	P	
	CC: HV13/14B														X		X		X	E	B	P	
	CV: HV18A	*	*	*	*	*		*	*	*	*	*	*	X	X	X	X	*	*	*	*	P	
	CV: HV18B	*	*	*	*	*		*	*	*	*	*	*		X		X	*	*	*	*	P	
	CV: HV34	*	*	*	*	*		*	*	*	*	*	*		*		*	*	*	*	*	*	*
	SI: HV12A													X	X	X	X	X		E	B	P	
	SI: HV12B														X		X		X	E	B	P	
	SI: HV12C													X	X	X	X			E	B	P	
	SI: HV12D														X		X			E	B	P	
	SC: HV16A													X	X	X	X	X		E	B	P	
	SC: HV16B														X		X		X	E	B	P	
	CS: HV10A													X	X	X	X			E	B	P	
	CS: HV10B														X		X			E	B	P	
IA	IA												T/X							X	X	P	
CD	CD	*	*	*	*	*		*	*	*	*	T/X								X	X	P	
CW	CW	*	*	*	*	*		*	*	*	*	T								X	X		
WT	WT	*	*	*	*	*		*	*	*	*									X	X	T	
WH	WH	*	*	*	*	*		*	*	*	*									X	X	T	

T - Loss of SSC(s) will cause an initiating event.

P - A partial loss of SSC(s) may cause transient.

X - Unavailable during the onset of accident condition.

B - Limited availability due to the battery capacity during SBO condition with AAC available.

E - Emergency power supplied from the each dedicated EDG.

I - Availability depends on the successful isolation of impacted SG.

* - Not considered in the event tree top events.

Table 19.1-12

RELAP Thermal-Hydraulic Run Summaries

Case	LOCA Size	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation
Large Break Loss of Coolant Accident – Safety Injection						
1(a)	Double-ended rupture (30 inch diameter)	Three Safety Injection pumps Two Injection tanks	No Charging pumps No Auxiliary Feedwater pumps No Containment Spray pumps No Shutdown Cooling pumps (Sensitivity analysis with location is performed)	< 1400 K (< 2060^{o}F)	Core damage prevented	N/A
Small Break Loss of Coolant Accident – ASC Timing						
1(b)	2 inch (0.02 ft2)	One Safety Injection tank	One AFW pump One SC pump One Atmospheric Dump Valve No Safety Injection pumps No Charging pumps No Containment Spray pumps	< 998.4 K	Core damage prevented	40 min
Double Ended Steam Generator Tube Rupture – ASC Timing						
1(c)	0.75 inch (one U-tube double-ended rupture)	MSSVs	One AFW pump One SC pump One Atmospheric Dump Valve No Safety Injection pumps No Charging pumps No Containment Spray pumps No Safety Injection Tanks	< 640 K	Core damage prevented	23 hrs
1(d)		One ADV opens on the ruptured SG		< 640 K	Core damage prevented	5 hrs

Table 19.1-13 (1 of 7)

MAAP Thermal-Hydraulic Run Summaries

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation	Notes
6 inch Medium Break Loss of Coolant Accident – Safety Injection						
1(a)	One SI pump	No Charging pumps No AFW pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1400^{o}F at t=0	Core damage prevented	N/A	N/A

Table 19.1-13 (2 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
2 inch Small Break Loss of Coolant Accident – Hot Leg Break –SC Injection Timing						
2(a)	One SC pump at 7.5 hrs	One AFW pump One Shutdown Cooling pump One Safety Injection Tank No Safety Injection Pump No Charging pumps No Containment Spray pumps	~1400°F at t=0	Core damage prevented	40 minutes (100°F/hr)	N/A
2 inch Small Break Loss of Coolant Accident – Cold Leg Break – Early Feed & Bleed Timing						
2(b)	One SI pump and two POSRV used for F&B at 80 min	No Charging pumps No AFW pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1400°F	Core damage prevented	N/A	N/A
3/8 inch Small Break Loss of Coolant Accident – Cold Leg Break – Late Feed & Bleed Timing						
2(c)	One SI pumps and two POSRVs used for F&B at 12.5 hrs	One AFW pump One Atmospheric Dump Valve No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1400°F at t=0	Core damage prevented	N/A	Secondary Heat Removal available for 8 hrs

Table 19.1-13 (3 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
Double Ended Steam Generator Tube Rupture – Steam Generator Overfill						
3(a)	One ADV opens on ruptured SG	Four Safety Injection pumps Four Safety Injection tanks Two AFW pumps No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps	N/A	N/A	N/A	3.7 hrs to SG overfill with AFW flow throttled
Double Ended Steam Generator Tube Rupture – IRWST depletion timing						
3(b)	One SI pump (One ADV does not open on ruptured SG)	One AFW pump No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	N/A	N/A	N/A	IRWST depleted in 31.6 hrs
3(c)	Four SI pumps (One ADV opens on ruptured SG)					IRWST depleted in 15.8 hrs
Double Ended Steam Generator Tube Rupture – SCP injection timing						
3(d)	One SC pump at 11 hrs	One AFW pump No Safety Injection Tanks No Safety Injection pumps No Charging pumps No Containment Spray pumps	~1700°F	Core damage prevented	7.5 hrs (100°F/hr)	N/A

Table 19.1-13 (4 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
General Transient – Early Feed & Bleed						
4(a)	One SI pump and two POSRVs used for F&B at 90 min	No Charging pumps No AFW pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1600°F	Core damage prevented	N/A	N/A
General Transient – Late Feed & Bleed						
4(b)	One SI pump and two POSRVs used for F&B at 12.5 hrs	One AFW pump One Atmospheric Dump Valve No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1600°F	Core damage prevented	N/A	Secondary Heat Removal available for 8.0 hrs
General Transient – Secondary Heat Removal						
4(c)	One AFW pump	No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	>5000°F after SG dryout	Core damage limit exceeded	N/A	AFWST depletion at t= 19.0 hrs

Table 19.1-13 (5 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
General Transient – Steam Generator Dry-out timing						
4(d)	One ADV RCPs tripped at 20 min	No Charging pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection tanks No Shutdown Cooling pumps	>5000°F after RCS boildown	Core damage limit exceeded	N/A	SG dryout at 54 min (Rapid temperature rise begins at 1.6 hrs)
Loss of Feedwater - Early Feed & Bleed						
5(a)	One SI pump and two POSRVs used for F&B at 70 min	No Charging pumps No AFW pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection tanks	>1720°F	Core damage prevented	N/A	N/A
Loss of Feedwater - Late Feed & Bleed						
5(b)	One SI pump and two POSRVs used for F&B at 12.5 hrs	One AFW pump One Atmospheric Dump Valve No Charging pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection Tanks	~1400°F	Core damage prevented	N/A	Secondary Heat Removal available for 8.0 hrs

Table 19.1-13 (6 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
Loss of Feedwater - AFWST depletion						
5(c)	One ADV, MSSVs RCPs tripped at 30 min	One AFW pump No Charging pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection tanks No Shutdown Cooling pumps	~1400°F at t=0	Core damage prevented	N/A	AFWST depletion at 32.0 hrs
5(d)	One ADV		>5100°F	Core damage limit exceeded	N/A	AFWST depletion at 16.6 hrs
Loss of Feedwater – Steam Generator Dryout timing						
5(e)	One ADV RCPs tripped at 20 min	No Charging pumps No AFW pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection tanks No Shutdown Cooling pumps	>5000°F	Core damage limit exceeded	N/A	SG dryout at 34 min (Rapid temperature rise begins at 65 min)
Loss of Feedwater – IRWST cooling						
5(f)	One SI pump and two POSRVs used for F&B at 70 min	No Charging pumps No AFW pumps No Containment Spray pumps No Shutdown Cooling pumps No Safety Injection tanks	N/A	N/A	N/A	IRWST is saturated at t = 2.6 hrs

Table 19.1-13 (7 of 7)

Case	Available Components	Other Initial and Boundary Conditions	Peak Fuel Temperature	Results	ASC Initiation and Rate	Notes
Station Blackout – AFWST depletion timing						
6(a)	One ADV, MSSVs	One AFW pump No Charging pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection Tanks No Shutdown Cooling pumps	~1400°F at t=0	Core damage prevented	N/A	AFWST depletion at 33 hrs
6(b)	MSSVs				N/A	AFWST depletion at 42 hrs
Station Blackout – Steam Generator Dry-out timing						
6(c)	No components available	No Charging pumps No AFW pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection tanks No Shutdown Cooling pumps	>5000°F	Core damage limit exceeded	N/A	SG dryout at 81 minutes (Rapid temperature rise begins at 2 hrs)
FWLB – AF Isolation Valve Cycling						
7(a)	One ADV, MSSVs RCPs tripped at 20 min	One AFW pump No Charging pumps No Containment Spray pumps No Safety Injection pumps No Safety Injection tanks No Shutdown Cooling pumps	~1400°F at t=0	Core damage prevented	N/A	Cycling number of 37 (Open/Close of 74)
7(b)	MSSVs RCPs tripped at 20 min		~1400°F at t=0	Core damage prevented	N/A	Cycling number of 57 (Open/Close of 114)

Table 19.1-14 (1 of 16)

Component Failure Rate Data

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--ADY	Fail to Operate of Air Dryer	h	5.00E-06	0.30	6.00E+04	18.8	Gamma	Table 10-5, ADU FTOP, Running
--AHL	Fail to Load and Run of Fan (≤1h)	h	1.07E-03	33.50	3.13E+04	1.3	Beta	Table 9-13, FAN FTR, Standby
--AHR	Fail to Run of Fan (>1h)	h	4.54E-05	4.50	9.92E+04	2.0	Gamma	Table 9-13, FAN FTR, Standby
--AHS	Fail to Start of Fan	d	8.42E-04	34.50	4.09E+04	1.3	Beta	Table 9-13, FAN FTR, Standby
SXAHR	Fail to Run of ESW Cooling Tower Fan	h	2.30E-06	2.50	1.09E+06	2.5	Gamma	Table 10-11, CTF FTR, Running/Alternating
SXAHS	Fail to Start of ESW Cooling Tower Fan	d	7.73E-04	1.50	1.94E+03	3.3	Beta	Table 10-11, CTF FTS, Running/Alternating
VGAHR	Fail to Run of Fan	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VGAHS	Fail to Start of Fan	d	7.09E-04	42.50	5.99E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
--AVC	Fail to Close of Air Operated Valve	d	9.51E-04	1.11	1.17E+03	4.0	Beta	Table 1-4, AOV FTO/C, All
--AVO	Fail to Open of Air Operated Valve	d	9.51E-04	1.11	1.17E+03	4.0	Beta	Table 1-4, AOV FTO/C, All
--AVT	Fail to Remain Open of Air Operated Valve	h	1.31E-07	0.68	5.21E+06	6.0	Gamma	Table 1-4, AOV SOP, All

Table 19.1-14 (2 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
MSAVC	Fail to Close of Turbine Bypass Valve	d	2.47E-04	0.50	2.02E+03	8.5	Beta	Table 1-22, TBV FTC, All
MSAVO	Fail to Open of Turbine Bypass Valve	d	4.20E-03	8.50	2.02E+03	1.7	Beta	Table 1-22, TBV FTO, All
--BCY	Fail to Operate of Battery Charger	h	2.71E-06	1.28	4.73E+05	3.6	Gamma	Table 5-4, BCH FTOP, All
--BDY	Failure of Isolable Phase Bus Duct	h	1.39E-06	0.70	5.07E+05	5.8	Gamma	Table 5-19, BUS FTOP, AC
--BSY	Fail to Operate of Electrical AC Bus	h	1.39E-06	0.70	5.07E+05	5.8	Gamma	Table 5-19, BUS FTOP, AC
DCBSY	Fail to Operate of Electrical DC Bus	h	2.35E-07	1.50	6.38E+06	3.3	Gamma	Table 5-19, BUS FTOP, DC
NHBSY	Fail to Operate of Electrical MCC Bus (Non-Class 1E)	h	2.61E-07	0.84	3.23E+06	4.9	Gamma	Table 5-22, MCC FTOP, All
PHBSY	Fail to Operate of Electrical MCC Bus (Class 1E)	h	2.61E-07	0.84	3.23E+06	4.9	Gamma	Table 5-22, MCC FTOP, All
--BTY	Fail to Provide Output of Battery	h	5.86E-07	1.88	3.21E+06	2.9	Gamma	Table 5-7, BAT FTOP, All
--CCT	Fail to Proper Output of Core Protection Calculator	h	2.19E-06	-	-	2.0	Lognormal	IEEE Standard 500

Table 19.1-14 (3 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--CHR	Fail to Run of Chiller Unit	h	3.05E-05	180.50	5.91E+06	1.1	Gamma	Table 9-10, CHL FTR, All
--CHS	Fail to Start of Chiller Unit	d	1.30E-02	0.58	4.41E+01	6.9	Beta	Table 9-10, CHL FTS, All
--CMR	Fail to Run of Air Compressor	h	8.50E-05	2.00	2.36E+04	2.8	Gamma	Table 10-4, CMP FTR, Motor-driven
--CMS	Fail to Start of Air Compressor	d	1.71E-02	0.59	3.37E+01	6.8	Beta	Table 10-4, CMP FTS, Motor-driven
--CVC	Fail to Close of Check Valve	d	2.38E-04	0.81	3.38E+03	5.1	Beta	Table 1-28, CKV FTC, All
--CVO	Fail to Open of Check Valve	d	1.07E-05	0.50	4.68E+04	8.4	Beta	Table 1-28, CKV FTO, All
--DGL	Fail to Load and Run of Diesel Generator (≤1h)	d	3.78E-03	2.77	7.31E+02	2.4	Beta	Table 3-4, EDG FTLR, All
--DGR	Fail to Run of Diesel Generator (>1h)	h	1.10E-03	4.49	4.09E+03	2.0	Gamma	Table 3-4, EDG FTR, All
--DGS	Fail to Start of Diesel Generator	d	2.89E-03	8.11	2.80E+03	1.7	Beta	Table 3-4, EDG FTS, All
--TGL	Fail to Run of Alternate AC Generator (≤1h)	d	1.60E-05	2.50	1.56E+05	2.5	Beta	Table 3-8, CTG FTLR, All
--TGR	Fail to Run of Alternate AC Gas Turbine Generator (>1h)	h	7.40E-03	3.50	4.73E+02	2.2	Gamma	Table 3-8, CTG FTR, All

Table 19.1-14 (4 of 16)

Type Code(1)	Description	Unit	Mean	α	β	EF(2)	Distribution (Source)	Data Source(4)
--TGS	Fail to Start of Alternate AC Gas Turbine Generator	d	1.56E-02	10.50	6.63E+02	1.6	Beta	Table 3-8, CTG FTS, All
--DPL	Fail to Load and Run of Positive Displacement Pump (≤1H)	h	7.09E-04	2.50	3.53E+03	2.5	Beta	Table 2-13, PDP FTR≤1H, Standby
--DPR	Fail to Run of Positive Displacement Pump (>1H)	h	2.13E-03	2.50	1.18E+03	2.5	Gamma	Table 2-13, PDP FTR>1H, Standby
--DPS	Fail to Start of Positive Displacement Pump	d	1.79E-03	14.50	8.07E+03	1.5	Beta	Table 2-13, PDP FTS, Standby
--EVC	Fail to Close of Electro-Hydraulic Valve	d	1.20E-03	24.50	2.05E+04	1.4	Beta	Table 1-10, HOV FTO/C, All
--EVO	Fail to Open of Electro-Hydraulic Valve	d	1.20E-03	24.50	2.05E+04	1.4	Beta	Table 1-10, HOV FTO/C, All
MSEVC	Fail to Close of Main Steam Isolation Valve	d	7.79E-04	23.50	3.02E+04	1.4	Beta	Table 1-25, MSV FTO/C, All
--FLP	Fail to Operate of Filter due to Plug	h	3.10E-07	3.50	1.13E+07	2.2	Gamma	Table 6-4, FLT PG, FLT
SXFLP	Fail to Operate of ESW Debris Filter due to Plug	h	2.32E-06	44.50	1.91E+07	1.3	Gamma	Table 6-6, FLTSC PG, Self-Cleaning
SISPP-S-IRWST	Fail to Operate of Sump Strainer due to Plug	h	5.08E-07	5.50	1.08E+07	1.9	Gamma	Table 6-8, SMP PG, Sump

Table 19.1-14 (5 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
SISPP-S-CHEMICAL	Debris Induced Loss of Long Term Cooling (Downstream/Chemical Effect)	d	1.00E-05	-	-	10.0	Lognormal	Engineering Judgment
--FMY	Fail to Operate of ESW Debris Filter Motor	h	4.00E-06	76.50	1.91E+07	1.2	Gamma	Table 6-6, FLTSC FTOP, Self-Cleaning
--GDT	Failure of Log Power Calculator in Ex-core Drawer	h	2.64E-06	-	-	2.0	Lognormal	IEEE Standard 500
--HBC	Fail to Close of High Voltage Circuit Breaker	d	6.66E-03	1.09	1.63E+02	4.0	Beta	Table 5-13, CBK FTO/C, HV
--HBO	Fail to Open of High Voltage Circuit Breaker	d	6.66E-03	1.09	1.63E+02	4.0	Beta	Table 5-13, CBK FTO/C, HV
--HBI	Open Spuriously of High Voltage Circuit Breaker	h	8.08E-07	1.37	1.70E+06	3.5	Gamma	Table 5-13, CBK SOP, HV
--HEY	Fail to Operate of Heat Exchanger	h	4.57E-07	0.53	1.17E+06	7.8	Gamma	Table 10-22, HTX LOHT, All
CCHEY	Fail to Operate of CC Heat Exchanger	h	5.23E-07	16.50	3.16E+07	1.5	Gamma	Table 10-22, HTX LOHT, CCW
--HTR	Fail to Run of H2 Igniter	-	-	-	-	-	-	Igniter data may be used for sensitivity analysis for Level 2 PRA if required. The final value and source of igniter data are not determined yet.
--HTS	Fail to Start of H2 Igniter	-	-	-	-	-	-	

Table 19.1-14 (6 of 16)

Type Code(1)	Description	Unit	Mean	α	β	EF(2)	Distribution (Source)	Data Source(4)
HGPAR	Fail to Operate of PAR	h	1.00E-05	-	-	10.0	Lognormal	Engineering Judgment (for Level 2 PRA)
--HVL	Fail to Load and Run of Cubicle Cooler (Standby) (≤1H)	h	1.07E-03	33.50	3.13E+04	1.3	Beta	Table 9-13, FAN FTR, Standby
--HVR	Fail to Run of Cubicle Cooler (Standby) (>1H)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Standby
--HVS	Fail to Start of Cubicle Cooler (Standby)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTR, Standby
VKHVR-A-HV18A	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVR-B-HV18B	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVR1A-HV13A	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVR1B-HV13B	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVR2A-HV14A	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVR2B-HV14B	Fail to Run of Cubicle Cooler (Running)	h	5.88E-06	0.53	9.02E+04	7.9	Gamma	Table 9-13, FAN FTR, Running/Alternating
VKHVS-A-HV18A	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating

Table 19.1-14 (7 of 16)

Type Code(1)	Description	Unit	Mean	α	β	EF(2)	Distribution (Source)	Data Source(4)
VKHVS-B-HV18B	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
VKHVS1A-HV13A	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
VKHVS1B-HV13B	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
VKHVS2A-HV14A	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
VKHVS2B-HV14B	Fail to Run of Cubicle Cooler (Running)	d	7.09E-04	42.50	6.00E+04	1.3	Beta	Table 9-13, FAN FTS, Running/Alternating
--INY	Fail to Operate of Inverter	h	5.60E-06	1.18	2.11E+05	3.8	Gamma	Table 5-16, INV FTOP, All
LBC	Fail to Open of Low Voltage Circuit Breaker	d	2.72E-03	0.56	2.05E+02	7.4	Beta	Table 5-13, CBK FTO/C, MV
DCLBC	Fail to Close of DC Power Circuit Breaker	d	5.73E-04	7.50	1.31E+04	1.7	Beta	Table 5-13, CBK FTO/C, DC
DCLBI	Open Spuriously of DC Power Circuit Breaker	h	4.94E-08	4.50	9.12E+07	2.0	Gamma	Table 5-13, CBK SOP, DC
DCLBO	Fail to Open of DC Power Circuit Breaker	d	5.73E-04	7.50	1.31E+04	1.7	Beta	Table 5-13, CBK FTO/C, DC
--LTY	Fail to Operate of Level Transmitter	h	1.02E-07	0.50	4.92E+06	8.4	Gamma	Table 7-7, STL FTOP, All
--PTY	Fail to Operate of Pressure Transmitter	h	8.22E-07	0.50	6.08E+05	8.4	Gamma	Table 7-7, STP FTOP, All

Table 19.1-14 (8 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--TTY	Fail to Operate of Temperature Transmitter	h	8.40E-07	0.50	5.95E+05	8.5	Gamma	Table 7-7, STT FTOP, All
--MPL	Fail to Load and Run of Motor Driven Pump (≤ 1h)	h	1.23E-04	1.82	1.48E+04	3.0	Beta	Table 2-4, MDP FTR≤1H, Standby
--MPR	Fail to Run of Motor Driven Pump (>1h)	h	3.53E-06	2.29	6.50E+05	2.6	Gamma	Table 2-4, MDP FTR, Running/Alternating
--MPS	Fail to Start of Motor Driven Pump	d	1.36E-03	3.28	2.41E+03	2.3	Beta	Table 2-4, MDP FTS, Running/Alternating
AFMPR	Fail to Run of Aux. Feedwater Motor-Driven Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby
AFMPS	Fails to Start of Aux. Feedwater Motor-Driven Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
AFTPS	Fail to Start of Aux. Feedwater Turbine-Driven Pump	d	6.48E-03	0.94	1.44E+02	4.5	Beta	Table 2-7, TDP FTS, Standby
CSMPR	Fail to Run of Containment Spray Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby
CSMPS	Fail to Start of Containment Spray Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby

Table 19.1-14 (9 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--XPL	Fail to Load and Run of Diesel Driven Pump (≤ 1h)	h	1.26E-03	0.55	4.41E+02	7.4	Gamma	Table 2-10, EDP FT≤1H, Standby
--XPR	Fail to Run of Diesel Driven Pump (>1h)	h	2.27E-03	9.50	4.18E+03	1.6	Gamma	Table 2-10, EDP FTR>1H, Standby
--XPS	Fail to Start of Diesel Driven Pump	d	5.09E-03	0.73	1.43E+02	5.6	Beta	Table 2-10, EDP FTS, Standby
DAMPS	Fail to Start of Motor Driven Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
DOMPR	Fail to Run of Motor Driven Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby
DOMPS	Fail to Start of Motor Driven Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
SIMPR	Fail to Run of Safety Injection Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby
SIMPS	Fail to Start of Safety Injection Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
SIMPR1A-SCPP01A	Fail to Run of Shutdown Cooling Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby
SIMPR1B-SCPP01B	Fail to Run of Shutdown Cooling Pump	h	1.04E-05	0.78	7.50E+04	5.3	Gamma	Table 2-4, MDP FTR>1H, Standby

Table 19.1-14 (10 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
SIMPS1A-SCPP01A	Fail to Start of Shutdown Cooling Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
SIMPS1B-SCPP01B	Fail to Start of Shutdown Cooling Pump	d	9.47E-04	1.95	2.05E+03	2.9	Beta	Table 2-4, MDP FTS, Standby
--MVC	Fail to Close of Motor Operated Valve	d	9.63E-04	2.05	2.12E+03	2.8	Beta	Table 1-7, MOV FTO/C, All
--MVO	Fail to Open of Motor Operated Valve	d	9.63E-04	2.05	2.12E+03	2.8	Beta	Table 1-7, MOV FTO/C, All
--MVR	Fail to Control of Motor Operated Valve	h	6.62E-08	1.46	2.21E+07	3.4	Gamma	Table 1-7, MOV FC, All
--MVT	Fail to Remain Open Of Motor Operated Valve	h	3.39E-08	0.57	1.68E+07	7.2	Gamma	Table 1-7, MOV SOP, All
AFMVC[3]	Fail to Close of AF Isolation Valve for Cycling Operation	d	5.78E-02	130.30	2.12E+03	1.1	Beta	Engineering Judgment with Table 1-7, MOV FTO/C, All
AFMVO[3]	Fail to Open of AF Isolation Valve for Cycling Operation	d	5.78E-02	130.30	2.12E+03	1.1	Beta	Engineering Judgment with Table 1-7, MOV FTO/C, All
--MWA	Manual Pushbutton (Hand Switch) Failure to Transfer	d	1.26E-04	0.50	3.96E+03	8.4	Beta	Table 7-12, MSW FTO/C, All

Table 19.1-14 (11 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--NET	Ex-core Detector (Neutron Flux Detector) Improper Output	h	5.00E-06	-	-	5.0	Lognormal	WSRC-TR-83-262, Rev.1, Table 1f, Radiation Failure (Reference 15)
--NZP	Fail to Operate of Spray Nozzle due to Plug	d	1.00E-06	0.30	3.00E+05	18.7	Gamma	Table 10-15, ORF PG, Running
--PVO	Fail to Open of Pilot Operated Safety Relief Valve (POSRV)	d	3.54E-03	16.50	4.64E+03	1.5	Beta	Table 4-10, PORV FTO, RCS
AFPVR	Fail to Run of AF TDP/MDP due to Volute Failure	h	6.57E-05	7.50	1.14E+05	1.7	Gamma	Table 2-16, PMP FTR, AFW
--RBO	Fail to Open of Reactor Trip Circuit Breaker	d	1.54E-05	0.50	3.25E+04	8.4	Beta	Table 7-10, RTB BME FTOP, All
--RVO	Fail to Open of Safety Valve	d	4.51E-04	0.50	1.12E+03	8.4	Beta	Table 4-7, SVV FTO, PWR MSS
--SDT	Failure of Sub-channel Power Calculator in Ex-core Drawer	h	2.19E-06	-	-	2.0	Lognormal	IEEE Standard 500
--SQA	Fail to Operate of DG Sequencer	d	1.76E-03	3.50	1.98E+03	2.2	Beta	Table 5-27, SEQ FTOP, All
--STE	Fail to Energize of Shunt Trip Device	d	3.29E-04	0.50	1.52E+03	8.4	Beta	Table 7-10, RTB BSN FTOP, All

Table 19.1-14 (12 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--SVO	Fail to Open of Solenoid Operated Valve	d	1.19E-03	30.50	2.56E+04	1.3	Beta	Table 1-13, SOV FTO/C, All
--SVC	Fail to Close of Solenoid Operated Valve	d	1.19E-03	30.50	2.56E+04	1.3	Beta	Table 1-13, SOV FTO/C, All
--SVR	Fail to Control of Solenoid Operated Valve	h	4.68E-07	61.50	1.31E+08	1.2	Gamma	Table 1-13, SOV FC, All
AFSVI	Spurious Close of AFW Modulation Valve	h	3.43E-08	4.50	1.31E+08	0.2	Gamma	Table 1-13, SOV SOP, All
--TKB	Fail to Operate of Pressurized Liquid Tank	h	3.26E-07	6.50	1.99E+07	1.7	Gamma	Table 10-14, TNK ELS, Liquid & Pressurized
CDTKB	Fail to Operate of Unpressurized Liquid Tank	h	2.60E-07	6.50	2.50E+07	1.1	Gamma	Table 10-14, TNK ELS, Liquid & Unpressurized
CTTKB	Fail to Operate of Unpressurized Liquid Tank	h	2.60E-07	6.50	2.50E+07	1.1	Gamma	Table 10-14, TNK ELS, Liquid & Unpressurized
IATKB	Fail to Operate of Gas Tank	h	6.86E-07	2.50	3.65E+06	2.5	Gamma	Table 10-14, TNK ELS & ELL, Gas
--TWY	Fail to Operate of Temperature Switch	h	1.00E-06	-	-	3.0	Lognormal	WSRC-TR-83-262, Rev.1, Table 1f, Temperature Failure (Reference 15)

Table 19.1-14 (13 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--UVD	Fail to De-energize of Under-voltage Trip Device	d	4.13E-04	0.50	1.21E+03	8.4	Beta	Table 7-10, RTB BUV FTOP, All
--VVC	Fail to Close of Manual Valve	d	1.92E-04	0.50	2.61E+03	8.4	Beta	Table 1-31, XVM FTO/C, All
--VVO	Fail to Open of Manual Valve	d	1.92E-04	0.50	2.61E+03	8.4	Beta	Table 1-31, XVM FTO/C, All
--VVT	Transfer Closed of Manual Valve	h	8.42E-08	8.50	1.01E+08	1.6	Gamma	Table 1-31, XVM SOP, All
--XHY	Fail to Operate of High Voltage Transformer	h	9.44E-07	0.96	1.01E+06	4.5	Gamma	Table 5-25, TFM FTOP, All
--XLY	Fail to Operate of Low Voltage Transformer	h	9.44E-07	0.96	1.01E+06	4.5	Gamma	Table 5-25, TFM FTOP, All
--XMY	Fail to Operate of Medium Voltage Transformer	h	9.44E-07	0.96	1.01E+06	4.5	Gamma	Table 5-25, TFM FTOP, All
--XOY	Fail to Operate of Main Transformer	h	9.44E-07	0.96	1.01E+06	4.5	Gamma	Table 5-25, TFM FTOP, All
--XWA	Failure of Automatic Transfer Switch	d	1.60E-03	0.50	3.12E+02	8.4	Beta	Table 5-10, ABT FF, All
--ZVO	Fail to Open of Power Operated Check Valve	h	1.07E-05	0.50	4.68E+04	8.4	Beta	Table 1-28, CKV FTO, All

Table 19.1-14 (14 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
DPTCA	Fail to Actuate (Open) of Trip Contractor for MG Set-X (DPS-X)	d	2.48E-05	0.50	2.01E+04	3.8	Beta	Table 7-14, RLY FTOP, All
I-ATWS-RPMCF	Failure to Scram due to Mechanical Failures	d	2.98E-07	28.50	9.56E+07	1.3	Gamma	Table 8-6, ROD FTOP, ROD
--AIY	Failure of Analog Input Module	h	8.89E-06	-	-	2.8	Lognormal	Reference plant data
--BPT	Fail to Operate of RP Bi-stable Processor (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
--CIY	Fail to Operate of Communication Module (CI631)	h	7.78E-07	-	-	2.8	Lognormal	Reference plant data
--CPT	Fail to Operate of Computational Module for LCL (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
--DIY	Failure of Ovation Digital Input Module	h	2.65E-06	-	-	2.8	Lognormal	Reference plant data
--DOY	Failure of Ovation Digital Output Module	h	2.65E-06	-	-	2.8	Lognormal	Reference plant data
--GCT	Fail to Operate of ESFAS logic controller (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data

Table 19.1-14 (15 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--GXY	Fail to Operate of Group Controller (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
--IAT	Failure of Bistable Analog Input Module	h	8.89E-06	-	-	2.8	Lognormal	Reference plant data
--IOT	Failure of Digital Output Module (DI-630)	h	1.00E-06	-	-	2.8	Lognormal	Reference plant data
RPIDY	Failure of Trip Signal from Bi-stable Input Module	h	1.00E-06	-	-	2.8	Lognormal	Reference plant data
--IRE	Fail to De-energized of Interposing Relay	d	9.50E-06	-	-	4.6	Lognormal	Reference plant data
--LPT	Fail to Operate of DPS Channel Processor (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
T--LPY	Fail to Operate of Local Panel (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
--LXY	Fail to Operate of Loop Controller (PM646)	h	3.95E-06	-	-	2.8	Lognormal	Reference plant data
--ORT	Fail to Operate of Fiber Optic Receiver	h	5.36E-06	-	-	2.8	Lognormal	Reference plant data
--OTT	Fail to Operate of Fiber Optic Transmitter	h	5.36E-06	-	-	2.8	Lognormal	Reference plant data

Table 19.1-14 (16 of 16)

Type Code[1]	Description	Unit	Mean	α	β	EF[2]	Distribution (Source)	Data Source[4]
--WDA	Fail to Open of Watchdog Timer Switch	d	1.00E-07	-	-	2.8	Lognormal	Reference plant data
--WDY	Fail to Operate of Watchdog Timer	d	1.00E-07	-	-	2.8	Lognormal	Reference plant data

(1) Refer to the type codes in Table 19.1-15.

(2) The error factor is the 95th percentile divided by the median provided in each data source.

(3) AF isolation valve cycles are estimated to be 60 based on MAAP evaluation, which is multiplied with 9.63E-04 of MOV fail to open/close data provided in NUREG/CR-6928 (Reference 11).

(4) The table numbers designate the table numbers in the NUREG/CR-6928 (Reference 11).

Table 19.1-15 (1 of 13)

Component Boundaries

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--ADY	Fail to Operate of Air Dryer	h	Air dryer package for IA system	Air dryer package
--AHL	Fail to Run of Fan (≤1h)	h	Fans in IA, VU systems	Fan, motor, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
--AHR	Fail to Run of Fan (>1h)	h		
--AHS	Fail to Start of Fan	d		
SXAHR	Fail to Run of ESW Cooling Tower Fan	h	Cooling tower fans for SX system	Fan, motor, local circuit breaker, local lubrication or cooling systems, local instrumentation and control circuitry
SXAHS	Fail to Start of ESW Cooling Tower Fan	d		
VGAHR	Fail to Run of Fan	h	ESW pump room cooling fans	Fan, motor, local circuit breaker, local lubrication or cooling systems, local instrumentation and control circuitry
VGAHS	Fail to Start of Fan	d		
--AVC	Fail to Close of Air Operated Valve	d	Air operated valves for AT, CD, CV, IA systems	Valve, valve operator (including the associated solenoid operated valves), local instrumentation and control circuitry
--AVO	Fail to Open of Air Operated Valve	d		
--AVT	Fail to Remain Open of Air Operated Valve	h		
MSAVC	Fail to Close of Turbine Bypass Valve	d	Turbine bypass valves for MS system	Valve, valve operator (including the associated solenoid operated valves), local instrumentation and control circuitry
MSAVO	Fail to Open of Turbine Bypass Valve	d		
--BCY	Fail to Operate of Battery Charger	h	Class 1E battery chargers for DC power	Battery charger

Table 19.1-15 (2 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--BDY	Failure of Isolable Phase Bus	h	Isolable phase bus	Bus component itself including the bus bar, fuses, and control circuitry
--BSY	Fail to Operate of Electrical AC Bus	h	Bus for AC power	Bus component itself including the bus bar, fuses, and control circuitry
DCBSY	Fail to Operate of Electrical DC Bus	h	Bus for DC power	Bus component itself including the bus bar, fuses, and control circuitry
NHBSY	Fail to Operate of Non Class 1E Electrical MCC Bus	h	Bus for MCC power	MCC cabinet, the bus bars, fuses, and protection equipment
PHBSY	Fail to Operate of Class 1E Electrical MCC Bus	h	Bus for MCC power	MCC cabinet, the bus bars, fuses, and protection equipment
--BTY	Fail to Provide Output of Battery	h	Class 1E batteries for DC power	Battery cells
--BTY	Fail to Provide Output of Battery	h		
--CCT	Fail to Proper Output of Core Protection Calculator	h	Core protection calculators for RPS/ESFAS	Core protection calculator
--CHR	Fail to Run of Chiller Unit	h	Essential chillers for WO system	Compressor, motor, evaporator, condenser, control unit, local instrumentations, local panel, valves and breakers
--CHS	Fail to Start of Chiller Unit	d		
--CMR	Fail to Run of Air Compressor	h	Motor driven centrifugal air compressors for IA system	Compressor, driver, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
--CMS	Fail to Start of Air Compressor	d		

Table 19.1-15 (3 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--CVC	Fail to Close of Check Valve	d	Check valves or check dampers	Valve only
--CVO	Fail to Open of Check Valve	d		
FWCVO	Fail to Open of Check Valve	d		
--DGL	Fail to Run of Diesel Generator (≤1h)	d	Class 1E emergency diesel generators	Diesel engine with all components in the exhaust path, electrical generator, generator exciter, output breaker, combustion air, lube oil systems, fuel oil feed pump, diesel fuel oil day tank and starting compressed air system, and local instrumentation and control circuitry, cooling flow control valves for the EDG HX.
--DGR	Fail to Run of Diesel Generator (>1h)	h		
--DGS	Fail to Start of Diesel Generator	d		
--TGL	Fail to Run of Alternate AC Gas Turbine Generator (≤1h)	d	Non-1E alternate AC gas turbine generator	Gas turbine, generator, circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
DATGR-S-AACTG	Fail to Run of Alternate AC Gas Turbine Generator (>1h)	h		
DATGS-S-AACTG	Fail to Start of Alternate AC Gas Turbine Generator	d		
--DMO	Fails to Open of Pneumatic Operated Damper	d	Pneumatic Operated Damper	Valve, valve operator, and local instrumentation and control circuitry
VKDMT	Transfer Closed of Hydraulic Operated Damper	h	Hydraulic Operated Damper	Valve, valve operator, and local instrumentation and control circuitry

Table 19.1-15 (4 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--DPL	Fail to Run of Positive Displacement Pump (≤ 1h)	h	Positive displacement pumps for CV systems	Pump, motor, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
--DPR	Fail to Run of Positive Displacement Pump (>1h)	h		
--DPS	Fail to Start of Positive Displacement Pump	d		
--EVC	Fail to Close of Electro-Hydraulic Valve	d	Main feedwater isolation valves for FW system	Valve, valve operator, and local instrumentation and control circuitry
--EVO	Fail to Open of Electro-Hydraulic Valve	d		
MSEVC	Fail to Close of Main Steam Isolation Valve	d	Main steam isolation valves for MS system	Valve, valve operator, local circuit breaker, and local instrumentation and control circuitry
--FLP	Fail to Operate of Filter due to Plug	h	Filters for CV, IA, VG, WH, WT systems	Filter
SXFLP	Fail to Operate of ESW Debris Filter due to Plug	h	ESW debris filters for SX system	Strainer, rotating assembly, backwash valves, and control circuitry
SISPP-S-IRWST	Fail to Operate of Sump Strainer due to Plug	h	Sump strainer for IRWST	Strainer
--FMY	Fail to Operate of ESW Debris Filter Motor	h	ESW debris filter motors for SX system	Debris filter motor
--GDT	Failure of Log Power Calculator in Ex-core Drawer	h	Log power calculators	Calibrated avg. power calculator in ex-core drawer

Table 19.1-15 (5 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--HBC	Fail to Close of High Voltage Circuit Breaker	d	Circuit Breakers ≥ 4.16kV	Breaker itself and local instrumentation and control circuitry
--HBO	Fail to Open of High Voltage Circuit Breaker	d		
--HEY	Fail to Operate of Heat Exchanger	h	Heat exchangers for CS, CV, IA, SI, WT systems	Heat exchanger shell and tubes
CCHEY	Fail to Operate of CC Heat Exchanger	h	Heat exchangers for CC system	Heat exchanger shell and tubes
--HVL	Fail to Run of Cubicle Cooler (≤1h)	h	Room cubicle coolers for standby systems	Fan, cooling unit, valves, control circuitry, and breakers
--HVR	Fail to Run of Cubicle Cooler (>1h)	h		
--HVS	Fail to Start of Cubicle Cooler	d		
VKHVR-A-HV18A	Fails to Run of Cubicle Cooler	h	Room cubicle coolers for normally running systems	Fan, cooling unit, valves, control circuitry, and breakers
VKHVR-B-HV18B	Fails to Run of Cubicle Cooler	h		
VKHVR1A-HV13A	Fails to Run of Cubicle Cooler	h		
VKHVR1B-HV13B	Fails to Run of Cubicle Cooler	h		
VKHVR2A-HV14A	Fails to Run of Cubicle Cooler	h		
VKHVR2B-HV14B	Fails to Run of Cubicle Cooler	h		
VKHVS-B-HV18B	Fails to Start of Cubicle Cooler	d		
VKHVS1A-HV13A	Fails to Start of Cubicle Cooler	d		

Table 19.1-15 (6 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
VKHVS1B-HV13B	Fails to Start of Cubicle Cooler	d	Room cubicle coolers for normally running systems	Fan, cooling unit, valves, control circuitry, and breakers
VKHVS2A-HV14A	Fails to Start of Cubicle Cooler	d		
VKHVS2B-HV14B	Fails to Start of Cubicle Cooler	d		
VOHVR1A-HV31A	Fails to Run of Cubicle Cooler	h		
VOHVR1B-HV31B	Fails to Run of Cubicle Cooler	h		
VOHVR2A-HV32A	Fails to Run of Cubicle Cooler	h		
VOHVR2B-HV32B	Fails to Run of Cubicle Cooler	h		
VOHVS1A-HV31A	Fails to Start of Cubicle Cooler	d		
VOHVS1B-HV31B	Fails to Start of Cubicle Cooler	d		
VOHVS2A-HV32A	Fails to Start of Cubicle Cooler	d		
VOHVS2B-HV32B	Fails to Start of Cubicle Cooler	d		
--INY	Fail to Operate of Inverter	h	Inverters	Inverter unit
--LBC	Fails to Close of Low Voltage Circuit Breaker	d	Circuit breakers < 4.16kV	Breaker itself and local instrumentation and control circuitry
--LTT	Fail to Operate of Level Transmitter	h	Level transmitters	Sensor and transmitter
--LTY	Fail to Operate of Level Transmitter	h		
--PTT	Fail to Operate of Pressure Transmitter	h	Pressure transmitters	Sensor and transmitter
--PTY	Fail to Operate of Pressure Transmitter	h		

Table 19.1-15 (7 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--TTY	Fail to Operate of Temperature Transmitter	h	Temperature transmitters	Sensor and transmitter
--MPR	Fail to Run of Motor Driven Pump	h	Motor driven pumps for normally running systems	Pump, motor, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
--MPS	Fail to Start of Motor Driven Pump	d		
CCMPR	Fail to Run of Component Cooling Water Pump	h		
CCMPS	Fail to Start of Component Cooling Water Pump	d		
--MPL	Fail to Run of Motor Driven Pump (≤1h)	h	Motor driven pumps for standby systems	Pump, motor, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
AFMPR	Fail to Run of Aux. Feedwater Motor-Driven Pump (>1h)	h		
AFMPS	Fail to Start of Aux. Feedwater Motor-Driven Pump	d		
CSMPR	Fail to Run of Containment Spray Pump (>1h)	h		
CSMPS	Fail to Start of Containment Spray Pump	d		
DOMPR	Fail to Run of Motor Driven Pump (>1h)	h	Motor driven pumps for standby systems	Pump, motor, local circuit breaker, local lubrication or cooling systems, and local instrumentation and control circuitry
DOMPS	Fail to Start of Motor Driven Pump	d		
SIMPR	Fail to Run of Safety Injection System Pump (>1h)	h		
SIMPS	Fail to Start of Safety Injection System Pump	d		

Table 19.1-15 (8 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
AFTPL	Fail to Run of Aux. Feedwater Turbine-Driven Pump (≤1h)	h	Turbine driven pumps for AF system	Pump, turbine, governor control, steam emission valve, local lubrication or cooling systems, and local instrumentation and controls
AFTPR	Fail to Run of Aux. Feedwater Turbine-Driven Pump (>1h)	h		
AFTPS	Fail to Start of Aux. Feedwater Turbine-Driven Pump	d		
--XPL	Fail to Load and Run of Diesel Driven Pump (≤1h)	h	Diesel driven pump	Pump, diesel engine, local lubrication or cooling systems, and local instrumentation and control circuitry
--XPR	Fail to Run of Diesel Driven Pump (>1h)	h		
--XPS	Fail to Start of Diesel Driven Pump	d		
--MVC	Fail to Close of Motor Operated Valve	d	Motor operated valves	Valve, valve operator, local circuit breaker, and local instrumentation and control circuitry
--MVO	Fail to Open of Motor Operated Valve	d		
--MVR	Fail to Control of Motor Operated Valve	h		
--MVT	Fail to Remain Open Of Motor Operated Valve	h		
--MWA	Manual Pushbutton (Hand Switch) Failure to Transfer	d	Manual hand switch	Switch itself
--NET	Ex-core Detector (Neutron Flux Detector) Improper Output	h	Ex-core detector (neutron flux detector)	Ex-core detector

Table 19.1-15 (9 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
AFMVC	Fail to Close of AF Motor Operated Isolation Valve for Cycling Operation	d	Motor operated valves for cycling operation in AF system	Valve, valve operator, local circuit breaker, and local instrumentation and control circuitry
AFMVO	Fail to Open of AF Motor Operated Isolation Valve for Cycling Operation	d		
--NZP	Fail to Operate of Spray Nozzle due to Plug	h	Containment spray nozzle	Containment spray nozzle
--PVC	Fail to Close of Pilot Operated Safety Relief Valve (POSRV)	d	Pilot operated safety relief valves for RC system	Spring loaded safety valves, and its operator
--PVO	Fail to Open of POSRV	d		
AFPVR	Fail to Run of AF TDP/MDP due to Volute Failure	h	Pump volutes for AF system	Pump volute portion of AFW MDPs and TDPs
--RBO	Fails to Open of Reactor Trip Circuit Breaker	d	Main/Bypass trip breakers including all related mechanical components	Entire trip breaker (mechanical portion of the breaker)
--RVO	Fail to Open of Safety Valve	d	Main steam safety valves	Valve and valve operator
--SDT	Failure of Sub-channel Power Calculator in Ex-core Drawer	h	Sub-channel power calculator in ex-core drawer	Calibrated avg. power calculator in ex-core drawer
--SQA	Fail to Operate of DG Sequencer	d	DG sequencers	Relays, logic modules, etc. that comprise the sequencer function of the EDG load process
--STE	Shunt Trip Device Fails to energize	d	Shunt trip devices	Shunt trip device

Table 19.1-15 (10 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--SVO	Fails to Open of Solenoid Operated Valve	d	Solenoid operated valves for AF, CV, RG systems	Valve, valve operator, and local instrumentation and control circuitry
--SVR	Fail to Control of Solenoid Operated Valve	h		
AFSVI	Spurious Close of AFW Modulation Valve	h	Solenoid operated valves for AF system	Valve, valve operator, and local instrumentation and control circuitry
--TKB	Fail to Operate of Pressurized Liquid Tank	h	Pressurized liquid tanks	Tank
CDTKB	Fail to Operate of Unpressurized Tank	h	Unpressurized liquid tanks	Tank
CTTKB	Fail to Operate of Unpressurized Tank	h		
IATKB	Fail to Operate of Gas Tank	h	Gas tanks for IA system	Tank
--TWY	Fail to Operate of Temperature Switch	h	Temperature switch	Temperature switch
--UVD	Under-voltage Trip Device fails to de-energize	d	Under-voltage trip devices	Under-voltage trip device
--VVC	Fail to Close of Manual Valve	d	Manual valves	Valve, valve operator
--VVO	Fail to Open of Manual Valve	d		
--VVR	Transfer Closed (SOP)	h		
--VVT	Transfer Close of Manual Valve	h		
--XHY	Fails to Operate of High Voltage Transformer	h	Transformers (UATs/SATs)	Transformer unit including the wiring, cooling and protection equipment

Table 19.1-15 (11 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--XLY	Fails to Operate of Low Voltage Transformer	h	Transformers (480-120V)	Transformer unit including the wiring, cooling and protection equipment
--XMY	Fails to Operate of Medium Voltage Transformer	h	Transformers (4160-480V)	Transformer unit including the wiring, cooling and protection equipment
--XOY	Fails to Operate of Main Transformer	h	Main transformer	Transformer unit including the wiring, cooling and protection equipment
--XWA	Failure of Automatic Transfer Switch	d	Automatic/Manual transfer switch	Automatic/Manual transfer switch
--ZVO	Fail to Open of Power Operated Check Valve	h	Startup feedwater pump discharge stop check valve for FW system	Valve only
I-ATWS-RPMCF	Failure to Scram due to Mechanical Failures	d	Control rod	Control rod excluding the drive mechanism
--AIY	Failure of Analog Input Module	h	Analog input modules for RPS/ESFAS and VU system	Analog Input Module
--BPT	Fail to Operate of RP Bi-stable Processor (PM646)	h	Bi-stables for RPS/ESFAS	Bistable processor
--CIT	Fail to Operate of Communication Module (CI631)	h	Communication modules for RPS/ESFAS	Communication module
--CPT	Fail to Operate of RP LCL Processor (PM646)	h	LCL processors	LCL processor
--DIY	Failure of Digital Input Module	h	Digital input modules for RPS/ESFAS	Digital input module
--DOY	Failure of Digital Output Module	h	Digital output modules for RPS/ESFAS	Digital output module

Table 19.1-15 (12 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--GCT	Fail to Operate of ESFAS Logic Controller (PM646)	h	Group controllers for RPS/ESFAS	Group controller
--GDT	Failure of Log Power Calculator in Ex-core Drawer	h	Log Power Calculator	Log Power Calculator
--GXT	Fail to Operate of Group Controller (PM646)	h	Group controllers for components	Group controller
--GXY	Fail to Operate of Group Controller (PM646)	h		
--IAT	Failure of Bistable Analog Input Module	h	Bistable analog input modules	Analog input module
--IOT	Failure of Digital Output Module (DI-630)	h	Digital output module(DI-630)	Digital output module
RPIDY	Failure of Trip Signal from Bi-stable Input Module	h	Bi-stable input module	Bi-stable input module
--IRE	Fail to De-energized of Interposing Relay	d	Interposing relay	Interposing relay
--LDT	Failure of Calibrated Avg. Power Calculator in Ex-core Drawer	h	Calibrated Average Power Calculator	Calibrated Average Power Calculator
--LPT	Fail to Operate of DPS Channel Processor (PM646)	h	DPS processors	DPS processor
--LPY	Fail to Operate of Local Panel (PM646)	h	Local panels	Local panel
--LXY	Fail to Operate of Loop Controller (PM646)	h	Loop controllers	Loop controller
--ORT	Fail to Operate of Fiber Optic Receiver	h	Fiber optic receiver	Fiber optic receiver

Table 19.1-15 (13 of 13)

Type Code	Description	Unit	Grouping	Equipment Boundary Definition
--OTT	Fail to Operate of Fiber Optic Transmitter	h	Fiber optic transmitter	Fiber optic transmitter
--WDA	Fail to Open of Watchdog Timer Switch	d	Watch dog switch	Watch dog switch
--WDY	Fail to Operate of Watchdog Timer	d	Watch dog timers	Watch dog timer

Table 19.1-16

Special Basic Events

Basic Event	Value	Description	Data Source
MTC-ATWS	1.60E-01	No Adverse Moderator Temperature Coefficient	Engineering Judgment
SEAL-AFSUC	4.00E-03	RCP Seal LOCA Probability after success of secondary heat removal	Engineering Judgment
RAC16H-PL	3.03E-03	Non-recoverable probability of Offsite power within 16 hours after plant-centered LOOP	NUREG/CR-6890, Volume 1, Table 4-1
RAC16H-SW	5.89E-03	Non-recoverable probability of Offsite power within 16 hours after switchyard-centered LOOP	NUREG/CR-6890, Volume 1, Table 4-1
RAC16H-GR	1.01E-02	Non-recoverable probability of Offsite power within 16 hours after grid-related LOOP	NUREG/CR-6890, Volume 1, Table 4-1
RAC16H-WE	1.59E-01	Non-recoverable probability of Offsite power within 16 hours after weather-related LOOP	NUREG/CR-6890, Volume 1, Table 4-1
PFLOOP-TRANS	2.40E-03	Conditional LOOP upon Transients	EPRI Interim Technical Report (Reference 11)
PFLOOP-LOCA	2.40E-02	Conditional LOOP upon LOCA initiators	EPRI Interim Technical Report

Table 19.1-17

Level 1 Internal Events CDF Contribution by Initiating Events

Initiator	Frequency (/yr)	Percent Contribution (%)
SBO+LOOP	5.11E-07	39.4
TLOCCW+TLOESW	1.58E-07	12.2
MLOCA	1.23E-07	9.5
PLOCCW	1.22E-07	9.4
PLOESW	7.04E-08	5.4
ATWS	5.57E-08	4.3
SLOCA	4.93E-08	3.8
SGTR	4.88E-08	3.8
LSSB-D	4.55E-08	3.5
RVR	3.06E-08	2.4
FWLB	1.89E-08	1.5
GTRN	1.68E-08	1.3

Table 19.1-18 (1 of 8)

Level 1 Internal Events Top Accident Sequences

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
1	LOOP_005	1.73E-07	13.4	LOOP * /RT-LOOP * /PRC-MSSV * /DG * SHR-E12LO * PO-E24LO	LOOP * Success of reactor trip * No POSRV challenge * Success of one or more EDGs * Failure of secondary heat removal * Failure of bleed for F&B operation
2	SBO_009	1.14E-07	22.2	SBO * AAC * /SHR1-E12TD * /RSF-SBO-AFSUC * RAC-16HR	SBO * Failure of AAC * Success of secondary heat removal with AF TDPs * No RCP seal LOCA * Failure of offsite power recovery within 16hours
3	PLOCCW_007	1.13E-07	30.9	PLOCCW * /RT-LOCCW * SHR-E12CC * / PO-E24CC * SIF-I12CC	PLOCCW * Success of reactor trip * Failure of secondary heat removal * Success of bleed for F&B operation * Failure of SI feed for F&B operation
4	MLOCA_002	1.10E-07	39.4	MLOCA * /RT-MLOCA * / SI-I14 * CS-S12	MLOCA * Success of reactor trip * Success of SI injection * Failure of CS operation
5	PLOESW_007	6.53E-08	44.4	PLOESW * /RT-LOESW * SHR-E12CC * / PO-E24CC * SIF-I12CC	PLOESW * Success of reactor trip * Failure of secondary heat removal * Success of bleed for F&B operation * Failure of SI feed for F&B operation
6	SBO_004	6.27E-08	49.3	SBO * /AAC * SHR-12AC * /PO-E22 * /SIF-I12SBO * SCR12CSS12SBO	SBO * Success of AAC * Failure of secondary heat removal * Success of F&B operation * Failure of long term cooling with SC/CS
7	TLOCCW_002	5.86E-08	53.8	TLOCCW * /RT-LOCCW * /GTRN-GRID * /SHR-E12TC * RSF-TC-AFSUC	TLOCCW * Success of reactor trip * No consequential LOOP * Success of secondary heat removal * RCP seal LOCA occurs

Table 19.1-18 (2 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
8	TLOESW_002	5.86E-08	58.3	TLOESW * /RT-LOCCW * /GTRN-GRID * /SHR-E12TC * RSF-TC-AFSUC	TLOESW * Success of reactor trip * No consequential LOOP * Success of secondary heat removal * RCP seal LOCA occurs
9	LOOP_004	5.07E-08	62.2	LOOP * /RT-LOOP * /PRC-MSSV * /DG * SHR-E12LO * /PO-E24LO * SIF-I14LO	LOOP * Success of reactor trip * No POSRV challenge * Success of one or more EDGs * Failure of secondary heat removal * Success of bleed for F&B operation * Failure of SI feed for F&B operation
10	SLOCA_007	4.50E-08	65.7	SLOCA * /RT-SLOCA * SI-I14 * /ASC-12SL * SC-I12SL	SLOCA * Success of reactor trip * Failure of SI injection * Success of aggressive secondary cooling operation * Failure of shutdown cooling injection
11	ATWS_007	4.13E-08	68.9	ATWS * MTC-ATWS	ATWS * Adverse MTC (Moderator Temperature Coefficient)
12	GRID-SBO_003	3.63E-08	71.7	GRID-SBO * /AAC * SHR-E12AC	GRID-SBO * Success of AAC * Failure of secondary heat removal
13	RVR_001	3.06E-08	74.0	RVR	Reactor vessel rupture
14	LOOP_003	2.87E-08	76.3	LOOP * /RT-LOOP * /PRC-MSSV * /DG * SHR-E12LO * /PO-E24LO * / SIF-I14LO * SCR12CSS12LO	LOOP * Success of reactor trip * No POSRV challenge * Success of one or more EDGs * Failure of secondary heat removal * Success of F&B operation * Failure of long term cooling with SC/CS

Table 19.1-18 (3 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
15	LSSB-D_019	2.63E-08	78.3	LSSB-D * /RT-LSSB * /PRC-LSSB * PISGTR * / SI-I14SG * ISOL-LSSBD	LSSB * Success of reactor trip * No POSRV challenge * Pressure-induced SGTR occurs * Success of SI injection * Failure of steam line isolation
16	TLOCCW_003	2.04E-08	79.9	TLOCCW * /RT-LOCCW * /GTRN-GRID * SHR-E12TC	TLOCCW * Success of reactor trip * No consequential LOOP * Failure of secondary heat removal
17	TLOESW_003	2.04E-08	81.4	TLOESW * /RT-LOCCW * /GTRN-GRID * SHR-E12TC	TLOESW * Success of reactor trip * No consequential LOOP * Failure of secondary heat removal
18	SGTR_006	1.83E-08	82.9	SGTR * /RT-SGTR * /SI-I14SG * /SHR-E11SG * ECLDN * LCLDN * CV-IRWST	SGTR * Success of reactor trip * Success of SI injection * Success of secondary heat removal * Failure of initial RCS cooldown and late cooldown * Failure of IRWST refill
19	SGTR_009	1.77E-08	84.2	SGTR * /RT-SGTR * /SI-I14SG * SHR-E11SG * PO-E24	SGTR * Success of reactor trip * Success of SI injection * Failure of secondary heat removal * Failure of bleed for F&B operation
20	GTRN_005	1.64E-08	85.5	GTRN * /RT-GTRN * /PRC-GTRN * /GTRN-GRID * SHR-E12GT * PO-E24	GTRN * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation
21	FWLB_005	1.56E-08	86.7	FWLB * /RT-LOFW * /PISGTR * / ISOL * SHR-E11FB * PO-E24	FWLB * Success of reactor trip * No Pressure-induced SGTR * Success of steam line isolation * Failure of secondary heat removal * Failure of bleed for F&B operation

Table 19.1-18 (4 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
22	MLOCA_003	1.35E-08	87.7	MLOCA * / RT-MLOCA * SI-I14	MLOCA * Success of reactor trip * Failure of SI injection
23	LSSB-D_009	1.21E-08	88.7	LSSB-D * /RT-LSSB * /PRC-LSSB * /PISGTR * ISOL-LSSBD * PO-E24ISOL	LSSB * Success of reactor trip * No POSRV challenge * No Pressure-induced SGTR * Failure of steam line isolation * Failure of bleed for F&B operation
24	SBO_011	1.03E-08	89.5	SBO * AAC * SHR1-E12TD	SBO * Failure of AAC * Failure of secondary heat removal with AF TDPs
25	GRID-LOOP_005	1.01E-08	90.2	GRID-LOOP * /DG * SHR1-E12LO * PO-E24LO	GRID-LOOP * Success of one or more EDGs * Failure of secondary heat removal * Failure of bleed for F&B operation
26	LOFW_005	9.77E-09	91.0	LOFW * /RT-LOFW * /PRC-GTRN * /LOFW-GRID * SHR-E12GT * PO-E24	LOFW * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation
27	LLOCA_003	9.56E-09	91.7	LLOCA * /ST-I24LL * /SI-I34LL * SI-HL-LL	LLOCA * Success of SIT injection * Success of SI injection * Failure of SI hot leg injection
28	LOCV_005	9.17E-09	92.4	LOCV * /RT-LOCV * /PRC-POSRV * /LOCV-GRID * SHR-E12GT * PO-E24	LOCV * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation
29	SBO_010	8.57E-09	93.1	SBO * AAC * /SHR1-E12TD * RSF-SBO-AFSUC	SBO * Failure of AAC * Success of secondary heat removal with AF TDPs * RCP seal LOCA occurs

Table 19.1-18 (5 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
30	SBO_005	7.78E-09	93.7	SBO * /AAC * SHR-12AC * /PO-E22 * SIF-I12SBO	SBO * Success of AAC * Failure of secondary heat removal * Success of bleed for F&B operation * Failure of SI feed for F&B operation
31	ATWS_004	5.85E-09	94.2	ATWS * /MTC-ATWS * /PFO-ATWS * / PRC-ATWS * PISGTR	ATWS * No adverse MTC (Moderator Temperature Coefficient) * Success of POSRVs open * Success of POSRVs reseat * Pressure-induced SGTR occurs
32	SGTR_004	5.06E-09	94.5	SGTR * /RT-SGTR * /SI-I14SG * /SHR-E11SG * ECLDN * /LCLDN * SC-C12 * CV-IRWST	SGTR * Success of reactor trip * Success of SI injection * Success of secondary heat removal * Failure of initial RCS cooldown * Success of late RCS cooldown * Failure of shutdown cooling operation * Failure of IRWST refill
33	ATWS_002	4.07E-09	94.9	ATWS * /MTC-ATWS * /PFO-ATWS * /PRC-ATWS * /PISGTR * /SHR-E22FW * EBR	ATWS * No adverse MTC (Moderator Temperature Coefficient) * Success of POSRVs open * Success of POSRVs reseat * No Pressure-induced SGTR * Success of secondary heat removal * Failure of boron injection via charging pump
34	SGTR_012	3.80E-09	95.2	SGTR * /RT-SGTR * SI-I14SG * /ASC-11SG * SC-I12SL	SGTR * Success of reactor trip * Failure of SI injection * Success of aggressive secondary cooling operation * Failure of shutdown cooling injection
35	PLOCCW_008	3.31E-09	95.4	PLOCCW * /RT-LOCCW * SHR-E12CC * PO-E24CC	PLOCCW * Success of reactor trip * Failure of secondary heat removal * Failure of bleed for F&B operation
36	ATWS_006	3.07E-09	95.6	ATWS * /MTC-ATWS * PFO-ATWS	ATWS * No adverse MTC (Moderator Temperature Coefficient) * Failure of POSRVs open

Table 19.1-18 (6 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
37	LSSB-U_005	3.06E-09	95.9	LSSB-U * /RT-LSSB * /PRC-LSSB * /PISGTR * /ISOL-LSSBU * SHR1-E11LS * PO-E24	LSSB * Success of reactor trip * No POSRV challenge * No Pressure-induced SGTR * Success of steam line isolation * Failure of secondary heat removal * Failure of bleed for F&B operation
38	SLOCA_004	3.02E-09	96.1	SLOCA * /RT-SLOCA * /SI-I14 * SHR1-E12SL * PO-E24	SLOCA * Success of reactor trip * Success of SI injection * Failure of secondary heat removal * Failure of bleed for F&B operation
39	LODCA_005	2.81E-09	96.3	LODCA * /RT-LODC * /PRC-POSRV * /LODCA-GRID * SHR-E12DA * PO-E22DA	LODC * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation
40	LODCB_005	2.81E-09	96.5	LODCB * /RT-LODC * /PRC-POSRV * /LODCB-GRID * SHR-E12DB * PO-E22DB	LOCV * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation
41	SGTR_013	2.69E-09	96.8	SGTR * /RT-SGTR * SI-I14SG * ASC-11SG	SGTR * Success of reactor trip * Failure of SI injection * Failure of aggressive secondary cooling operation
42	LSSB-D_022	2.44E-09	96.9	LSSB-D * RT-LSSB	LSSB * Failure of reactor trip
43	PLOCCW_006	2.40E-09	97.1	PLOCCW * /RT-LOCCW * SHR-E12CC * /PO-E24CC * /SIF-I12CC * SCR11CSS11-SI	PLOCCW * Success of reactor trip * Failure of secondary heat removal * Success of F&B operation * Failure of long term cooling with SC/CS

Table 19.1-18 (7 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
44	LSSB-D_020	2.23E-09	97.3	LSSB-D * /RT-LSSB * /PRC-LSSB * PISGTR * SI-I14SG	LSSB * Success of reactor trip * No POSRV challenge * Pressure-induced SGTR occurs * Failure of SI injection
45	SBO_002	2.20E-09	97.5	SBO * /AAC * /SHR-12AC * RCPSEAL	SBO * Success of AAC * Success of secondary heat removal * RCP seal LOCA occurs
46	PLOCCW_009	2.16E-09	97.6	PLOCCW * RT-LOCCW	PLOCCW * Failure of reactor trip
47	LLOCA_004	2.06E-09	97.8	LLOCA * /ST-I24LL * SI-I34LL	LLOCA * Success of SIT injection * Failure of SI injection
48	PLOESW_008	1.86E-09	97.9	PLOESW * /RT-LOESW * SHR-E12CC * PO-E24CC	PLOESW * Success of reactor trip * Failure of secondary heat removal * Failure of bleed for F&B operation
49	LSSB-D_015	1.82E-09	98.1	LSSB-D * /RT-LSSB * /PRC-LSSB * PISGTR * /SI-I14SG * /ISOL-LSSBD * /SHR1-E12LS-SI * ECLDN * LCLDN * CV-IRWST	LSSB * Success of reactor trip * No POSRV challenge * Pressure-induced SGTR occurs * Success of SI injection * Success of steam line isolation * Success of secondary heat removal * Failure of initial RCS cooldown and late cooldown * Failure of IRWST refill
50	GRID-SBO_007	1.51E-09	98.2	GRID-SBO * AAC * /SHR1-E12TD * RSF-SBO-AFSUC	GRID-SBO * Failure of AAC * Success of secondary heat removal with AF TDPs * RCP seal LOCA occurs
51	SBO_006	1.45E-09	98.3	SBO * /AAC * SHR-12AC * PO-E22	SBO * Success of AAC * Failure of secondary heat removal * Failure of bleed for F&B operation

Table 19.1-18 (8 of 8)

Rank	Sequence No.	Sequence Frequency (/yr)	Cumulative Contribution	Sequence Cutsets	Sequence Description
52	PLOESW_006	1.33E-09	98.4	PLOESW * /RT-LOESW * SHR-E12CC * /PO-E24CC * /SIF-I12CC * SCR11CSS11-SI	PLOESW * Success of reactor trip * Failure of secondary heat removal * Success of F&B operation * Failure of long term cooling with SC/CS
53	GRID-SBO_008	1.33E-09	98.5	GRID-SBO * AAC * SHR1-E12TD	GRID-SBO * Failure of AAC * Failure of secondary heat removal with AF TDPs
54	FWLB_004	1.25E-09	98.6	FWLB * /RT-LOFW * /PISGTR * /ISOL * SHR-E11FB * /PO-E24 * SIF-I14	FWLB * Success of reactor trip * No Pressure-induced SGTR * Success of steam line isolation * Failure of secondary heat removal * Success of bleed for F&B operation * Failure of SI feed for F&B operation
55	PLOESW_009	1.24E-09	98.7	PLOESW * RT-LOESW	PLOESW * Failure of reactor trip
56	ATWS_003	1.23E-09	98.8	ATWS * /MTC-ATWS * /PFO-ATWS * /PRC-ATWS * /PISGTR * SHR-E22FW	ATWS * No adverse MTC (Moderator Temperature Coefficient) * Success of POSRVs open * Success of POSRVs reseat * No Pressure-induced SGTR * Failure of secondary heat removal
57	PLOCCW_003	1.07E-09	98.9	PLOCCW * /RT-LOCCW * /SHR-E12CC * RSF-CC-AFSUC * /SI-I12CC * SCR11CSS11-SI	PLOCCW * Success of reactor trip * Success of secondary heat removal * RCP seal LOCA occurs * Success of SI injection * Failure of long term cooling with SC/CS
58	LOIA_005	1.04E-09	99.0	LOIA * /RT-LOIA * /PRC-MSSV * /LOIA-GRID * SHR-E12GT * PO-E24	LOIA * Success of reactor trip * No POSRV challenge * No consequential LOOP * Failure of secondary heat removal * Failure of bleed for F&B operation

Table 19.1-19 (1 of 24)

Level 1 Internal Events Top 100 CDF Cutsets

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
1	4.47E-08	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	3.4	3.4
		CVDPR-S-PP03	4.78E-02	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
2	4.47E-08	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	3.4	6.9
		CVDPR-S-PP03	4.78E-02	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
3	3.13E-08	%GTRN	6.56E-01	GENERAL TRANSIENT	2.4	9.3
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		MTC-ATWS	1.60E-01	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
4	3.06E-08	%RVR	3.06E-08	REACTOR VESSEL RUPTURE	2.4	11.6
5	2.43E-08	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	1.9	13.5
		SISPP-S-IRWST	1.22E-05	FAILURE OF IRWST SUMP DUE TO PLUGGING		

Table 19.1-19 (2 of 24)

Rank	Cutset Frequency	Cutsets: Cutset	Cutsets: Basic Event Probability	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
6	1.64E-08	%LOOP-GR	1.16E-02	GRID-RELATED LOOP	1.3	14.8
		PFHBWQ4-SW2OUAT	2.71E-05	CCF OF PCB BETWEEN UAT & 4.16kV SW01A, 1B ,1C, 1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	5.20E-02	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
7	1.47E-08	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	1.1	15.9
		CSMVWD2-003/004	3.04E-05	CCF OF CS HX DISCHARGE ISOLATION VALVES FAIL TO OPEN		
8	1.39E-08	%LOOP-SW	9.88E-03	SWITCHYARD-CENTERED LOOP	1.1	17.0
		PFHBWQ4-SW2OUAT	2.71E-05	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	5.20E-02	OPERATOR FAIL TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
9	1.03E-08	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.8	17.8
		CVOPH-S-RCPSEAL	1.10E-02	OPERATOR FAILS TO RECOVER RCP SEAL COOLING		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
10	1.03E-08	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.8	18.6
		CVOPH-S-RCPSEAL	1.10E-02	OPERATOR FAILS TO RECOVER RCP SEAL COOLING		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		

Table 19.1-19 (3 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
11	8.98E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.7	19.2
		CCMVWD2-097/8	1.85E-05	2/2 CCF OF CCW MOV 097/098 FOR CS HX HE01A/B INLET		
12	7.23E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.6	19.8
		DGDGR-C-DGC	2.49E-02	FAILS TO RUN OF EDG C		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
13	6.62E-09	%SGTR	1.97E-03	STEAM GENERATOR TUBE RUPTURE	0.5	20.3
		HR-RCSCD1-ISOL	1.40E-03	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	1.00E+00	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
14	6.50E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.5	20.8
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
15	5.91E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.5	21.3
		SISPP-S-IRWST	1.22E-05	FAILURE OF IRWST SUMP DUE TO PLUGGING		

Table 19.1-19 (4 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
16	5.23E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.4	21.7
		PFHBWQ4-SW2OUAT	2.71E-05	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	5.20E-02	OPERATOR FAIL TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
17	5.15E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.4	22.1
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	1.98E-02	ECW CHILLER 2B TRAIN UNAVAILABLE DUE TO T&M		
18	5.15E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.4	22.5
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
19	4.43E-09	%GTRN	1.60E-01	GENERAL TRANSIENT	0.3	22.8
		MTC-ATWS	6.56E-01	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-19 (5 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
20	4.31E-09	%LOOP-GR	1.16E-02	GRID-RELATED LOOP	0.3	23.1
		PFHBC2A-SW01C-E2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
21	4.31E-09	%LOOP-GR	1.16E-02	GRID-RELATED LOOP	0.3	23.5
		NBHBC2A-SW03N-F2	6.66E-03	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
22	4.28E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.3	23.8
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		DGDGKQ4-DG01ABCD	4.63E-05	CCF OF EDGS FAIL TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
23	4.25E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.3	24.1
		MSEVXQ2-012/14	2.15E-05	CCF OF MSIV 012 AND 014 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
24	4.25E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.3	24.4
		MSEVXQ2-012/13	2.15E-05	CCF OF MSIV 012 AND 013 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-19 (6 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
25	4.25E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.3	24.8
		MSEVXQ2-011/13	2.15E-05	CCF OF MSIV 011 AND 013 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
26	4.25E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.3	25.1
		MSEVXQ2-011/14	2.15E-05	CCF OF MSIV 011 AND 014 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
27	4.18E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.3	25.4
		DGDGM-C-DGC	1.44E-02	EDG C UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
28	4.18E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.3	25.7
		DGDGM-D-DGD	1.44E-02	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-C-DGC	2.49E-02	FAILS TO RUN OF EDG C		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		

Table 19.1-19 (7 of 24)

Rank	Cutset Frequency	Cutsets: Cutset	Basic Event Probability	Cutset Description	Contribution to CDF (%): Cutset	Cumulative
29	4.04E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.3	26.1
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		WOCHWQ4-CH01A/2A/1B/2B	4.38E-05	CCF OF ECW CHILLERS FAIL TO START		
30	3.75E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.3	26.3
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
31	3.75E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.3	26.6
		DGDGM-D-DGD	1.44E-02	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
32	3.75E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.3	26.9
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-19 (8 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
33	3.74E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.3	27.2
		PFHBC2A-SW01C-E2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
34	3.74E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.3	27.5
		PFHBC2A-SW01C-E2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
35	3.74E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.3	27.8
		NBHBC2A-SW03N-F2	6.66E-03	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
36	3.74E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.3	28.1
		NBHBC2A-SW03N-F2	6.66E-03	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
37	3.67E-09	%LOOP-SW	9.88E-03	SWITCHYARD-CENTERED LOOP	0.3	28.4
		NBHBC2A-SW03N-F2	6.66E-03	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-19 (9 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
38	3.67E-09	%LOOP-SW	9.88E-03	SWITCHYARD-CENTERED LOOP	0.3	28.6
		PFHBC2A-SW01C-E2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
39	3.44E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.3	28.9
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	1.32E-02	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
40	3.39E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.3	29.2
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	1.30E-02	ECW CHILLER 2B FAILS TO START		
41	3.12E-09	%LOFW	6.55E-02	LOSS OF MAIN FEEDWATER	0.2	29.4
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		MTC-ATWS	1.60E-01	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		

Table 19.1-19 (10 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
42	2.98E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.2	29.6
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVZO8-HV12/13ABCD	3.23E-05	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR		
43	2.98E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	29.9
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	1.98E-02	ECW CHILLER 2B TRAIN UNAVAILABLE DUE TO T&M		
44	2.98E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	30.1
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	1.98E-02	ECW CHILLER 2B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-19 (11 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
45	2.91E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.2	30.3
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVKO8-HV12/13ABCD	3.15E-05	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN		
46	2.76E-09	%SGTR	1.97E-03	STEAM GENERATOR TUBE RUPTURE	0.2	30.5
		CVOPH-S-IRWST	1.00E-03	OPERATOR FAILS TO REFILL THE IRWST VIA CVCS		
		HR-RCSCD1-ISOL	1.40E-03	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	1.00E+00	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
47	2.72E-09	%LOOP-GR	1.16E-02	GRID-RELATED LOOP	0.2	30.7
		MSAVO-B-110	4.20E-03	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
48	2.66E-09	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	0.2	30.9
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-19 (12 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
49	2.66E-09	%SGTR	1.97E-03	STEAM GENERATOR TUBE RUPTURE	0.2	31.1
		CVMVO-S-509	9.65E-04	IRWST RETURN LINE ISOLATION VALVE FAILS TO OPEN		
		HR-RCSCD1-ISOL	1.40E-03	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	1.00E+00	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
50	2.66E-09	%LOCV	5.57E-02	LOSS OF CONDENCER VACCUM	0.2	31.3
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		MTC-ATWS	1.60E-01	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
51	2.58E-09	%LOOP-PL	1.83E-03	PLANT-CENTERED LOOP	0.2	31.5
		PFHBWQ4-SW2OUAT	2.71E-05	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	5.20E-02	OPERATOR FAIL TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
52	2.52E-09	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	0.2	31.7
		AFOPH-S-ALT-LT	9.10E-04	OPERATOR FAIL TO ALIGN FOR SUPPLYING AN ALTERNATE SOURCE		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
		RCOPH-S-SDSL-LD	5.79E-02	FAILURE OF POSRVS LATE PHASE OPEN WITH LOW DEPENDENCY		

Table 19.1-19 (13 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
53	2.50E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	31.9
		MSOPV-S-MSIS	1.00E-01	OPERATOR FAILS TO RECOVERY FOR MSIS		
		PELXKD2-LX09A11B	3.41E-06	CCF OF LOOP CONTROLLER LX09A & LX11B FAIL TO OPERATE		
		RCOPH-S-SDSE-FW-CD	1.00E+00	FAILURE OF POSRVS EARLY PHASE OPEN WITH COMPLETE DEPENDENCY		
54	2.45E-09	%LOFW	6.55E-02	LOSS OF MAIN FEEDWATER	0.2	32.1
		AFPVKQ4-TP01A/B/MP02A/B	4.12E-06	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN		
		RCOPH-S-SDSE-FW	9.10E-03	FAILURE OF POSRVS EARLY PHASE OPEN		
55	2.41E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	32.3
		DGDGM-C-DGC	1.44E-02	EDG C UNAVAILABLE DUE TO T&M		
		DGDGM-D-DGD	1.44E-02	EDG D UNAVAILABLE DUE TO T&M		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
56	2.36E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.2	32.5
		AFMVO1A-045	5.78E-02	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN		
		RAC-12H-WE	1.97E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 12HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-19 (14 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
57	2.36E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.2	32.7
		AFMVC1A-045	5.78E-02	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE		
		RAC-12H-WE	1.97E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 12HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		
58	2.36E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.2	32.9
		MSAVO-B-110	4.20E-03	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
59	2.36E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.2	33.0
		MSAVO-B-110	4.20E-03	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
60	2.31E-09	%LOOP-SW	9.88E-03	SWITCHYARD-CENTERED LOOP	0.2	33.2
		MSAVO-B-110	4.20E-03	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-19 (15 of 24)

Rank	Cutset Frequency	Cutsets: Cutset	Cutsets: Basic Event Probability	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
61	2.30E-09	%GTRN	1.60E-01	GENERAL TRANSIENT	0.2	33.4
		MTC-ATWS	6.56E-01	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
		CVOPH-S-BORATION	1.40E-02	OPERATOR FAILS TO INITIATE EMERGENCY BORATION TO RCS		
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
62	2.29E-09	%SGTR	1.97E-03	STEAM GENERATOR TUBE RUPTURE	0.2	33.6
		AFMPM2A-MDP02A	3.63E-03	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-FW	9.10E-03	FAILURE OF POSRVS EARLY PHASE OPEN		
63	2.24E-09	%GTRN	6.56E-01	GENERAL TRANSIENT	0.2	33.7
		AFPVKQ4-TP01A/B/MP02A/B	4.12E-06	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN		
		FWOPH-S-ERY	5.50E-03	OPERATOR FAILS TO ALIGN STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
		RCOPH-S-SDSE-FW-MD	1.51E-01	FAILURE OF POSRVS EARLY PHASE OPEN WITH MEDIUM DEPENDENCY		

Table 19.1-19 (16 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
64	2.21E-09	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	0.2	33.9
		DGDGKQ4-DG01ABCD	4.63E-05	CCF OF EDGS FAIL TO RUN		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
65	2.20E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	34.1
		MSEVXQ4-011/12/13/14	1.11E-05	CCF OF MSIVS FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
66	2.18E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	34.2
		I-ATWS-RPMCF	2.98E-07	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
67	2.17E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	34.4
		DGDGM-D-DGD	1.44E-02	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
68	2.17E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	34.6
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-19 (17 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
69	2.17E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	34.7
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		DGDGM-D-DGD	1.44E-02	EDG D UNAVAILABLE DUE TO T&M		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
70	2.09E-09	%LOCV	5.57E-02	LOSS OF CONDENCER VACCUM	0.2	34.9
		AFPVKQ4-TP01A/B/MP02A/B	4.12E-06	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN		
		RCOPH-S-SDSE-FW	9.10E-03	FAILURE OF POSRVS EARLY PHASE OPEN		
71	2.02E-09	%FWLB	1.74E-03	FEEDWATER LINE BREAK	0.2	35.1
		AFMPM2A-MDP02A	3.63E-03	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-FW	9.10E-03	FAILURE OF POSRVS EARLY PHASE OPEN		
72	2.00E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.2	35.2
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	3.52E-02	AFW PUMP 1B FAILS TO RUN		
		FWMPM-S-PP07	6.90E-03	STARTUP FW PUMP UNAVAILABLE DUE TO T&M		
73	2.00E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.2	35.4
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	3.52E-02	AFW PUMP 1B FAILS TO RUN		
		FWMPM-S-PP07	6.90E-03	STARTUP FW PUMP UNAVAILABLE DUE TO T&M		

Table 19.1-19 (18 of 24)

Rank	Cutset Frequency	Cutsets: Cutset	Basic Event Probability	Cutset Description	Contribution to CDF (%): Cutset	Cumulative
74	1.99E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	35.5
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	1.32E-02	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
75	1.99E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	35.7
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	1.32E-02	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
76	1.97E-09	%SGTR	1.97E-03	STEAM GENERATOR TUBE RUPTURE	0.2	35.8
		C-RCD1-SCLT-RFIR	1.00E-06	COMBINED OPERATOR ERROR FOR HR-RCSCD1-ISOL, SIOPH-S-LTC-SC and CVOPH-S-IRWST		
77	1.96E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	36.0
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	1.30E-02	ECW CHILLER 2B FAILS TO START		
78	1.96E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	36.1
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	1.30E-02	ECW CHILLER 2B FAILS TO START		

Table 19.1-19 (19 of 24)

Rank	Cutset Frequency	Cutsets: Cutset	Basic Event Probability	Cutset Description	Contribution to CDF (%): Cutset	Cumulative
79	1.93E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	36.3
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFHBO2A-SW01C-C2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
80	1.93E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	36.4
		DGDGR-C-DGC	2.49E-02	FAILS TO RUN OF EDG C		
		PFHBO2B-SW01D-G2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
81	1.91E-09	%LOFW	6.55E-02	LOSS OF MAIN FEEDWATER	0.1	36.6
		AFOPH-S-ALT-LT	9.10E-04	OPERATOR FAIL TO ALIGN FOR SUPPLYING AN ALTERNATE SOURCE		
		RCOPH-S-SDSL-LD	5.79E-02	FAILURE OF POSRVS LATE PHASE OPEN WITH LOW DEPENDENCY		
		WMVVT-S-V1700	5.53E-04	DEMINERALIZED WATER TRANSFER PUMPS DISCHARGE MANUAL VALVE TRANSFER CLOSE		
82	1.80E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	36.7
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOMPM2B-PP02B	6.90E-03	ECW PUMP 2B UNAVAILABLE DUE TO T&M		

Table 19.1-19 (20 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
83	1.74E-09	%LLOCA-HL2	5.05E-07	LARGE LOCA IN HOT LEG 2	0.1	36.8
		SIMPM2A-PP02C	3.45E-03	SI PUMP 2C UNAVAILABLE DUE TO T&M		
84	1.74E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.1	37.0
		DATGR-S-AACTG	1.56E-01	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVWO8-HV12/13ABCD	1.89E-05	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START		
85	1.74E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	37.1
		DGDGR-B-DGB	2.49E-02	FAILS TO RUN OF EDG B		
		PFHBO2B-SW01D-G2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
86	1.74E-09	%PLOCCW	4.36E-03	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	37.2
		DGDGR-D-DGD	2.49E-02	FAILS TO RUN OF EDG D		
		PFHBO1B-SW01B-H2	6.66E-03	CLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-19 (21 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
87	1.72E-09	%PLOESW	2.52E-03	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	37.4
		DGDGM-B-DGB	1.44E-02	EDG B UNAVAILABLE DUE TO T&M		
		PFLOOP-TRANS	2.40E-03	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	1.98E-02	ECW CHILLER 2B TRAIN UNAVAILABLE DUE TO T&M		
88	1.70E-09	%MLOCA	4.85E-04	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	37.5
		SIMPWQ4-CSP1A/B/SCP1A/B	3.50E-06	CCF OF CS AND SC PUMPS FAIL TO START		
89	1.68E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.1	37.6
		CVDPS-S-PP03	1.79E-03	AUXILIARY CHARGING PUMP (PP03) FAIL TO START		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
90	1.68E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.1	37.8
		CVDPS-S-PP03	1.79E-03	AUXILIARY CHARGING PUMP (PP03) FAIL TO START		
		SEAL-AFSUC	4.00E-03	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
91	1.65E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	37.9
		MSEVXQ3-011/12/13	8.33E-06	CCF OF MSIVS 011, 012 AND 013 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-19 (22 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
92	1.65E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	38.0
		MSEVXQ3-012/13/14	8.33E-06	CCF OF MSIVS 012, 013 AND 014 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
93	1.65E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	38.1
		MSEVXQ3-011/13/14	8.33E-06	CCF OF MSIVS 011, 013 AND 014 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
94	1.65E-09	%LSSB-D	7.32E-03	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	38.3
		MSEVXQ3-011/12/14	8.33E-06	CCF OF MSIVS 011, 012 AND 014 FAIL TO CLOSE		
		PI-SGTR	2.70E-02	PRESSURE INDUECD SGTR PROBABILITY		
95	1.65E-09	%LOOP-WE	3.71E-03	WEATHER-RELATED LOOP	0.1	38.4
		DATGM-S-AACTG	5.00E-02	AAC GAS TURBINE GENERATOR UNAVAILABLE DUE TO T&M		
		RAC-16H-WE	1.59E-01	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	5.58E-05	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-19 (23 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
96	1.62E-09	%LOCV	5.57E-02	LOSS OF CONDENCER VACCUM	0.1	38.5
		AFOPH-S-ALT-LT	9.10E-04	OPERATOR FAIL TO ALIGN FOR SUPPLYING AN ALTERNATE SOURCE		
		RCOPH-S-SDSL-LD	5.79E-02	FAILURE OF POSRVS LATE PHASE OPEN WITH LOW DEPENDENCY		
		WMVVT-S-V1700	5.53E-04	DEMINERALIZED WATER TRANSFER PUMPS DISCHARGE MANUAL VALVE TRANSFER CLOSE		
97	1.59E-09	%TLOESW	2.34E-04	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.1	38.6
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	3.52E-02	AFW PUMP 1B FAILS TO RUN		
		FWOPH-S-ERY	5.50E-03	OPERATOR FAILS TO ALIGN STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
98	1.59E-09	%TLOCCW	2.34E-04	TOTAL LOSS OF COMPONANT COOLING WATER	0.1	38.8
		AFTPR1A-TDP01A	3.52E-02	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	3.52E-02	AFW PUMP 1B FAILS TO RUN		
		FWOPH-S-ERY	5.50E-03	OPERATOR FAILS TO ALIGN STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		

Table 19.1-19 (24 of 24)

Rank	Cutset Frequency	Cutsets			Contribution to CDF (%)	
		Cutset	Basic Event Probability	Cutset Description	Cutset	Cumulative
99	1.54E-09	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	0.1	38.9
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
		VDHVZO8-HV12/13ABCD	3.23E-05	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR		
100	1.50E-09	%SLOCA	1.99E-03	SMALL LOSS OF COOLANT ACCIDENT	0.1	39.0
		PFLOOP-LOCA	2.40E-02	CONDITIONAL LOOP UPON LOCA INITIATORS		
		VDHVKO8-HV12/13ABCD	3.15E-05	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN		

Table 19.1-20 (1 of 6)

Level 1 Internal Events Key Components by RAW (CDF)

Rank	Equipment ID	Equipment Description	RAW
1	DC-MC01A/1B	CLASS 1E 125V DC BUS 1A/1B	34
2	CC-TK01B	COMPONENT COOLING WATER SURGE TANK 1B	20
3	DC-BT01B	CLASS 1E 125V DC BATTERY 1B	20
4	DC-BT01A	CLASS 1E 125V DC BATTERY 1A	18
5	WO-TK01B/2B	ESSENTIAL CHILLED WATER COMPRESSION TANK 1B/2B	17
6	SX-MV073/74	ULTIMATE HEAT SINK COOLING TOWER 1B DISCHARGE LINE CONTROL AND BYPASS VALVE	16
7	IP-IN01B	CLASS 1E 120V AC INVERTER 1B	16
8	IP-IN01A	CLASS 1E 120V AC INVERTER 1A	15
9	CC-HE01B/2B	COMPONENT COOLING WATER HEAT EXCHANGER	14
10	CC-HE01A/2A	COMPONENT COOLING WATER HEAT EXCHANGER	11
11	VO-TE085A	AUXILIARY FEEDWATER MOTOR-DRIVEN PUMP 2A ROOM TEMPERATURE TRANSMITTER	10
12	CC-TK01A	COMPONENT COOLING WATER SURGE TANK 1A	9
13	WM-VV1700	DEMINERALIZED WATER PUMPS DISCHARGE MANUAL VALVE	8
14	NB-SW01M	NON-1E 4.16kV SWITCHGEAR	8
15	NG-LC10M/TR10M	NON-1E 480V LOAD CENTER AND TRANSFORMER	8
16	AX-CV1600	DEMINERALIZE WATER LINE CHECK VALVE	8
17	NH-MC03M	NON-1E 480V MOTOR CONTROL CENTER (MCC)	8
18	WM-VV1201A	DEMINERALIZED WATER PUMP SUCTION ISOLATION MANUAL VALVE	8
19	WM-VV1205	DEMINERALIZED WATER PUMPS DISCHARGE MANUAL VALVE	8
20	WM-VV1220	DEMINERALIZED WATER PUMPS DISCHARGE MANUAL VALVE	8
21	DC-MC01C	CLASS 1E 125V DC BUS 1C	8
22	PG-LC01A/TR01A	CLASS 1E 480V LOAD CENTER AND TRANSFORMER	7

Table 19.1-20 (2 of 6)

Rank	Equipment ID	Equipment Description	RAW
23	PF-SW01A/C	CLASS 1E 4.16kV SWITCHGEAR	7
24	WO-TK01A/2A	ESSENTIAL CHILLED WATER COMPRESSION TANK 1A/2A	6
25	PG-LC01C/TR01C	CLASS 1E 480V LOAD CENTER AND TRANSFORMER	6
26	DG-EDG B	EMERGENCY DIESEL GENERATOR B	6
27	PF-SW01B-H2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	5
28	DC-BT01D	CLASS 1E 125V DC BATTERY 1D	5
29	PH-MC01A	CLASS 1E 480V MOTOR CONTROL CENTER (MCC)	5
30	IP-IN01D	CLASS 1E 120V AC INVERTER 1D	5
31	MS-AOV110/ AT-AOV009	AF TURBINE-DRIVEN PUMP 1A TURBINE STEAM SUPPLY AND ISOLATION VALVE	5
32	DC-BC01C	CLASS 1E 125V DC BATTERY CHARGER 1C	5
33	DC-BT01C	CLASS 1E 125V DC BATTERY 1C	4
34	VD-HV12B/13B	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT B	4
35	AF-MV045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE	4
36	IP-IN01C	CLASS 1E 120V AC INVERTER 1C	4
37	PG-LC01D/TR01D	CLASS 1E 480V LOAD CENTER AND TRANSFORMER	4
38	PF-SW01D	CLASS 1E 4.16kV SWITCHGEAR	4
39	CC-MV192	EDG 1B CCW INLET VALVE	4
40	AF-MDP02A	AF MOTOR-DRIVEN PUMP 2A	4
41	VO-HV33A	AUXILIARY FEEDWATER MOTOR-DRIVEN PUMP 2A ROOM CUBICLE COOLER	4
42	AF-CV1004A	AF TURBINE-DRIVEN PUMP 1A DISCHARGE CHECK VALVE	4
43	AF-CV1008A	AF TURBINE-DRIVEN PUMP 1A DISCHARGE CHECK VALVE	4
44	AF-CV1014A	AF TURBINE-DRIVEN PUMP 1A MINI-FLOW LINE CHECK VALVE	4
45	AT-CV1020A	AF TURBINE-DRIVEN PUMP 1A TURBINE STEAM SUPPLY CHECK VALVE	4

Table 19.1-20 (3 of 6)

Rank	Equipment ID	Equipment Description	RAW
46	DG-EDG A	EMERGENCY DIESEL GENERATOR A	4
47	PF-SW01B	CLASS 1E 4.16kV SWITCHGEAR	4
48	NB-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB FOR SW01C	4
49	PF-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB (AAC)	4
50	PF-SW01A-H2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	4
51	DG-EDG D	EMERGENCY DIESEL GENERATOR D	3
52	CV-MV509	IRWST RETURN LINE ISOLATION VALVE	3
53	CV-VV126/649	IRWST REFILL LINE MANUAL ISOLATION VALVE	3
54	CV-MV553	IRWST RETURN LINE ISOLATION VALVE	3
55	IA-TK01/02	INSTRUMENT AIR RECEIVER TK01/02	3
56	CC-MV098	CS HEAT EXCHANGER 1B CCW INLET VALVE	3
57	CS-MV004	CONTAINMENT SPRAY HEAT EXCHANGER 1B DISCHARGE ISOLATION VALVE	3
58	DC-MC01M	NON-CLASS 1E 125V DC BUS 1M	3
59	CV-CV189	IRWST RETURN LINE CHECK VALVE	3
60	PF-SW01D-G2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	3
61	PH-MC01D	CLASS 1E 480V MOTOR CONTROL CENTER (MCC)	3
62	PG-LC01B/TR01B	CLASS 1E 480V LOAD CENTER AND TRANSFORMER	3
63	CC-MV097	CS HEAT EXCHANGER 1A CCW INLET VALVE	3
64	CS-MV003	CONTAINMENT SPRAY HEAT EXCHANGER 1A DISCHARGE ISOLATION VALVE	3
65	VD-HV12A/13A	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT A	3
66	VD-HV12D/13D	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT D	3
67	SX-MV071/72	ULTIMATE HEAT SINK COOLING TOWER 1B DISCHARGE LINE CONTROL AND BYPASS VALVE	3
68	CC-MV182	EDG 1D CCW INLET VALVE	3
69	PH-MC01C	CLASS 1E 480V MOTOR CONTROL CENTER (MCC)	3
70	AF-SOV0037	AF TURBINE-DRIVEN PUMP 1A DISCHARGE MODULATION VALVE	3

Table 19.1-20 (4 of 6)

Rank	Equipment ID	Equipment Description	RAW
71	DC-MC01D	CLASS 1E 125V DC BUS 1D	3
72	AF-MV043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE	3
73	CS-HE01B	CONTAINMENT SPRAY HEAT EXCHANGER 1B	3
74	CS-HE01A	CONTAINMENT SPRAY HEAT EXCHANGER 1A	3
75	CC-MV191	EDG 1A CCW INLET VALVE	3
76	AF-CV1003A	AF MOTOR-DRIVEN PUMP 2A DISCHARGE CHECK VALVE	3
77	AF-CV1007A	AF MOTOR-DRIVEN PUMP 2A DISCHARGE CHECK VALVE	3
78	AF-CV1012A	AF MOTOR-DRIVEN PUMP 2A MINI-FLOW LINE CHECK VALVE	3
79	FW-MP07	STARTUP FEEDWATER PUMP	3
80	CS-MV002	CONTAINMENT SPRAY HEAT EXCHANGER 1B DISCHARGE VALVE	3
81	FW-MV093	STARTUP FEEDWATER PUMP DISCHARGE VALVE	3
82	WO-CH02B	ESSENTIAL CHILLER 2B	3
83	PF-SW01C-C2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	3
84	WO-CH01B	ESSENTIAL CHILLER 1B	3
85	CS-MV001	CONTAINMENT SPRAY HEAT EXCHANGER 1A DISCHARGE VALVE	3
86	AF-TP01A	AF TURBINE-DRIVEN PUMP 1A	3
87	NP-SW02N	NON-1E 13.8KV SWITCHGEAR	3
88	CS-CV1007	CONTAINMENT SPRAY CHECK VALVE TO CS HEADER 1	3
89	NB-SW02N	NON-1E 4.16kV SWITCHGEAR	3
90	CS-CV1008	CONTAINMENT SPRAY CHECK VALVE TO CS HEADER 2	3
91	NG-LC05N/TR05N	NON-1E 480V LOAD CENTER AND TRANSFORMER	3
92	CV-BAST	BORIC ACID STORAGE TANK	3

Table 19.1-20 (5 of 6)

Rank	Equipment ID	Equipment Description	RAW
93	RC-POSRV V200/201/202/203	PILOT OPERATED SAFETY AND RELIEF VALVE	3
94	DC-BC01D	CLASS 1E 125V DC BATTERY CHARGER 1D	3
95	WO-PP02B	ESSENTIAL CHILLED WATER PUMP 2B	2
96	DG-EDG C	EMERGENCY DIESEL GENERATOR C	2
97	CV-DP03	AUXILIARY CHARGING PUMP	2
98	CV-CV334	AUXILIARY CHARGING PUMP DISCHARGE CHECK VALVE	2
99	PG-LC02	CLASS 1E 480V LOAD CENTER	2
100	FW-CV1026	STARTUP FEEDWATER PUMP DISCHARGE CHECK VALVE	2
101	FW-ZV058	STARTUP FEEDWATER PUMP DISCHARGE STOP CHECK VALVE	2
102	CD-TK01/02	DEAERATOR STORAGE TANK A/B	2
103	IA-ADP1	INSTRUMENT AIR DRYER PACKAGE 1	2
104	DC-MC01N	NON-1E 125V DC BUS 1N	2
105	NH-MC20N	NON-1E 480V MOTOR CONTROL CENTER (MCC)	2
106	IA-FT03A/4A	INSTRUMENT AIR PREFILTER AND AFTER FILTER	2
107	VO-HV31B	ESSENTIAL CHILLED WATER PUMP 1B ROOM CUBICLE COOLER	2
108	PH-MC04D	CLASS 1E 480V MOTOR CONTROL CENTER (MCC)	2
109	DO-TK01D	DIESEL FUEL OIL STORAGE TANK D	2
110	PH-MC01B	CLASS 1E 480V MOTOR CONTROL CENTER (MCC)	2
111	SX-PP02B	ESSENTIAL SERVICE WATER PUMP 2B	2
112	VO-HV32B	ESSENTIAL CHILLED WATER PUMP 2B ROOM CUBICLE COOLER	2
113	AF-TP01B	AF TURBINE-DRIVEN PUMP 1B	2
114	IA-AOV1027	AIR PRESSURE REDUCING MODULATION VALVE	2
115	CC-MP02B	COMPONENT COOLING WATER MOTOR-DRIVEN PUMP 2B	2
116	CS-PP01B	SHUTDOWN COOLING PUMP 1B	2

Table 19.1-20 (6 of 6)

Rank	Equipment ID	Equipment Description	RAW
117	SI-PP02C (SIP)	SAFETY INJECTION PUMP 2C	2
118	WO-PP01B	ESSENTIAL CHILLED WATER PUMP 1B	2
119	CC-MV132	ESSENTIAL CHILLER CONDENSER 2B OUTLET VALVE	2
120	AF-MDP02B	AF MOTOR-DRIVEN PUMP 2B	2
121	VD-HV12C/13C	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT C	2
122	VG-AH02B	ESSENTIAL SERVICE WATER PUMP 2B ROOM SUPPLY FAN	2
123	SX-AH02B	ESSENTIAL SERVICE WATER COOLING TOWER FAN	2
124	CC-MV181	EDG 1C CCW INLET VALVE	2
125	MS-AOV109	AF TURBINE-DRIVEN PUMP 1B TURBINE STEAM SUPPLY VALVE	2
126	SX-PP01B	ESSENTIAL SERVICE WATER PUMP 1B	2
127	VO-HV33B	AF MOTOR-DRIVEN PUMP 2B ROOM CUBICLE COOLER	2

Table 19.1-21 (1 of 2)

Level 1 Internal Events Key Components by FV (CDF)

Rank	Equipment ID	Equipment Description	FV
1	DG-EDG B	EMERGENCY DIESEL GENERATOR B	16.3%
2	DG-EDG D	EMERGENCY DIESEL GENERATOR D	10.2%
3	AF-MV045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE	8.9%
4	AF-MV046	AF TURBINE-DRIVEN PUMP 1B DISCHARGE ISOLATION VALVE	8.5%
5	AF-TP01A	AF TURBINE-DRIVEN PUMP 1A	8.5%
6	CV-DP03	AUXILIARY CHARGING PUMP	7.4%
7	DA-AACTG	ALTERNATE AC TURBINE GENERATOR	7.0%
8	DG-EDG A	EMERGENCY DIESEL GENERATOR A	6.8%
9	AF-TP01B	AF TURBINE-DRIVEN PUMP 1B	6.3%
10	WO-CH02B	ESSENTIAL CHILLER 2B	5.8%
11	DG-EDG C	EMERGENCY DIESEL GENERATOR C	5.6%
12	DC-BT01B	CLASS 1E 125V DC BATTERY 1B	5.4%
13	DC-BT01A	CLASS 1E 125V DC BATTERY 1A	4.8%
14	IP-IN01B	CLASS 1E 120V AC INVERTER 1B	4.0%
15	IP-IN01A	CLASS 1E 120V AC INVERTER 1A	3.7%
16	WO-CH02A	ESSENTIAL CHILLER 2A	3.1%
17	PF-SW01B-H2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	2.9%
18	SX-PP02B	ESSENTIAL SERVICE WATER PUMP 2B	1.9%
19	NB-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB FOR SW01C	1.7%
20	PF-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB (AAC)	1.7%
21	PF-SW01A-H2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	1.7%
22	MS-AOV110	AF TURBINE-DRIVEN PUMP 1A TURBINE STEAM SUPPLY VALVE	1.6%
23	PF-SW01D-G2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	1.6%
24	VD-HV12B/13B	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT B	1.5%

Table 19.1-21 (2 of 2)

Rank	Equipment ID	Equipment Description	FV
25	FW-MP07	STARTUP FEEDWATER PUMP	1.5%
26	WO-CH01B	ESSENTIAL CHILLER 1B	1.4%
27	AF-MDP02A	AF MOTOR-DRIVEN PUMP 2A	1.4%
28	WO-CH01A	ESSENTIAL CHILLER 1A	1.3%
29	WO-PP02B	ESSENTIAL CHILLED WATER PUMP 2B	1.2%
30	DC-BT01D	CLASS 1E 125V DC BATTERY 1D	1.2%
31	PF-SW01C-C2	CLASS 1E 4.16kV SWITCHGEAR PCB (UAT)	1.2%
32	VO-HV33A	MAFP ROOM A/B CUBICLE COOLER HV33A	1.1%
33	IP-IN01D	CLASS 1E 120V AC INVERTER 1D	1.1%
34	VD-HV12D/13D	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT D	1.0%
35	VD-HV12A/13A	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT A	1.0%
36	DC-BT01C	CLASS 1E 125V DC BATTERY 1C	0.9%
37	CS-PP01B	SHUTDOWN COOLING PUMP 1B	0.9%
38	SX-PP02A	ESSENTIAL SERVICE WATER PUMP 2A	0.8%
39	IP-IN01C	CLASS 1E 120V AC INVERTER 1C	0.8%
40	CS-PP01A	SHUTDOWN COOLING PUMP 1A	0.7%
41	CC-MP02B	COMPONENT COOLING WATER MOTOR-DRIVEN PUMP 2B	0.7%
42	WO-PP02A	ESSENTIAL CHILLED WATER PUMP 2A	0.6%
43	VD-HV12C/13C	EDG ROOM EMERGENCY CUBICLE COOLER - QUADRANT C	0.5%
44	SI-PP02C (SIP)	SAFETY INJECTION PUMP 2C	0.5%
45	AF-MDP02B	AF MOTOR-DRIVEN PUMP 2B	0.5%

Table 19.1-22 (1 of 3)

Level 1 Internal Events Key CCF Events by RAW (CDF)

Rank	Common Cause Events	Component CCF ID Description	RAW
1	RP-TCB-A1/A2/B1/B2/C1/C2/D1/D2	TRIP CIRCUIT BREAKER A1/A2/B1/B2/C1/C2/D1/D2	1.32E+05
2	DC-BT01A/1B/1C/1D	CLASS 1E 125V DC BATTERY 1A/1B/1C/1D	5734
3	SI-CV123/143	SAFETY INJECTION PUMP 2A/2B INJECTION LINE CHECK VALVE	3669
4	SI-CV217/227/237/247	SAFETY INJECTION LINE CHECK VALVE - DVI NOZZLE 1A/1B/2A/2B	3669
5	SI-CV541/543	SAFETY INJECTION PUMP 2A/2B DISCHARGE CHECK VALVE	3669
6	VG-AH01A/1B/2A/2B	ESSENTIAL SERVICE PUMP ROOM FAN 1A/1B/2A/2B	2071
7	SX-PP01A/1B/2A/2B	ESSENTIAL SERVICE WATER PUMP 1A/1B/2A/2B	2050
8	SX-AH01A/1B/2A/2B	ULTIMATE HEAT SINK COOLING TOWER FAN 1A/1B/2A/2B	2027
9	CC-MP01A/1B/2A/2B	COMPONENT COOLING WATER PUMP 1A/1B/2A/2B	2005
10	AF-MDP02A/2B	AF MOTOR-DRIVEN PUMP 2A/2B	1701
11	AF-TP01A/1B	AF TURBINE-DRIVEN PUMP 1A/1B	1701
12	AF-CV1003A/3B	AF MOTOR-DRIVEN PUMP 2A/2B DISCHARGE CHECK VALVE	1682
13	AF-CV1004A/4B	AF TURBINE-DRIVEN PUMP 1A/1B DISCHARGE CHECK VALVE	1682
14	AF-CV1007A/7B	AF MOTOR-DRIVEN PUMP 2A/2B DISCHARGE CHECK VALVE	1682
15	AF-CV1008A/8B	AF TURBINE-DRIVEN PUMP 1A/1B DISCHARGE CHECK VALVE	1682
16	AF-CV1012A/2B	AF MOTOR-DRIVEN PUMP 2A/2B MINI-FLOW LINE CHECK VALVE	1645
17	AF-CV1014A/B	AF TURBINE-DRIVEN PUMP 1A/1B MINI-FLOW LINE CHECK VALVE	1645

Table 19.1-22 (2 of 3)

Rank	Common Cause Events	Component CCF ID Description	RAW
18	PF-SW01A-H2/1B-H2/1C-C2/1D-G2	CLASS 1E 4.16kV SWITCH GEAR 1A/1B/1C/1D PCB (UAT)	1165
19	SX-FT01A/1B/2A/2B/3A/3B	ESSENTIAL SERVICE WATER DEBRIS FILTER 1A/1B/2A/2B/3A/3B	964
20	CC-CV1001/1002/1003/1004	COMPONENT COOLING WATER PUMPS DISCHARGE CHECK VALVE	746
21	SX-CV1001/1002/1003/1004	ESSENTIAL SERVICE WATER PUMPS DISCHARGE CHECK VALVE	746
22	SI-MV616/626/636/646	SAFETY INJECTION PUMPS DISCHARGE MOTOR-OPERATED VALVE	668
23	SI-PP02A/B/C/D	SAFETY INJECTION PUMP	667
24	SI-CV113/133	SAFETY INJECTION PUMP 2C/2D INJECTION LINE CHECK VALVE	663
25	SI-CV404/405/434/446	SAFETY INJECTION PUMP 2A/2B/2C/2D DISCHARGE CHECK VALVE	663
26	SI-CV540/542	SAFETY INJECTION PUMP 2C/2D DISCHARGE CHECK VALVE	663
27	CC-MV143/144/145/146/147/148/149/150	COMPONENT COOLING WATER MOTOR-OPERATE VALVE FOR NON-SAFETY LOADS	607
28	CS-CV1001/1002	CONTAINMENT SPRAY PUMP 1A/1B DISCHARGE CHECK VALVE	458
29	SI-CV157/158/159/160	CONTAINMENT SPRAY AND SHUTDOWN COOLING PUMPS IRWST SUCTION LINE CHECK VALVE	458
30	SI-CV568/569	SHUTDOWN COOLING PUMP 1A/1B DISCHARGE CHECK VALVE	458
31	CS-MV003/004	CONTAINMENT SPRAY HEAT EXCHANGER 1A/1B DISCHARGE ISOLATION VALVE	377
32	CC-MV097/098	COMPONENT COOLING WATER MOTOR-OPERATE VALVE FOR CONTAINMENT SPRAY HEAT EXCHANGER 1A/1B	377
33	CS-PP01A/1B	CONTAINMENT SPRAY PUMP 1A/1B	376
34	SI-PP01A/1B	SHUTDOWN COOLING PUMP 1A/1B	376

Table 19.1-22 (3 of 3)

Rank	Common Cause Events	Component CCF ID Description	RAW
35	CS-CV1007/1008	CONTAINMENT SPRAY HEAT EXCHANGER 1A/B DISCHARGE CHECK VALVE	376
36	CC-MV182/191/192	EDG 1A, 1B AND 1D CCW INLET VALVES	351
37	CC-MV181	EDG 1C CCW INLET VALVE	341
38	WO-CH01A/1B/2A/2B	ESSENTIAL CHILLER 1A/1B/2A/2B	333
39	VO-HV31A/31B/32A/33B	ESSENTIAL CHILLED PUMP 1A/1B/2A/2B ROOM CUBICLE COOLER	309
40	SI-CV100/101	SAFETY INJECTION PUMPS IRWST RETURN LINE CHECK VALVE	288
41	WO-PP01A/1B/2A/2B	ESSENTIAL CHILLED WATER PUMP 1A/1B/2A/2B	281
42	SI-CV424/426/448/451	SAFETY INJECTION PUMP 2A/2B/2C/2D MINI-FLOW LINE CHECK VALVE	281
43	DG-EDG A/B/C/D	EMERGENCY DIESEL GENERATOR A/B/C/D	268
44	VD-HV12A/12B/12C/12D /13A/13B/13C/13D	EMERGENCY DIESEL GENERATOR A/B/C/D ROOM EMERGENCY CUBICLE COOLER	267
45	DO-PP01A/1B/1C/1D/2A/2B/2C/2D	DIESEL FUEL OIL TRANSFER PUMP 1A/1B/1C/1D/2A/2B/2C/2D	262
46	MS-MSSV	MAIN STEAM SAFETY VALVES (MSSVS)	257
47	DO-CV1005A/1005B /1005C/1005D/1007A /1007B/1007C/1007D	DIESEL FUEL OIL TRANSFER PUMP 1A/1B/1C/1D/2A/2B/2C/2D DISCHARGE CHECK VALVE	222
48	MS-EV011/012/013/014	MAIN STEAM ISOLATION VALVE (MSIV)	209
49	WO-CV1010A/1010B /1014A/1014B	ESSENTIAL CHILLED WATER PUMP 1A/1B/2A/2B DISCHARGE CHECK VALVE	144
50	VO-TE085A/086B	AUXILIARY FEEDWATER MOTOR-DRIVEN PUMP 2A/2B ROOM TEMPERATURE TRANSMITTER	40
51	DC-BC01A/1B/1C/1D /2A/2B/2C/2D	CLASS 1E 125V DC BATTERY CHARGER 1A/1B/1C/1D/2A/2B/2C/2D	30

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-23

Level 1 Internal Events Key CCF Events by FV (CDF)

Rank	Common Cause Events	Component CCF ID Description	FV
1	PF-SW01A-H2/1B-H2/1C-C2/1D-G2	CLASS 1E 4.16kV SWITCH GEAR 1A/1B/1C/1D PCB (UAT)	4.0%
2	DG-EDG A/B/C/D	EMERGENCY DIESEL GENERATOR A/B/C/D	2.7%
3	AF-TP01A/1B	AF TURBINE-DRIVEN PUMP 1A/1B	2.3%
4	VD-HV12A/12B/12C/12D /13A/13B/13C/13D	EMERGENCY DIESEL GENERATOR A/B/C/D ROOM EMERGENCY CUBICLE COOLER	2.3%
5	AF-MV043/44/45/46	AF MOTOR-DRIVEN PUMPS AND TURBINE DRIVEN PUMPS DISCHARGE ISOLATION VALVE	1.9%
6	WO-CH01A/1B/2A/2B	ESSENTIAL CHILLER 1A/1B/2A/2B	1.8%
7	MS-EV011/012/013/014	MAIN STEAM ISOLATION VALVE (MSIV)	1.6%
8	CS-MV003/004	CONTAINMENT SPRAY HEAT EXCHANGER 1A/1B DISCHARGE ISOLATION VALVE	1.1%
9	AF-MDP02A/2B	AF MOTOR-DRIVEN PUMP 2A/2B	0.9%
10	CC-MV097/098	COMPONENT COOLING WATER MOTOR-OPERATE VALVE FOR CONTAINMENT SPRAY HEAT EXCHANGER 1A/1B	0.7%
11	CC-MP01A/1B/2A/2B	COMPONENT COOLING WATER PUMP 1A/1B/2A/2B	0.5%

Table 19.1-24

Level 1 Internal Events Key Operator Actions by RAW (CDF)

Rank	Pre-initiator Events	Description	RAW
1	HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL	12
2	RPOPU-S-LT1113ABCD	MISCALIBRATION OF LO SG1 LEVEL CHANNELS	12
3	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	10
4	RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	9
5	RPOPU-S-PT102ABCD	MISCALIBRATION OF LO PZR PRESSURE CHANNELS	9
6	AFOPV-S-AFAS-FW	OPERATORS FAIL TO RECOVER AFAS	6
7	CVOPH-S-IRWST	OPERATORS FAIL TO REFILL THE IRWST VIA CVCS	3
8	FWOPH-S-ERY	OPERATORS FAIL TO ALIGN STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	3
9	CDOPH-S-ALIGN	OPERATORS FAIL TO MANUALLY START CD PUMPS	3
10	CVOPH-S-RCPSEAL	OPERATORS FAIL TO RECOVER RCP SEAL COOLING	3
11	RPOPU-S-LT1123ABCD	MISCALIBRATION OF LO SG2 LEVEL CHANNELS	3

Table 19.1-25

Level 1 Internal Events Key Operator Actions by FV (CDF)

Rank	Operator Action	Description	FV
1	RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	12.8%
2	PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL4.16kV	4.2%
3	AFOPV-S-AFAS-FW	OPERATORS FAIL TO RECOVER AFAS	3.0%
4	FWOPH-S-ERY	OPERATORS FAIL TO ALIGN STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	2.5%
5	WOOPH-S-1AB2AB	OPERATORS FAIL TO START ECW PUMPS MANUALLY	1.9%
6	CVOPH-S-RCPSEAL	OPERATORS FAIL TO RECOVER RCP SEAL COOLING	1.7%
7	HR-RCSCD2	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS AFTER OVERFILL	1.5%
8	HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL	1.5%
9	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	0.8%
10	RCOPH-S-SDSL	OPERATORS FAIL TO OPEN SDS VALVES DURING LATE PHASE	0.8%

Table 19.1-26

PDS Grouping Parameters

No	Parameter	Parameter Values	Code
1	Containment Bypass (CONBYPASS)	SGTR	SGTR
		ISLOCA	ISLOCA
		No Containment Bypass	NOBYPASS
2	Containment Isolation (CONISOL)	Not Isolated	NOT_ISOLATED
		Containment Failure Before Core Melt	RBCM
		Containment Isolated	ISOLATED
3	LOCA or Transient (LOCATRAN)	Large LOCA	LL
		Medium LOCA	ML
		Small LOCA	SL
		RCP Seal LOCA	RSF
		Transient	TRAN
4	RCS Pressure at Core Damage (PRCSCD)	Low Pressure	LOW
		Medium Pressure	MED
		High Pressure	HIGH
5	Cavity Condition (CAVCOND)	Cavity Flooded	WET
		External Reactor Vessel Cooling	ERVC
		Cavity Not Flooded	DRY
6	In-Vessel Injection (INVINJ)	In-Vessel Injection	ON
		In-Vessel Injection Available but Not Injected due to High Pressure	DEADHEADED
		Failed	FAILED
7	Release Point (RELPOINT)	Release to Containment	INC
		Release to IRWST only	IRWST
8	Containment Heat Removal (CHR)	Containment Heat Removal Available	YES
		CHR Recovered Late	RECOVERED
		CHR Not Available	NO
9	SG Feedwater Available (SG)	SGs are wet at the time of core damage	WET
		SGs are dry at the time of core damage	DRY

Table 19.1-27

Frequency of PDS and Dominant PDS ET Sequences

Rank	PDS No.	Frequency (/yr)	Fraction (%)	Cumulative (%)	Contribution	
					PDS ET Sequences	Fraction (%)
1	14	3.12E-07	29.2	29.2	SBO sequence 03 LOOP sequence 03	34.7 13.4
2	8	2.68 E-07	25.1	54.4	LOOP sequence 18 GTRN sequence 26	32.0 31.9
3	13	9.96 E-08	9.3	63.7	RVR sequence 01 LOOP sequence 08	30.7 16.4
4	98	7.55E-08	7.1	70.8	LOOP sequence 26 GTRN sequence 36	60.4 19.8
5	103	4.19E-08	3.9	74.7	ATWS sequence 73 ATWS sequence 60	93.1 6.9
6	2	3.77E-08	3.5	78.3	LSSB-D sequence 62 ATWS sequence 43	59.4 15.2
7	7	3.59E-08	3.4	81.6	MLOCA sequence 02 LLOCA sequence 02	99.7 0.3
8	9	3.51E-08	3.3	84.9	GRID-SBO sequence 03 LOOP sequence 19	39.3 29.5
9	1	3.37E-08	3.2	88.1	SGTR sequence 08 SGTR sequence 10	60.8 10.9
10	17	2.70E-08	2.5	90.6	SBO sequence 05 LOOP sequence 05	70.6 16.7
11	18	2.51E-08	2.4	93.0	SBO sequence 38 SBO sequence 105	67.3 24.0
12	106	1.13E-08	1.0	94.0	LOOP sequence 31 TLOCCW sequence 09 TLOESW sequence 09	35.3 30.9 30.9
13	100	8.63E-09	0.8	94.8	LOOP sequence 27 GRID-SBO sequence 11	71.5 28.4
14	35	5.95E-09	0.6	95.4	SBO sequence 57 SBO sequence 04	51.8 23.4

Table 19.1-28

Containment Failure Modes and Results

Failure Mode		Force	Median Pressure (psi)	Logarithmic Standard Deviation	Failure Size Category
Cylinder Wall	Hoop Direction	Membrane	204.79	0.20	Rupture
	Meridional Dire.	Membrane	257.66	0.19	Rupture
Dome	Hoop Dire. (above 45 deg.)	Membrane	221.90	0.23	Rupture
	Meridional Dire. (under 45deg.)	Membrane	237.31	0.18	Rupture
Basemat -Cylinder Wall Junction	Radial Dire.	Shear	214.80	0.29	Rupture
	Meridional Dire.	Moment	224.28	0.16	Rupture
Basemat	Screen out	-	-	-	Rupture
Equipment Hatch	Spherical Hatch Cover	Buckling	225.71	0.15	Rupture
	Welded Stud	Shear	251.69	0.11	Rupture
	Wall-Hatch Junction	Shear	459.10	0.29	Rupture
Personnel Air lock	Spherical Hatch Cover (Bulkhead plate)	Buckling	222.18	0.15	Rupture
	Welded Stud	Shear	253.03	0.11	Rupture
	Wall-Hatch Junction	Shear	443.92	0.24	Rupture
Fuel Transfer Tube	Blind Flange	-	223.08	0.15	Rupture
	Sleeve	-	281.03	0.15	Rupture
Fuel Transfer Tube	Welded Stud	Shear	420.55	0.15	Rupture
	Wall-Hatch Junction	Shear	752.43	0.24	Rupture
Liner Tearing of Equipment Hatch	-	-	188.0	0.15	Leak

Table 19.1-29 (1 of 3)

Summary of Source Term Evaluation

	MAAP CASE	STC-01	STC-02	STC-03	STC-04	STC-05	STC-06	STC-07
FP Releases at end of MAAP run	CsI (%)	45.7	0.0017	41.6	25.9	0.76	3.5	16.1
	TeO_2 (%)	16.8	0.00055	30.4	27.8	0.26	2.6	8.5
	CsOH (%)	17.3	0.0012	43.5	27.3	0.16	3.0	8.9
	Te_2 (%)	45.7	0.0017	41.6	25.9	0.76	3.5	16.1
LRF or not		LRF	NOT LRF	LRF	LRF	NOT LRF	LRF	LRF
FP Releases at end of MAAP run 4 hours after a general emergency declaration	CsI (%)	12.2	0.00094	28.4	19.6	0.75	3.4	0.54
	TeO_2 (%)	6.0	0.00044	17.1	18.4	0.26	2.5	0.44
	CsOH (%)	6.1	0.00092	28.3	19.6	0.16	3.0	0.45
	Te_2 (%)	-	-	-	-	0.01	0.018	0.0
LERF or not		LERF	NOT LERF	LERF	LERF	NOT LERF	LERF	NOT LERF

Table 19.1-29 (2 of 3)

	MAAP CASE	STC-08	STC-09	STC-10	STC-11	STC-12	STC-13	STC-14
FP Releases at end of MAAP run	CsI (%)	25.4	0.00088	0.0024	0.0088	No sequence is assigned to STC-12	15.6	0.27
	TeO_2 (%)	18.9	0.00059	0.0023	0.0016		6.7	0.067
	CsOH (%)	19.4	0.00063	0.0015	0.059		4.1	0.060
	Te_2 (%)	0.15	0.0	0.0	0.0017		-	0.026
LRF or not		LRF	NOT LRF	NOT LRF	NOT LRF		LRF	NOT LRF
FP Releases at end of MAAP run 4 hours after a general emergency declaration	CsI (%)	15.3	-	-	0.0024		5.5	0.0018
	TeO_2 (%)	13.8	-	-	0.0016		6.1	0.0017
	CsOH (%)	14.8	-	-	0.012		3.3	0.0012
	Te_2 (%)	-	-	-	-		-	-
LERF or not		LERF	NOT LERF	NOT LERF	NOT LERF		LERF	NOT LERF

Table 19.1-29 (3 of 3)

	MAAP CASE	STC-15	STC-16	STC-17	STC-18	STC-19	STC-20	STC-21
FP Releases at end of MAAP run	CsI (%)	No sequence is assigned to STC-15	1.5	0.014	0.67	1.2	2.8	5.0
	TeO_2 (%)		0.049	0.0022	0.066	0.013	0.098	0.077
	CsOH (%)		0.20	0.0036	0.094	0.19	0.034	0.049
	Te_2 (%)		0.00061	-	0.027	-	0.0060	-
LRF or not			NOT LRF	NOT LRF	NOT LRF	NOT LRF	LRF	LRF
FP Releases at end of MAAP run 4 hours after a general emergency declaration	CsI (%)		0.0021	0.0018	0.0018	0.0017	0.0021	0.0018
	TeO_2 (%)		0.0017	0.0020	0.0017	0.0019	0.0017	0.0020
	CsOH (%)		0.0012	0.0014	0.0012	0.0013	0.0012	0.0014
	Te_2 (%)		-	-	-	-	-	-
LERF or not			NOT LERF	NOT LERF	NOT LERF	NOT LERF	NOT LERF	NOT LERF

Table 19.1-30 (1 of 2)

Source Term Category Frequencies and Contributions to LRF

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 1	SGTR w/o scrubbing	LRF / LERF	5.33E-08	4.1	48.5
STC 21	Late containment failure with a rupture failure size	LRF	2.96E-08	2.3	26.9
STC 8	CFBRB with a rupture failure size	LRF / LERF	1.30E-08	1.0	11.8
STC 7	CFBRB with a leak failure size	LRF	1.14E-08	0.9	10.4
STC 13	Early containment failure with a rupture failure size	LRF / LERF	1.79E-09	0.1	1.6
STC 6	Not isolation w/o CS	LRF / LERF	1.23E-09	0.1	1.1
STC 4	ISLOCA with scrubbing	LRF / LERF	6.49E-11	0.0	5.9E-02
STC 3	ISLOCA w/o scrubbing	LRF / LERF	5.31E-11	0.0	4.8E-02
STC 20	Late containment failure with a rupture failure size	LRF	1.19E-11	0.0	1.1E-02
STC 2	SGTR with scrubbing	Non-LRF	2.41E-08	1.8	
STC 5	Not isolation with CS	Non-LRF	2.46E-09	0.2	
STC 9	Intact containment w/o RPV breach	Non-LRF	3.67E-07	28	
STC 10	Intact containment with RPV breach	Non-LRF	7.64E-07	58.2	
STC 11	Basemat Melt-through	Non-LRF	1.33E-08	1.0	
STC 12	Early containment failure with a leak failure size	Non-LRF	0.00	0.0	
STC 14	Late containment failure with a leak failure size	Non-LRF	4.28E-11	0.0	

Table 19.1-30 (2 of 2)

Source Term Category	Description	LRF, LERF or non-LRF	Frequency	% of total STC freq	% of total LRF
STC 15	Late containment failure with a leak failure size	Non-LRF	0.00	0.0	
STC 16	Late containment failure with a leak failure size	Non-LRF	7.30E-12	0.0	
STC 17	Late containment failure with a leak failure size	Non-LRF	2.70E-08	2.1	
STC 18	Late containment failure with a rupture failure size	Non-LRF	4.19E-10	0.0	
STC 19	Late containment failure with a rupture failure size	Non-LRF	4.01E-09	0.3	
Total frequency of all STCs			1.31E-06		
Total frequency of the Large Release STCs			1.10E-07		

Table 19.1-31 (1 of 33)

Level 2 Internal Events Top 100 LRF Cutsets

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	4.43E-09	-MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT	4.0	4.0
		%GTRN	GENERAL TRANSIENT		
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
2	4.25E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	3.8	7.8
		MSEVXQ2-012/13	CCF OF MSIVS 012 AND 013 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
3	4.25E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	3.8	11.6
		MSEVXQ2-011/14	CCF OF MSIVS 011 AND 014 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
4	4.25E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	3.8	15.4
		MSEVXQ2-012/14	CCF OF MSIVS 012 AND 014 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (2 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	4.25E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	3.8	19.2
		MSEVXQ2-011/13	CCF OF MSIVS 011 AND 013 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
6	2.20E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	2.0	21.2
		MSEVXQ4-011/12/13/14	CCF OF MSIVS FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
7	2.05E-09	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	1.9	23.1
		CVDPR-S-PP03	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		

Table 19.1-31 (3 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	2.05E-09	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	1.9	25.0
		CVDPR-S-PP03	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
9	1.65E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	1.5	26.5
		MSEVXQ3-011/12/14	CCF OF MSIVS 011, 012 AND 014 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
10	1.65E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	1.5	28.0
		MSEVXQ3-011/13/14	CCF OF MSIVS 011, 013 AND 014 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
11	1.65E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	1.5	29.5
		MSEVXQ3-012/13/14	CCF OF MSIVS 012, 013 AND 014 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (4 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
12	1.65E-09	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	1.5	31.0
		MSEVXQ3-011/12/13	CCF OF MSIVS 011, 012 AND 013 FAIL TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
13	1.47E-09	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	1.3	32.3
		CSMVWD2-003/004	CCF OF CS HX DISCHARGE ISOLATION VALVES FAIL TO OPEN		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
14	1.11E-09	%SLOCA	SMALL LOSS OF COOLANT ACCIDENT	1.0	33.3
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
15	8.98E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.8	34.1
		CCMVWD2-097/8	2/2 CCF OF CCW MOV 097/098 FOR CS HX HE01A/B INLET		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		

Table 19.1-31 (5 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	8.90E-10	%LOOP-GR	GRID-RELATED LOOP	0.8	34.9
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
17	8.45E-10	%GTRN	GENERAL TRANSIENT	0.8	35.7
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
18	7.58E-10	%LOOP-SW	SWITCHYARD-CENTERED LOOP	0.7	36.4
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		

Table 19.1-31 (6 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	7.23E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.7	37.1
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
20	6.64E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.6	37.7
		HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
21	5.87E-10	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.5	38.2
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		

Table 19.1-31 (7 of 33)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to LRF (%): Cutset	Contribution to LRF (%): Cumulative
22	4.73E-10	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.4	38.6
		CVOPH-S-RCPSEAL	OPERATOR FAILS TO RECOVER RCP SEAL COOLING		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
23	4.73E-10	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	0.4	39.0
		CVOPH-S-RCPSEAL	OPERATOR FAILS TO RECOVER RCP SEAL COOLING		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
24	4.43E-10	-MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT	0.4	39.4
		%LOFW	LOSS OF MAIN FEEDWATER		
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (8 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	4.31E-10	%LOOP-GR	GRID-RELATED LOOP	0.4	39.8
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
26	4.31E-10	%LOOP-GR	GRID-RELATED LOOP	0.4	40.2
		NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
27	4.18E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.4	40.6
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
28	4.18E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.4	41.0
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		

Table 19.1-31 (9 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	3.77E-10	-MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT	0.3	41.3
		%LOCV	LOSS OF CONDENCER VACCUM		
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
30	3.67E-10	%LOOP-SW	SWITCHYARD-CENTERED LOOP	0.3	41.6
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
31	3.67E-10	%LOOP-SW	SWITCHYARD-CENTERED LOOP	0.3	41.9
		NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-31 (10 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
32	3.42E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.3	42.2
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
33	3.31E-10	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.3	42.5
		CVDPR-S-PP03	FAILS TO RUN AUX. CHARGING PUMP PP03		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS_69	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-69		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
34	3.31E-10	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	0.3	42.8
		CVDPR-S-PP03	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS_69	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-69		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		

Table 19.1-31 (11 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
35	3.20E-10	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.3	43.1
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
36	3.10E-10	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	0.3	43.4
		NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
37	3.10E-10	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.3	43.7
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-31 (12 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
38	3.10E-10	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.3	44.0
		NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
39	3.10E-10	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	0.3	44.3
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
40	2.85E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.3	44.6
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		

Table 19.1-31 (13 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
41	2.80E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.3	44.9
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
42	2.77E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.3	45.2
		CVOPH-S-IRWST	OPERATOR FAILS TO REFILL THE IRWST VIA CVCS		
		HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
43	2.72E-10	%LOOP-GR	GRID-RELATED LOOP	0.2	45.4
		MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-31 (14 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	2.72E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	45.6
		ERVC	Failure of ERVC system		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
45	2.71E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	45.8
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-31 (15 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	2.67E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	46.0
		CVMVO-S-509	IRWST RETURN LINE ISOLCATION VALVE FAILS TO OPEN ON DEMAND		
		HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
47	2.41E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	46.2
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
48	2.36E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.2	46.4
		AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		RAC-12H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 9.5HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-31 (16 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	2.36E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.2	46.6
		AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		RAC-12H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 9.5HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
50	2.33E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.2	46.8
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
51	2.31E-10	%LOOP-SW	SWITCHYARD-CENTERED LOOP	0.2	47.0
		MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-31 (17 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
52	2.20E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.2	47.2
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
53	2.03E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	47.4
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_92	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-92		
54	1.98E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.2	47.6
		C-RCD1-SCLT-RFIR	COMBINED OPERATOR ERROR FOR HR-RCSCD1-ISOL, SIOPH-S-LTC-SC and CVOPH-S-IRWST		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (18 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	1.98E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.2	47.8
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
56	1.98E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	48.0
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-31 (19 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	1.98E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	48.2
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
58	1.95E-10	%TLOCCW	TOTAL LOSS OF COMPONANT COOLING WATER	0.2	48.4
		MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
59	1.95E-10	%TLOESW	TOTAL LOSS OF ESSENTIAL SERVICE WATER	0.2	48.6
		MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-31 (20 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	1.93E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	48.8
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBO2B-SW01D-G2	4.16kV CLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
61	1.93E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	49.0
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
62	1.82E-10	-MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT	0.2	49.2
		%LOIA	LOSS OF INTRUMENT AIR		
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (21 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	1.81E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	49.4
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
64	1.79E-10	%SLOCA	SMALL LOSS OF COOLANT ACCIDENT	0.2	49.6
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS_51	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-51		
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
65	1.78E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.2	49.8
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-31 (22 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
66	1.76E-10	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.2	50.0
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
67	1.70E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.2	50.2
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START		
68	1.62E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.1	50.3
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVZO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR		

Table 19.1-31 (23 of 33)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to LRF (%): Cutset	Contribution to LRF (%): Cumulative
69	1.58E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.1	50.4
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN		
70	1.57E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	50.5
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
71	1.57E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	50.6
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-31 (24 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
72	1.43E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.1	50.7
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		RAC-12H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 9.5HR (WEATHER RELATED)		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
73	1.40E-10	%LOOP-PL	PLANT-CENTERED LOOP	0.1	50.8
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL		
74	1.38E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	50.9
		HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL		
		HR-RCSCD2-CD	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL		
		IAAVO-S-1027	PRESSURE REDUCING VALVE 1027 FAILS TO MODULATE (OPEN)		
		IAOPH-S-ALIGN-LD	OPERATOR FAILS TO OPEN PRESSURE REDUCING BYPASS VALVE 1030 WITH LOW DEP.		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		

Table 19.1-31 (25 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	1.38E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.1	51.0
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
76	1.38E-10	%LOOP-WE	WEATHER-RELATED LOOP	0.1	51.1
		NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		
77	1.22E-10	%SLOCA	SMALL LOSS OF COOLANT ACCIDENT	0.1	51.2
		ERVC	Failure of ERVC system		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
		SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED		

Table 19.1-31 (26 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
78	1.20E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	51.3
		MSEVC-C-MSIV011	SG1 MSIV 011 FAILS TO CLOSE		
		MSEVC-D-MSIV014	SG2 MSIV 014 FAILS TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
79	1.20E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	51.4
		MSEVC-C-MSIV013	SG2 MSIV 013 FAILS TO CLOSE		
		MSEVC-D-MSIV012	SG1 MSIV 012 FAILS TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
80	1.20E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	51.5
		MSEVC-C-MSIV011	SG1 MSIV 011 FAILS TO CLOSE		
		MSEVC-C-MSIV013	SG2 MSIV 013 FAILS TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
81	1.20E-10	%LSSB-D	LARGE SECONDARY SIDE BREAK (MSIV DOWNDSTREAM)	0.1	51.6
		MSEVC-D-MSIV012	SG1 MSIV 012 FAILS TO CLOSE		
		MSEVC-D-MSIV014	SG2 MSIV 014 FAILS TO CLOSE		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		

Table 19.1-31 (27 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	1.18E-10	%ISLOCA	INTERFACING LOSS OF COOLANT ACCIDENT	0.1	51.7
		PDS_3	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-3		
83	1.14E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	51.8
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
84	1.14E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	51.9
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		

Table 19.1-31 (28 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	1.14E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	52.0
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
86	1.12E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	52.1
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
87	1.12E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	52.2
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBO2B-SW01D-G2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN4.16kV		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		

Table 19.1-31 (29 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
88	1.10E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	52.3
		CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
89	1.09E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	52.4
		DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION		
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
90	1.09E-10	%MLOCA	MEDIUM LOSS OF COOLANT ACCIDENT	0.1	52.5
		DGDGL-C-DGC	DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
91	1.05E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	52.6
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		

Table 19.1-31 (30 of 33)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to LRF (%): Cutset	Contribution to LRF (%): Cumulative
92	1.05E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	52.7
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
93	1.05E-10	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.1	52.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PEAIY-A-LX01A04	FAILURE OF ANALOG INPUT MODULE LX01A BRANCH 04		
		RCOPH-S-SDSE-FW-HD	FAILURE OF POSRVS EARLY PHASE OPEN WITH HIGH DEPENDENCY		
		VOOPV-S-AFMDP	OPERATOR FAILS TO START FOR HV33A,33B(AF MDP) BY HAND SWITCH		

Table 19.1-31 (31 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	1.03E-10	%PLOESW	PARTIAL LOSS OF ESSENTIAL SERVICE WATER	0.1	52.9
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
95	1.03E-10	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	53.0
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-31 (32 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
96	1.02E-10	%SLOCA	SMALL LOSS OF COOLANT ACCIDENT	0.1	53.1
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-LOCA	CONDITIONAL LOOP UPON LOCA INITIATORS		
97	9.84E-11	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.1	53.2
		DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M		
		PDS-FREQ-SDR-PO-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V & POSRV OPERATING)		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		RCOPH-S-SDSE-FW-HD	FAILURE OF POSRVS EARLY PHASE OPEN WITH HIGH DEPENDENCY		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		

Table 19.1-31 (33 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	9.61E-11	%SGTR	STEAM GENERATOR TUBE RUPTURE	0.1	53.3
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
		VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A		
99	9.47E-11	%LOOP-WE	WEATHER-RELATED LOOP	0.1	53.4
		DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN		
		PDS_93	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-93		
		RAC-16H-WE	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (WEATHER RELATED)		
		VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START		
100	9.46E-11	%PLOCCW	PARTIAL LOSS OF COMPONANT COOLING WATER	0.1	53.5
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS-FREQ-SDR-3W	PDS FREQUENCY ADJUSTMENT FOR SDR (3WAY V/V OPERATING)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
		WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M		

Table 19.1-32

Level 2 Internal Events LRF Contributions by Initiating Events

Initiator	LRF	Fraction
LSSB-D	2.95E-08	26.7%
LOOP	1.53E-08	13.8%
SBO	1.38E-08	12.5%
MLOCA	1.16E-08	10.5%
ATWS	7.19E-09	6.5%
PLOCCW	6.99E-09	6.3%
TLOCCW	4.49E-09	4.1%
TLOESW	4.49E-09	4.1%
PLOESW	4.02E-09	3.6%
SGTR	4.00E-09	3.6%
GRID-SBO	3.98E-09	3.6%
SLOCA	2.55E-09	2.3%
Others	2.64E-09	2.4%
Total	1.11E-07	100.0%

Table 19.1-33

Significant PDS Contributors to LRF

PDS No.	Frequency (/yr)	Contribution (%)	Cumulative (%)	PDS characteristics
PDS-2	4.01E-08	36.3	36.3	SGTR, Dry SG
PDS-14	2.18E-08	19.7	56.0	Depressurized RCS into Low pressure, Wet Cavity, SI unavailable, Release to In-containment, Containment Heat Removal Unavailable
PDS-7	2.11E-08	19.1	75.1	Large and medium LOCAs with successful injection but failure of containment sprays, or transients with failure of secondary heat removal followed by successful feed and bleed cooling but with failure of containment sprays or cooling IRWST.
PDS-86	1.11E-08	10.0	85.1	Not-depressurized RCS(High pressure), Wet Cavity, SI deadheaded, Release to IRWST, Containment Heat Removal Available, Dry SG
PDS-93	6.28E-09	5.7	90.7	Not-depressurized RCS(High pressure), Wet Cavity, SI failed, Release to IRWST, Containment Heat Removal Unavailable, Wet SG
PDS-9	3.39E-09	3.1	93.8	Depressurized RCS into Low pressure, Wet Cavity, SI available, Release to In-containment, Containment Heat Removal Unavailable
PDS-94	1.26E-09	1.1	95.0	Not-depressurized RCS(High pressure), Wet Cavity, SI failed, Release to IRWST, Containment Heat Removal Unavailable, Dry SG
PDS-6	1.23E-09	1.1	96.1	Containment Not-isolated, Containment Heat Removal Unavailable
PDS-88	1.16E-09	1.1	97.1	Not-depressurized RCS(High pressure), Wet Cavity, SI deadheaded, Release to IRWST, Containment Heat Removal Unavailable, Dry SG
Others	3.18E-09	2.9	100.0	

Table 19.1-34 (1 of 12)

Level 2 Internal Events Key Basic Events by RAW (LRF)

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	1320
SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED	1020
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	42
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	33
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	20
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	18
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	17
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	16
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	16
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	15
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	15
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	15
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	14
DCBTT-B-BT01B	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	13
DCBTT-A-BT01A	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	12
SXMVR-B-MV074	LOSS OF SX DIV.II DUE TO THE MOV074 SPURIOUS OPEN (FLOW DIVERSION)	12
SXMVR-B-MV073	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	12
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	11
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	11
DCBTY-B-BT01B	BAT. BT01B (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	10

Table 19.1-34 (2 of 12)

Basic Event	Description	RAW
PEAIY-A-LX01A04	FAILURE OF ANALOG INPUT MODULE LX01A BRANCH 04	10
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	9
VOTTY-A-TE085A	MAFP ROOM TEMPERATURE TE085A FAILS WHILE OPERATING FOR HV33A INTERLOCK SIGNAL	9
PEDOY-D-LX02D04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02D BRANCH 04	8
CCHEY01B-HE01B	CCW HX HE01B FAILS WHILE OPERATING	8
CCHEY02B-HE02B	CCW HX HE02B FAILS WHILE OPERATING	8
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	7
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	7
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	7
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	7
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	7
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	7
CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING	6
CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING	6
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	6
PELXY-B-LX11B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX11B	6
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	6
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	6
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	6
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	6
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	6
IPINM-D-IN01D	CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M	5
DCBTM-D-BT01D	CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M	5
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	5

Table 19.1-34 (3 of 12)

Basic Event	Description	RAW
PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C	5
ATAVO-C-009	FAILS TO OPEN AFW TDP PP01A TURBINE STEAM ISOLATION AOV 009	5
DCBTM-C-BT01C	CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M	5
IPINM-C-IN01C	CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M	5
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	5
SICVWQ3-V569/1001/1002	3/4 CSP DISCH LINE 1001, 1002 AND SCP DISCH. LINE CV 569	5
AFVVT1A-V1616	AFW TDP PP01A MINI FLOW MANUAL VALVE V1616 TRANSFER CLOSED	4
AFVVT1A-V1013A	AFW TDP PP01A MINI FLOW MANUAL VALVE V1013A TRANSFER CLOSED	4
MSVVT-B-V1151	MS MANUAL VALVE V1151 FOR AFW TDP01A TRANSFER CLOSED	4
AFVVT1A-V1006A	AFW TDP01A DISCHARGE MANUAL VALVE V1006A TRANSFER CLOSED	4
AFVVT1A-V1002A	AFW SUCT. MANUAL VALVE V1002A TRANSFER CLOSED	4
PELXY-C-LX04C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04C	4
PEDOY-C-LX02C04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02C BRANCH 04	4
PEDOY-B-LX11B04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX11B BRANCH 04	4
PELXY-D-LX02D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02D	4
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	4
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	4
AFMVT1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 TRANSFER CLOSED	4
PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE	4

Table 19.1-34 (4 of 12)

Basic Event	Description	RAW
NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE	4
SICVWQ3-V568/569/1002	3/4 CSP DISCH LINE 1002 AND SCP DISCHARGE LINE CV 568, 569	4
SICVWQ3-V568/569/1001	3/4 CSP DISCH LINE 1001 AND SCP DISCH. LINE CV 568, 569	4
DCBCY-C-BC01C	CLASS 1E 125V DC BATT. CHARGER BC01C FAILS OPERATING	4
MSEVC-D-MSIV014	SG2 MSIV 014 FAILS TO CLOSE	4
MSEVC-C-MSIV013	SG2 MSIV 013 FAILS TO CLOSE	4
PEDOY-C-LX04C04	FAILURE OF DIGITAL OUTPUT MODULE LX04C BRANCH 04	4
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	4
CI-HATCH	HATCH FAILS TO ISOLATE	4
MSEVC-C-MSIV011	SG1 MSIV 011 FAILS TO CLOSE	4
MSEVC-D-MSIV012	SG1 MSIV 012 FAILS TO CLOSE	4
PGBSY2B-LC01D	BUS FAULT ON 480V LC LC01D	4
CCMVO-B-098	CS HX HE01A INLET MOV 098 FAILS TO OPEN	4
CSMVO1B-004	CS ISOLATION MOV 004 IN CS TR. B HX DISCH. PATH FAILS TO OPEN	4
PFBSY2B-SW01D	BUS FAULT ON 4.16kV SWGR SW01D	4
AFCVO1A-V1004A	FAILS TO OPEN AFW TDP01A DISCHARGE CHECK VALVE V1004A	4
AFCVO1A-V1008A	FAILS TO OPEN AFW TDP01A DISCHARGE CHECK VALVE V1008A	4
ATCVO-C-V1020A	FAILS TO OPEN AFW TBN SYSTEM CHECK VALVE V1020A FOR AFW TDP01A	4
AFCVO1A-V1014A	FAILS TO OPEN AFW TDP01A MINI FLOW CHECK VALVE V1014A	4
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	4
PGXMY2B-TR01D	480V LC TRANSFORMER LC-TR01D FAULT	4
DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	4

Table 19.1-34 (5 of 12)

Basic Event	Description	RAW
PAGXY-A-PM3-PA03A-P	FAILURE OF PRIMARY GROUP CONTROLLER OF 752-PA-PA03A	4
CSMVO1A-003	CS ISOL. MOV 003 IN CS TRAIN A DISCH. PATH FAILS TO OPEN	4
CCMVO-A-097	CS HX HE01A INLET MOV 097 FAILS TO OPEN	4
PELXY-D-LX03D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-J-LX03D	4
PEDOY-A-LX03A02	FAILURE OF DIGITAL OUTPUT MODULE LX03A BRANCH 02	4
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	4
PEDOY-D-LX03D02	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 02	4
CVMVO-S-509	IRWST RETURN LINE ISOLATION VALVE FAILS TO OPEN	4
PODOY-M-LX2501	FAILS TO OPERATE DO MODULE LX25 BRANCH 01	4
POLXY-M-LX25-P	PRIMARY LOOP CONTROLLER LX25 FAILS TO RUN	4
CVVVO-S-V649	BAMPS DISCHARGE VV 649 FAILS TO OPEN	4
CVVVO-S-V126	BAMPS DISCHARGE VV 126 FAILS TO OPEN	4
CVMVT-S-553	IRWST RETURN LINE MOV 553 FAILS TO REMAIN OPEN	4
DEAVC-S-006	CTMT. ISOL. AOV DE-006 FAIL TO CLOSE	4
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	4
DCBSY-M-MC01M	BUS FAULT ON 125VDC BUS MC01M	4
CVCVO-S-V189	IRWST RETURN LINE CV 189 FAILS TO OPEN	4
IATKB-S-TK01	INSTRUMENT AIR SYSTEM TANKS TK01 LEAKAGE (EXTERNAL) / RUPTURE / BREAKS	4
IATKB-S-TK02	INSTRUMENT AIR SYSTEM TANKS TK02 LEAKAGE (EXTERNAL) / RUPTURE / BREAKS	4
DCBTT-D-BT01D	CLASS 1E 125V DC BATTERY BT01D FAILS BETWEEN TEST INTERVAL	3
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	3
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	3
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	3
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	3

Table 19.1-34 (6 of 12)

Basic Event	Description	RAW
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	3
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	3
DGDGL-B-DGB	DG B FAILS TO LOAD AND RUN DURING FIRST 1HR OF OPERATION	3
PHBSY2B-MC01D	BUS FAULT ON 480V MCC MC01D	3
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	3
GWSVO-S-002	CONTAINMENT ISOLATION SOV GW-002 FAIL TO CLOSE	3
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	3
CSHEM2B-HE01B	CS HX HE01B FAILS DUE TO T&M	3
WTTKB-S-TK01	TGBCCW SURGE TANK TK01 LEAKAGE (EXTERNAL) / RUPTURE / BREAK	3
DGDGS-B-DGB	FAILS TO START OF EDG B	3
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	3
CCVVT-B-V1212	CS HX HE01B OUTLET MANUAL VALVE V1212 TRANSFER CLOSED	3
PELXY-B-LX05B-P	PRIMARY LOOP CONTROLLER LX05B-P FAILS TO RUN	3
PELXY-C-LX03C-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	3
CSHEM2A-HE01A	CS HX HE01A FAILS DUE TO T&M	3
AFSVI1A-0037	AFW TDP01A DISCHARGE MODULATION VALVE 037 FAILS SPURIOUSLY CLOSED	3
PEDOY-C-LX03C02	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 02	3
CCVVT-A-V1211	CS HX HE01A OUTLET MANUAL VALVE V1211 TRANSFER CLOSED	3
DGSQA-B-LOADSQ	LOAD SEQUNCER A FAILS TO OPERATE	3
CSMVT1B-002	MOV 001 IN CS HX 1 DISCHARGE PATH FAILS TO REMAIN OPEN	3
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	3
PELXY-A-LX05A-P	PRIMARY LOOP CONTROLLER LX05A FAILS TO RUN	3
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	3

Table 19.1-34 (7 of 12)

Basic Event	Description	RAW
CSMVT1A-001	MOV 001 IN CS HX 1 DISCHARGE PATH FAILS TO REMAIN OPEN	3
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	3
CSHEY2A-HE01A	CS HX 1 HE01A FAILS WHILE OPERATING	3
CSCVO1A-V1007	CV V1007 IN CSS DISCH. LINE A FAILS TO OPEN	3
CSHEY2B-HE01B	CS HX 2 HE01B FAILS WHILE OPERATING	3
CSCVO1B-V1008	CV V1008 IN CSS DISCHARGE LINE B FAILS TO OPEN	3
DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	3
DCBTY-D-BT01D	BAT. BT01D (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	3
DCBTT-C-BT01C	CLASS 1E 125V DC BATTERY BT01C FAILS BETWEEN TEST INTERVAL	3
AFMPL2A-MDP02A	FAILS TO RUN FOR 1HR AFW MDP PP02A	3
DGDGS-D-DGD	FAILS TO START OF EDG D	3
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	3
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	3
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1011A TRANSFER CLOSED	3
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	3
PHBSY2A-MC01C	BUS FAULT ON 480V MCC MC01C	3
VDHVM-B-HV13B	CUBICLE COOLER HV13B UNAVAILABLE DUE TO T&M	3
VDHVM-B-HV12B	CUBICLE COOLER HV12A UNAVAILABLE DUE TO T&M	3
DGSQA-D-LOADSQ	LOAD SEQUNCER D FAILS TO OPERATE	3
VDHVM-D-HV13D	CUBICLE COOLER HV13D UNAVAILABLE DUE TO T&M	3
VDHVM-D-HV12D	CUBICLE COOLER HV12D UNAVAILABLE DUE TO T&M	3
VDHVL-D-HV13D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13D FOR 1HR	3

Table 19.1-34 (8 of 12)

Basic Event	Description	RAW
VDHVL-D-HV12D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12D FOR 1HR	3
VDHVR-D-HV12D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12D	3
VDHVR-D-HV13D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13D	3
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	3
CCMVO-D-182	CCW MOV 182 FOR EDG01D INLET FAILS TO OPEN	3
VDHVS-D-HV12D	FAILS TO START EDG ROOM CUBICLE COOLER HV12D	3
VDHVS-D-HV13D	FAILS TO START EDG ROOM CUBICLE COOLER HV13D	3
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	3
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	3
DGDGR-D-DGD	FAILS TO RUN OF EDG D	3
VDHVL-B-HV13B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13B FOR 1HR	3
VDHVL-B-HV12B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12B FOR 1HR	3
VDHVR-B-HV12B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12B	3
VDHVR-B-HV13B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13B	3
DGDGR-B-DGB	FAILS TO RUN OF EDG B	3
CCMVO-B-192	CCW MOV 192 FOR EDG01B INLET FAILS TO OPEN	3
VDHVS-B-HV13B	FAILS TO START EDG ROOM CUBICLE COOLER HV13B	3
VDHVS-B-HV12B	FAILS TO START EDG ROOM CUBICLE COOLER HV12B	3
IAFLP-A-FT03A	AIR PREFILTER FT03A PLUGGED	3
IAFLP-A-FT04A	INSTRUMENT AIR SYSTEM AFTERFILTER FT04A PLUGGED IN TRAIN A	3
IAADY-A-ADP1	AIR DRYER PACKAGE1 FAILS TO FLOW INSTRUMENT AIR	3
DOVVT-D-V1015D	DIESEL FUEL OIL TRANSFER PUMP DISCHARGE VALVE V1015D FAILS TO REMAIN OPEN	2
DOVVT-D-V1002D	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1002D FAILS TO REMAIN OPEN	2

Table 19.1-34 (9 of 12)

Basic Event	Description	RAW
DOVVT-D-V1010D	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1010D FAILS TO REMAIN OPEN	2
DOVVT-D-V4011D	DIESEL FUEL OIL TRANSFER PUMP DISCHARGE VALVE V4011D FAILS TO REMAIN OPEN	2
CCVVT-D-V1282	EDG01D OUTLET MANUAL VALVE V1282 TRANSFER CLOSED	2
DOVVT-D-V1009D	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1009D FAILS TO REMAIN OPEN	2
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	2
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	2
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	2
CSMPM2B-PP01B	CS PUMP PP01B UNAVAILABLE DUE TO MAINTENANCE	2
AFCVO2A-V1007A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1017A	2
AFCVO2A-V1012A	FAILS TO OPEN AFW MDP02A MINI FLOW CHECK VALVE V1012A	2
AFCVO2A-V1003A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1003A	2
PEDOY-A-LX05A03	FAILURE OF DIGITAL OUTPUT MODULE LX05A BRANCH 03	2
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2
DCBTY-C-BT01C	BAT. BT01C (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	2
IAAVO-S-1027	PRESSURE REDUCING VALVE 1027 FAILS TO MODULATE (OPEN)	2
FWMPM-S-PP07	STARTUP FW PUMP UNAVAILABLE DUE TO T&M	2
FWMPS-S-PP07	STARTUP FW PUMP PP07 FAILS TO START	2
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	2
FWMVO-S-093	STARTUP FW PUMP DISCH.MOV 093 FAILS TO OPEN	2
FWVVT-S-V1025	STARTUP FW PUMP SUCTION VV 1025 TRANSFERS CLOSED	2

Table 19.1-34 (10 of 12)

Basic Event	Description	RAW
SXMVR-A-MV072	LOSS OF SX DIV.II DUE TO THE MOV072 SPURIOUS OPEN (FLOW DIVERSION)	2
SXMVR-A-MV071	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	2
PEDOY-B-LX05B04	FAILURE OF DIGITAL OUTPUT MODULE LX05B BRANCH 04	2
WMVVT-S-V1700	DEMINERALIZED WATER TRANSFER PUMPS DISCHARGE MANUAL VALVE TRANFER CLOSE	2
DGDGL-C-DGC	DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
EFGXT-A-PM3-GC1	FAILURE OF CH. A GC-1 OUTPUT GC1-PM3	2
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	2
AXLTKD2-LS003A/004B	AFST A/B WATER LEVEL SWITCH LS003A/B FAILS TO OPERATE	2
NBBSY-M-SW01M	BUS FAULTS ON NON-1E 4.16kV SWGR SW01M	2
NGBSY1M-LC10M	BUS FAULT ON 480V LC LC10M	2
DGDGS-C-DGC	FAILS TO START OF EDG C	2
NGXMY1M-TR10M	480V LC TRANSFORMER LC-TR10M FAULT	2
AXCVO-S-V1600	FAILS TO OPEN CHECK VALVE V1600	2
FWMPL-S-PP07	STARTUP FW PUMP PP07 FAILS TO RUN FOR 1HR	2
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	2
POLXY-N-LX54-P	PRIMARY LOOP CONTROLLER LX54 FAILS TO RUN	2
POLXY-N-LX58-P	PRIMARY LOOP CONTROLLER LX58 FAILS TO RUN	2
PODOY-N-LX5802	FAILURE OF DIGITAL OUTPUT MODULE LX58 BRANCH 02	2
PODOY-N-LX5402	FAILURE OF DIGITAL OUTPUT MODULE LX54 BRANCH 02	2
FWMPR-S-PP07	STARTUP FW PUMP PP07 FAILS TO RUN	2
NPBSY2N-SW02N	BUS FAULTS ON NON-1E 13.8KV SWGR SW02N	2
NGBSY2N-LC05N	BUS FAULT ON 480V LC LC05N	2
NBBSY-N-SW02N	BUS FAULTS ON NON-1E 4.16kV SWGR SW02N	2
WOCHR1B-CH01B	ECW CHILLER 01B FAILS TO RUN FOR 24 HOURS	2
CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE	2

Table 19.1-34 (11 of 12)

Basic Event	Description	RAW
DGSQA-C-LOADSQ	LOAD SEQUNCER C FAILS TO OPERATE	2
PHBSY2B-MC04D	BUS FAULT ON 480V MCC MC04D	2
DOTKB-D-TK01D	DIEDEL FUEL OIL STORAGE TANK D TK01D FAILS CATASTROPHICALLY	2
VDHVM-C-HV12C	CUBICLE COOLER HV12C UNAVAILABLE DUE TO T&M	2
VDHVM-C-HV13C	CUBICLE COOLER HV13C UNAVAILABLE DUE TO T&M	2
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	2
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	2
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	2
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	2
EFCIT-A-GC1A	FAILURE OF CH. A GC-1 CI631 COMMUNICATION CARD	2
VDHVL-C-HV12C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12C FOR 1HR	2
VDHVL-C-HV13C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13C FOR 1HR	2
VDHVR-C-HV12C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12C	2
VDHVR-C-HV13C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13C	2
VDHVM-A-HV12A	CUBICLE COOLER HV12A UNAVAILABLE DUE TO T&M	2
VDHVM-A-HV13A	CUBICLE COOLER HV13A UNAVAILABLE DUE TO T&M	2
AFTPL1A-TDP01A	AFW PUMP 1A FAILS TO RUN FOR 1HR	2
CCMVO-C-181	CCW MOV 181 FOR EDG01C INLET FAILS TO OPEN	2
VDHVS-C-HV12C	FAILS TO START EDG ROOM CUBICLE COOLER HV12C	2
VDHVS-C-HV13C	FAILS TO START EDG ROOM CUBICLE COOLER HV13C	2
NGXMY2N-TR05N	480V LC TRANSFORMER LC-TR05N FAULT	2
DGDGL-A-DGA	DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
DCBCY-D-BC01D	CLASS 1E 125V DC BATT. CHARGER BC01D FAILS OPERATING	2
NHBSY1M-MC03M	BUS FAULT ON NON-1E 480V MCC MC03M	2
WMVVR-S-V1205	WM MANUAL VALVE 1205 TRANSFER CLOSED	2

Table 19.1-34 (12 of 12)

Basic Event	Description	RAW
WMVVR-S-V1201A	MANUAL VALVE V1202B TRANSFER CLOSED	2
RCPVC-B-202	POSRV V202 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-C-201	POSRV V201 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-D-203	POSRV V203 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-A-200	POSRV V200 FAILS TO CLOSE (HARDWARE FAIL)	2
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	2

Table 19.1-35 (1 of 3)

Level 2 Internal Events Key Basic Events by FV (LRF)

Basic Event	Description	FV
SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED	5.7%
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	5.2%
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	4.8%
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	4.7%
CVDPR-S-PP03	AUXILIARY CHARGING PUMP (PP03) FAILS TO RUN	4.4%
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	4.3%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	4.2%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	4.2%
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	4.1%
DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	4.0%
AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	3.3%
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	3.3%
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	3.0%
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	3.0%
AFMVC1B-046	AFW ISOLATION MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	3.0%
AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION	3.0%
DATGR-S-AACTG	AAC GAS TURBINE GENERATOR FAILS TO RUN	2.9%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	2.5%
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	2.4%
PFHBC2A-SW01C-E2	CLASS 1E 4.16kV SWITCHGEAR PCB SW01C-E2 (AAC) FAILS TO CLOSE	2.1%
NBHBC2A-SW03N-F2	NON-1E 4.16kV AAC SWITCHGEAR PCB SW03N-F2 FOR SW01C FAILS TO CLOSE	2.1%

Table 19.1-35 (2 of 3)

Basic Event	Description	FV
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	2.1%
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2.0%
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	1.7%
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	1.7%
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	1.6%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	1.5%
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	1.3%
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	1.3%
SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M	1.3%
DCBTM-D-BT01D	CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M	1.2%
IPINM-D-IN01D	CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M	1.2%
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	1.1%
DCBTM-C-BT01C	CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M	1.0%
IPINM-C-IN01C	CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M	1.0%
CSMPM2B-PP01B	CS PUMP PP01B UNAVAILABLE DUE TO MAINTENANCE	1.0%
FWMPM-S-PP07	STARTUP FW PUMP UNAVAILABLE DUE TO T&M	0.9%
WOCHS1B-CH01B	ECW CHILLER CH01B FAILS TO START ON DEMAND	0.9%
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	0.9%
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	0.9%
DGDGL-B-DGB	DG B FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	0.9%
DATGM-S-AACTG	AAC GAS TURBINE GENERATOR UNAVAILABLE DUE TO MAINTENANCE	0.9%

Table 19.1-35 (3 of 3)

Basic Event	Description	FV
DGDGR-A-DGA	FAILS TO RUN OF EDG A	0.9%
WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND	0.9%
CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE	0.8%
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	0.8%
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	0.7%
DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	0.7%
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	0.7%
DGDGS-B-DGB	FAILS TO START OF EDG B	0.7%
RAC-12H-GR	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 9.5HR (GRID RELATED)	0.6%
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	0.6%
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	0.6%
DGDGS-D-DGD	FAILS TO START OF EDG D	0.5%
RAC-16H-GR	NON-RECOVERY PROBABILITY OF OFFSITE POWER WITHIN 16HR (GRID RELATED)	0.5%

Table 19.1-36 (1 of 10)

Level 2 Internal Events Key CCF Events by RAW (LRF)

Basic Event	Description	RAW
RPRBWO8-TCBALL	CCF FAILURE OF ALL TRIP CIRCUIT BRAKER TCB	2.3E+05
RPRBWO4-TCB-AB1BD2	4/8 CCF OF TCB A-1, B-1, B-2 D-2	2.3E+05
RPRBWO4-TCB-AB1AC2	4/8 CCF OF TCB A-1, B-1, A-2, C-2	2.3E+05
RPRBWO4-TCB-CD1AC2	4/8 CCF OF TCB C-1, D-1, A-2 C-2	2.3E+05
RPRBWO4-TCB-CD1BD2	4/8 CCF OF TCB C-1, D-1, B-2, D-2	2.3E+05
DCBTWQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS UPON DEMAND	6790
DCBTKQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS TO RUN	6680
DCBTWQ3-BT01ABC	3/4 CCF OF 125V DC BATTERY BT01A/01B/01C FAILS UPON DEMAND	4690
DCBTWQ3-BT01ABD	3/4 CCF OF 125V DC BATTERY BT01A/01B/01D FAILS UPON DEMAND	4670
DCBTKQ3-BT01ABD	3/4 CCF OF 125V DC BATTERY BT01A/01B/01D FAILS TO RUN	4440
DCBTKQ3-BT01ABC	3/4 CCF OF 125V DC BATTERY BT01A/01B/01C FAILS TO RUN	4420
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	2340
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	2310
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	2280
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	2250
DCBTWQ2-BT01AB	2/4 CCF OF 125V DC BATTERY BT01A/01B FAILS UPON DEMAND	1850
MSEVXQ2-012/13	CCF OF MSIVS 012 AND 013 FAIL TO CLOSE	1800
MSEVXQ2-011/13	CCF OF MSIVS 011 AND 013 FAIL TO CLOSE	1800
MSEVXQ2-011/14	CCF OF MSIVS 011 AND 014 FAIL TO CLOSE	1800
MSEVXQ2-012/14	CCF OF MSIVS 012 AND 014 FAIL TO CLOSE	1800
MSEVXQ4-011/12/13/14	CCF OF MSIVS FAIL TO CLOSE	1800
MSEVXQ3-011/12/13	CCF OF MSIVS 011, 012 AND 013 FAIL TO CLOSE	1800

Table 19.1-36 (2 of 10)

Basic Event	Description	RAW
MSEVXQ3-011/12/14	CCF OF MSIVS 011, 012 AND 014 FAIL TO CLOSE	1800
MSEVXQ3-011/13/14	CCF OF MSIVS 011, 013 AND 014 FAIL TO CLOSE	1800
MSEVXQ3-012/13/14	CCF OF MSIVS 012, 013 AND 014 FAIL TO CLOSE	1800
DCBTKQ2-BT01AB	2/4 CCF OF 125V DC BATTERY BT01A/01B FAILS TO RUN	1460
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	928
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	921
PELXKQ4-LX05AB3CD	4/4 CCF OF LOOP CONTROLLER LX05A LX05B, LX03C, LX03D	898
PELXKQ4-LX06A04B03C03D	4/4 CCF OF LOOP CONTROLLER LX06A 12, LX04B 12, LX03C 12, LX03D 12	898
RPBPWO8-BSALL	CCF ALL BISTABLE PROCESS MODULES	844
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	800
SXCVWQ4-V1001/2/3/4	4/4 CCF OF ESW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN (DEMAND)	800
CCCVWQ4-V1001/2/3/4	4/4 CCF OF CCW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN	800
DCBTWQ3-BT01ACD	3/4 CCF OF 125V DC BATTERY BT01A/01C/01D FAILS UPON DEMAND	746
DCBTWQ3-BT01BCD	3/4 CCF OF 125V DC BATTERY BT01B/01C/01D FAILS UPON DEMAND	703
CCMVXO8-143-150	8/8 CCF (DEMAND) OF MOV 143,144,145,146,147, 148,149,150 IN NON-SAFETY LOAD LINE	699
RPUVWQ8-UVALL	CCF OF ALL UNDER-VOLTAGE TRIP DEVICES	617
RPIOWO8-ALL	CCF ALL LCL DIGITAL OUTPUT MODULES	617
PELXKQ4-LX03ABCD	4/4 CCF OF LOOP CONTROLLER LX03A/B/C/D	609
DCBTKQ3-BT01BCD	3/4 CCF OF 125V DC BATTERY BT01B/01C/01D FAILS TO RUN	545
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 AND SC CV 159/160	539
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCHARGE LINE 1001, 1002 AND SCP DISCHARGE LINE CV 568, 569	539

Table 19.1-36 (3 of 10)

Basic Event	Description	RAW
DCBTKQ3-BT01ACD	3/4 CCF OF 125V DC BATTERY BT01A/01C/01D FAILS TO RUN	531
CSMVWD2-003/004	CCF OF CS HX DISCHARGE ISOLATION VALVES FAIL TO OPEN	443
CCMVWD2-097/8	2/2 CCF OF CCW MOV 097/098 FOR CS HX HE01A/B INLET	442
SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START	442
SIMPKQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A, PP01B TO RUN	442
SIMPZQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A, PP01B TO RUN FOR 1HR	442
CSCVWD2-V1007/1008	CCF (FTO) OF CV V1007/1008 IN CS TRS. 1&2 DISCH. PATHS	442
PELXKQ4-LX1A/1B/1C/1D	4/4 CCF OF LOOP CONTROLLER LX01A, LX01B, LX01C, LX01D	388
SICVWO8-DVIS	8/8 CCF OF SI LINE CHECK VALVES 123,143,217,227,237,247,541,543 TO OPEN	388
SICVWO4-V143/217/27/37	4/8 CCF OF SI LINE CHECK VALVES 143,217,227,237	370
SICVWO4-V123/217/37/543	4/8 CCF OF SI LINE CHECK VALVES 123,217,237,543	370
SICVWO4-V123/43/217/37	4/8 CCF OF SI LINE CHECK VALVES 123,143,217,237	370
SICVWO4-V123/217/37/47	4/8 CCF OF SI LINE CHECK VALVES 123,217,237,247	370
SICVWO4-V217/37/541/43	4/8 CCF OF SI LINE CHECK VALVES 217,237,541,543	370
SICVWO4-V217/27/37/47	4/8 CCF OF SI LINE CHECK VALVES 217,227,237,247	370
SICVWO4-V143/217/37/541	4/8 CCF OF SI LINE CHECK VALVES 143,217,237,541	370
SICVWO4-V217/27/37/543	4/8 CCF OF SI LINE CHECK VALVES 217,227,237,543	370
SICVWO4-V217/37/47/541	4/8 CCF OF SI LINE CHECK VALVES 217,237,247,541	370
AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN	341
AFCVWO4-V1007AB/8AB	4/8 CCF OF AF DISCH. CHECK VALVE V1007AB/8AB FAIL TO OPEN	317
AFCVWO4-V1003AB/4AB	4/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB FAIL TO OPEN	317

Table 19.1-36 (4 of 10)

Basic Event	Description	RAW
AFCVWO8-V1003AB/4AB/7AB/8AB	8/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB/7AB/8AB FAIL TO OPEN	314
RPIRWO8-IRALL	CCF OF ALL INTERPOSING R/C Q1 2 3 & 4 ASSOCIATED WITH RPS	309
SIMVWQ4-616/26/36/46	4/4 CCF OF DVI LINEMOV 616,626,636,646	306
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	306
PELXKQ4-LX8A/12B/1C/1D	4/4 CCF OF LOOP CONTROLLER LX08A 12, LX12B 12, LX01C 12, LX01D 12	301
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	301
SIMPZQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D FOR 1HR	301
SICVWO8-SIPUMPS	8/8 CCF OF SI PUMP DISCHARGE LINE CV 113,133,404,405,434,446,540,542 TO OPEN	301
SICVWD2-V100/01	2/2 CCF OF CV 100/101 IN TRAIN A&B IRWST RETURN LINES	289
PELXKD2-LX09A11B	CCF OF LOOP CONTROLLER LX09A & LX11B FAIL TO OPERATE	288
SICVWO4-V404/05/46/542	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,446,542	282
SICVWO4-V133/404/05/46	4/8 CCF OF SI PUMP DISCHARGE LINE CV 133,404,405,446	282
SICVWO4-V404/05/34/46	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,434,446	282
SICVWO4-V404/05/34/540	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,434,540	282
SICVWO4-V113/404/05/34	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,404,405,434	282
SICVWO4-V113/33/404/05	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,133,404,405	282
SICVWO4-V133/404/05/540	4/8 CCF OF SI PUMP DISCHARGE LINE CV 133,404,405,540	282
SICVWO4-V113/404/05/542	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,404,405,542	282
SICVWO4-V404/05/540/42	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,540,542	282

Table 19.1-36 (5 of 10)

Basic Event	Description	RAW
RPIAWO8-ALL	CCF ALL ANLOG INPUT MODULES OF BISTABLE	279
AFCVWQ4-V1012A/B/4A/B	4/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 1014A/B FAIL TO OPEN	278
SICVWQ4-V424/26/48/51	4/4 CCF OF SI LINE C/V 424,426,448,451 TO OPEN	271
DCBTWQ2-BT01BC	2/4 CCF OF 125V DC BATTERY BT01B/01C FAILS UPON DEMAND	223
DCBTWQ2-BT01AD	2/4 CCF OF 125V DC BATTERY BT01A/01D FAILS UPON DEMAND	222
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	211
CCMVWQ3-191/2/181	3/4 CCF OF CCW MOV 191, 192, 181 FOR EDG01A/B/C INLET	205
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	199
VOHVKQ4-HV32A/32B/31A/31B	4/4 CCF OF RUN FOR CUBICLE COOLER HV32A/32B/31A/31B	180
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	164
EFOTWO8-GCLCALL	CCF OF GC-LC FIBER OPTIC TRANSMITTER	161
EFORWO8-GCLCALL	CCF OF GC-LC FIBER OPTIC RECEIVER	161
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	161
EFGXKO8-PA03ABCD	CCF OF GC TO LC PM646 MODULES	160
VDHVZO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR	160
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	160
EFOTWO8-FOMCALL	CCF OF GC FIBER OPTIC TRANSMITTER	160
EFORWO8-FOMCALL	CCF OF GC FIBER OPTIC RECEIVER	160
EFGCWO8-PM12ABCD	CCF OF PM1 (PM646C) GC MODULE	159
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	158
DGSQWQ4-LOADSQABCD	4/4 CCF OF LOAD SEQUNCER A, B, C, D FAIL TO OPERATE	154

Table 19.1-36 (6 of 10)

Basic Event	Description	RAW
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	154
EFCIKO8-PA03ABCD	CCF OF GC CI MODULES	153
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	153
DGDGZQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	153
PALXKD2-PA06CD	2/2 CCF OF LOOP CONTROLLER PA06C, PA06D	153
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG 01A/B/C/D INLET	150
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	147
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	146
DOMPZO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN FOR 1HR	142
DOCVWO8-V1005/7ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP CV V1005/1007 A/B/C/D FAIL TO OPEN	127
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	125
DCBTKQ2-BT01BC	2/4 CCF OF 125V DC BATTERY BT01B/01C FAILS TO RUN	123
DCBTKQ2-BT01AD	2/4 CCF OF 125V DC BATTERY BT01A/01D FAILS TO RUN	123
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	118
VOHVWQ4-HV32A/32B/31A/31B	4/4 CCF OF START FOR CUBICLE COOLER HV32A/32B/31A/31B	113
DGSQWQ3-LOADSQABD	3/4 CCF OF LOAD SEQUNCER A, B, D FAIL TO OPERATE	107
DGDGWQ3-DG01ABD	3/4 CCF OF EDG 01A/01B/01D FAIL TO START	106
DGDGZQ3-DG01ABD-LOAD	3/4 CCF OF EDG 01A/01B/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	104
WOLPKQ4-CH01A/2A/1B/2B	4/4 CCF OF ECW CH01A/2A/1B/2B (LP02A/3A/2B/3B) ACTUATING CIRCUIT (RUNNING)	103

Table 19.1-36 (7 of 10)

Basic Event	Description	RAW
PELXKQ4-LX01A2BCD	4/4 CCF OF LOOP CONTROLLER LX01A, LX02B, LX02C, LX02D	103
DGSQWQ3-LOADSQABC	3/4 CCF OF LOAD SEQUNCER A, B, C FAIL TO OPERATE	101
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	100
DGDGWQ3-DG01ABC	3/4 CCF OF EDG 01A/01B/01C FAIL TO START	100
DGDGZQ3-DG01ABC-LOAD	3/4 CCF OF EDG 01A/01B/01C FAIL TO LOAD AND RUN DURING 1ST 1HOUR	98
WOCVWQ4-V1010A/B/14A/B	CCF OF DISCH. CV 1010A/10B/14A/14B (FAIL TO OPEN)	86
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	55
AFPVKQ3-TP01A/MP02A/B	3/4 CCF OF AFW TDP01A, MDP02A/B DUE TO THE VOLUTE FAIL TO RUN	53
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	53
WOCHKQ3-CH02A/1B/2B	RUNNING CCF OF ECW CHILLERS 2A/1B/2B	52
AFPVKQ3-TP01A/B/MP02A	3/4 CCF OF AFW TDP01A/B, MDP02A DUE TO THE VOLUTE FAIL TO RUN	51
SXMPWQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (START)	50
WOCHWQ3-CH02A/1B/2B	DEMAND CCF OF ECW CHILLERS 2A/1B/2B	47
MSRVWO8-MSSV-ALL	20/20 CCF OF MSSVs 1301~1320 ON SG 1/2	47
WOCHWQ3-CH01A/2A/2B	DEMAND CCF OF ECW CHILLERS 1A/2A/2B	46
WOCHKQ3-CH01A/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/2B	45
CCMPWQ3-PP01A/2A/1B	3/4 CCF OF CCW PUMPS PP01A/2A/1B (DEMAND)	45
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	45
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	45
CCMPWQ3-PP01A/2A/2B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (DEMAND)	43
CCMVWQ3-192/181/2	3/4 CCF OF CCW MOV 192, 181, 182 FOR EDG01B/C/D INLET	43

Table 19.1-36 (8 of 10)

Basic Event	Description	RAW
SXMPWQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (START)	42
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	42
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	42
SXMPWQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (START)	41
WOMPWQ3-PP02A/1B/2B	DEMAND CCF OF ECW PUMPS 2A/1B/2B	40
VOHVKQ3-HV32A/32B/31B	3/4 CCF OF RUN FOR CUBICLE COOLER HV32A/32B/31B	39
WOMPWQ3-PP01A/2A/2B	DEMAND CCF OF ECW PUMPS 1A/2A/2B	39
CCMPWQ3-PP01A/1B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (DEMAND)	37
DGSQWQ3-LOADSQBCD	3/4 CCF OF LOAD SEQUNCER B, C, D FAIL TO OPERATE	37
VOHVWQ3-HV32A/32B/31B	3/4 CCF OF START FOR CUBICLE COOLER HV32A/32B/31B	36
DGDGWQ3-DG01BCD	3/4 CCF OF EDG 01B/01C/01D FAIL TO START	36
DGDGKQ3-DG01BCD	3/4 CCF OF EDG 01B/01C/01D FAIL TO RUN	36
VOHVWQ3-HV32A/32B/31A	3/4 CCF START FOR OF CUBICLE COOLER HV32A/32B/31A	36
WOMPKQ3-PP02A/1B/2B	RUNNING CCF OF ECW PUMPS 2A/1B/2B	35
AFPVKQ2-TP01A/MP02A	2/4 RUNNING CCF OF AFW TDP01A, MDP02A DUE TO THE VOLUTE FAILURE	35
DGDGZQ3-DG01BCD-LOAD	3/4 CCF OF EDG 01B/01C/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	34
PELXKQ4-LX03CD4AB	4/4 CCF OF LOOP CONTROLLER LX03C/D/4A/4B	33
SXAHKQ3-AH01A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 01B, 02B	33
DGDGKQ3-DG01ABD	3/4 CCF OF EDG 01A/01B/01D FAIL TO RUN	32
VOHVKQ3-HV32A/32B/31A	3/4 CCF RUN FOR OF CUBICLE COOLER HV32A/32B/31A	32
DGDGKQ3-DG01ACD	3/4 CCF OF EDG 01A/01C/01D FAIL TO RUN	32
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	31

Table 19.1-36 (9 of 10)

Basic Event	Description	RAW
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	31
CCMVWQ3-191/181/2	3/4 CCF OF CCW MOV 191, 181, 182 FOR EDG01A/C/D INLET	31
VGAHKQ3-AH01A/2A/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A, 02B	30
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	28
WOCHWQ3-CH01A/1B/2B	DEMAND CCF OF ECW CHILLERS 1A/1B/2B	27
WOMPKQ3-PP01A/2A/2B	RUNNING CCF OF ECW PUMPS 1A/2A/2B	27
WOLPKQ3-CH02A/1B/2B	3/4 CCF OF ECW CH02A/1B/2B (LP03A/2B/3B) ACTUATING CIRCUIT (RUNNING)	27
PELXKQ3-LX01A2CD	3/4 CCF OF LOOP CONTROLLER LX01A, LX02C, LX02D	27
PELXKQ3-LX02BCD	3/4 CCF OF LOOP CONTROLLER LX02B, LX02C, LX02D	27
WOLPKQ3-CH01A/2A/2B	3/4 CCF OF ECW CH01A/2A/2B (LP02A/3A/3B) ACTUATING CIRCUIT (RUNNING)	27
DGSQWQ3-LOADSQACD	3/4 CCF OF LOAD SEQUNCER A, C, D FAIL TO OPERATE	26
DCBTWQ2-BT01BD	2/4 CCF OF 125V DC BATTERY BT01B/01D FAILS UPON DEMAND	26
CCMPKQ3-PP01A/2A/B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (RUNNING)	26
DGDGWQ3-DG01ACD	3/4 CCF OF EDG 01A/01C/01D FAIL TO START	26
AFCVWQ2-V1012A/4A	2/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/4A FAIL TO OPEN	26
WOCHWQ3-CH01A/2A/1B	DEMAND CCF OF ECW CHILLERS 1A/2A/1B	26
SXMPKQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (RUNNING)	26
DGDGKQ3-DG01ABC	3/4 CCF OF EDG 01A/01B/01C FAIL TO RUN	25
AFCVWO2-V1007A/8A	2/8 CCF OF AF DISCH. CHECK VALVE V1007A/8A FAIL TO OPEN	24
AFCVWO2-V1003A/4A	2/8 CCF OF AF DISCH. CHECK VALVE V1003A/4A FAIL TO OPEN	24
AFCVWO2-V1004A/7A	2/8 CCF OF AF DISCH. CHECK VALVE V1004A/7A FAIL TO OPEN	24

Table 19.1-36 (10 of 10)

Basic Event	Description	RAW
AFCVWO2-V1003A/8A	2/8 CCF OF AF DISCH. CHECK VALVE V1003A/8A FAIL TO OPEN	24
DGDGZQ3-DG01ACD-LOAD	3/4 CCF OF EDG 01A/01C/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	23
SXAHKQ3-AH01A/02A/01B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B	23
SXAHKQ3-AH01A/02A/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 02B	22
DCBTWQ2-BT01CD	2/4 CCF OF 125V DC BATTERY BT01C/01D FAILS UPON DEMAND	21
AFPVKQ3-TP01B/MP02A/B	3/4 CCF OF AFW TDP01B, MDP02A/B DUE TO THE VOLUTE FAIL TO RUN	21
AFPVKQ3-TP01A/B/MP02B	3/4 CCF OF AFW TDP01A/B, MDP02B DUE TO THE VOLUTE FAIL TO RUN	21
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	20

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-37

Level 2 Internal Events Key CCF Events by FV (LRF)

Basic Event	Description	FV
MSEVXQ2-012/13	CCF OF MSIVS 012 AND 013 FAIL TO CLOSE	3.9%
MSEVXQ2-011/13	CCF OF MSIVS 011 AND 013 FAIL TO CLOSE	3.9%
MSEVXQ2-011/14	CCF OF MSIVS 011 AND 014 FAIL TO CLOSE	3.9%
MSEVXQ2-012/14	CCF OF MSIVS 012 AND 014 FAIL TO CLOSE	3.9%
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	2.2%
MSEVXQ4-011/12/13/14	CCF OF MSIVS FAIL TO CLOSE	2.0%
MSEVXQ3-011/12/13	CCF OF MSIVS 011, 012 AND 013 FAIL TO CLOSE	1.5%
MSEVXQ3-011/12/14	CCF OF MSIVS 011, 012 AND 014 FAIL TO CLOSE	1.5%
MSEVXQ3-011/13/14	CCF OF MSIVS 011, 013 AND 014 FAIL TO CLOSE	1.5%
MSEVXQ3-012/13/14	CCF OF MSIVS 012, 013 AND 014 FAIL TO CLOSE	1.5%
CSMVWD2-003/004	CCF OF CS HX DISCHARGE ISOLATION VALVES FAIL TO OPEN	1.3%
CCMVWD2-097/8	2/2 CCF OF CCW MOV 097/098 FOR CS HX HE01A/B INLET	0.8%
AFTPKD2-TDP01A/B	2/2 CCF OF FOR AFW TDP PP01/A/B FAIL TO RUN	0.8%
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	0.7%
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	0.5%
VDHVZO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR	0.5%
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	0.5%

Table 19.1-38

Level 2 Internal Events Key Operator Actions by RAW (LRF)

Basic Event	Description	RAW
HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL	12
RPOPU-S-LT1113ABCD	OPERATOR ERROR: COMMON MISCALIBRATION OF LO SG1 LVL.	10
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	4
CVOPH-S-IRWST	OPERATOR FAILS TO REFILL THE IRWST VIA CVCS	4
RPOPU-S-PT102ABCD	OPERATOR ERROR: COMMON MISCALIBRATION OF LO PZR PR. CH.A/B/C/D	3
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	3
AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS	3
FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	2
CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH	2

Table 19.1-39

Level 2 Internal Events Key Operator Actions by FV (LRF)

Basic Event	Description	FV
H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)	6.9%
PFOPH-S-UATBKR-LOCAL	OPERATOR FAILS TO RECOVER PCB FOR 1E 4.16kV SW01A,B,C,D AT LOCAL	3.0%
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	2.6%
HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL	1.6%
HR-RCSCD2-CD	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RCS DEPRESS AFTER OVERFILL	1.6%
RCOPH-S-SDSE-FW-HD	FAILURE OF POSRVS EARLY PHASE OPEN WITH HIGH DEPENDENCY	1.4%
CVOPH-S-RCPSEAL	OPERATOR FAILS TO RECOVER RCP SEAL COOLING	1.1%
AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS	1.1%
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	0.8%
FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	0.8%
WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B	0.5%

Table 19.1-40

Results of LRF Sensitivity Analyses

Case No.	Description	Large Release (%)	Large, Early Release (%)	Containment Failure (%)	Intact Containment (%)
Baseline	Baseline Results	8.4	5.3	13.8	86.2
R1	Failure of ECSBS	43.2	12.8	66.6	33.4
R2	Failure of Cavity Flood System	6.2	5.2	60.1	39.9
R3	Failure of PARs	9.7	6.6	15.2	84.8
R4	Failure of Rapid Depressurization	10.0	6.8	15.3	84.7
R5	Level 2 Operator Actions are always successful	8.0	4.8	12.6	87.4
R6	External Reactor Vessel Cooling is Credited	8.4	5.3	13.8	86.2
R7	Effects of Induced SGTR with “Pristine” SG tubes	5.8	2.6	11.4	88.6
R8	No Induced Hot Leg or Surge Line Failure before Vessel Failure	8.4	5.3	13.9	86.1

Table 19.1-41 (1 of 2)

Systems Considered for Seismic Equipment List

System	Description
Actuation	Reactor trip
	Safety Injection (SI)
	Containment isolation (CIS)
	Containment ventilation isolation (CVIS)
	Main steam line isolation
	Feedwater line isolation
	AFW start
	EDG start and load sequence
CRD	Control rods
RCS	Reactor Coolant System, including RC Pumps, SG, PZR, POSRVs
MS	Main Steam: MSSVs, MSIVs, MSADVs
AFW	Auxiliary Feedwater (MD and TD)
CVCS	Chemical Volume & Control System: Charging, pressurizer spray, and RCP seal injection
SC	Shutdown Cooling System
CS	Containment Spray
SI	Safety Injection
CCW	Component Cooling Water
ESW	Essential Service Water
ECW	Essential Chilled Water
EDG HVAC	Emergency Diesel Generator Area HVAC System
E-I&C HVAC	Electrical and I&C Equipment Areas HVAC System
ESW/CCW HVAC	ESW Pump Building / CCW HX Building HVAC System
Aux Bldg HVAC	Aux Building Controlled Area HVAC System
Aux Bldg HVAC	Aux Building Clean Area HVAC System

Table 19.1-41 (2 of 2)

System	Description
MCR	Main Control Room Consoles
ESF	ESF Cabinets
RX Trip	Reactor Trip Switchgear
DG Fuel	Diesel Fuel Oil Transfer System
EDG	Emergency Diesel Generators
EP	Electrical power

Table 19.1-42 (1 of 19)

Seismic Equipment List

No.	Equipment ID	Equipment Description	Floor Elevation	Building
1	1-431-M-RV01	Reactor Pressure Vessel	69'-156'	Containment
2	-	Reactor Vessel Internals	69'-156'	Containment
3	1-431-M-SG01	Steam Generator #1	114'-136'	Containment
4	1-431-M-SG02	Steam Generator #2	114'-136'	Containment
5	1-431-M-PZ01	Pressurizer	114'-156'	Containment
6	1-431-M-PP01A	Reactor Coolant Pump #1	114'-136'	Containment
7	1-431-M-PP01B	Reactor Coolant Pump #2	114'-136'	Containment
8	1-431-M-PP01C	Reactor Coolant Pump #3	114'-136'	Containment
9	1-431-M-PP01D	Reactor Coolant Pump #4	114'-136'	Containment
10	1-451-M-HE01	Regenerative Heat Exchanger	128'	Containment
11	1-451-M-PP01A	Charging Pumps #1	55'	A/B
12	1-451-M-PP01B	Charging Pumps #2	55'	A/B
13	1-451-M-HE02	Letdown Heat Exchanger	100'	Containment
14	1-441-M-TK01A	Safety Injection Tank 1	136'	Containment
15	1-441-M-TK01B	Safety Injection Tank 2	136'	Containment
16	1-441-M-TK01C	Safety Injection Tank 3	136'	Containment
17	1-441-M-TK01D	Safety Injection Tank 4	136'	Containment
18	1-521-V-0012	Main Steam Isolation Valve	137'	A/B

Table 19.1-42 (2 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
19	1-521-V-0011	Main Steam Isolation Valve	137'	A/B
20	1-521-V-0014	Main Steam Isolation Valve	137'	A/B
21	1-521-V-0013	Main Steam Isolation Valve	137'	A/B
22	1-521-V-0102	Main Steam Atmospheric Dump Valve	137'	A/B
23	1-521-V-0101	Main Steam Atmospheric Dump Valve	137'	A/B
24	1-521-V-0104	Main Steam Atmospheric Dump Valve	137'	A/B
25	1-521-V-0103	Main Steam Atmospheric Dump Valve	137'	A/B
26	1-461-M-TK01A	Component Cooling Water Surge Tank	172'	A/B
27	1-461-M-TK01B	Component Cooling Water Surge Tank	172'	A/B
28	1-633-M-CH01A	Essential Chiller (includes Compressor Condenser, Evaporator, controls, RVs, Tanks)	78'	A/B
29	1-633-M-CH02A	Essential Chiller (includes Compressor Condenser, Evaporator, controls, RVs, Tanks)	78'	A/B
30	1-633-M-CH01B	Essential Chiller (includes Compressor Condenser, Evaporator, controls, RVs, Tanks)	78'	A/B
31	1-633-M-CH02B	Essential Chiller (includes Compressor Condenser, Evaporator, controls, RVs, Tanks)	78'	A/B
32	1-607-M-HV33A	MDAFW Pump Room Unit	78'	A/B
33	1-607-M-HV33B	MDAFW Pump Room Unit	78'	A/B
34	1-607-M-CW33A	MDAFW Pump Room Cubical Cooler Cooling Coil	78'	A/B
35	1-607-M-CW33B	MDAFW Pump Room Cubical Cooler Cooling Coil	78'	A/B

Table 19.1-42 (3 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
36	1-431-V-0200	POSRV 200	136'	Containment
37	1-431-V-0201	POSRV 201	136'	Containment
38	1-431-V-0132	MOV Control Valves (POSRV 201)	136'	Containment
39	1-431-V-0133	MOV Control Valves (POSRV 201)	136'	Containment
40	1-431-V-0202	POSRV 202	136'	Containment
41	1-431-V-0134	MOV Control Valves (POSRV 202)	136'	Containment
42	1-431-V-0135	MOV Control Valves (POSRV 202)	136'	Containment
43	1-431-V-0203	POSRV 203	136'	Containment
44	1-431-V-0136	MOV Control Valves (POSRV 203)	136'	Containment
45	1-431-V-0137	MOV Control Valves (POSRV 203)	136'	Containment
46	1-441-M-PP02A	SI Pump 1	50'	A/B
47	1-441-M-PP01A	SDC Pump 1	50'	A/B
48	1-441-M-HE02A	SDC Miniflow HX 1	50'	A/B
49	1-441-M-HE01A	SDC HX 1	50'	A/B
50	1-441-M-PP02C	SI Pump 3	50'	A/B
51	1-441-M-PP02B	SI Pump 2	50'	A/B
52	1-441-M-PP01B	SDC Pump 2	50'	A/B
53	1-441-M-HE02B	SDC Miniflow HX 2	50'	A/B
54	1-441-M-HE01B	SDC HX 2	50'	A/B
55	1-441-M-PP02D	SI Pump 4	50'	A/B

Table 19.1-42 (4 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
56	1-442-M-PP01A	Containment Spray Pump 1	50'	A/B
57	1-442-M-HE02A	CS Pump 1 Miniflow Heat Exchanger	50'	A/B
58	1-442-M-HE01A	Containment Spray Line 1 Heat Exchanger	55'	A/B
59	1-442-M-PP01B	Containment Spray Pump 2	50'	A/B
60	1-442-M-HE02B	CS Pump 2 Miniflow Heat Exchanger	50'	A/B
61	1-442-M-HE01B	Containment Spray Line 2 Heat Exchanger	55'	A/B
62	1-451-M-PP03	Auxiliary Charging Pump	55'	A/B
63	1-461-M-PP01A	CCW Pump 1A	55'	A/B
64	1-461-M-PP02A	CCW Pump 2A	55'	A/B
65	1-461-M-HE01A	CCW Heat Exchanger 1A	100'	CCW HX Building
66	1-461-M-HE02A	CCW Heat Exchanger 2A	100'	CCW HX Building
67	1-461-M-HE03A	CCW Heat Exchanger 3A	100'	CCW HX Building
68	1-461-M-PP03B	CCW Makeup Pump 3B	78'	A/B
69	1-461-M-PP01B	CCW Pump 1B	55'	A/B
70	1-461-M-PP02B	CCW Pump 2B	55'	A/B
71	1-461-M-HE01B	CCW Heat Exchanger 1B	100'	CCW HX Building
72	1-461-M-HE02B	CCW Heat Exchanger 2B	100'	CCW HX Building
73	1-461-M-HE03B	CCW Heat Exchanger 3B	100'	CCW HX Building
74	1-451-M-HE04	Charging Pump Mini-Flow Heat Exchanger	55'	A/B
75	1-462-M-PP01A	ESW Pump 1A	69'	ESW building

Table 19.1-42 (5 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
76	1-462-M-PP02A	ESW Pump 2A	69'	ESW building
77	1-462-M-PP01B	ESW Pump 1B	69'	ESW building
78	1-462-M-PP02B	ESW Pump 2B	69'	ESW building
79	1-542-M-PP01A	Aux Feedwater Pump C (Turbine Driven)	78'	A/B
80	1-542-M-PP02A	Aux Feedwater Pump A (Motor Driven)	78'	A/B
81	1-542-M-PP02B	Aux Feedwater Pump B (Motor Driven)	78'	A/B
82	1-542-M-PP01B	Aux Feedwater Pump D (Turbine Driven)	78'	A/B
83	1-591-M-PP22A	Fuel Oil Feed Pump	100'	EDG Building
84	1-591-M-PP22B	Fuel Oil Feed Pump	100'	EDG Building
85	1-591-M-PP22C	Fuel Oil Feed Pump	100'	A/B
86	1-591-M-PP22D	Fuel Oil Feed Pump	100'	A/B
87	1-595-M-TK01A	Diesel Fuel Oil Storage Tank A	63'	EDG Building
88	1-595-M-PP02A	Diesel Fuel Oil Transfer Pump	63'	EDG Building
89	1-595-M-PP01A	Diesel Fuel Oil Transfer Pump	63'	EDG Building
90	1-595-M-TK01B	Diesel Fuel Oil Storage Tank B	63'	EDG Building
91	1-595-M-PP02B	Diesel Fuel Oil Transfer Pump	63'	EDG Building
92	1-595-M-PP01B	Diesel Fuel Oil Transfer Pump	63'	EDG Building
93	1-595-M-TK01C	Diesel Fuel Oil Storage Tank C	65'	A/B
94	1-595-M-PP02C	Diesel Fuel Oil Transfer Pump	65'	A/B
95	1-595-M-PP01C	Diesel Fuel Oil Transfer Pump	65'	A/B

Table 19.1-42 (6 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
96	1-595-M-TK01D	Diesel Fuel Oil Storage Tank D	65'	A/B
97	1-595-M-PP02D	Diesel Fuel Oil Transfer Pump	65'	A/B
98	1-595-M-PP01D	Diesel Fuel Oil Transfer Pump	65'	A/B
99	1-595-M-TK02A	Diesel Fuel Oil Day Tank A	121'	EDG Building
100	1-595-M-TK02B	Diesel Fuel Oil Day Tank B	121'	EDG Building
101	1-595-M-TK02C	Diesel Fuel Oil Day Tank C	120'	A/B
102	1-595-M-TK02D	Diesel Fuel Oil Day Tank D	120'	A/B
103	1-601-V-Y0011A	Electro-Hydraulic Inlet Damper	172'	A/B
104	1-601-V-Y0011B	Electro-Hydraulic Inlet Damper	172'	A/B
105	1-602-M-HV12A	EDG Room Emergency Cubical Cooler	100'	EDG Building
106	1-602-M-AH02A	EDG Room Exhaust Fan/Motor	100'	EDG Building
107	1-602-M-HV13A	EDG Room Emergency Cubical Cooler	135'	EDG Building
108	1-602-M-HV12B	EDG Room Emergency Cubical Cooler	100'	EDG Building
109	1-602-M-AH12B	EDG Room Emergency Cubical Cooler Fan/Motor	100'	EDG Building
110	1-602-M-AH02B	EDG Room Exhaust Fan/Motor	100'	EDG Building
111	1-602-M-HV13B	EDG Room Emergency Cubical Cooler	135'	EDG Building
112	1-602-M-AH13B	EDG Room Emergency Cubical Cooler Fan/Motor	135'	EDG Building
113	1-602-M-HV12C	EDG Room Emergency Cubical Cooler	100'	A/B
114	1-602-M-AH12C	EDG Room Emergency Cubical Cooler Fan/Motor	100'	A/B
115	1-602-M-AH02C	EDG Room Exhaust Fan/Motor	172'	A/B

Table 19.1-42 (7 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
116	1-602-M-HV13C	EDG Room Emergency Cubical Cooler	100'	A/B
117	1-602-M-AH13C	EDG Room Emergency Cubical Cooler Fan/Motor	100'	A/B
118	1-602-M-HV12D	EDG Room Emergency Cubical Cooler	100'	A/B
119	1-602-M-AH12D	EDG Room Emergency Cubical Cooler Fan/Motor	100'	A/B
120	1-602-M-AH02D	EDG Room Exhaust Fan/Motor	172'	A/B
121	1-602-M-HV13D	EDG Room Emergency Cubical Cooler	100'	A/B
122	1-602-M-AH13D	EDG Room Emergency Cubical Cooler Fan/Motor	100'	A/B
123	1-603-M-HV11A	ELECT. PENETRATION RM Cubical Cooler	137'	A/B
124	1-603-M-HV10A	480V CLASS-1E MCC 03C RM Cubical Cooler	137'	A/B
125	1-603-M-HV09A	ELECT. PENETRATION RM Cubical Cooler	120'	A/B
126	1-603-M-HV04A	CHANNEL C DC&IP EQUIP. RM Cubical Cooler	78'	A/B
127	1-603-M-HV02A	CLASS 1E LOADCENTER 01C RM Cubical Cooler	78'	A/B
128	1-603-M-HV01A	CLASS 1E SWITCHGEAR 01C RM Cubical Cooler	78'	A/B
129	1-603-M-HV14A	480V CLASS-1E MCC 03A RM Cubical Cooler	137'	A/B
130	1-603-M-HV15A	480V CLASS-1E MCC 04A RM Cubical Cooler	137'	A/B
131	1-603-M-HV12A	PENETRATION MUX A RM Cubical Cooler	137'	A/B
132	1-603-M-HV13A	ELECTRICAL PENETRATION RM(A) Cubical Cooler	137'	A/B
133	1-603-M-AH21A	Class 1E Battery Rm Exhaust Fan	100'	A/B
134	1-603-M-HV03A	CHANNEL A DC&IP EQUIP. RM CC Cubical Cooler	78'	A/B
135	1-603-M-HV05A	MUX A RM Cubical Cooler	78'	A/B

Table 19.1-42 (8 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
136	1-603-M-HV07A	CLASS-1E SWITCHGEAR 01A RM Cubical Cooler	78'	A/B
137	1-603-M-AH21C	Class 1E Battery Rm Exhaust Fan	78'	A/B
138	1-603-M-HV11B	ELECT. PENETRATION RM (D) Cubical Cooler	137'	A/B
139	1-603-M-HV10B	480V CLASS-1E MCC 03D RM Cubical Cooler	137'	A/B
140	1-603-M-HV15B	480V CLASS-1E MCC 04B RM Cubical Cooler	137'	A/B
141	1-603-M-HV12B	PENETRATION MUX B RM Cubical Cooler	137'	A/B
142	1-603-M-HV13B	ELECTRICAL PENETRATION RM(B) Cubical Cooler	137'	A/B
143	1-603-M-HV18A	RSC RM Cubical Cooler	137'	A/B
144	1-603-M-HV18B	RSC RM Cubical Cooler	137'	A/B
145	1-603-M-HV09B	ELECT. PENETRATION (D) RM Cubical Cooler	120'	A/B
146	1-603-M-HV14B	480V CLASS-1E MCC 03B RM Cubical Cooler	120'	A/B
147	1-603-M-HV06B	480V CLASS 1-E MCC 01B RM Cubical Cooler	100'	A/B
148	1-603-M-HV03B	CHANNEL B DC&IP EQUIP. RM Cubical Cooler	78'	A/B
149	1-603-M-HV05B	MUX B RM Cubical Cooler	78'	A/B
150	1-603-M-HV02B	CLASS 1E LOADCENTER 01D RM Cubical Cooler	78'	A/B
151	1-603-M-HV01B	CLASS 1E SWITCHGEAR 01D RM Cubical Cooler	78'	A/B
152	1-603-M-HV04B	CHANNEL D DC&IP EQUIP. RM Cubical Cooler	78'	A/B
153	1-603-M-HV07B	CLASS-1E SWITCHGEAR 01B RM Cubical Cooler	78'	A/B
154	1-603-M-HV17A	I&C Equipment Room (C) Cubical Cooler	157'	A/B
155	1-603-M-HV16A	I&C Equipment Room (A) Cubical Cooler	157'	A/B

Table 19.1-42 (9 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
156	1-603-M-HV17B	I&C Equipment Room (D) Cubical Cooler	157'	A/B
157	1-603-M-HV16B	I&C Equipment Room (B) Cubical Cooler	157'	A/B
158	1-605-M-AH03A	CCW Heat Exchanger Room Supply Fan	100'	CCW HX Building
159	1-605-M-AH03B	CCW Heat Exchanger Room Supply Fan	100'	CCW HX Building
160	1-605-M-AH01A	ESW Pump Room Supply Fan	90'	ESW building
161	1-605-M-AH02A	ESW Pump Room Supply Fan	90'	ESW building
162	1-605-M-AH01B	ESW Pump Room Supply Fan	90'	ESW building
163	1-605-M-AH02B	ESW Pump Room Supply Fan	90'	ESW building
164	1-606-M-HV14A	CCW PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
165	1-606-M-HV15A	CS HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
166	1-606-M-HV13A	CCW PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
167	1-606-M-HV16A	SC PUMP & MINIFLOW HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
168	1-606-M-HV12A	SI PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
169	1-606-M-HV17A	SC HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
170	1-606-M-HV10A	CS PUMP & MINIFLOW HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
171	1-606-M-HV11A	SI PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
172	1-606-M-HV18A	CHARGING PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B

Table 19.1-42 (10 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
173	1-606-M-HV10B	CS PUMP & MINIFLOW HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
174	1-606-M-HV11B	SI PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
175	1-606-M-HV12B	SI PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
176	1-606-M-HV21B	AUX. CHARGING PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
177	1-606-M-HV18B	CHARGING PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
178	1-606-M-HV15B	CS HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
179	1-606-M-HV14B	CCW PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
180	1-606-M-HV13B	CCW PUMP RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
181	1-606-M-HV16B	SC PUMP & MINIFLOW HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	50'	A/B
182	1-606-M-HV17B	SC HEAT EXCHANGER RM Aux Bld Controlled Area HVAC Fan/Motor	55'	A/B
183	1-606-M-HV20A	Mechanical Pen Room HVAC Fan/Motor	120'	A/B
184	1-606-M-HV19A	Mechanical Pen Room HVAC Fan/Motor	100'	A/B
185	1-606-M-HV20B	Mechanical Pen Room HVAC Fan/Motor	120'	A/B
186	1-606-M-HV19B	Mechanical Pen Room HVAC Fan/Motor	100'	A/B
187	1-606-M-AU01A	Aux Building Controlled Area (I) Emergency Exhaust ACU	156'	A/B
188	1-606-M-AH01A	Aux Building Controlled Area (I) Emergency Exhaust ACU Fan/Motor	156'	A/B
189	1-606-V-Y0002A	Aux Building Controlled Area (I) Emergency Exhaust ACU Inlet Damper	156'	A/B

Table 19.1-42 (11 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
190	1-606-V-Y0001A	Aux Building Controlled Area (I) Emergency Exhaust ACU Outlet Damper	156'	A/B
191	1-606-M-AU01B	Aux Building Controlled Area (II) Emergency Exhaust ACU	195'	A/B
192	1-606-M-AH01B	Aux Building Controlled Area (II) Emergency Exhaust ACU Fan/Motor	195'	A/B
193	1-606-V-Y0002B	Aux Building Controlled Area (II) Emergency Exhaust ACU Inlet Damper	195'	A/B
194	1-606-V-Y0001B	Aux Building Controlled Area (II) Emergency Exhaust ACU Outlet Damper	195'	A/B
195	1-633-M-PP01A	Essential Chilled Water Pump	78'	A/B
196	1-633-M-PP02A	Essential Chilled Water Pump	78'	A/B
197	1-607-M-CW31A	Ess. Chiller Room Cubical Cooler Cooling Coil	78'	A/B
198	1-607-M-CW32A	Ess. Chiller Room Cubical Cooler Cooling Coil	78'	A/B
199	1-603-M-CW02C	Class 1E Load Center 01C Room Cubical Cooler Cooling Coil	78'	A/B
200	1-603-M-CW01C	Class 1E Switchgear 01C Room Cubical Cooler Cooling Coil	78'	A/B
201	1-603-M-CW03A	Channel A DC&IP Equip Room Cubical Cooler Cooling Coil	78'	A/B
202	1-603-M-CW04C	Channel C DC&IP Equip Room Cubical Cooler Cooling Coil	78'	A/B
203	1-606-M-CW10A	CS (Quad C) Mini Flow HX Room Cubical Cooler Cooling Coil	50'	A/B
204	1-606-M-CW15A	CS HX Room Cubical Cooler Cooling Coil	55'	A/B
205	1-606-M-CW14A	CCW Pump (Quad C) Room Cubical Cooler Cooling Coil	55'	A/B
206	1-606-M-CW11A	SI Pump (Quad C) Room Cubical Cooler Cooling Coil	50'	A/B
207	1-603-M-CW07A	Class 1E Switchgear 01A Room Cubical Cooler Cooling Coil	78'	A/B
208	1-607-M-CW33A	MDAFW Pump Room Cubical Cooler Cooling Coil	78'	A/B

Table 19.1-42 (12 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
209	1-603-M-CW06A	480V Class 1E MCC 01A Room Cubical Cooler Cooling Coil	100'-0"	A/B
210	1-606-M-CW17A	SC HX Room Cubical Cooler Cooling Coil	55'	A/B
211	1-606-M-CW16A	SC Pump & Mini Flow HX Room Cubical Cooler Cooling Coil	50'	A/B
212	1-606-M-CW13A	CCW Pump (Quad A) Room Cubical Cooler Cooling Coil	55'	A/B
213	1-606-M-CW12A	SI Pump (Quad A) Room Cubical Cooler Cooling Coil	55'	A/B
214	1-601-M-CW01A	Control Room Supply AHU Cooling Coil	172'	A/B
215	1-603-M-CW17C	I&C Equip Room C Cubical Cooler Cooling Coil	157'	A/B
216	1-603-M-CW16A	I&C Equip Room A Cubical Cooler Cooling Coil	157'	A/B
217	1-603-M-CW10C	480V Class 1E MCC 03C Room Cubical Cooler Cooling Coil	137'	A/B
218	1-603-M-CW15A	480V Class 1E MCC 04A Room Cubical Cooler Cooling Coil	137'	A/B
219	1-603-M-CW14A	480V Class 1E MCC 03A Room Cubical Cooler Cooling Coil	137'	A/B
220	1-633-M-PP01B	Essential Chilled Water Pump	78'	A/B
221	1-633-M-PP02B	Essential Chilled Water Pump	78'	A/B
222	1-607-M-CW31B	Ess. Chiller Room Cubical Cooler Cooling Coil	78'	A/B
223	1-607-M-CW32B	Ess. Chiller Room Cubical Cooler Cooling Coil	78'	A/B
224	1-603-M-CW02D	Class 1E Load Center 01D Room Cubical Cooler Cooling Coil	78'	A/B
225	1-603-M-CW01D	Class 1E Switchgear 01D Room Cubical Cooler Cooling Coil	78'	A/B
226	1-603-M-CW03B	Channel B DC&IP Equip Room Cubical Cooler Cooling Coil	78'	A/B
227	1-603-M-CW04D	Channel D DC&IP Equip Room Cubical Cooler Cooling Coil	78'	A/B

Table 19.1-42 (13 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
228	1-606-M-CW10B	CS (Quad D) Mini Flow HX Room Cubical Cooler Cooling Coil	50'	A/B
229	1-606-M-CW14B	CCW Pump (Quad D) Room Cubical Cooler Cooling Coil	55'	A/B
230	1-606-M-CW11B	SI Pump (Quad D) Room Cubical Cooler Cooling Coil	50'	A/B
231	1-603-M-CW06B	480V Class 1E MCC 01B Room Cubical Cooler Cooling Coil	100'	A/B
232	1-607-M-CW33B	MDAFW Pump Room Cubical Cooler Cooling Coil	78'	A/B
233	1-603-M-CW07B	Class 1E Switchgear 01B Room Cubical Cooler Cooling Coil	78'	A/B
234	1-606-M-CW16B	SC Pump & Mini Flow HX Room Cubical Cooler Cooling Coil	50'	A/B
235	1-606-M-CW17B	SC HX Room Cubical Cooler Cooling Coil	55'	A/B
236	1-606-M-CW13B	CCW Pump (Quad B) Room Cubical Cooler Cooling Coil	55'	A/B
237	1-606-M-CW12B	SI Pump (Quad B) Room Cubical Cooler Cooling Coil	50'	A/B
238	1-601-M-CW01B	Control Room Supply AHU Cooling Coil	172'	A/B
239	1-603-M-CW16B	I&C Equip Room B Cubical Cooler Cooling Coil	157'	A/B
240	1-603-M-CW17D	I&C Equip Room D Cubical Cooler Cooling Coil	157'	A/B
241	1-603-M-CW18B	RSC Room Cubical Cooler Cooling Coil	137'	A/B
242	1-603-M-CW10D	480V Class 1E MCC 03D Room Cubical Cooler Cooling Coil	137'	A/B
243	1-603-M-CW15B	480V Class 1E MCC 04B Room Cubical Cooler Cooling Coil	137'	A/B
244	1-603-M-CW12B	Pent. MUX B Room Cubical Cooler Cooling Coil	137'	A/B
245	1-603-M-CW13B	Elect Penetration Room B Cubical Cooler Cooling Coil	137'	A/B
246	1-603-M-CW14B	480V Class 1E MCC 03B Room Cubical Cooler Cooling Coil	120'''	A/B

Table 19.1-42 (14 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
247	1-606-M-CW20B	Mechanical Penetration Room Cubical Cooler Cooling Coil	120'"	A/B
248	1-591-M-DG01A	4.16kV CLASS 1E DIESEL GENERATORS 1-591-M-DG01A	100'	EDG Building
249	1-591-M-DG01B	4.16kV CLASS 1E DIESEL GENERATORS 1-591-M-DG01B	100'	EDG Building
250	1-591-M-DG01C	4.16kV CLASS 1E DIESEL GENERATORS 1-591-M-DG01C	100'	A/B
251	1-591-M-DG01D	4.16kV CLASS 1E DIESEL GENERATORS 1-591-M-DG01D	100'	A/B
252	1-823-E-SW01A	CLASS 1E AB 4.16kV SWGR 01A	78'	A/B
253	1-823-E-SW01B	CLASS 1E AB 4.16kV SWGR 01B	78'	A/B
254	1-823-E-SW01D	CLASS 1E AB 4.16kV SWGR 01D	78'	A/B
255	1-823-E-SW01C	CLASS 1E AB 4.16kV SWGR 01C	78'	A/B
256	1-825-E-LC01A	CLASS 1E AUX. BLDG 480V LOAD CENTER 1-825-E-LC01A	78'	A/B
257	1-825-E-LC01A-A3	CLASS 1E 480V LOAD CENTER 1A	78'	A/B
258	1-825-E-LC01B	CLASS 1E AUX. BLDG 480V LOAD CENTER 1-825-E-LC01B(DIV.II)	78'	A/B
259	1-825-E-LC01B-A3	CLASS 1E 480V LOAD CENTER 1B	78'	A/B
260	1-825-E-LC01C	CLASS 1E AUX. BLDG 480V LOAD CENTER 1-825-E-LC01C	78'	A/B
261	1-825-E-LC01D	CLASS 1E AUX. BLDG 480V LOAD CENTER 1-825-E-LC01D	78'	A/B
262	1-825-E-LC02	CLASS 1E AUX. BLDG 480V SWING LOAD CENTER 1-825-E-LC02	78'	A/B

Table 19.1-42 (15 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
263	1-825-E-TR01A	480V LOAD CENTER XFMR	78'	A/B
264	1-825-E-TR01B	480V LOAD CENTER XFMR	78'	A/B
265	1-825-E-TR01C	480V LOAD CENTER XFMR	78'	A/B
266	1-825-E-TR01D	480V LOAD CENTER XFMR	78'	A/B
267	1-827-E-MC01A	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC01A	100'	A/B
268	1-827-E-MC01A-3	120/208V AC DIST. PNL	100'	A/B
269	1-827-E-MC01B	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC01B	100'	A/B
270	1-827-E-MC01B-3	120/208V AC DIST. PNL	100'	A/B
271	1-827-E-MC01C	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC01C	78'	A/B
272	1-827-E-MC01C-3	120/208V AC DIST. PNL	78'	A/B
273	1-827-E-MC01D	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC01D	78'	A/B
274	1-827-E-MC01D-3	120/208V AC DIST. PNL	78'	A/B
275	1-827-E-MC02A	CLASS 1E ESW STRUCTURE AREA 480V MCC 1-827-E-MC02A	100'	ESW building
276	1-827-E-MC02A-3	120/208V AC DIST. PNL	100'	ESW building
277	1-827-E-MC02B	CLASS 1E ESW STRUCTURE AREA 480V MCC 1-827-E-MC02B	100'	ESW building
278	1-827-E-MC02B-3	120/208V AC DIST. PNL	100'	ESW building
279	1-827-E-MC02C	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC02C	78'	A/B
280	1-827-E-MC02C-3	120/208V AC DIST. PNL	78'	A/B

Table 19.1-42 (16 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
281	1-827-E-MC02D	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC02D	78'	A/B
282	1-827-E-MC02D-3	120/208V AC DIST. PNL	78'	A/B
283	1-827-E-MC03A	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC03A	137'	A/B
284	1-827-E-MC03A-3	120/208V AC DIST. PNL	137'	A/B
285	1-827-E-MC03B	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC03B	120'	A/B
286	1-827-E-MC03B-3	120/208V AC DIST. PNL	120'	A/B
287	1-827-E-MC03C	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC03C	137'	A/B
288	1-827-E-MC03C-3	120/208V AC DIST. PNL	137'	A/B
289	1-827-E-MC03D	CLASS 1E A/B 480V MCC 1-827-E-MC03D	137'	A/B
290	1-827-E-MC03D-3	120/208V AC DIST. PNL	137'	A/B
291	1-827-E-MC04A	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC04A	137'	A/B
292	1-827-E-MC04A-3	120/208V AC DIST. PNL	137'	A/B
293	1-827-E-MC04B	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC04B	137'	A/B
294	1-827-E-MC04B-3	120/208V AC DIST. PNL	137'	A/B
295	1-827-E-MC04C	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC04C	100'	A/B
296	1-827-E-MC04C-3	120/208V AC DIST. PNL	100'	A/B
297	1-827-E-MC04D	CLASS 1E AUX. BLDG 480V MCC 1-827-E-MC04D(DIV. II)	100'	A/B
298	1-827-E-MC04D-3	120/208V AC DIST. PNL	100'	A/B
299	1-827-E-MC05A	CLASS 1E EDG-A BLDG 480V MCC 1-827-E-MC05A	100'	EDG Building

Table 19.1-42 (17 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
300	1-827-E-MC05A-3	120/208V AC DIST. PNL	100'	EDG Building
301	1-827-E-MC05B	CLASS 1E EDG-B BLDG 480V MCC 1-827-E-MC05B	100'	EDG Building
302	1-827-E-MC05B-3	120/208V AC DIST. PNL	100'	EDG Building
303	1-841-E-BC01A	CLASS 1E BATT. CHARGER (A/B)	78'	A/B
304	1-841-E-BC01B	CLASS 1E BATT. CHARGER (A/B)	78'	A/B
305	1-841-E-BC01C	CLASS 1E BATT. CHARGER (A/B)	78'	A/B
306	1-841-E-BC01D	CLASS 1E BATT. CHARGER (A/B)	78'	A/B
307	1-841-E-BC02A	CLASS 1E BATT. CHARGER (STAND-BY) (A/B)	78'	A/B
308	1-841-E-BC02B	CLASS 1E BATT. CHARGER (STAND-BY) (A/B)	78'	A/B
309	1-841-E-BC02C	CLASS 1E BATT. CHARGER (STAND-BY) (A/B)	78'	A/B
310	1-841-E-BC02D	CLASS 1E BATT. CHARGER (STAND-BY) (A/B)	78'	A/B
311	1-841-E-BT01A	CLASS 1E 125V DC BATTERY	100'	A/B
312	1-841-E-BT01B	CLASS 1E 125V DC BATTERY	100'	A/B
313	1-841-E-BT01C	CLASS 1E 125V DC BATTERY	78'	A/B
314	1-841-E-BT01D	CLASS 1E 125V DC BATTERY	78'	A/B
315	1-841-E-MC01A	CLASS 1E 125V DC CONTROL CENTER (A/B)	78'	A/B
316	1-841-E-MC01A-C1	CLASS 1E 125V DC DISTR. PNL 1	78'	A/B
317	1-841-E-MC01A-D1	CLASS 1E 125V DC DISTR. PNL 2	78'	A/B

Table 19.1-42 (18 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
318	1-841-E-MC01B	CLASS 1E 125V DC CONTROL CENTER (A/B)	78'	A/B
319	1-841-E-MC01B-C1	CLASS 1E 125V DC DISTR. PNL 1	78'	A/B
320	1-841-E-MC01B-D1	CLASS 1E 125V DC DISTR. PNL 2	78'	A/B
321	1-841-E-MC01C	CLASS 1E 125V DC CONTROL CENTER (A/B)	78'	A/B
322	1-841-E-MC01C-D1	CLASS 1E 125V DC DISTR. PNL	78'	A/B
323	1-841-E-MC01D	CLASS 1E 125V DC CONTROL CENTER (A/B)	78'	A/B
324	1-841-E-MC01D-D1	CLASS 1E 125V DC DISTR. PNL 2	78'	A/B
325	1-842-E-IN01A	CLASS 1E CH.A 40KVA INVERTER (A/B)	78'	A/B
326	1-842-E-IN01B	CLASS 1E CH.A 40KVA INVERTER (A/B)	78'	A/B
327	1-842-E-IN01C	CLASS 1E CH.C 40KVA INVERTER (A/B)	78'	A/B
328	1-842-E-IN01D	CLASS 1E CH.C 40KVA INVERTER (A/B)	78'	A/B
329	1-842-E-IN02A	CLASS 1E SAFETY MOV INVERTER (RC SYS ONLY)	78'	A/B
330	1-842-E-IN02B	CLASS 1E SAFETY MOV INVERTER 30KVA	78'	A/B
331	1-842-E-IN02C	CLASS 1E SAFETY MOV INVERTER	78'	A/B
332	1-842-E-IN02D	CLASS 1E SAFETY MOV INVERTER 30KVA	78'	A/B
333	1-842-E-TR01A	CLASS 1E REGULATING TRANSFORMER	78'	A/B
334	1-842-E-TR01B	CLASS 1E REGULATING TRANSFORMER	78'	A/B
335	1-842-E-TR01C	CLASS 1E REGULATING TRANSFORMER	78'	A/B
336	1-842-E-TR01D	CLASS 1E REGULATING TRANSFORMER	78'	A/B

Table 19.1-42 (19 of 19)

No.	Equipment ID	Equipment Description	Floor Elevation	Building
337	1-752-J-PA03B	ESF-CCS Group Controller Cabinet (Ch.BE)	157'	A/B
338	1-752-J-PA03C	ESF-CCS Group Controller Cabinet (Ch.CE)	157'	A/B
339	1-752-J-PA03D	ESF-CCS Group Controller Cabinet (Ch.DE)	157'	A/B
340	1-752-J-PA03A	ESF-CCS Cabinet(A, B, C, D)	157'	A/B
341	1-752-J-PA14B	PPS Cabinet Ch.B-1	157'	A/B
342	1-752-J-PA14C	Plant Protection System Cabinet(C)	157'	A/B
343	1-752-J-PA14D	PPS Cabinet Ch.D-1	157'	A/B
344	1-752-J-PA14A	Plant Protection System Cabinet(A)	157'	A/B
345	1-772-E-SW01C	Reactor Trip Switchgear	137'	A/B
346	1-772-E-SW01A	Reactor Trip Switchgear	137'	A/B
347	1-772-E-SW01D	Reactor Trip Switchgear	137'	A/B
348	1-772-E-SW01B	Reactor Trip Switchgear	137'	A/B
349	1-751-J-PM01	RO Console (Frame)	157'	A/B
350	1-751-J-PM02	TO/EO Console (Frame)	157'	A/B
351	1-751-J-PM03	SS Console (Frame)	157'	A/B
352	1-751-J-PM04	STA Console (Frame)	157'	A/B
353	1-751-J-PM05	Safety Console (Frame)	157'	A/B

Table 19.1-43 (1 of 10)

Seismic Fragility Analysis Results Summary

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF[(1)] (g)	Mean Failure Prob	Qualification Method	Remark
Reactor Pressure Vessel	Containment El. 69'~156'	11.28	Support	>1.5	-	-	S/O	-	Analysis	
Reactor Vessel Internal	Containment El. 69'~156'	11.28	Core Support Barrel	>1.5	-	-	S/O	-	Analysis	
Steam Generator	Containment El. 114'~136'06"	11.28	Upper Support	>1.5	-	-	S/O	-	Analysis	
Pressurizer	Containment El. 114'~156'	11.28	Shear Lug	>1.5	-	-	S/O	-	Analysis-	
Reactor Coolant Pumps	Containment El. 114'~136'06"	11.28	Upper Support	>1.5	-	-	S/O	-	Analysis	
Reactor Coolant System Piping	Containment	-	Generic	>1.5	-	-	S/O	-	Generic DB	
Regenerative Heat Exchanger	Containment El. 114'	>33	Foundation bolt	>1.5	-	-	S/O	-	Analysis	
Charging Pumps	A/B El. 55'	-	Nozzle MB	>1.5	-	-	S/O	-	Analysis	
Letdown Heat Exchanger	Containment El. 100'	>33	Base Plate	>1.5	-	-	S/O	-	Analysis	
Auxiliary Charging Pump	A/B El. 55'	>33	Concrete Coning	>1.5	-	-	S/O	-	Analysis	

Table 19.1-43 (2 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF(1) (g)	Mean Failure Prob	Qualification Method	Remark
Safety Injection Tanks	Containment El. 136' 06"	11.86	Concrete Coning	1.79	0.42	0.36	0.50	1.46E-01	Analysis	
Shutdown Cooling Pumps	A/B El. 50'	>33	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Shutdown Cooling Heat Exchanger	A/B El. 50'	>33	Concrete Coning	>1.5*	-	-	S/O	-	Analysis	
SC Pump Miniflow Heat Exchanger	A/B El. 50'	>33	Saddle Plate	>1.5	-	-	S/O	-	Analysis	
Safety Injection Pump	A/B El. 50'	>33	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Containment Spray Pump	A/B El. 50'	>33	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
CS Miniflow Hx	A/B El. 50'	7.1	Support	>1.5	-	-	S/O	-	Analysis	
Containment Spray Heat Exchanger	A/B El. 55'	7.43	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Main Steam Isolation Valves	A/B El. 137' 06"	-	Generic	>1.5	-	-	S/O	-	Generic DB	
Main Steam Atmospheric Valves(ADV)	A/B El. 137'06"	-	Generic	>1.5	-	-	S/O	-	Generic DB	
Main Steam Safety Valves	A/B El. 137'06"	-	Generic	>1.5	-	-	S/O	-	Generic DB	

Table 19.1-43 (3 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF[1] (g)	Mean Failure Prob	Qualification Method	Remark
AFW Pump-Motor Driven	A/B El. 78'	>33	Base Plate	>1.5	-	-	S/O	-	Test/ Analysis	
AFW Pump-Turbine Driven	A/B El. 78'	24.5	Foundation Bolt	>1.5	-	-	S/O	-	Analysis	
Emergency Diesel Generators	EDG[2] El. 100' A/B El. 100'	3	Fixation Bolt	1.82	0.42	0.37	0.50	1.42E-01	Analysis	
Emergency Diesel Fuel Oil transfer pump	EDG El. 65' A/B El. 63'	>33	Base Plate	>1.5	-	-	S/O	-	Test/ Analysis	
Starting Air Tank	A/B El. 100'	>33	Skirt Support	>1.5	-	-	S/O	-	Analysis	
Diesel Fuel Oil Day Tank	EDG El. 121' A/B El. 120'	>33	Saddle Support	>1.5	-	-	S/O	-	Analysis	
Diesel Fuel Oil Storage Tank	EDG El. 63' A/B El. 65'	4.1	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Silencer	A/B El. 100'	0.58	Head Plate	>1.5	-	-	S/O	-	Analysis	
Air Intake Filter	A/B El. 109'	11.6	Body	>1.5	-	-	S/O	-	Analysis	
Lube Oil Water Hx	A/B El. 100'	5.84	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Motor Driven Fuel Oil Feed Pump	EDG El. 100' A/B El. 100'	>33	Pump Pad	>1.5	-	-	S/O	-	Analysis	
Essential Service Water Pump	ESW building El. 69'	18	Discharge Head Rib	>1.	-	-	S/O	-	Analysis	

Table 19.1-43 (4 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF(1) (g)	Mean Failure Prob	Qualification Method	Remark
CCW Heat Exchangers	CCW HX Building El. 100'	10.97	Head Plate	>1.5	-	-	S/O	-	Analysis	
CCW Pump	A/B El. 55'	>33	Pump Mt Bolt	>1.5	-	-	S/O	-	Analysis	
CCW Surge Tank	A/B El. 172'	>33	Concrete Coning	>1.5	-	-	S/O	-	Analysis	
Essential Chilled Water Pumps	A/B El. 78'	>33	Pump Mt Bolt	>1.5	-	-	S/O	-	Analysis	
Essential Chillers	A/B El. 78'	>33	Functional	>1.5	-	-	S/O	-	Test	
		>33	Concrete Coning	>1.5	-	-	S/O		Analysis	
ECW Compression Tank	A/B El. 172'	26.1	Vessel Shell	>1.5	-	-	S/O	-	Analysis	
ECW Air Separator	A/B El. 78'	>33	Structure	>1.5	-	-	S/O	-	Analysis	
Essential Chilled Water System Control Panel	A/B El. 78'	15.12	Functional	>1.5	-	-	S/O	-	Test	
			Structural	>1.5	-	-	S/O			
AFWP Room Cubicle Cooler-MD	A/B El. 78'	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Foundation Bolt	>1.5	-	-	S/O		Analysis	
CCWP Room Cubicle Cooler	A/B El. 55'	11.53	Functional	>1.5	-	-	S/O	-	Test	
			Drain Pipe	>1.5	-	-	S/O		Analysis	

Table 19.1-43 (5 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF(1) (g)	Mean Failure Prob	Qualification Method	Remark
SI Room Cubicle Cooler	A/B El. 50' A/B El. 55'	11.53	Functional	>1.5	-	-	S/O	-	Test	
			Drain Pipe	>1.5	-	-	S/O		Analysis	
SC Pump & Mini-flow HX Room Cubicle Cooler	A/B El. 50' A/B El. 55'	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Fan/Motor Frame	>1.5	-	-	S/O		Analysis	
Mech. Pen. Room Cubicle Cooler	A/B El. 100' A/B El. 120'	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Fan/Motor Frame	>1.5	-	-	S/O		Analysis	
CS Pump Room Cubicle Cooler	A/B El. 50' A/B El. 55'	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Fan/Motor Frame	>1.5	-	-	S/O		Analysis	
Aux Charging Pump Room Cubicle Cooler	A/B El. 55'	11.53	Functional	>1.5	-	-	S/O	-	Test	
			Outlet End Skin	>1.5	-	-	S/O		Analysis	
Charging Pump Room Cubicle Cooler	A/B El. 55'	11.53	Functional	>1.5	-	-	S/O	-	Test	
			Outlet End Skin	>1.5	-	-	S/O		Analysis	
Elect. Pen. Room Area Cubicle Cooler	A/B El. 120' A/B El. 137' 6"	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Fan/Motor Frame	>1.5	-	-	S/O		Analysis	

Table 19.1-43 (6 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF(1) (g)	Mean Failure Prob	Qualification Method	Remark
Essential Chiller & Pump Cubicle Cooler	A/B El. 78'	8.67	Functional	>1.5	-	-	S/O	-	Test	
			Fan/Motor Frame	>1.5	-	-	S/O		Analysis	
CCW HX Room Supply Fans	CCW HX Building El. 100'	17	Functional	>1.5	-	-	S/O	-	Test	
	El. 126'		Structural	>1.5	-	-	S/O		Analysis	
ESW Pump Room Supply Fan	ESW building El. 90'	>33	Functional	>1.5	-	-	S/O	-	Test	
			Structural	>1.5	-	-	S/O		Analysis	
EDG Room Emergency Exhaust Fan	EDG El. 100' A/B El. 172'	32	Functional	>1.5	-	-	S/O	-	Test	
			Structural	>1.5	-	-	S/O		Analysis	
Control Room Emergency Makeup ACU	A/B El. 172'	10.13	Functional	>1.5	-	-	S/O	-	Test	
			Housing	>1.5	-	-	S/O		Analysis	
ESF-CCS GC Cabinet	A/B El. 156'	11.9	Functional	1.01	0.25	0.38	0.35		Test	There are no relays to affect the function of the panel. The structural failure is related to the parts and accessory which are listed in table below.
			Structure	1.5	0.25	0.42	0.50	2.03E-01		
ESF-CCS LC Cabinet	A/B El. 156'	12.14	Functional	1.01	0.25	0.38	0.35	-	Test	
			Structural	1.5	0.25	0.42	0.50	2.03E-01		
	A/B El. 137'6"	12.14	Functional	1.2	0.25	0.38	0.42	-		
			Structural	>1.5	-	-	S/O			

Table 19.1-43 (7 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF[1] (g)	Mean Failure Prob	Qualification Method	Remark
Plant Protection System Cabinet	A/B El. 156'	12.1	Functional	1.01	0.25	0.38	0.35	-	Test	There are no relays to affect the function of the panel. The structural failure is related to the parts and accessory which are listed in table below.
			Structural	1.5	0.25	0.42	0.50	2.03E-01		
Reactor Trip Switchgear	A/B El. 137'6"	-	Functional	>1.5	-	-	S/O	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			
MCR Operator Consoles	A/B El. 156'	>33	Functional	1.13	0.36	0.44	0.3	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			
MCR Safety Consoles	A/B El. 156'	>33	Functional	-	-	-	-	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			
125V DC Battery Chargers	A/B El. 78'	13.94	Functional	1.12	0.21	0.36	0.44	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			
SI Inverter	A/B El. 78'	14.07	Functional	1.36	0.21	0.43	0.48	-	Test	There are no relays to affect the function of the pane
			Structural	>1.5	-	-	S/O			
20V AC Inverter(VBPSS)	A/B El. 78'	9	Functional	1.11	0.21	0.33	0.46	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			

Table 19.1-43 (8 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF[(1)] (g)	Mean Failure Prob	Qualification Method	Remark
Regulating Transformer	A/B El. 78'	9.49	Functional	1.27	0.21	0.41	0.46	-	Test	There are no relays to affect the function of the panel
			Structural	>1.5	-	-	S/O			
125V DC Control Center	A/B El. 78'	6.4	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
4.16kV MCSG	A/B El. 78'	6.23	Functional	1.62	0.32	0.4	0.50	1.73E-01	Test	Lockout Relay which can be recoverable by operator
			Structural	>1.5	-	-	S/O			
480V Load Center	A/B El. 78'	7.7	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
480V MCC (Aux. EL.137'06")	A/B El. 137'06"	14.32	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
480V MCC (Aux. EL.120')	A/B El. 120'	14.32	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
480V MCC (Aux. EL.100')	A/B El. 100'	14.32	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
480V MCC (Aux. EL.78')	A/B El. 78'	14.32	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			
480V MCC(ESW IS EL.100')	ESW building El. 90'	14.32	Functional	>1.5	-	-	S/O	-	Test	Relay is the solid state which is inherently rugged
			Structural	>1.5	-	-	S/O			

Table 19.1-43 (9 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF[(1)] (g)	Mean Failure Prob	Qualification Method	Remark
Batteries & Racks	A/B El. 78' A/B El. 100'	25.9	Functional	>1.5	-	-	S/O	-	Test	-
			Structural	>1.5	-	-	S/O			
BOP Piping & Supports	various	-	Generic	>1.5	-	-	S/O	-	-	-
HVAC Ducting & Dampers	various	-	Generic	>1.5	-	-	S/O	-	-	-
Cable Trays & Supports	various	-	Generic	>1.5	-	-	S/O	-	-	-
Motor Operated Valves	various	-	Generic	>1.5	-	-	S/O	-	-	-
Air Operated Valves	various	-	Generic	>1.5	-	-	S/O	-	-	-
Off-Site Power	various	-	Generic	1.7	0.3	0.45	0.50	1.63E-01	-	-
Electrical Conduit	various	-	Generic	>1.5	-	-	S/O	-	-	-
Relief and Check Valves	various	-	Generic	>1.5	-	-	S/O	-	-	-
Resistance Temperature Detectors	various	-	Generic	>1.5	-	-	S/O	-	-	-
Pressure Transmitters	various	-	Generic	>1.5	-	-	S/O	-	-	-

Table 19.1-43 (10 of 10)

Component	Location	Freq (Hz)	Failure mode	Am	Br	Bu	HCLPF(1) (g)	Mean Failure Prob	Qualification Method	Remark
Containment Building Exterior Walls	-	-	-	1.418	0.153	0.308	0.66	1.55E-01	Analysis	-
Containment Building Internal Structure	-	-	-	2.616	0.153	0.427	1.01	1.70E-02	Analysis	-
Auxiliary Building	-	-	-	1.492	0.154	0.327	0.67	1.34E-01	Analysis	-
Emergency Diesel Generator (EDG) Building	-	-	-	1.492	0.154	0.327	0.67	-	Assumption(3)	-

(1) S/O: Screened Out

(2) EDG: EDG Building

(3) Assumed EDG Building fragilities are greater than the associated EDG equipment contained in the building.

Table 19.1-44 (1 of 9)

Dominant Contributors to the Plant HCLPF

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.03E-01	SEIS-ESF-RPS-FAIL SEISMIC	SEISMIC-INDUCED FAILURE OR ESF CCS CABINETS. SEISMIC EVENT CAUSES LOOP	-	-
2	1.70E-01	SEIS-4KV-BUS-FAIL	SEISMIC-INDUCED FAILURE OF 4.16kV AC SAFETY BUS	-	-
3	1.55E-01	SEIS-CTS-EX-FAIL SEISMIC	SEISMIC FAILURE OF THE CONTAINMENT EXTERIOR SEISMIC EVENT CAUSES LOOP	-	
4	1.34E-01	SEIS-AB-FAIL SEISMIC	SEISMIC FAILURE OF THE AUXILIARY BUILDING SEISMIC EVENT CAUSES LOOP	-	-
5	1.00E-01	SIOPH-S-LTC-SC	OPERATOR FAILS TO ALIGN SCS FOR LONG TERM COOLING	-	-
6	7.14E-02	SEIS-IP-INV-FAIL SEIS-IP-REGTR-FAIL SEISMIC	SEISMIC FAILURE OF 120 VAC INVERTERS SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS SEISMIC EVENT CAUSES LOOP	-	-
7	2.17E-02	S-LLOCA SEIS-DG-AB-FAIL	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA SEISMIC-INDUCED FAILURE OF EDGS A AND B	-	-
8	2.17E-02	S-LLOCA SEIS-DG-CD-FAIL	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA SEISMIC-INDUCED FAILURE OF EDGS C AND D	-	-
9	1.96E-02	SEIS-DG-AB-FAIL SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B SEISMIC-INDUCED FAILURE OF EDGS C AND D	-	-

Table 19.1-44 (2 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	1.70E-02	SEIS-CTS-IN-FAIL	CONTAINMENT INTERNAL STRUCTURE FAILS	-	-
		SEISMIC	SEISMIC EVENT CAUSES LOOP		
11	1.55E-02	S-LLOCA	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA	-	-
		SIOPH-S-HLI	OPERATOR FAILS TO HOT LEG INJECTION		
12	1.00E-02	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
13	1.00E-02	HR-RCSCD1-ISOL	OPERATORS FAIL TO TAKE ACTION FOR SG COOLDOWN & RCS DEPRESS PRIOR TO OVERFILL	-	-
		HR-RCSCD2	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RC DEPRESS		
14	4.28E-03	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
15	4.28E-03	SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SIOPH-S-IRWSTCOOL	OPERATE FAILS TO COOL THE IRWST WATER		
16	4.28E-03	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		

Table 19.1-44 (3 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
17	2.51E-03	AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
18	1.40E-03	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D		
		SIOPH-S-IRWSTCOOL	OPERATE FAILS TO COOL THE IRWST WATER		
19	4.62E-04	AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
20	4.28E-04	SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
21	4.13E-04	AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION	-	-
		HR-RCSCD2	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RC DEPRESS		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		

Table 19.1-44 (4 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	4.13E-04	AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	-	-
		HR-RCSCD2	OPERATOR FAILS TO TAKE ACTION FOR SG COOLDOWN, RC DEPRESS		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
23	3.80E-04	AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
24	3.58E-04	SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS	-	-
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
		SIMPM1B-SCPP01B	SC PUMP PP01B FAILS DUE TO T&M		
25	3.36E-04	PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS	-	-
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
26	3.15E-04	AFTPL1A-TDP01A	AFW PUMP 1A FAILS TO RUN FOR 1HR	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
27	3.00E-04	MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		

Table 19.1-44 (5 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
28	2.76E-04	DGDGR-B-DGB	FAILS TO RUN OF EDG B	-	-
		S-LLOCA	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
29	2.49E-04	DGDGR-B-DGB	FAILS TO RUN OF EDG B	-	-
		SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
30	2.40E-04	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS		
31	1.78E-04	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
32	1.78E-04	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		

Table 19.1-44 (6 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	1.59E-04	DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	-	-
		S-LLOCA	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
34	1.44E-04	DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	-	-
		SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
35	1.43E-04	AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	-	-
		AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
36	1.43E-04	AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	-	-
		AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		

Table 19.1-44 (7 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
37	1.43E-04	AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	-	-
		AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
38	1.43E-04	AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	-	-
		AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
39	1.30E-04	SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D	-	-
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
		WOCHS1B-CH01B	ECW CHILLER CH01B FAILS TO START ON DEMAND		
40	1.28E-04	AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	-	-
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
41	1.07E-04	DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		

Table 19.1-44 (8 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	1.07E-04	DGDGR-C-DGC	FAILS TO RUN OF EDG C	-	-
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
43	1.03E-04	PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS	-	-
		SEIS-DG-CD-FAIL	SEISMIC-INDUCED FAILURE OF EDGS C AND D		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
44	1.03E-04	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
45	1.03E-04	AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	-	-
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
		SEIS-IP-REGTR-FAIL	SEISMIC FAILURE OF 120 VAC REGULATING TRANSFORMERS		
46	9.62E-05	DGDGR-A-DGA	FAILS TO RUN OF EDG A	-	-
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		S-LLOCA	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA		

Table 19.1-44 (9 of 9)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	9.62E-05	DGDGR-C-DGC	FAILS TO RUN OF EDG C	-	-
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		S-LLOCA	SEISMICALLY-INDUCED LARGE OR MEDIUM LOCA		
48	8.71E-05	AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	-	-
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
49	8.71E-05	AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	-	-
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		
50	8.71E-05	AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	-	-
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		SEIS-DG-AB-FAIL	SEISMIC-INDUCED FAILURE OF EDGS A AND B		
		SEIS-IP-INV-FAIL	SEISMIC FAILURE OF 120 VAC INVERTERS		

Table 19.1-45 (1 of 16)

Fire Compartment Initiator Development and Screening

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F000-C01	REACTOR CONTAINMENT	SLOCA	DETAIL ANALYSIS
F157-AMCR	MAIN CONTROL ROOM	TLOMCR	DETAIL ANALYSIS
F000-TB	TURBINE GENERATOR AREA	LOOP	DETAIL ANALYSIS
F120-A05D	ELECTRICAL EQUIP. RM	GTRN	DETAIL ANALYSIS
F120-A11B	GENERAL ACCESS AREA-120' B	LODCB	DETAIL ANALYSIS
F122-T01	SWITCHGEAR RM	LOOP	DETAIL ANALYSIS
F137-A11C	ELECTRICAL PENETRATION RM (C)	GTRN	DETAIL ANALYSIS
F157-A01D	I&C EQUIPMENT RM	LODCB	DETAIL ANALYSIS
F157-A25C	I&C EQUIPMENT RM	GTRN	DETAIL ANALYSIS
F100-T15	SWITCHGEAR RM	LOOP	DETAIL ANALYSIS
F120-A15B	480V CLASS 1E MCC 03B RM	LODCB	DETAIL ANALYSIS
F000-ADGD	DIESEL GENERATOR ROOM	LODCB	DETAIL ANALYSIS
F157-ACPX	COMPUTER RM PACU RM	LODCB	DETAIL ANALYSIS
F078-AEEB	CLASS 1E SWITCHGEAR 01B ROOM	LODCB	DETAILED ANALYSIS
F078-A05D	CHANNEL-D DC & IP EQUIP RM	GTRN	DETAILED ANALYSIS
F067-T02	UNDERGROUND COMMON TUNNEL	LOOP	DETAILED ANALYSIS

Table 19.1-45 (2 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F120-A05C	ELECTRICAL EQUIP. RM	PLOCCW	DETAILED ANALYSIS
F157-AMAX	MEETING ROOM	PLOCCW	DETAILED ANALYSIS
F100-AEEB	480V CLASS 1E MCC 01B ROOM	LODCB	DETAILED ANALYSIS
F078-A19B	CORRIDOR	LODCB	DETAILED ANALYSIS
FW-W00	CIRCULATING WATER PUMP BUILDING	LOCV	DETAILED ANALYSIS
F120-AMPB	MECHANICAL PENETRATION ROOM	GTRN	DETAILED ANALYSIS
F120-AGAD	GENERAL ACCESS AREA-120' D	LODCB	DETAILED ANALYSIS
F078-AGAD	GENERAL ACCESS AREA	LODCB	DETAILED ANALYSIS
F100-A08C	N1E DC & IP EQUIPMENT RM	PLOCCW	DETAILED ANALYSIS
F157-ATOC	TSC EQUIP. REPAIR & MAINT ROOM	PLOCCW	DETAILED ANALYSIS
F078-A52D	480V N1E MCC RM	LODCB	DETAILED ANALYSIS
F120-A14A	SG BLOWDOWN REGEN HX RM	PLOCCW	DETAILED ANALYSIS
F078-AGAC	GENERAL ACCESS AREA	PLOCCW	DETAILED ANALYSIS
F078-A25A	CLASS 1E SWITCHGEAR 01A RM	PLOCCW	DETAILED ANALYSIS
F100-A08D	N1E DC & IP EQUIPMENT RM	LODCB	DETAILED ANALYSIS
F000-ACVU	CVCS SYSTEM AREA	GTRN	DETAILED ANALYSIS
F055-AGAC	GENERAL ACCESS AREA-55' C	LODCA	DETAILED ANALYSIS

Table 19.1-45 (3 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F120-A09C	ELECTRICAL PENETRATION ROOM (C)	PLOCCW	DETAILED ANALYSIS
F100-A06D	GENERAL ACCESS AREA	LOFW	DETAILED ANALYSIS
F100-A05D	ELECTRICAL EQUIPMENT RM	LOFW	DETAILED ANALYSIS
F137-A11D	ELECTRICAL PENETRATION RM (D)	GTRN	DETAILED ANALYSIS
F137-A01C	CABLE SPREADING AREA	LODCA	DETAILED ANALYSIS
F157-A17C	CORRIDOR	GTRN	SCREEN OUT
F055-AGAD	GENERAL ACCESS AREA-55' D	GTRN	SCREEN OUT
F120-A09D	ELECTRICAL PENETRATION ROOM (D)	LODCB	SCREEN OUT
F000-RW	ACCESS AREA	GTRN	SCREEN OUT
F078-A03D	CLASS 1E LOADCENTER 01D RM	GTRN	SCREEN OUT
FK-K02	ESW STRUCTURE "B" BUILDING	GTRN	SCREEN OUT
F137-AEPA	ELECTRICAL PENETRATION ROOM (A)	GTRN	SCREEN OUT
F000-ADGC	DIESEL GENERATOR ROOM	PLOCCW	SCREEN OUT
F137-A05D	PCS RM	LOFW	SCREEN OUT
FD-D01A	CCW HEAT EXCHANGER "A" BUILDING	GTRN	SCREEN OUT
FD-D01B	CCW HEAT EXCHANGER "B" BUILDING	GTRN	SCREEN OUT
FX-X00	FIRE PUMP & WATER/WASTEWATER TREATMENT BUILDING	GTRN	SCREEN OUT
FW-W01	CW COOLING TOWER STRUCTURE AREA 1	LOCV	SCREEN OUT
F078-A56B	CHANNEL-B DC & IP EQUIP. RM	LODCB	SCREEN OUT
F078-A56A	CHANNEL-A DC & IP EQUIP. RM	LODCA	SCREEN OUT
F120-A01D	PIPING CABLE AREA	LODCB	SCREEN OUT
F078-A05C	CHANNEL-C DC & IP EQUIP RM	PLOCCW	SCREEN OUT

Table 19.1-45 (4 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F137-A01D	CABLE SPREADING AREA	LODCB	SCREEN OUT
F078-A04C	MISC. ELECTRICAL EQUIP RM	LODCA	SCREEN OUT
F078-A02D	CLASS 1E SWITCHGEAR 01D RM	LODCB	SCREEN OUT
F078-A03C	CLASS 1E LOADCENTER 01C RM	PLOCCW	SCREEN OUT
F157-A19D	I&C EQUIPMENT RM	GTRN	SCREEN OUT
F100-AEEA	480V CLASS 1E MCC 01A RM	PLOCCW	SCREEN OUT
F137-AEPB	ELECTRICAL PENETRATION ROOM (B)	GTRN	SCREEN OUT
F000-AFHU	FUEL HANDLING UPPER AREA	GTRN	SCREEN OUT
FK-K01	ESW STRUCTURE "A" BUILDING	PLOCCW	SCREEN OUT
F050-A04B	SC PUMP & MINI FLOW HX RM	LODCB	SCREEN OUT
F055-A02D	CCW PUMP RM	LODCB	SCREEN OUT
FN-N00	AAC BUILDING	GTRN	SCREEN OUT
F100-H02A	EMERGENCY D/G ROOM	GTRN	SCREEN OUT
F000-AC	ACCESS AREA	GTRN	SCREEN OUT
F120-AGAA	GENERAL ACCESS AREA-120' A	PLOCCW	SCREEN OUT
F157-A19C	I&C EQUIPMENT RM	GTRN	SCREEN OUT
F050-A01D	CS PUMP & MINI FLOW HX RM	GTRN	SCREEN OUT
F050-A02D	SI PUMP RM	GTRN	SCREEN OUT
F078-A19A	CORRIDOR	PLOCCW	SCREEN OUT
F078-A04D	MISC. ELECTRICAL EQUIP RM	LODCB	SCREEN OUT
F078-A11C	ESSENTIAL CHILLER RM	LODCA	SCREEN OUT
F137-A09D	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F120-A01C	PIPING CABLE AREA	LODCA	SCREEN OUT
F100-H02B	EMERGENCY D/G ROOM	GTRN	SCREEN OUT
FY-MTR1	MAIN TRANSFORMER 1 AREA	GTRN	SCREEN OUT
FY-MTR2	MAIN TRANSFORMER 2 AREA	GTRN	SCREEN OUT
FY-MTR3	MAIN TRANSFORMER 3 AREA	GTRN	SCREEN OUT

Table 19.1-45 (5 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
FY-UAT1	UNIT AUX. TRANSFORMER 1 AREA	GTRN	SCREEN OUT
FY-UAT2	UNIT AUX. TRANSFORMER 2 AREA	GTRN	SCREEN OUT
F000-AFHL	FUEL HANDLING LOWER AREA	GTRN	SCREEN OUT
FY-EXTR	EXCITATION TRANSFORMER	GTRN	SCREEN OUT
F078-A47B	ELECTRICAL EQUIPMENT RM	GTRN	SCREEN OUT
F137-A10D	480V CLASS 1E MCC 03D RM	GTRN	SCREEN OUT
FS-S01	SWYD CONTROL BUILDING	GTRN	SCREEN OUT
F100-AGAC	GENERAL ACCESS AREA	PLOCCW	SCREEN OUT
F073-T11	SWITCHGEAR AREA	LOFW	SCREEN OUT
F137-A30D	MAIN STEAM ENCLOSURE	LODCB	SCREEN OUT
F120-AGAC	GENERAL ACCESS AREA-120' C	PLOCCW	SCREEN OUT
FK-K03	ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA	GTRN	SCREEN OUT
F078-AAFC	TURBINE DRIVEN AUX FEEDWATER PUMP ROOM	GTRN	SCREEN OUT
FK-K04	ESW ULTIMATE HEAT SINK COOLING TOWER 1B AREA	GTRN	SCREEN OUT
F078-A11D	ESSENTIAL CHILLER RM	GTRN	SCREEN OUT
FY-SAT2	STAND-BY AUX. TRANSFORMER 2 AREA	GTRN	SCREEN OUT
FY-SAT1	STAND-BY AUX. TRANSFORMER 1 AREA	GTRN	SCREEN OUT
F137-ANEA	ELECTRICAL EQUIPMENT ROOM	GTRN	SCREEN OUT
F100-T11	TURBINE LUBE OIL RESERVIOR RM	GTRN	SCREEN OUT
F137-A02C	ELECTRICAL EQUIPMENT ROOM	GTRN	SCREEN OUT
F137-A03C	CEDM M/G SET RM	GTRN	SCREEN OUT
F078-A01D	PNS SWGR RM	GTRN	SCREEN OUT
FB-B01	AUX. BOILER BUILDING	GTRN	SCREEN OUT
F050-A01C	CS PUMP & MINI FLOW HX RM	PLOCCW	SCREEN OUT
F050-A02C	SI PUMP RM	PLOCCW	SCREEN OUT

Table 19.1-45 (6 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F078-A20B	MOTOR DRIVEN AUX. FEEDWATER PUMP RM	GTRN	SCREEN OUT
F137-A20A	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F120-A08C	480V N1E MCC RM	GTRN	SCREEN OUT
F174-P01	ELEV. MACHINE RM	GTRN	SCREEN OUT
F078-AAFD	TURBINE DRIVEN AUX FEEDWATER PUMP ROOM	GTRN	SCREEN OUT
F100-A10B	GENERAL ACCESS AREA	LODCB	SCREEN OUT
F078-A01C	PNS SWGR RM	GTRN	SCREEN OUT
F137-A10C	480V CLASS 1E MCC 03C RM	GTRN	SCREEN OUT
F137-A02D	ELECTRICAL EQUIP. RM	GTRN	SCREEN OUT
F137-A31C	MAIN STEAM VALVE RM	GTRN	SCREEN OUT
F137-A31D	MAIN STEAM VALVE RM	GTRN	SCREEN OUT
F078-A02C	CLASS 1E SWITCHGEAR 01C RM	PLOCCW	SCREEN OUT
F100-A10A	GENERAL ACCESS AREA	LODCA	SCREEN OUT
F000-ACVL	CVCS ACCESS AREA	GTRN	SCREEN OUT
F078-A12D	ESSENTIAL WATER CHILLER RM	GTRN	SCREEN OUT
F055-AGAA	GENERAL ACCESS AREA-55' A	LODCA	SCREEN OUT
F187-T01	ELEV. MACHINE RM	GTRN	SCREEN OUT
F078-A12C	ESSENTIAL WATER CHILLER RM	GTRN	SCREEN OUT
F100-A05C	ELECTRICAL EQUIPMENT RM	GTRN	SCREEN OUT
F055-A02A	CCW PUMP RM	LODCA	SCREEN OUT
F137-A15A	480V CLASS 1E MCC 04A RM	GTRN	SCREEN OUT
F055-A02B	CCW PUMP RM	LODCB	SCREEN OUT
FW-W02	CW COOLING TOWER STRUCTURE AREA 2	GTRN	SCREEN OUT
F157-A20D	I&C EQUIPMENT RM	GTRN	SCREEN OUT
FJ-J00	COLD MACHINE SHOP	GTRN	SCREEN OUT
F000-ACV	CVCS ACCESS AREA	GTRN	SCREEN OUT
F100-A04C	CABLE ACCESS AREA	LODCA	SCREEN OUT

Table 19.1-45 (7 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F170-A01A	ELEV. MACHINE RM	GTRN	SCREEN OUT
F215-A02B	ELEV. MACHINE RM	GTRN	SCREEN OUT
F216-A01C	ELEV. MACHINE RM	GTRN	SCREEN OUT
F216-A01D	ELEV. MACHINE RM	GTRN	SCREEN OUT
F172-A05C	480V N1E MCC RM	GTRN	SCREEN OUT
F055-A14D	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
FK-K05	ESW ULTIMATE HEAT SINK AREA	GTRN	SCREEN OUT
F072-T02	LUBE OIL STORAGE	GTRN	SCREEN OUT
F073-T06	CAUSTIC/ACID DAY TANK & PUMP RM	GTRN	SCREEN OUT
F055-A14C	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
F078-ANEC	480V N1E MCC RM	GTRN	SCREEN OUT
F172-A05D	ELECTRICAL EQUIP. RM	GTRN	SCREEN OUT
F100-A04D	CABLE ACCESS AREA	LODCB	SCREEN OUT
FQ-Q01	CHLORINATION BUILDING	GTRN	SCREEN OUT
F172-A13D	480V N1E MCC RM	GTRN	SCREEN OUT
F137-A15B	480V CLASS 1E MCC 04B RM	GTRN	SCREEN OUT
F057-P01	ACCESS AREA	GTRN	SCREEN OUT
F137-A14B	480V N1E MCC RM	GTRN	SCREEN OUT
F100-A37B	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F120-A08D	480V N1E MCC RM	GTRN	SCREEN OUT
F172-A13C	480V N1E MCC RM	GTRN	SCREEN OUT
F055-A02C	CCW PUMP RM	PLOCCW	SCREEN OUT
F100-H03	ELECTICAL EQUIP. RM	GTRN	SCREEN OUT
F055-AGAB	GENERAL ACCESS AREA-55' B	LODCB	SCREEN OUT
F072-T01	CHEMICAL HANDLING RM	GTRN	SCREEN OUT
F157-A16D	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F157-A20C	I&C EQUIPMENT RM	GTRN	SCREEN OUT
F157-A16C	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F050-A04A	SC PUMP & MINI FLOW HX RM	PLOCCW	SCREEN OUT

Table 19.1-45 (8 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F078-A20A	MOTOR DRIVEN AUX. FEEDWATER PUMP RM	GTRN	SCREEN OUT
F050-A03B	SI PUMP RM	GTRN	SCREEN OUT
F137-A24B	480V N1E MCC RM	GTRN	SCREEN OUT
F120-P01	ACCESS AREA	GTRN	SCREEN OUT
F100-P09	ACCESS AREA	GTRN	SCREEN OUT
F072-T03	MAIN TURBINE LUBE OIL CONDITIONER RM	GTRN	SCREEN OUT
F100-A13A	MECHANICAL PENETRATION RM	GTRN	SCREEN OUT
F067-T01	ELEV. HOISTWAY	GTRN	SCREEN OUT
F078-A51B	BORIC ACID MAKEUP PUMP RM	GTRN	SCREEN OUT
FB-B02	AUX. BOILER FUEL OIL STORAGE TANK	GTRN	SCREEN OUT
FZ-Z01	LUBE OIL STORAGE TANK & CENTRIFUGE HOUSE	GTRN	SCREEN OUT
F157-A23D	AEB RM	GTRN	SCREEN OUT
F172-A24C	CONTROL RM AREA SUPPLY AHU/ACU RM	GTRN	SCREEN OUT
F172-A24D	CONTROL RM AREA SUPPLY AHU/ACU RM	GTRN	SCREEN OUT
F157-A21D	INSTRUMENT MAINTENANCE SHOP	GTRN	SCREEN OUT
F156-A14A	AUX. BLDG CONTROLLED AREA (I) NORMAL/EMERGENCY EXHAUST ACU RM	GTRN	SCREEN OUT
F100-P48	ACCESS AREA	GTRN	SCREEN OUT
F073-T01	STAIR	GTRN	SCREEN OUT
F172-A15B	CONTAINMENT HIGH/LOW VOLUME PURGE ACU RM	GTRN	SCREEN OUT
F063-H03B	DIESEL FUEL OIL STORAGE TANK ROOM	GTRN	SCREEN OUT
F063-H03A	DIESEL FUEL OIL STORAGE TANK ROOM	GTRN	SCREEN OUT
FS-S02	SWITCHYARD AREA	GTRN	SCREEN OUT

Table 19.1-45 (9 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F137-A35C	REACTOR TRIP SWITCHGEAR RM	GTRN	SCREEN OUT
F050-A03A	SI PUMP RM	GTRN	SCREEN OUT
F120-A16A	MECHANICAL PENETRATION RM	GTRN	SCREEN OUT
F100-T17	BATTERY RM	GTRN	SCREEN OUT
F100-A20A	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F063-P13	ACCESS AREA	GTRN	SCREEN OUT
F055-A04C	SEISMIC CAT-1 FIRE WATER TANK RM	GTRN	SCREEN OUT
F055-A04D	SEISMIC CAT-1 FIRE WATER TANK RM	GTRN	SCREEN OUT
F135-H03A	EDG RM NORMAL SUPPLY AHU RM	GTRN	SCREEN OUT
F135-H03B	EDG RM NORMAL SUPPLY AHU RM	GTRN	SCREEN OUT
F100-P58	ACCESS AREA	GTRN	SCREEN OUT
F055-A55B	CHARGING PUMP RM	GTRN	SCREEN OUT
F073-T07	STAIR	GTRN	SCREEN OUT
F073-T08	STAIR	GTRN	SCREEN OUT
F073-T10	STAIR	GTRN	SCREEN OUT
F120-A06D	PIPE CHASE	GTRN	SCREEN OUT
F055-A42A	CHARGING PUMP RM	GTRN	SCREEN OUT
F055-A54B	AUX. CHARGING PUMP RM	GTRN	SCREEN OUT
F172-A16B	CONTAINMENT HIGH VOLUME PURGE AHU RM	GTRN	SCREEN OUT
F079-P01	ACCESS AREA	GTRN	SCREEN OUT
F120-P10	ACCESS AREA	GTRN	SCREEN OUT
F195-A05C	480V N1E LOADCENTER RM	GTRN	SCREEN OUT
F100-A24A	SFP COOLING HX RM	GTRN	SCREEN OUT
F100-A32B	SFP COOLING HX RM	GTRN	SCREEN OUT
F172-A14C	EDG RM NORMAL SUPPLY AHU RM	GTRN	SCREEN OUT
F174-P02	ACCESS AREA	GTRN	SCREEN OUT

Table 19.1-45 (10 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
FZ-Z02	TANK AREA	GTRN	SCREEN OUT
FZ-Z03	CHEMICAL STORAGE TANK AREA	GTRN	SCREEN OUT
FZ-Z04	CONDENSATE STORAGE TANK	GTRN	SCREEN OUT
FZ-Z05	REACTOR MAKE-UP WATER TANK	GTRN	SCREEN OUT
FZ-Z06	HOLD-UP TANK	GTRN	SCREEN OUT
FZ-Z07	BORIC ACID STORAGE TANK	GTRN	SCREEN OUT
FZ-Z08	N2 & H2 GAS STORAGE AREA	GTRN	SCREEN OUT
FZ-Z09	FRESH WATER STORAGE TANK	GTRN	SCREEN OUT
FZ-Z10	DEMI. WATER STORAGE TANK	GTRN	SCREEN OUT
FZ-Z12	RAW WATER SOURCE INTAKE STRUCTURE	GTRN	SCREEN OUT
F172-A14D	EDG RM NORMAL SUPPLY AHU RM	GTRN	SCREEN OUT
F195-A08B	AUX. BLDG CONTROLLED AREA (II) NORMAL/EMERGENCY EXHAUST ACU ROOM	GTRN	SCREEN OUT
F137-A41A	REMOTE CONTROL CONSOLE ROOM	GTRN	SCREEN OUT
F172-AGAD	GENERAL ACCESS AREA-172' D	GTRN	SCREEN OUT
F120-A35B	BATTERY RM	GTRN	SCREEN OUT
F100-A13B	MECHANICAL PENETRATION RM	GTRN	SCREEN OUT
F065-A01C	DIESEL FUEL OIL STORAGE TANK RM	GTRN	SCREEN OUT
F065-A01D	DIESEL FUEL OIL STORAGE TANK RM	GTRN	SCREEN OUT
F055-A21B	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
F172-AGAC	GENERAL ACCESS AREA-172' C	GTRN	SCREEN OUT
F195-A05D	480V N1E LOADCENTER RM	GTRN	SCREEN OUT
F137-A37C	REACTOR TRIP SWITCHGEAR RM	GTRN	SCREEN OUT
F137-A36C	REACTOR TRIP SWITCHGEAR RM	GTRN	SCREEN OUT
F137-A38C	REACTOR TRIP SWITCHGEAR RM	GTRN	SCREEN OUT
F063-P01	ACCESS AREA	GTRN	SCREEN OUT
F120-A24A	FUEL HANDLING AREA EMER. EXHAUST ACU RM	GTRN	SCREEN OUT

Table 19.1-45 (11 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F137-A09C	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F137-A04C	CEDM POWER CONTROL CABINET RM	GTRN	SCREEN OUT
F100-A11A	CHANNEL-A BATTERY RM	GTRN	SCREEN OUT
F120-A21A	FUEL HANDLING AREA EMER. EXHAUST ACU ROOM	GTRN	SCREEN OUT
F055-A21A	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
F156-AGAB	SST ROOM	GTRN	SCREEN OUT
F120-A03D	DIESEL FUEL OIL DAY TANK RM	GTRN	SCREEN OUT
FZ-Z11	GUARD HOUSE	GTRN	SCREEN OUT
F100-P14	ACCESS AREA	GTRN	SCREEN OUT
F120-A31B	GENERAL ACCESS AREA-120' B	GTRN	SCREEN OUT
F172-A01C	EDG RM NORMAL EXHAUST FAN RM	GTRN	SCREEN OUT
F172-A01D	EDG RM NORMAL EXHAUST FAN RM	GTRN	SCREEN OUT
F100-A11B	CHANNEL-B BATTERY RM	GTRN	SCREEN OUT
F172-A23C	AUX. BLDG. CLEAN AREA SUPPLY AHU RM	GTRN	SCREEN OUT
F172-A23D	AUX. BLDG. CLEAN AREA SUPPLY AHU RM	GTRN	SCREEN OUT
F175-A01D	MSIV RM SUPPLY AHU RM	GTRN	SCREEN OUT
F100-A14A	PERSONNEL AIR LOCK ENTRANCE	GTRN	SCREEN OUT
F085-P12	ACCESS AREA	GTRN	SCREEN OUT
F063-P56	ACCESS AREA	GTRN	SCREEN OUT
F085-P18	ACCESS AREA	GTRN	SCREEN OUT
F085-P26	ACCESS AREA	GTRN	SCREEN OUT
F100-P12	ACCESS AREA	GTRN	SCREEN OUT
F100-P13	ACCESS AREA	GTRN	SCREEN OUT
F100-P17	ACCESS AREA	GTRN	SCREEN OUT
F100-P18	ACCESS AREA	GTRN	SCREEN OUT
F100-P19	ACCESS AREA	GTRN	SCREEN OUT
F100-P29	ACCESS AREA	GTRN	SCREEN OUT

Table 19.1-45 (12 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F100-P40	VESTIBULE	GTRN	SCREEN OUT
F100-P59	ACCESS AREA	GTRN	SCREEN OUT
F078-A06D	N1E BATTERY RM	GTRN	SCREEN OUT
F120-A03C	DIESEL FUEL OIL DAY TANK RM	GTRN	SCREEN OUT
F078-A21A	PIPE CHASE	GTRN	SCREEN OUT
F078-A21B	PIPE CHASE	GTRN	SCREEN OUT
F078-A07C	CHANNEL-C BATTERY RM	GTRN	SCREEN OUT
F078-A06C	N1E BATTERY RM	GTRN	SCREEN OUT
F078-A07D	CHANNEL-D BATTERY RM	GTRN	SCREEN OUT
F078-A40B	BORIC ACID CONC. RM	GTRN	SCREEN OUT
F195-AGAC	GENERAL ACCESS AREA-190' C	GTRN	SCREEN OUT
F195-AGAD	GENERAL ACCESS AREA-190' D	GTRN	SCREEN OUT
F137-ASTD	STAIR	GTRN	SCREEN OUT
F137-A06D	REMOTE SHUTDOWN RM	GTRN	SCREEN OUT
F137-AGAB	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F121-H02B	DIESEL FUEL OIL DAY TANK RM	GTRN	SCREEN OUT
F055-A01C	CS HX RM	GTRN	SCREEN OUT
F100-A23A	AUX. BLDG. CONTROLLED AREA I SUPPLY AHU ROOM	GTRN	SCREEN OUT
F063-P66	ACCESS AREA	GTRN	SCREEN OUT
F063-P17	ACCESS AREA	GTRN	SCREEN OUT
F063-P18	ACCESS AREA	GTRN	SCREEN OUT
F063-P20	ACCESS AREA	GTRN	SCREEN OUT
F063-P50	ACCESS AREA	GTRN	SCREEN OUT
F063-P51	ACCESS AREA	GTRN	SCREEN OUT
F063-P76	ACCESS AREA	GTRN	SCREEN OUT
F063-P77	ACCESS AREA	GTRN	SCREEN OUT
F078-A53C	480V N1E LOADCENTER RM	GTRN	SCREEN OUT
F078-A53D	480V N1E LOADCENTER RM	GTRN	SCREEN OUT

Table 19.1-45 (13 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F120-A29B	AUX. BLDG CONTROLLED AREA (I) ECCS EQUIP. RM EXHAUST ACU RM	GTRN	SCREEN OUT
F121-H02A	DIESEL FUEL OIL DAY TANK RM	GTRN	SCREEN OUT
F100-A38A	FUEL HANDLING AREA NORMAL EXHAUST ACU RM	GTRN	SCREEN OUT
F120-A06C	PIPE CHASE	GTRN	SCREEN OUT
F055-A10C	TENDON GALLERY ENTRANCE AREA	GTRN	SCREEN OUT
F157-A13C	VESTIBULE	GTRN	SCREEN OUT
F157-A13D	VESTIBULE	GTRN	SCREEN OUT
F137-A30C	MAIN STEAM ENCLOSURE	GTRN	SCREEN OUT
F100-A07C	AUX. FEEDWATER(AFW) TANK	GTRN	SCREEN OUT
F100-A07D	AUX. FEEDWATER(AFW) TANK	GTRN	SCREEN OUT
F100-H04A	AIR INTAKE & EXHAUST SHAFT	GTRN	SCREEN OUT
F100-H04B	AIR INTAKE & EXHAUST SHAFT	GTRN	SCREEN OUT
F100-H05A	AIR INTAKE & EXHAUST SHAFT	GTRN	SCREEN OUT
F100-H05B	AIR INTAKE & EXHAUST SHAFT	GTRN	SCREEN OUT
F156-A10A	EQUIPMENT HATCH ACCESS RM	GTRN	SCREEN OUT
F156-A16A	SIS FILLING TANK RM	GTRN	SCREEN OUT
F157-A18C	CLEAN AGENT RM	GTRN	SCREEN OUT
F157-A22D	GUEST RM	GTRN	SCREEN OUT
F157-A27C	GENERAL ACCESS AREA	GTRN	SCREEN OUT
F157-A28D	BREATHING AIR RACK	GTRN	SCREEN OUT
F175-A01C	MSIV RM SUPPLY AHU RM	GTRN	SCREEN OUT
F195-A06C	HVAC VENT RM	GTRN	SCREEN OUT
F195-A06D	HVAC VENT RM	GTRN	SCREEN OUT
F120-A02C	LUBE OIL MAKE-UP TANK RM	GTRN	SCREEN OUT
F120-A02D	LUBE OIL MAKE-UP TANK RM	GTRN	SCREEN OUT
F121-H01A	LUBE OIL MAKEUP TANK RM	GTRN	SCREEN OUT
F121-H01B	LUBE OIL MAKEUP TANK RM	GTRN	SCREEN OUT

Table 19.1-45 (14 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F137-A32B	PIPE CHASE	GTRN	SCREEN OUT
F156-A04B	CONT. ENTERANCE AREA	GTRN	SCREEN OUT
F078-A23A	BUTTRESS OPNG	GTRN	SCREEN OUT
F137-A25A	AUX. BLDG. CONTROLLED AREA (I) ECCS EQUIPMENT RM EXHAUST ACU RM	GTRN	SCREEN OUT
F137-A44C	ELEV. HALL	GTRN	SCREEN OUT
F137-A44D	ELEV. HALL	GTRN	SCREEN OUT
F156-A13A	ELEV. HALL	GTRN	SCREEN OUT
F156-A13B	ELEV. HALL	GTRN	SCREEN OUT
F156-A15B	PIPE CHASE	GTRN	SCREEN OUT
F172-A17B	ELEV. HALL	GTRN	SCREEN OUT
F172-A18C	ELEV. HALL	GTRN	SCREEN OUT
F172-A18D	ELEV. HALL	GTRN	SCREEN OUT
F172-A22B	HVAC CHASE	GTRN	SCREEN OUT
F172-A25C	HVAC CHASE	GTRN	SCREEN OUT
F195-A07B	ELEV. HALL	GTRN	SCREEN OUT
F078-A23B	BUTTRESS OPNG	GTRN	SCREEN OUT
F068-A05A	HVAC CHASE	GTRN	SCREEN OUT
F055-A01D	CS HX RM	GTRN	SCREEN OUT
F078-A13D	DUCT RM	GTRN	SCREEN OUT
F137-A19A	SG BLOWDOWN FLASH TANK RM	GTRN	SCREEN OUT
F078-A14C	BUTTRESS OPNG	GTRN	SCREEN OUT
F100-A21A	NEW RESIN STORAGE RM	GTRN	SCREEN OUT
F100-A42C	D/G OIL STORAGE ACCESS	GTRN	SCREEN OUT
F100-A42D	D/G OIL STORAGE ACCESS	GTRN	SCREEN OUT
F100-A43C	D/G OIL STORAGE ENTRANCE	GTRN	SCREEN OUT
F100-A43D	D/G OIL STORAGE ENTRANCE	GTRN	SCREEN OUT
F100-A44D	VESTIBULE	GTRN	SCREEN OUT

Table 19.1-45 (15 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F100-H06A	VALVE RM	GTRN	SCREEN OUT
F100-H06B	VALVE RM	GTRN	SCREEN OUT
F135-H02A	AIR INTAKE FILTER RM	GTRN	SCREEN OUT
F135-H02B	AIR INTAKE FILTER RM	GTRN	SCREEN OUT
F055-A18A	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
F078-A09C	HVAC CHASE	GTRN	SCREEN OUT
F100-A16C	PIPE CHASE	GTRN	SCREEN OUT
F100-A16D	PIPE CHASE	GTRN	SCREEN OUT
F078-A55C	ELEV. HALL	GTRN	SCREEN OUT
F078-A55D	ELEV. HALL	GTRN	SCREEN OUT
F055-A18B	PIPE CHASE & VALVE RM	GTRN	SCREEN OUT
F063-H01	STAIR	GTRN	SCREEN OUT
F078-A09D	HVAC CHASE	GTRN	SCREEN OUT
F078-A16C	HVAC CHASE	GTRN	SCREEN OUT
F078-A16D	HVAC CHASE	GTRN	SCREEN OUT
F078-A54A	ELEV. HALL	GTRN	SCREEN OUT
F078-A54B	ELEV. HALL	GTRN	SCREEN OUT
F100-A45B	ELEV. HALL	GTRN	SCREEN OUT
F100-A46C	ELEV. HALL	GTRN	SCREEN OUT
F100-A46D	ELEV. HALL	GTRN	SCREEN OUT
F120-A13B	STAIR	GTRN	SCREEN OUT
F120-A17A	STAIR	GTRN	SCREEN OUT
F120-A25A	FUEL HANDLING AREA EMER. EXHAUST ACU ROOM	GTRN	SCREEN OUT
F120-A33A	ELEV. HALL	GTRN	SCREEN OUT
F120-A33B	ELEV. HALL	GTRN	SCREEN OUT
F120-A34C	ELEV. HALL	GTRN	SCREEN OUT
F120-A34D	ELEV. HALL	GTRN	SCREEN OUT
F137-A16A	ELEV. HALL	GTRN	SCREEN OUT
F137-A16B	ELEV. HALL	GTRN	SCREEN OUT

Table 19.1-45 (16 of 16)

Fire Compartment	Description	Fire Induced Initiator	Results of Quant. Screening
F049-A01C	ELEV. HOISTWAY	GTRN	SCREEN OUT
F055-A05C	STAIR	GTRN	SCREEN OUT
F049-A01D	ELEV. HOISTWAY	GTRN	SCREEN OUT
F055-A05D	STAIR	GTRN	SCREEN OUT
F049-A02A	ELEV. HOISTWAY	GTRN	SCREEN OUT
F049-A02B	ELEV. HOISTWAY	GTRN	SCREEN OUT
F055-A20A	STAIR	GTRN	SCREEN OUT
F055-A20B	STAIR	GTRN	SCREEN OUT
F055-A22A	PIPE CHASE	GTRN	SCREEN OUT
F055-A22B	PIPE CHASE	GTRN	SCREEN OUT
F055-A60A	ELEV. HALL	GTRN	SCREEN OUT
F055-A60B	ELEV. HALL	GTRN	SCREEN OUT
F055-A61C	ELEV. HALL	GTRN	SCREEN OUT
F055-A61D	ELEV. HALL	GTRN	SCREEN OUT
F100-A45A	ELEV. HALL	GTRN	SCREEN OUT
FY-Y00	CABLE BURIED UNDERGROUND AREA	LOOP	SCREEN OUT

Table 19.1-46

Fires Results in Each Identified Fire Induced Internal Event Initiators

Event	Description	FI-IEF[(2)] (/yr)	% Total IEF
GTRN	General Transient	1.19E-01	83.3%
LOCV	Loss of Condenser Vacuum	7.68E-03	5.4%
PLOCCW	Partial Loss of CCW	5.62E-03	3.9%
LODCB	Loss of DC Bus "B"	4.90E-03	3.4%
LOFW	Loss of Feedwater	2.03E-03	1.4%
LOOP	Loss of Offsite Power	1.87E-03	1.3%
LODCA	Loss of DC Bus "A"	1.35E-03	0.9%
MCR EVAC [(1)]	Alternate Shutdown (MCR Evacuation)	5.73E-06	0.0%

(1) MCR EVAC is not truly an initiator, and is based on an assumed “unknown” core damage event as a result of failure to safely shutdown following an MCR fire requiring evacuation.

(2) FI-IEF: Fire Induced - Internal Event Frequency

Table 19.1-47

Internal Fire PRA CDF Contribution by Top Fire Induced Initiators

Event	Description	CDF (/yr)	Contribution
MCR EVAC	Fire Induced Main Control Room Evacuation	6.03E-07	32.4%
LODCB	Fire Induced Loss of DC Bus B	4.80E-07	25.8%
GTRN	Fire Induced General Transient	2.96E-07	15.9%
LOOP	Fire Induced Loss of Offsite Power	2.44E-07	13.1%
PLOCCW	Fire Induced Partial Loss of CCW	1.27E-07	6.8%
LODCA	Fire Induced Loss of DC Bus A	4.86E-08	2.6%
LOCV	Fire Induced Loss of Condenser Vacuum	2.98E-08	1.6%
SLOCA	Fire Induced Small LOCA	1.95E-08	1.0%
LOFW	Fire Induced Loss of Feedwater	9.09E-09	0.5%

Table 19.1-48

Internal Fire PRA LRF Contribution by Fire Induced Initiators

Event	Description	LRF (/yr)	Contribution
MCR EVAC	Fire Induced Main Control Room Evacuation	6.03E-08	35.7%
LODCB	Fire Induced Loss of DC Bus B	5.19E-08	30.7%
GTRN	Fire Induced General Transient	1.60E-08	9.4%
LOOP	Fire Induced Loss of Offsite Power	2.76E-08	16.3%
PLOCCW	Fire Induced Partial Loss of CCW	6.21E-09	3.7%
LODCA	Fire Induced Loss of DC Bus A	4.35E-09	2.6%
LOCV	Fire Induced Loss of Condenser Vacuum	1.73E-09	1.0%
SLOCA	Fire Induced Small LOCA	7.53E-10	0.4%
LOFW	Fire Induced Loss of Feedwater	5.14E-10	0.3%

Table 19.1-49 (1 of 21)

Internal Fire PRA Top 100 CDF Cutsets

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.36E-07	#F157-AMCR-4-4 ASD-CDF	MCR TRANS FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	12.7	12.7
2	1.52E-07	#F157-AMCR-3-4 ASD-CDF	MCR SAFETY CONSOLE FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	8.2	20.9
3	7.56E-08	#F157-AMCR-2-4 ASD-CDF	MCR FIRE CONT PNL FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	4.1	24.9
4	7.56E-08	#F157-AMCR-1-4 ASD-CDF	MCR CCTV FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	4.1	29.0
5	3.43E-08	#F157-AMCR-6-4 ASD-CDF	MCR CABLE W/C FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	1.8	30.8
6	1.96E-08	#F078-AAFD_F078-AGAD F-WOOPH-S-CROSSTIE-A WOCHM4A-CH04A	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	1.1	31.9
7	1.37E-08	#F078-AAFD_F078-AGAD WOMPM5A-PP05A	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	0.7	32.6
8	1.32E-08	#F078-AAFD_F078-AGAD PFHBO2A-SW01C-C2	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD 4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	0.7	33.3

Table 19.1-49 (2 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
9	1.29E-08	#F078-AAFD_F078-AGAD F-WOOPH-S-CROSSTIE-A WOCHS4A-CH04A	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH ECW CHILLER CH04A FAILS TO START ON DEMAND	0.7	34.0
10	1.16E-08	#F137-A03C_F157-AMCR ASD-CDF-MCA	MULTI-COMPARTMENT FIRE FROM F137-A03C TO F157-AMCR ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF	0.6	34.7
11	8.69E-09	#F157-ACPX-U_F157-AMCR ASD-CDF-MCA	MULTI-COMPARTMENT FIRE FROM F157-ACPX TO F157-AMCR ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF	0.5	35.1
12	7.01E-09	#F078-AGAD_F078-AAFD F-WOOPH-S-CROSSTIE-A WOCHM4A-CH04A	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	0.4	35.5
13	4.88E-09	#F078-AGAD_F078-AAFD WOMPM5A-PP05A	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	0.3	35.8
14	4.71E-09	#F078-AGAD_F078-AAFD PFHBO2A-SW01C-C2	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD 4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	0.3	36.0
15	4.65E-09	#F078-A52D-U AFTPR1A-TDP01A AFTPR1B-TDP01B WOCHM4A-CH04A F-WOOPH-S-CROSSTIE-A	F078-A52D UNSUPPRESSED FIRES AFW PUMP 1A FAILS TO RUN AFW PUMP 1B FAIL TO RUN ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH	0.3	36.3

Table 19.1-49 (3 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	4.60E-09	#F078-AGAD_F078-AAFD F-WOOPH-S-CROSSTIE-A WOCHS4A-CH04A	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH ECW CHILLER CH04A FAILS TO START ON DEMAND	0.2	36.5
17	4.26E-09	#F137-A02D_F157-AMCR ASD-CDF-MCA	MULTI-COMPARTMENT FIRE FROM F137-A02D TO F157-AMCR ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF	0.2	36.7
18	3.39E-09	#F157-A25C_F157-A17C AFOPV-S-AFAS-FW RCOPH-S-SDSE-SL-MD	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A17C OPERATOR FAILS TO RECOVER AFAS FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY	0.2	36.9
19	3.39E-09	#F157-A25C_F157-A16C AFOPV-S-AFAS-FW RCOPH-S-SDSE-SL-MD	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A16C OPERATOR FAILS TO RECOVER AFAS FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY	0.2	37.1
20	3.24E-09	#F078-A52D-U AFTPR1A-TDP01A AFTPR1B-TDP01B WOMPM5A-PP05A	F078-A52D UNSUPPRESSED FIRES AFW PUMP 1A FAILS TO RUN AFW PUMP 1B FAIL TO RUN ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	0.2	37.3

Table 19.1-49 (4 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	3.16E-09	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.2	37.4
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PR	POSRV FAILS TO RECLOSE		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
22	3.05E-09	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.2	37.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
23	2.69E-09	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.1	37.8
		WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A		
24	2.38E-09	#F078-A19B-U	F078-A19B UNSUPPRESSED FIRES	0.1	37.9
		AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE		
		FLAG-L-FNB	FLAG FOR CONSIDERING THE FAILURE OF LONG TERM 2NDARY HEAT REMOVAL		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
		MSOPH-S-SGADV	OPERATOR FAILS TO OPEN ADVS		

Table 19.1-49 (5 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	2.20E-09	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	38.0
		PR	POSRV FAILS TO RECLOSE		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
26	2.07E-09	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	38.1
		PR	POSRV FAILS TO RECLOSE		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
27	1.88E-09	#F078-AGAC_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AGAC TO F078-AGAD	0.1	38.2
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
28	1.84E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	38.3
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
29	1.81E-09	#F137-A05D_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F137-A05D TO F157-AMCR	0.1	38.4
		ASD-CDF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF		
30	1.79E-09	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	38.5
		DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A		

Table 19.1-49 (6 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
31	1.77E-09	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	38.6
		FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
32	1.68E-09	#F100-AEEB-U	F100-AEEB UNSUPPRESSED FIRES	0.1	38.7
		AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
33	1.67E-09	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	38.8
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
34	1.66E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	38.9
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		

Table 19.1-49 (7 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
35	1.66E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	39.0
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
36	1.58E-09	#F157-A25C_F157-A17C	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A17C	0.1	39.0
37	1.58E-09	#F157-A25C_F157-A16C	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A16C	0.1	39.1
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
38	1.54E-09	#F137-ASTD_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F137-ASTD TO F157-AMCR	0.1	39.2
		ASD-CDF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF		
39	1.49E-09	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	39.3
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
40	1.48E-09	#F157-A25C-U	F157-A25C UNSUPPRESSED FIRES	0.1	39.4
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
		VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B		

Table 19.1-49 (8 of 21)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
41	1.40E-09	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	39.4
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
42	1.39E-09	#F157-A25C-U	F157-A25C UNSUPPRESSED FIRES	0.1	39.5
		AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M		
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
43	1.30E-09	#F100-T15-U	F100-T15 UNSUPPRESSED FIRES	0.1	39.6
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
44	1.29E-09	#FK-K01	ESW STRUCTURE "A" BUILDING FIRE	0.1	39.7
		CVOPH-S-RCPSEAL	OPERATOR FAILS TO RECOVER RCP SEAL COOLING		
		SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)		
		VGAHM2B-AH02B	ESW PUMP B FAN 605-VG-AH02B UNAVAILABLE DUE TO T&M		

Table 19.1-49 (9 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
45	1.28E-09	#F078-AGAC_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AGAC TO F078-AGAD	0.1	39.7
		PR	POSRV FAILS TO RECLOSE		
46	1.24E-09	#F100-AEEB-U	F100-AEEB UNSUPPRESSED FIRES	0.1	39.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
47	1.23E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	39.9
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
48	1.23E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	39.9
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
49	1.21E-09	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	40.0
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		PELXY-C-LX04C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04C		

Table 19.1-49 (10 of 21)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
50	1.18E-09	#F100-T15-U	F100-T15 UNSUPPRESSED FIRES	0.1	40.1
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
51	1.18E-09	#F100-T15-U	F100-T15 UNSUPPRESSED FIRES	0.1	40.1
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
52	1.16E-09	#F100-AEEB-U	F100-AEEB UNSUPPRESSED FIRES	0.1	40.2
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
53	1.14E-09	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	40.2
		FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		

Table 19.1-49 (11 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
54	1.14E-09	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.1	40.3
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
55	1.05E-09	#F000-ADGC_F120-A01C	MULTI-COMPARTMENT FIRE FROM F000-ADGC TO F120-A01C	0.1	40.4
		AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE		
		FLAG-L-FNB	FLAG FOR CONSIDERING THE FAILURE OF LONG TERM 2NDARY HEAT REMOVAL		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
56	1.04E-09	#F137-A11C-U	F137-A11C UNSUPPRESSED FIRES	0.1	40.4
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
57	1.03E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	40.5
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		

Table 19.1-49 (12 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	1.03E-09	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	40.5
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
59	1.03E-09	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.1	40.6
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
60	1.03E-09	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.1	40.6
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		

Table 19.1-49 (13 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	1.01E-09	#F078-A19B-U	F078-A19B UNSUPPRESSED FIRES	0.1	40.7
		AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE		
		FLAG-L-FNB	FLAG FOR CONSIDERING THE FAILURE OF LONG TERM 2NDARY HEAT REMOVAL		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
62	9.63E-10	#F120-A15B-U	F120-A15B UNSUPPRESSED FIRES	0.1	40.7
		AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
63	9.63E-10	#F078-AGAD_F078-AAFD	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD	0.1	40.8
		WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A		
64	9.61E-10	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	40.8
		DADGR-S-AACTG	AAC T/G FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
65	9.58E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	40.9
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		#F120-A15B-U	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		

Table 19.1-49 (14 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
66	9.58E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	41.0
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
67	9.53E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.1	41.0
		CCMVO-A-392	CCW MOV 392 FOR ECW CHILLER CH04A OUTLET FAIL TO OPEN		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
68	9.52E-10	#F157-A25C-U	F157-A25C UNSUPPRESSED FIRES	0.1	41.1
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
		VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M		
69	9.41E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	41.1
		AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
70	9.37E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	41.2
		AFTPKD2-TDP01A/B	2/2 CCF OF RUNNING AFW TDP PP01/A/B		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-49 (15 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	9.29E-10	#F157-A17C_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F157-A17C TO F157-AMCR	0.0	41.2
		ASD-CDF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF		
72	9.10E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.0	41.3
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PFGRID	GRID COLLAPSE ON TURBINE TRIP		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
73	8.98E-10	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.0	41.3
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-A-FOR6-AFAS1A-GC1FR	FAILURE OF GC-1 CH. A FIBER OPTIC RECEIVER FOR LC		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
		FWOPH-S-ERY-CD	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE) WITH COMPLETE DEPENDENCY		

Table 19.1-49 (16 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
74	8.98E-10	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.0	41.4
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-A-FOR6-AFAS1A-GC1FT	FAILURE OF GC-1 CH. A FIBER OPTIC TRANSMITTER FOR LC		
		RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY		
		FWOPH-S-ERY-CD	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE) WITH COMPLETE DEPENDENCY		
75	8.89E-10	#F000-C01-156-1	CTMT TRANSIENT FIRES EL 156'-0" AREA 1	0.0	41.4
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
76	8.69E-10	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.0	41.4
		DADGR-S-AACTG	AAC T/G FAILS TO RUN		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
77	8.69E-10	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.0	41.5
		DADGR-S- AACTG	AAC T/G FAILS TO RUN		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		

Table 19.1-49 (17 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
78	8.68E-10	#F100-T15-U	F100-T15 UNSUPPRESSED FIRES	0.0	41.5
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
79	8.68E-10	#F100-T15-U	F100-T15 UNSUPPRESSED FIRES	0.0	41.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
80	8.64E-10	#F000-ACVU-U	F000-ACVU UNSUPPRESSED FIRES	0.0	41.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B		
81	8.37E-10	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	41.7
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
82	8.27E-10	#F055-AGAC-U	F055-AGAC UNSUPPRESSED FIRES	0.0	41.7
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B		

Table 19.1-49 (18 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
83	8.22E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.0	41.8
		AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
84	8.22E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.0	41.8
		AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B		
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
85	8.17E-10	#F000-TB-LOCV2	TB FIRES LEADING TO LOCV WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	41.9
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		PFGRID	GRID COLLAPSE ON TURBINE TRIP		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
86	8.12E-10	#F000-ACVU-U	F000-ACVU UNSUPPRESSED FIRES	0.0	41.9
		AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M		
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
87	8.10E-10	#F000-C01-114-1	CTMT TRANSIENT FIRES EL 114'-0" AREA 1	0.0	41.9
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		

Table 19.1-49 (19 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
88	8.10E-10	#F000-C01-136-1	CTMT TRANSIENT FIRES EL 136'-6" AREA 1	0.0	42.0
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
89	8.10E-10	#F000-C01-100-1	CTMT TRANSIENT FIRES EL 100'-0" AREA 1	0.0	42.0
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
90	7.96E-10	#F100-AEEB-U	F100-AEEB UNSUPPRESSED FIRES	0.0	42.1
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
91	7.78E-10	#F055-AGAC-U	F055-AGAC UNSUPPRESSED FIRES	0.0	42.1
		AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
92	7.57E-10	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	42.2
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
93	7.57E-10	#F000-TB-LOOP2	TB FIRES LEADING TO LOOP WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	42.2
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		

Table 19.1-49 (20 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	7.55E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.0	42.2
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-A-FOR6-AFAS1A-GC1FT	FAILURE OF GC-1 CH. A FIBER OPTIC TRANSMITTER FOR LC		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
95	7.55E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.0	42.3
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-A-FOR6-AFAS1A-GC1FR	FAILURE OF GC-1 CH. A FIBER OPTIC RECEIVER FOR LC		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
96	7.50E-10	#F157-A25C-U	F157-A25C UNSUPPRESSED FIRES	0.0	42.3
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-B-FOR6-AFAS2B-GC1FT	FAILURE OF GC-1 CH. B FIBER OPTIC TRANSMITTER FOR LC		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		

Table 19.1-49 (21 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
97	7.50E-10	#F157-A25C-U	F157-A25C UNSUPPRESSED FIRES	0.0	42.4
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		EFORT-B-FOR6-AFAS2B-GC1FR	FAILURE OF GC-1 CH. B FIBER OPTIC RECEIVER FOR LC		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
98	7.38E-10	#F000-TB-LOCV2	TB FIRES LEADING TO LOCV WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	42.4
		PFGRID	GRID COLLAPSE ON TURBINE TRIP		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
99	7.38E-10	#F000-TB-LOCV2	TB FIRES LEADING TO LOCV WITH ALL OTHER CREDITED EQ. IN TB DAMAGED	0.0	42.4
		PFGRID	GRID COLLAPSE ON TURBINE TRIP		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
100	7.29E-10	#F000-C01-156-1	CTMT TRANSIENT FIRES EL 156'-0" AREA 1	0.0	42.5
		SISPP-S-CHEMICAL	DEBRIS INDUCED LOSS OF LONG TERM COOLING (DOWNSTREAM/CHEMICAL EFFECT)		

Table 19.1-50 (1 of 29)

Internal Fire PRA Top 100 LRF Cutsets

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.36E-08	#F157-AMCR-4-4 ASD-LRF	MCR TRANS FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	14.0	14.0
2	1.52E-08	#F157-AMCR-3-4 ASD-LRF	MCR SAFETY CONSOLE FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	9.0	23.0
3	7.56E-09	#F157-AMCR-1-4 ASD-LRF	MCR CCTV FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	4.5	27.4
4	7.56E-09	#F157-AMCR-2-4 ASD-LRF	MCR FIRE CONT PNL FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	4.5	31.9
5	3.43E-09	#F157-AMCR-6-4 ASD-LRF	MCR CABLE W/C FIRE, SUPP. FAILS, ASD ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	2.0	33.9
6	1.16E-09	#F137-A03C_F157-AMCR ASD-LRF-MCA	MULTI-COMPARTMENT FIRE FROM F137-A03C TO F157-AMCR ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF	0.7	34.6
7	1.06E-09	#F078-AAFD_F078-AGAD ERVC F-WOOPH-S-CROSSTIE-A PDS_14 WOCHM4A-CH04A	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD EXTERNAL REACTOR VESSEL COOLING FAILS OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14 ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	0.6	35.2

Table 19.1-50 (2 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	1.01E-09	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.6	35.8
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		RPPTM-A-PT102A	LO PZR PR. CH.A IS IN BYPASS (T&M)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
9	1.01E-09	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.6	36.4
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		RPPTM-C-PT102C	LO PZR PR. CH.C IS IN BYPASS (T&M)		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
10	8.69E-10	#F157-ACPX_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F157-ACPX TO F157-AMCR	0.5	37.0
		ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF		

Table 19.1-50 (3 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
11	7.40E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.4	37.4
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
12	7.14E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.4	37.8
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
13	6.97E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.4	38.2
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
14	6.87E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.4	38.6
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		

Table 19.1-50 (4 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	6.54E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.4	39.0
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
16	6.54E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.4	39.4
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
17	6.46E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.4	39.8
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		

Table 19.1-50 (5 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
18	4.41E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.3	40.1
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
19	4.36E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.3	40.4
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
20	4.30E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.3	40.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-50 (6 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	4.30E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.3	40.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
22	4.26E-10	#F137-A02D_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F137-A02D TO F157-AMCR	0.3	41.1
		ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF		
23	3.80E-10	#F078-AGAD_F078-AAFD	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD	0.3	40.6
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
24	2.98E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.3	40.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		#F078-AGAD_F078-AAFD	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD		

Table 19.1-50 (7 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	2.65E-10	ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS	0.3	41.1
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
26	2.64E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.2	41.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
27	2.64E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.2	41.9
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
28	2.63E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.2	42.1
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		

Table 19.1-50 (8 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	2.63E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.2	42.3
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
30	2.56E-10	#F078-AGAD_F078-AAFD	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD	0.2	42.4
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
31	2.55E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.2	42.6
		CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING		
		CCOPH-S-HX-ALIGN	OPERATOR FAILS TO OPEN CCW HX3A/B ISOL. V1145 /6 /ESW SUPPLYING V1027/8, 3014/5		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
32	2.55E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.2	42.7
		CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING		
		CCOPH-S-HX-ALIGN	OPERATOR FAILS TO OPEN CCW HX3A/B ISOL. V1145 /6 /ESW SUPPLYING V1027/8, 3014/5		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		

Table 19.1-50 (9 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	2.52E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	42.9
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
34	2.50E-10	#F078-AGAD_F078-AAFD	MULTI-COMPARTMENT FIRE FROM F078-AGAD TO F078-AAFD	0.1	43.0
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
35	2.37E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	43.1
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		RPIAT-C-PY102C	LO PZR PR. CONVERTER CH.C PT-102C FAILS TO PROVIDE PROPER OUTPUT		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		

Table 19.1-50 (10 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	2.37E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	43.3
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		RPIAT-A-PY102A	LO PZR PR. CONVERTER CH.A PT-102A FAILS TO PROVIDE PROPER OUTPUT		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
37	2.28E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	43.4
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
38	2.28E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	43.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		

Table 19.1-50 (11 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	2.20E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	43.7
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
40	2.15E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	43.8
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
41	2.15E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	43.9
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
42	2.02E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	44.1
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)		

Table 19.1-50 (12 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
43	2.02E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	44.2
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)		
44	1.85E-10	#F157-A25C_F157-A17C	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A17C	0.1	44.3
		AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_100	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-100		
		RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY		
45	1.81E-10	#F137-A05D_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F137-A05D TO F157-AMCR	0.1	44.4
		ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF		
46	1.76E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	44.5
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		

Table 19.1-50 (13 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	1.76E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	44.6
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
48	1.73E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	44.7
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
49	1.73E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	44.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-50 (14 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	1.69E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	44.9
		AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
51	1.66E-10	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	45.0
		DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
52	1.66E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	45.1
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		

Table 19.1-50 (15 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	1.56E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	45.2
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
54	1.54E-10	#F157-A25C_F157-A17C	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A17C	0.1	45.3
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_27	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-27		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
55	1.54E-10	#F137-ASTD_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F137-ASTD TO F157-AMCR	0.1	45.4
		ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF		
56	1.52E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	45.5
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PR	POSRV FAILS TO RECLOSE		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-50 (16 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	1.46E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.1	45.6
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A		
58	1.38E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	45.6
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
59	1.38E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	45.7
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
60	1.34E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	45.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-50 (17 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	1.33E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	45.9
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
		WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS		
62	1.33E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	46.0
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		WOCHR3A-CH03A	ECW CHILLER CH03A FAILS TO RUN FOR 24 HOURS		
63	1.29E-10	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	46.0
		CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		

Table 19.1-50 (18 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
64	1.28E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	46.1
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		VKHVS2A-HV14A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14A		
65	1.21E-10	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.1	46.2
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
66	1.20E-10	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	46.3
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-50 (19 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
67	1.19E-10	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.1	46.3
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
		PDS_17	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-17		
68	1.16E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	46.4
		AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
69	1.16E-10	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	69	1.16E-10
		AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-50 (20 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
70	1.13E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	70	1.13E-10
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE		
		PDS_17	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-17		
		RPPTM-A-PT102A	LO PZR PR. CH.A IS IN BYPASS (T&M)		
71	1.13E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	46.6
		CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)		
		EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE		
		PDS_17	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-17		
		RPPTM-C-PT102C	LO PZR PR. CH.C IS IN BYPASS (T&M)		
72	1.12E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	46.7
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-50 (21 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	1.12E-10	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	46.7
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		
74	1.09E-10	#F078-AGAC_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AGAC TO F078-AGAD	0.1	46.8
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
75	1.06E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	46.9
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
		PR	POSRV FAILS TO RECLOSE		

Table 19.1-50 (22 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
76	1.00E-10	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	46.9
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		PDS_94	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-94		
77	1.00E-10	#F078-A52D-U	F078-A52D UNSUPPRESSED FIRES	0.1	47.0
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		F-WOOPH-S-CROSSTIE-A	OPERATOR FAILS TO OPEN 1025A AND ALIGN FLOW PATH		
		PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS		
		PR	POSRV FAILS TO RECLOSE		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
78	9.97E-11	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	47.0
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		

Table 19.1-50 (23 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	9.84E-11	#F078-A19B-U	F078-A19B UNSUPPRESSED FIRES	0.1	47.1
		AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE		
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		FLAG-L-FNB	FLAG FOR CONSIDERING THE FAILURE OF LONG TERM 2NDARY HEAT REMOVAL		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
		PDS_9	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-9		
80	9.49E-11	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	47.1
		AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
81	9.49E-11	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	47.2
		AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-50 (24 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	9.29E-11	#F157-A17C_F157-AMCR	MULTI-COMPARTMENT FIRE FROM F157-A17C TO F157-AMCR	0.1	47.3
		ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF		
83	9.20E-11	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	47.3
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		
84	9.20E-11	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	47.4
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		

Table 19.1-50 (25 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	9.08E-11	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	47.4
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_94	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-94		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
86	9.08E-11	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	47.5
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_94	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-94		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
87	9.01E-11	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	47.5
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START		

Table 19.1-50 (26 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
88	9.01E-11	#F122-T01-U	F122-T01 UNSUPPRESSED FIRES	0.1	47.6
		DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE		
		WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B		
89	8.91E-11	#F157-A20D_F157-A21D	MULTI-COMPARTMENT FIRE FROM F157-A20D TO F157-A21D	0.1	47.6
		CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
90	8.91E-11	#F157-A20D_F157-A16D	MULTI-COMPARTMENT FIRE FROM F157-A20D TO F157-A16D	0.1	47.7
		CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		

Table 19.1-50 (27 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
91	8.88E-11	#F120-A11B-U	F120-A11B UNSUPPRESSED FIRES	0.1	47.7
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
92	8.87E-11	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	47.8
		DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
93	8.72E-11	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	47.8
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHR3A-CH03A	ECW CHILLER CH03A FAILS TO RUN FOR 24 HOURS		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
94	8.72E-11	#F157-A01D-U	F157-A01D UNSUPPRESSED FIRES	0.1	47.9
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-50 (28 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	8.60E-11	#F157-A25C_F157-A17C	MULTI-COMPARTMENT FIRE FROM F157-A25C TO F157-A17C	0.1	47.9
		AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_100	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-100		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
96	8.52E-11	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	48.0
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PELXY-C-LX04C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04C		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
97	8.52E-11	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.1	48.0
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
98	8.29E-11	#F078-AAFD_F078-AGAD	MULTI-COMPARTMENT FIRE FROM F078-AAFD TO F078-AGAD	0.0	48.1
		ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS		
		H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE		
		PDS_17	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-17		
		WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE		

Table 19.1-50 (29 of 29)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	8.28E-11	#F078-A05D-U	F078-A05D UNSUPPRESSED FIRES	0.0	48.1
		CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH		
		H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)		
		PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86		
		VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M		
		RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)		
100	8.24E-11	#F078-AEEB-U	F078-AEEB UNSUPPRESSED FIRES	0.0	48.2
		AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		SXAHS-A-AH02A	ESW COOLING TOWER FAN AH02A FAILS TO START		

Table 19.1-51 (1 of 8)

Internal Fire PRA Key Basic Events by RAW (CDF)

Basic Event	Description	RAW
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	317
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	302
SISPP-S-CHEMICAL	DEBRIS INDUCED LOSS OF LONG TERM COOLING (DOWNSTREAM/CHEMICAL EFFECT)	301
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	66
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	66
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	66
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	66
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	66
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	52
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	46
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	46
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	46
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	46
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	46
CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING	37
CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING	37
AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623	30
PELXY-C-LX04C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04C	29
AXCVO-A-V1628	FAILS TO OPEN CT SYSTEM CHECK VALVE V1628	27
CCHEY01B-HE01B	CCW HX HE01B FAILS WHILE OPERATING	27

Table 19.1-51 (2 of 8)

Basic Event	Description	RAW
CCHEY02B-HE02B	CCW HX HE02B FAILS WHILE OPERATING	27
PR	POSRV FAILS TO RECLOSE	26
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	24
PFGRID	GRID COLLAPSE ON TURBINE TRIP	17
SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)	15
IPINM-C-IN01C	INVERTER IN01C UNAVAIL. DUE TO T&M	8
SIVVT1B-V959	SI PUMP PP02B/D MINI FLOW LINE MANUAL VALVE 959 TRANSFER CLOSED	8
DCBTM-C-BT01C	POWER UNAVAILABLE OF BT01C (125VDC) DUE TO MAINTENANCE	7
SIMVT-B-303	SI PUMP PP02B/D MINI FLOW LINE MOV 303 FAILS TO REMAIN OPEN	7
SICVO-B-V101	CV 101 IN TRAIN B IRWST RETURN LINE FAILS TO OPEN	7
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	7
SIMVT-A-302	SI PUMP PP02A/C MINI FLOW LINE MOV 302 FAILS TO REMAIN OPEN	5
SIMVT-A-395	SI PUMP PP02A/C MINI FLOW LINE MOV 395 FAILS TO REMAIN OPEN	5
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	5
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	5
WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	5
ASD-CDF	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	5
WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A	5
DCBTM-D-BT01D	POWER UNAVAILABLE OF BT01C (125VDC) DUE TO MAINTENANCE	5
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	5
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	5

Table 19.1-51 (3 of 8)

Basic Event	Description	RAW
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	5
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	5
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	5
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	5
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	5
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	5
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	5
WOVVT5A-V1071A	ECW PP05A DISCH. LINE VV 1071A TRANSFER CLOSED	5
WOVVT5A-V1068A	ECW PP05A SUCTION LINE VV 1068A TRANSFER CLOSED	5
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	5
WOMPR5A-PP05A	FAILS TO RUN OF ECW PUMP 05A	5
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	5
SICVO-A-V100	CV100 IN TRAIN A IRWST RETURN LINE FAILS TO OPEN	4
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	4
PEDOY-C-LX04C01	FAILURE OF DIGITAL OUTPUT MODULE LX04C BRANCH 01	4
PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C	4
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	4
PEAIY-C-LX04C02	FAILURE OF ANALOG INPUT MODULE LX04C BRANCH 02	4
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	4
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	4
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	4

Table 19.1-51 (4 of 8)

Basic Event	Description	RAW
PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C	4
SXFLP1A-FT01A	ESW DEBRIS FILTERS PLUGGED	4
SXFLP2A-FT02A	ESW DEBIS FILTER FT02A PLUGGED	4
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	4
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	4
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	4
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	4
IPINM-A-IN01A	INVERTER IN01A UNAVAIL. DUE TO T&M	4
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	4
WOCVO5A-V1055A	ECW PP05A DISCH. LINE CV 1055A FAILS TO OPEN	4
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	4
WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS	4
DCBTM-A-BT01A	POWER UNAVAILABLE OF BT01A (125VDC) DUE TO MAINTENANCE	4
WOCHR3A-CH03A	ECW CHILLER CH03A FAILS TO RUN FOR 24 HOURS	4
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	4
IPINM-D-IN01D	INVERTER IN01D UNAVAILABLE DUE TO T&M	4
IPINM-B-IN01B	INVERTER IN01B UNAVAIL. DUE TO T&M	4
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1011A TRANSFER CLOSED	4
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	4
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	4
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	4

Table 19.1-51 (5 of 8)

Basic Event	Description	RAW
DCBTM-B-BT01B	POWER UNAVAILABLE OF BT01B (125V DC) DUE TO MAINTENANCE	3
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	3
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	3
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	3
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	3
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	3
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	3
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	3
ASD-CDF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF	3
PADIY-D-PA06C02	FAILURE OF DIGITAL INPUT MODULE PA06C BRANCH 02	3
PADIY-C-PA06C04	FAILURE OF DIGITAL INPUT MODULE 752-PA06C BRANCH 04	3
PEDOY-C-LX04C02	FAILURE OF DIGITAL OUTPUT MODULE LX04C BRANCH 02	3
WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	3
SXFLP1B-FT01B	ESW DEBIS FILTER FT01B PLUGGED	3
WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND	3
SXFLP2B-FT02B	ESW DEBIS FILTER FT02B PLUGGED	3
VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B	3
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	3
PELXY-D-LX02D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02D	3
VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M	3
PELXY-D-LX04D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04D	3

Table 19.1-51 (6 of 8)

Basic Event	Description	RAW
PEAIY-D-LX04D02	FAILURE OF ANALOG INPUT MODULE LX04D BRANCH 02	3
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	3
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	3
CSNZPA-PLUGNOZZ	CONTAINMENT SPRAY HEADER PIPE/NOZZLE PLUGGED (ECSBS)	3
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	3
CCMVO-A-392	CCW MOV 392 FOR ECW CHILLER CH04A OUTLET FAIL TO OPEN	3
WOCHR4A-CH04A	ECW CHILLER 04A FAILS TO RUN FOR 24 HOURS	3
WOCHR1B-CH01B	ECW CHILLER 01B FAILS TO RUN FOR 24 HOURS	3
AFMPS2B-MDP02B	FAILS TO START AFW MDP PP02B	3
WOCHR3B-CH03B	ECW CHILLER 03B FAILS TO RUN FOR 24 HOURS	3
ATAVO-C-009	FAILS TO OPEN AFW TDP PP01A TBN STM. ISOL AOV, 009	3
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	3
PELXY-C-LX03C-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	3
WOVVT4A-V1077A	ESSENTIAL CHILLER CH04A INLET VV 1077A TRANSFER CLOSED	3
WOVVT4A-V1078A	ESSENTIAL CHILLER CH04A OUTLET VV 1078A TRANSFER CLOSED	3
CCVVT-A-V1742	ECW CHILLER CH04A OUTLET MANUAL VALVE V1742 TRANSFER CLOSED	3
CCVVT-A-V1341	ECW CHILLER CH04A INLET MANUAL VALVE V1341 TRANSFER CLOSED	3
VDTTY-C-TE013C	EDG ROOM TEMPERATURE TE013C FAILS WHILE OPERATING FOR HV12A INTERLOCK SIGNAL	3
VDTTY-C-TE015C	EDG ROOM TEMPERATURE TE015C FAILS WHILE OPERATING FOR HV13A INTERLOCK SIGNAL	3
PEDOY-C-LX03C02	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 02	3
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	3
PEDOY-D-LX02D04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02D BRANCH 04	3

Table 19.1-51 (7 of 8)

Basic Event	Description	RAW
EFGXY-A-PM3-GC1	FAILURE OF CH. A GC-1 OUTPUT GC1-PM3	3
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	3
AFMPR2B-MDP02B	FAILS TO RUN AFW MDP PP02B	3
PHBSY2A-MC02C	BUS FAULT ON 480V MCC MC02C	3
AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B	3
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	3
AFTPM1B-TDP01B	AFW TDP PP01B UNAVAILABLE DUE TO T&M	3
VOHVR2B-HV33B	FAILS TO RUN OF MAFP ROOM B CUBICLE COOLER HV33B	2
MSAVO-A-109	FAILS TO OPEN MS AFW TDP PP01B TBN STM. SUPPLY AOV 109	2
AFVVT2B-V1604	AFW MDP02B MINI FLOW LINE MANUAL VALVE V1604 TRANSFER CLOSED	2
AFVVT2B-V1001B	AFW MDP02A SUCTION MANUAL VALVE V1001B TRANSFER CLOSED	2
AFVVT2B-V1011B	AFW MDP02B MINI FLOW LINE MANUAL VALVE V1011B TRANSFER CLOSED	2
AFVVT2B-V1005B	AFW MDP01B DISCH. MANUAL VALVE V1005B TRANSFER CLOSED	2
AFCVO2A-V1012A	FAILS TO OPEN AFW MDP02A MINI FLOW CHECK VALVE V1012A	2
AFCVO2A-V1003A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1003A	2
AFCVO2A-V1007A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1017A	2
EFGXY-B-PM3-GC1	FAILURE OF CH. B GC-1 OUTPUT GC1-PM3	2
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	2
PEDOY-B-LX02B04	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 04	2
PGBSY2B-LC01D	BUS FAULT ON 480V LC LC01D	2
PFBSY2B-SW01D	BUS FAULT ON 4.16kV SWGR SW01D	2

Table 19.1-51 (8 of 8)

Basic Event	Description	RAW
PHBSY2B-MC02D	BUS FAULT ON 480V MCC MC02D	2
PGXMY2B-TR01D	480V LC TRANSFORMER LC-TR01D FAULT	2
EFCIY-A-GC1A	FAILURE OF CH. A GC-1 CI631 COMMUNICATION CARD	2
ATAVO-D-010	FAILS TO OPEN AFW TDP PP01B TBN STM. ISOL AOV, 010	2
RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAULT)	2
RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAULT)	2
PADIY-D-PA06D03	FAILURE OF DIGITAL INPUT MODULE 752-PA06D BRANCH 03	2
PEDOY-D-LX04D02	FAILURE OF DIGITAL OUTPUT MODULE LX04D BRANCH 02	2
PEDIY-D-LX04D02	FAILURE OF DIGITAL INPUT MODULE LX04D BRANCH 02	2
AFMVT2B-0044	AFW ISOL. MOV V0044 TRANSFER CLOSED	2
DCBTY-D-BT01D	BAT. BT01D (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2
WOMPR1A-PP01A	FAILS TO RUN OF ECW PUMP 01A	2
DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN	2
EFCIY-B-GC1B	FAILURE OF CH. B GC-1 CI631 COMMUNICATION CARD	2
WOMPR4A-PP04A	FAILS TO RUN OF ECW PUMP 04A	2
EFORT-A-FOR6-AFAS1A-GC1FR	FAILURE OF GC-1 CHANNEL A FIBER OPTIC RECEIVER FOR LC	2
EFORT-A-FOR6-AFAS1A-GC1FT	FAILURE OF GC-1 CHANNEL A FIBER OPTIC TRANSMITTER FOR LC	2

Table 19.1-52 (1 of 2)

Internal Fire PRA Key Basic Events by FV (CDF)

Basic Event	Description	FV
ASD-CDF	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR CDF	43.7%
SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE	13.8%
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	10.4%
PFGRID	GRID COLLAPSE ON TURBINE TRIP	8.5%
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	6.8%
DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN	5.6%
WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	4.5%
WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND	2.9%
WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	2.8%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	2.6%
PR	POSRV FAILS TO RECLOSE	2.3%
ASD-CDF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA CDF	2.3%
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	2.2%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	2.1%
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	2.1%
SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)	1.7%
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	1.6%
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	1.5%
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	1.4%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	1.3%

Table 19.1-52 (2 of 2)

Basic Event	Description	FV
DGDGR-D-DGD	FAILS TO RUN OF EDG D	1.3%
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	1.3%
DADGM-S-AAC	AAC GTG UNAVAILABLE DUE TO MAINTENANCE	1.1%
AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B	1.0%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	1.0%
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	1.0%
DGDGM-B-DGB	DG B UNAVAILABLE DUE TO MAINTENANCE	0.9%
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	0.9%
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	0.9%
VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B	0.8%
AFTPM1B-TDP01B	AFW TDP PP01B UNAVAILABLE DUE TO T&M	0.8%
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	0.8%
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	0.7%
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	0.7%
WOCHM4B-CH04B	ECW CHILLER 04B TRAIN UNAVAILABLE DUE TO T&M	0.6%
MSAVO-A-109	FAILS TO OPEN MS AFW TDP PP01B TBN STM. SUPPLY AOV 109	0.6%
DGDGM-D-DGD	DG D UNAVAILABLE DUE TO MAINTENANCE	0.6%
AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623	0.5%
WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A	0.5%
VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M	0.5%
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	0.5%
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	0.5%

Table 19.1-53 (1 of 8)

Internal Fire PRA Key CCF Events by RAW (CDF)

Basic Event	Description	RAW
AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN	927
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	781
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	781
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	770
AFCVWQ4-V1007A/B/8A/B	4/4 CCF OF AFW DISCH. CHECK VALVE V1007A/B & 1008A/B	679
AFCVWQ4-V1003A/B/4A/B	4/4 CCF OF AFW DISCH. CHECK VALVE V1003A/B & 1004A/B	679
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	676
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	619
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOL. VALVES	530
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	526
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	526
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	526
AFCVWQ4-V1012A/B/4A/B	4/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 1014A/B	495
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	416
CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	407
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	353
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	351
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	328
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	325

Table 19.1-53 (2 of 8)

Basic Event	Description	RAW
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	325
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	319
SXFLKE6-FT01AB/2AB/3AB	6/6 CCF OF ESW DEBRIS FILTER 1A/1B, 2A/B, 3A/3B IN TRAIN A/B	312
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	311
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	305
PFHBWQ4-SW1DG	CCF OF SW01A&1B&1C&1D FEED BREAKER FROM DG A&B FAIL TO CLOSE	296
VDHVWQ4-HV13ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	295
VDHVWQ4-HV12ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	295
SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START	292
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	292
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	284
DGSQWQ4-LOADSQABCD	CCF OF LOAD SEQUNCER A, B, C, D	284
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	281
DGDGWQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	278
VGAHWQ4-AH01A/1B/2A/2B	4/4 START CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	277
SXAHWQ4-AH01A/02A/01B/02B	4/4 DEMAND CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	275
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG01A/B/C/D INLET	269
SIMPKQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A , PP01B TO RUN	266
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	265
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	261
VDHVKQ4-HV12ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	249

Table 19.1-53 (3 of 8)

Basic Event	Description	RAW
VDHVKQ4-HV13ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	249
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	246
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	246
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	246
PALXKQ4-PA06CD	4/4 CCF OF LOOP CONTROLLER PA06C, PA06D	239
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCH LINE 1001, 1002 AND SCP DISCH. LINE CV 568,569	231
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 SC CV 159/160	231
SIHEKQ4-HE01A/B-CS&SC	4/4 CCF OF SC HE01A/B, CS HE01A/B	231
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	208
RPIAWO8-ALL	CCF ALL ANLOG INPUT MODULES OF BISTABLE	198
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	195
PELXKO8-LX05AB3CD	8/8 CCF OF LOOP CONTROLLER LX05A LX05B, LX03C ,LX03D	194
PELXKO8-LX06A04B03C03D	8/8 CCF OF LOOP CONTROLLER LX06A 12, LX04B 12, LX03C 12, LX03D 12	194
EFOTWO8-FOMCALL	CCF OF GC FIBER OPTIC TRANSMITTER	185
EFORWO8-FOMCALL	CCF OF GC FIBER OPTIC RECEIVER	185
EFGCWO8-PM12ABCD	CCF OF PM1 (PM646C) GC MODULE	181
RPBPWO8-BSALL	CCF ALL BISTABLE PROCESS MODULES	181
VGCVWQ4-Y1002A/B/11A/B	4/4 DEMAND CCF OF ESW PP ROOM DAMPER Y1002A/B, Y1011A/B	161
AFPVKQ3-TP01A/B/MP02A	3/4 RUNNING CCF OF AFW TDP01A/B AND MDP02A DUE TO THE VOLUTE FAILURE	151
VDTTKD2-TE013C/14D	CCF OF EDG ROOM TEMPERATURE TE-013C, 014D	142
VDTTKD2-TE015C/16D	CCF OF EDG ROOM TEMPERATURE TE-015C, 016D	142
DOCVWO8-V1005/7ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP CV V1005/1007 A/B/C/D FAIL TO OPEN	141

Table 19.1-53 (4 of 8)

Basic Event	Description	RAW
PELXKQ4-LX04CD	4/4 CCF OF LOOP CONTROLLER 745-LX04C, LX04D	131
VKHVWQ4-HV11A/1B/2A/2B	4/4 CCF OF START FOR SI PUMP ROOM CUBICLE COOLER HV11A, 11B, 12A, 12B	103
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646	101
EFGXKO8-PA03ABCD	CCF OF GC TO LC PM646 MODULES	99
SXFLKE2-FT01A/B	2/6 CCF OF ESW DEBRIS FILTER 1A/1B	93
SXFLKE2-FT01A/2B	2/6 CCF OF ESW DEBRIS FILTER 1A/2B	93
SXFLKE2-FT02A/1B	2/6 CCF OF ESW DEBRIS FILTER 2A/1B	93
SXFLKE2-FT02A/2B	2/6 CCF OF ESW DEBRIS FILTER 2A/2B	93
AFPVKQ3-TP01A/B/MP02B	3/4 RUNNING CCF OF AFW TDP01A/B, MDP02B DUE TO THE VOLUTE FAILURE	81
AFPVKQ3-TP01A/MP02A/B	3/4 RUNNING CCF OF AFW TDP01A, MDP02A/B DUE TO THE VOLUTE FAILURE	78
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	75
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	74
WOCHKQ3-CH03A/4A/3B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B	74
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	72
CCCVWQ4-V1001/2/3/4	4/4 CCF OF CCW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN	72
WOCVWQ4-V1053A/B/55A/B	CCF OF DISCH. CV 1053A/53B/55A/55B (FAIL TO OPEN)	72
SXCVWQ4-V1001/2/3/4	4/4 CCF OF ESW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN (DEMAND)	72
WOCVWQ4-V1010A/B/14A/B	CCF OF DISCH. CV 1010A/10B/14A/14B (FAIL TO OPEN)	72
VKHVKQ4-HV11A/1B/2A/2B	4/4 CCF OF RUN FOR SI PUMP ROOM CUBICLE COOLER HV11A, 11B, 12A, 12B	71
MSRVWE6-MSSV-ALL	20/20 CCF OF MSSVS 1301~1320 ON SG 1/2	62
WOCHKQ2-CH01A/2A	RUNNING CCF OF ECW CHILLERS 1A/2A	61
WOCHKQ2-CH03A/4A	RUNNING CCF OF ECW CHILLERS 3A/4A	61

Table 19.1-53 (5 of 8)

Basic Event	Description	RAW
PELXKO8-LX04ABCD	8/8 CCF OF LOOP CONTROLLERS LX04A, LX04B, LX04C, LX04D	61
WOCHKQ3-CH01A/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/2B	61
WOCHKQ3-CH03A/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/4B	61
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	60
DOLTKQ4-LS3025A/B/C/D	4/4 CCF OF DIESEL FUEL OIL DAY TANK A/B/C/D LEVEL SWITCH LS3025A/B/C/D	59
EFCIKO8-PA03ABCD	CCF OF GC CI MODULES	55
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	53
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	52
VGAHKQ3-AH01A/2A/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A, 02B	51
VGAHKQ2-AH01A/2A	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A	50
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	50
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1C FAIL TO OPEN	50
CCMVXO4-143/5/7/9	4/4 CCF(DEMAND) OF MOV 143,145,147,149 IN NON-SAFETY LOAD LINE	47
SICVWD2-V100/101	CCF OF CV 100/101 IN TRAIN A&B IRWST RETURN LINES	45
WOMPKQ2-PP04A/5A	RUNNING CCF OF ECW PUMPS 4A AND 5A	44
CCMPKQ2-PP01/2A	2/4 CCF OF CCW PUMPS PP01A/2A (RUNNING)	44
WOMPKQ2-PP01A/2A	RUNNING CCF OF ECW PUMPS 1A AND 2A	44
SXMPKQ2-PP01/2A	2/4 CCF OF ESW PUMPS PP01A, PP02A (RUNNING)	44
VKHVKQ2-HV13A/14A	2/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 14A	44
AFPVKQ3-TP01B/MP02A/B	3/4 RUNNING CCF OF AFW TDP01B, MDP02A/B DUE TO THE VOLUTE FAILURE	44
PFHBWQ3-SW1OSATABC	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	43
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	43

Table 19.1-53 (6 of 8)

Basic Event	Description	RAW
WOCHKQ3-CH04A/3B/4B	RUNNING CCF OF ECW CHILLERS 4A/3B/4B	43
WOCHKQ2-CH01B/2B	RUNNING CCF OF ECW CHILLERS 1B/2B	42
WOCHKQ2-CH03B/4B	RUNNING CCF OF ECW CHILLERS 3B/4B	42
WOCHKQ3-CH02A/1B/2B	RUNNING CCF OF ECW CHILLERS 2A/1B/2B	42
DGDGKQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO RUN	41
AFCVWQ3-V1003A/4A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1003A & 4A/B	40
AFCVWQ3-V1007A/8A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1007A & 8A/B	40
DGDGKQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO RUN	40
RCPTKQ4-PT102ABCD	CCF OF LO PZR PRESS. TRANS. PT-102A B C & D	39
PELXKO8-LX02AB01CD	8/8 CCF OF LOOP CONTROLLER LX02A/B AND LX01C/D	39
SICVWQ4-V404/05/34/46	SI PUMP DISCHARGE C/V 404,405,434,446 CCF TO OPEN	39
AFPVKQ2-TP01A/MP02A	2/4 RUNNING CCF OF AFW TDP01A, MDP02A DUE TO THE VOLUTE FAILURE	38
RPIAWQ4-PY102ABCD	CCF OF ALL CONVERTER FOR LO PZR PR. PT-102A B C & D	38
WOCHWQ3-CH01A/2A/1B	DEMAND CCF OF ECW CHILLERS 1A/2A/1B	37
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C, 1D FAIL TO OPEN	37
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1D FAIL TO OPEN	36
VGAHKQ3-AH01B/2A/2B	3/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A, 02B	35
VGAHKQ2-AH01B/2B	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02B	35
PFHBWQ3-SW1DGABC	3/4 CCF OF SW01A&1B&1C FEED BREAKER FROM DG A&B FAIL TO CLOSE	34
PFHBWQ3-SW1OSATABD	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	34
AXCVWD2-V1628/9	2/2 CCF OF CT SYSTEM CHECK VALVE V1628/1629	33
PELXKO8-LX01ABCD	8/8 CCF OF LOOP CONTROLLER LX01A, LX01B, LX01C, LX01D	32

Table 19.1-53 (7 of 8)

Basic Event	Description	RAW
PELXKO8-LX08A12B01C01D	8/8 CCF OF LOOP CONTROLLER LX08A 12, LX12B 12, LX01C 12, LX01D 12	32
DGDGKQ3-DG01BCD	CCF OF EDG 01B/01C/01D FAIL TO RUN	32
CCMVXO4-144/6/8/50	4/4 CCF(DEMAND) OF MOV 144,146,148,150 IN NON-SAFETY LOAD LINE	31
VKHVKQ3-HV13A/13B/14A	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A	30
VKHVKQ3-HV13A/14A/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 14A, 14B	30
WOCHWQ3-CH03A/4A/3B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B	29
WOMPKQ3-PP04A/5A/4B	RUNNING CCF OF ECW PUMPS 4A/5A/4B	28
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	28
WOMPKQ3-PP01A/2A/1B	RUNNING CCF OF ECW PUMPS 1A/2A/1B	28
WOMPKQ3-PP01A/2A/2B	RUNNING CCF OF ECW PUMPS 1A/2A/2B	28
WOMPKQ3-PP04A/5A/5B	RUNNING CCF OF ECW PUMPS 4A/5A/5B	28
CCMPKQ3-PP01A/2A/B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (RUNNING)	28
MSRVWE6-MSSV-SG1	10/10 CCF OF MSSV 1301~1310 ON SG1	28
WOMPKQ2-PP04B/5B	RUNNING CCF OF ECW PUMPS 4B AND 5B	27
CCMPKQ2-PP01/2B	2/4 CCF OF CCW PUMPS PP01B/2B (RUNNING)	27
WOMPKQ2-PP01B/2B	RUNNING CCF OF ECW PUMPS 1B AND 2B	27
SXMPKQ2-PP01/2B	2/4 CCF OF ESW PUMPS PP01B, PP02B (RUNNING)	27
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	26
SXMPKQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (RUNNING)	26
PFHBWQ3-SW1DGABD	3/4 CCF OF SW01A&1B&1D FEED BREAKER FROM DG B FAIL TO CLOSE	26
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C, 1D FAIL TO OPEN	26
DGDGKQ3-DG01ACD	CCF OF EDG 01A/01C/01D FAIL TO RUN	25

Table 19.1-53 (8 of 8)

Basic Event	Description	RAW
VKHVKQ2-HV13B/14B	2/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13B, 14B	25
WOCHWQ3-CH01A/1B/2B	DEMAND CCF OF ECW CHILLERS 1A/1B/2B	24
WOCHWQ3-CH03A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/3B/4B	24
VKTTKQ4-TE211A/12B/09C/10D	CCF OF CS PUMP ROOM TEMPERATURE TE-211A, 212B, 209C, 210D	24
SICVWQ4-V424/26/48/51	SI LINE C/V 424,426,448,451 CCF TO OPEN	24
WOCHWQ3-CH03A/4A/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/4B	22
PFHBWQ3-SW1OSATBCD	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	22
AFTPKD2-TDP01A/B	2/2 CCF OF RUNNING AFW TDP PP01/A/B	21
VKHVKQ3-HV13B/14A/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13B, 14A, 14B	21
VKHVKQ3-HV13A/13B/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14B	21
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN	21
WOCHWQ3-CH01A/2A/2B	DEMAND CCF OF ECW CHILLERS 1A/2A/2B	21
WOCHWQ3-CH04A/3B/4B	DEMAND CCF OF ECW CHILLERS 4A/3B/4B	20

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-54

Internal Fire PRA Key CCF Events by FV (CDF)

Basic Event	Description	FV
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	1.5%
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	1.5%
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	1.5%
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	0.8%
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	0.8%
AFTPKD2-TDP01A/B	2/2 CCF OF RUNNING AFW TDP PP01A/B	0.6%

Table 19.1-55

Internal Fire PRA Key Operator Actions by RAW (CDF)

Basic Event	Description	RAW
RPOPU-S-PT102ABCD	OPERATOR ERROR: COMMON MISCALIBRATION OF LO PZR PR. CH.A/B/C/D	34
AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS	3
RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)	3
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	2
MSOPH-S-SGADV	OPERATOR FAILS TO OPEN ADVS	2
CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01,02,03 BY HAND SWITCH	2
FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	2

Table 19.1-56

Internal Fire PRA Key Operator Actions by FV (CDF)

Basic Event	Description	FV
RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)	6.4%
AFOPV-S-AFAS-FW	OPERATOR FAILS TO RECOVER AFAS	2.4%
RCOPH-S-SDSE-SL-MD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH MEDIUM DEPENDENCY	2.0%
RCOPH-S-SDSE-SL-LD	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4) WITH LOW DEPENDENCY	1.4%
FWOPH-S-ERY	OPERATOR FAILS TO ALINE STARTUP FEEDWATER PUMP PP07 (EARLY PHASE)	1.1%
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	1.1%
DAOPH-S-AACTG	OPERATOR FAILS TO PROVIDE 1E 4.16kV SW01A/B/C/D	1.1%
CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)	0.8%
CCOPH-S-HX-ALIGN	OPERATOR FAILS TO OPEN CCW HX3A/B ISOLATION V1145/6 ESW SUPPLY V1027/8 AND 3014/5	0.8%
EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS	0.7%
SIOPV-S-SIAS	OPERATOR FAILS TO RECOVERY FOR SIAS	0.5%

Table 19.1-57 (1 of 11)

Internal Fire PRA Key Basic Events by RAW (LRF)

Basic Event	Description	RAW
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	368
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	187
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	135
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	135
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	135
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	135
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	135
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	108
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	107
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	70
SISPP-S-CHEMICAL	DEBRIS INDUCED LOSS OF LONG TERM COOLING (DOWNSTREAM/CHEMICAL EFFECT)	70
CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING	69
CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING	69
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	54
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	53
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	53
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	53
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	53
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	53

Table 19.1-57 (2 of 11)

Basic Event	Description	RAW
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	42
PHBSY1A-MC03A	BUS FAULT ON 480V MCC MC03A	40
ASD-LRF	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	36
PELXY-C-LX04C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04C	28
CCHEY01B-HE01B	CCW HX HE01B FAILS WHILE OPERATING	27
CCHEY02B-HE02B	CCW HX HE02B FAILS WHILE OPERATING	27
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	22
PFGRID	GRID COLLAPSE ON TURBINE TRIP	20
ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF	20
PR	POSRV FAILS TO RECLOSE	18
AXVVO-A-V1623	FAILS TO OPEN CT SYSTEM MANUAL VALVE V1623	14
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	14
PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C	14
AXCVO-A-V1628	FAILS TO OPEN CT SYSTEM CHECK VALVE V1628	14
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	13
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	12
DCBTM-C-BT01C	POWER UNAVAILABLE OF BT01C (125VDC) DUE TO MAINTENANCE	12
IPINM-C-IN01C	INVERTER IN01C UNAVAIL. DUE TO T&M	12
SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)	10
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	10

Table 19.1-57 (3 of 11)

Basic Event	Description	RAW
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	9
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	9
SXFLP2A-FT02A	ESW DEBIS FILTER FT02A PLUGGED	9
SXFLP1A-FT01A	ESW DEBRIS FILTERS PLUGGED	9
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	8
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	8
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	8
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	8
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	7
DCBTM-D-BT01D	POWER UNAVAILABLE OF BT01C (125VDC) DUE TO MAINTENANCE	7
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	7
WOCHR3A-CH03A	ECW CHILLER CH03A FAILS TO RUN FOR 24 HOURS	7
WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS	7
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	6
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	6
IPINM-A-IN01A	INVERTER IN01A UNAVAIL. DUE TO T&M	6
DCBTM-A-BT01A	POWER UNAVAILABLE OF BT01A (125VDC) DUE TO MAINTENANCE	6
DCBTM-B-BT01B	POWER UNAVAILABLE OF BT01B (125VDC) DUE TO MAINTENANCE	6
IPINM-B-IN01B	INVERTER IN01B UNAVAIL. DUE TO T&M	6
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	6

Table 19.1-57 (4 of 11)

Basic Event	Description	RAW
IPINM-D-IN01D	INVERTER IN01D UNAVAIL. DUE TO T&M	6
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	6
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	5
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M T&M	5
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	5
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	5
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	5
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	5
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1011A TRANSFER CLOSED	5
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	5
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	5
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	5
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	5
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	5
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	5
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	5
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	5
AFCVO2A-V1003A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1003A	5
AFCVO2A-V1007A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1017A	5
AFCVO2A-V1012A	FAILS TO OPEN AFW MDP02A MINI FLOW CHECK VALVE V1012A	5

Table 19.1-57 (5 of 11)

Basic Event	Description	RAW
PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14	5
WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	4
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	4
WOMPR1A-PP01A	FAILS TO RUN OF ECW PUMP 01A	4
WOMPS5A-PP05A	FAILS TO START OF ECW PUMP 05A	4
WOMPR4A-PP04A	FAILS TO RUN OF ECW PUMP 04A	4
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	4
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	4
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	4
AFSVI2A-0035	AFW MDP02A DISCH. MOD. VALVE 035 FAILS SPURIOUSLY CLOSED	4
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	4
PEDOY-D-LX02D04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02D BRANCH 04	4
PEDOY-C-LX04C01	FAILURE OF DIGITAL OUTPUT MODULE LX04C BRANCH 01	4
WOVVT5A-V1071A	ECW PP05A DISCH. LINE VV 1071A TRANSFER CLOSED	4
WOVVT5A-V1068A	ECW PP05A SUCTION LINE VV 1068A TRANSFER CLOSED	4
PELXY-D-LX02D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02D	4
WOMPR5A-PP05A	FAILS TO RUN OF ECW PUMP 05A	4
ATAVO-C-009	FAILS TO OPEN AFW TDP PP01A TBN STM. ISOL AOV, 009	4
PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C	4
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	4

Table 19.1-57 (6 of 11)

Basic Event	Description	RAW
WOCVO5A-V1055A	ECW PP05A DISCH. LINE CV 1055A FAILS TO OPEN	4
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	4
PELXY-B-LX11B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX11B	4
AFVVT1A-V1002A	AFW SUCT. MANUAL VALVE V1002A TRANSFER CLOSED	4
AFVVT1A-V1013A	AFW TDP PP01A MINI FLOW MANUAL VALVE V1013A TRANSFER CLOSED	4
AFVVT1A-V1616	AFW TDP PP01A MINI FLOW MANUAL VALVE V1616 TRANSFER CLOSED	4
AFVVT1A-V1006A	AFW TDP01A DISCH. MANUAL VALVE V1006A TRANSFER CLOSED	4
MSVVT-B-V1151	MS MANUAL VALVE V1151 FOR AFW TDP01A TRANSFER CLOSED	4
RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)	4
RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)	4
SXFLP1B-FT01B	ESW DEBIS FILTER FT01B PLUGGED	4
RCMVO-A-132	MV 132 FAILS TO OPEN	4
RCMVO-C-133	MV 133 FAILS TO OPEN	4
RCMVO-C-131	MV 131 FAILS TO OPEN	4
RCMVO-A-130	MV 130 FAILS TO OPEN	4
SXFLP2B-FT02B	ESW DEBIS FILTER FT02B PLUGGED	3
PEDOY-B-LX11B04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX11B BRANCH 04	3
PEDOY-C-LX02C04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02C BRANCH 04	3
PELXY-A-LX08A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX08A	3
PELXY-C-LX05C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05C	3

Table 19.1-57 (7 of 11)

Basic Event	Description	RAW
DEAVC-S-006	CTMT. ISOL. AOV DE-006 FAIL TO CLOSE	3
PEDOY-C-LX05C01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX05C BRANCH 01	3
PEDOY-A-LX08A01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX08A BRANCH 01	3
WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	3
WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND	3
AFMVT1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 TRANSFER CLOSED	3
WOCHR1B-CH01B	ECW CHILLER 01B FAILS TO RUN FOR 24 HOURS	3
CI-HATCH	HATCH FAILS TO ISOLATE	3
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	3
WOCHR3B-CH03B	ECW CHILLER 03B FAILS TO RUN FOR 24 HOURS	3
PEDOY-C-LX04C04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX04C BRANCH 04	3
PELXY-C-LX03C-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	3
PEDOY-C-LX03C02	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 02	3
CCMVO-A-392	CCW MOV 392 FOR ECW CHILLER CH04A OUTLET FAIL TO OPEN	3
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	3
WOCHR4A-CH04A	ECW CHILLER 04A FAILS TO RUN FOR 24 HOURS	3
SXMPR1A-PP01A	ESW PUMP PP01A FAILS TO RUN	3
AFCVO1A-V1004A	FAILS TO OPEN AFW TDP01A DISCH. CHECK VALVE V1004A	3
AFCVO1A-V1008A	FAILS TO OPEN AFW TDP01A DISCH. CHECK VALVE V1008A	3
ATCVO-C-V1020A	FAILS TO OPEN AFW TBN SYSTEM CHECK VALVE V1020A FOR AFW TDP01A	3

Table 19.1-57 (8 of 11)

Basic Event	Description	RAW
AFCVO1A-V1014A	FAILS TO OPEN AFW TDP01A MINI FLOW CHECK VALVE V1014A	3
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	3
PFBSY2B-SW01D	BUS FAULT ON 4.16kVKV SWGR SW01D	3
WOVVT4A-V1078A	ESSENTIAL CHILLER CH04A OUTLET VV 1078A TRANSFER CLOSED	3
WOVVT4A-V1077A	ESSENTIAL CHILLER CH04A INLET VV 1077A TRANSFER CLOSED	3
PGBSY2B-LC01D	BUS FAULT ON 480V LC LC01D	3
VKHVR1A-HV13A	FAILS TO RUN CCW PUMP ROOM CUBICLE COOLER HV13A	3
PHBSY2A-MC02C	BUS FAULT ON 480V MCC MC02C	3
CCVVT-A-V1742	ECW CHILLER CH04A OUTLET MANUAL VALVE V1742 TRANSFER CLOSED	3
CCVVT-A-V1341	ECW CHILLER CH04A INLET MANUAL VALVE V1341 TRANSFER CLOSED	3
CCMPR1A-PP01A	CCW PUMP PP01A FAILS TO RUN	3
PGXMY2B-TR01D	480V LC TRANSFORMER LC-TR01D FAULT	3
PELXY-D-LX04D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04D	3
DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN	3
DADGR-S-AACTG	AAC GTG FAILS TO RUN	2
PHBSY2B-MC02D	BUS FAULT ON 480V MCC MC02D	2
DADGM-S-AAC	AAC GTG UNAVAILABLE DUE TO MAINTENANCE	2
NPXHM-M-SAT02M	SAT TR02M UNAVAILABLE DUE TO MAINTENANCE	2
AFMVR1A-045	AF TDP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CONROL FOR CYCLING	2
PHBSY2A-MC01C	BUS FAULT ON 480V MCC MC01C	2

Table 19.1-57 (9 of 11)

Basic Event	Description	RAW
DCBTY-D-BT01D	BAT. BT01D (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	2
IPINY-C-IN01C	120V AC POWER SUPPLY INVERTER IN01C FAILS WHILE OPERATING	2
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	2
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	2
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	2
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	2
DGDGR-B-DGB	FAILS TO RUN OF EDG B	2
WOMPR1B-PP01B	FAILS TO RUN OF ECW PUMP 01B	2
VUHVS-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO START	2
VUHVS-S-HV81	FAILS TO START OF HIGH VOLUME CUBICLE COOLER HV81	2
PFHBC1B-SW01B-D2	FAILS TO CLOSE OF FEEDER BRK SW01B-D2 TO DG B	2
PFHBO1B-SW01B-A2	FAILS TO OPEN OF PCB SW01B-A2 OF 4.16kV SWGR SW01B FROM SAT	2
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	2
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	2
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	2
DAMPM-A-PP02	AAC FUEL OIL FEED PUMP PP02 UNAVAILABLE DUE TO MAINTENANCE	2
WOMPR4B-PP04B	FAILS TO RUN OF ECW PUMP 04B	2
DADGS-S-AACTG	AAC GTG FAILS TO START	2
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	2

Table 19.1-57 (10 of 11)

Basic Event	Description	RAW
VUHVM-S-HV81	HIGH VOLUME CUBICLE COOLER HV81 UNAVAILABLE DUE TO MAINTENANCE	2
VUHVM-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 UNAVAILABLE DUE TO MAINTENANCE	2
AFSVI1A-0037	AFW TDP01A DISCH. MOD. VALVE 037 FAILS SPURIOUSLY CLOSED	2
DGDGM-B-DGB	DG B UNAVAILABLE DUE TO MAINTENANCE	2
SXMPR1B-PP01B	ESW PUMP PP01B FAILS TO RUN	2
AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B	2
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE	2
AFTPM1B-TDP01B	AFW TDP PP01B UNAVAILABLE DUE TO T&M	2
MSAVO-A-109	FAILS TO OPEN MS AFW TDP PP01B TBN STM. SUPPLY AOV 109	2
DAMPS-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO START	2
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	2
DGDGR-A-DGA	FAILS TO RUN OF EDG A	2
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	2
NPXHY-M-SAT02M	STANDBY AUX XFMR A FAILS WHILE OPERATING	2
ATAVO-D-010	FAILS TO OPEN AFW TDP PP01B TBN STM. ISOL AOV, 010	2
VKHVS2A-HV14A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14A	2
PFHBO1A-SW01A-A2	FAILS TO OPEN OF PCB SW01A-A2 OF 4.16kV SWGR SW01A FROM SAT	2
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	2
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	2

Table 19.1-57 (11 of 11)

Basic Event	Description	RAW
IPBSY-C-MC01C	120V AC DIST. PANEL BUS 1-842-E-IN01C LOCAL FAULTS	2
VKHVM2A-HV14A	CUBICLE COOLER HV14A UNAVAILABLE DUE TO T&M	2
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	2

Table 19.1-58 (1 of 4)

Internal Fire PRA Key Basic Events by FV (LRF)

Basic Event	Description	FV
ASD-LRF	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR LRF	35.2%
PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14	20.4%
SHR1-E12TD	UNRECOVERABLE SBO LEADS TO TDAFW PUMP FAILURE	20.3%
PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6	13.8%
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	12.6%
ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS	11.7%
PFGRID	GRID COLLAPSE ON TURBINE TRIP	10.2%
PDS_94	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-94	9.1%
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	8.8%
PDS-FREQ-CFS	PDS FREQUENCY ADJUSTMENT FOR CFS	8.7%
PDS_86	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-86	7.9%
DAMPR-A-PP02	AAC FUEL OIL FEED PUMP PP02 FAILS TO RUN	7.9%
WOCHM4A-CH04A	ECW CHILLER 04A TRAIN UNAVAILABLE DUE TO T&M	4.7%
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	4.6%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	4.0%
PDS_10	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-10	3.9%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	3.4%
WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND	3.1%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	2.9%

Table 19.1-58 (2 of 4)

Basic Event	Description	FV
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	2.5%
WOMPM5A-PP05A	ECW PP05A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	2.3%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	2.2%
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	2.1%
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	2.0%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	1.9%
ASD-LRF-MCA	ALTERNATE SHUTDOWN FAILURE PROBABILITY FOR MCA LRF	1.9%
DADGM-S-AAC	AAC GTG UNAVAILABLE DUE TO MAINTENANCE	1.8%
DGDGM-B-DGB	DG B UNAVAILABLE DUE TO MAINTENANCE	1.7%
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	1.7%
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	1.7%
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	1.6%
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	1.6%
PR	POSRV FAILS TO RECLOSE	1.6%
PDS_90	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-90	1.5%
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	1.5%
PDS_106	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-106	1.5%
PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7	1.5%
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	1.4%
MSAVO-B-110	AFW PUMP TURBINE STEAM SUPPLY VALVE 110 FAILS TO OPEN	1.3%

Table 19.1-58 (3 of 4)

Basic Event	Description	FV
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	1.3%
PDS_17	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-17	1.2%
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	1.2%
DGDGM-D-DGD	DG D UNAVAILABLE DUE TO MAINTENANCE	1.1%
WOCHM4B-CH04B	ECW CHILLER 04B TRAIN UNAVAILABLE DUE TO T&M	1.1%
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	1.1%
SEAL-AFSUC	SEAL FAILURE PROBABILITY (SECONDARY HEAT REMOVAL SUCCESS)	1.0%
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	1.0%
RCPVO-A-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)	0.9%
RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)	0.9%
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	0.9%
RPPTM-C-PT102C	LO PZR PR. CH.C IS IN BYPASS (T&M)	0.8%
RPPTM-A-PT102A	LO PZR PR. CH.A IS IN BYPASS (T&M)	0.8%
PFHBC1B-SW01B-D2	FAILS TO CLOSE OF FEEDER BRK SW01B-D2 TO DG B	0.8%
PFHBO1B-SW01B-A2	FAILS TO OPEN OF PCB SW01B-A2 OF 4.16kV SWGR SW01B FROM SAT	0.8%
WOCHS1B-CH01B	ECW CHILLER CH01B FAILS TO START ON DEMAND	0.8%
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO TEST OR MAINTENANCE	0.8%
AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B	0.8%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	0.7%
WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND	0.7%

Table 19.1-58 (4 of 4)

Basic Event	Description	FV
WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND	0.7%
WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND	0.7%
PFHBO1A-SW01A-A2	FAILS TO OPEN OF PCB SW01A-A2 OF 4.16kV SWGR SW01A FROM SAT	0.7%
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	0.7%
WOCHS3B-CH03B	ECW CHILLER CH03B FAILS TO START ON DEMAND	0.7%
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	0.6%
AFTPM1B-TDP01B	AFW TDP PP01B UNAVAILABLE DUE TO T&M	0.6%
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	0.6%
SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M	0.6%
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	0.5%
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	0.5%
VUHVS-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO START	0.5%
VUHVS-S-HV81	FAILS TO START OF HIGH VOLUME CUBICLE COOLER HV81	0.5%
MSAVO-A-109	FAILS TO OPEN MS AFW TDP PP01B TBN STM. SUPPLY AOV 109	0.5%

Table 19.1-59 (1 of 10)

Internal Fire PRA Key CCF Events by RAW (LRF)

Basic Event	Description	RAW
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	647
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	647
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	643
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	618
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	602
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOL. VALVES	571
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	570
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	570
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	570
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	534
CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143, 144, 145, 146, 147, 148, 149, 150 IN NON-SAFETY LOAD LINE	524
AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN	477
AFCVWQ4-V1007A/B/8A/B	4/4 CCF OF AFW DISCH. CHECK VALVE V1007A/B & 1008A/B	436
AFCVWQ4-V1003A/B/4A/B	4/4 CCF OF AFW DISCH. CHECK VALVE V1003A/B & 1004A/B	436
AFCVWQ4-V1012A/B/4A/B	4/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 1014A/B	411
SXFLKE6-FT01AB/2AB/3AB	6/6 CCF OF ESW DEBRIS FILTER 1A/1B, 2A/B, 3A/3B IN TRAIN A/B	358
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A, 1B, 1C, 1D FAIL TO OPEN	349

Table 19.1-59 (2 of 10)

Basic Event	Description	RAW
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	348
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	347
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	345
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	343
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	343
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	340
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	327
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	304
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A, 1B, 1C, 1D FAIL TO OPEN	303
PFHBWQ4-SW1DG	CCF OF SW01A&1B&1C&1D FEED BREAKER FROM DG A&B FAIL TO CLOSE	301
VDHVWQ4-HV12ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	301
VDHVWQ4-HV13ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	301
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	300
DGSQWQ4-LOADSQABCD	CCF OF LOAD SEQUNCER A, B, C, D	300
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	299
DGDGWQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	297
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG01A/B/C/D INLET	295
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	294
VGAHWQ4-AH01A/1B/2A/2B	4/4 START CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	294
SXAHWQ4-AH01A/02A/01B/02B	4/4 DEMAND CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	293

Table 19.1-59 (3 of 10)

Basic Event	Description	RAW
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	292
VDHVKQ4-HV13ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	287
VDHVKQ4-HV12ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	287
PALXKQ4-PA06CD	4/4 CCF OF LOOP CONTROLLER PA06C, PA06D	282
WOCVWQ4-V1053A/B/55A/B	CCF OF DISCH. CV 1053A/53B/55A/55B (FAIL TO OPEN)	278
CCCVWQ4-V1001/2/3/4	4/4 CCF OF CCW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN	277
WOCVWQ4-V1010A/B/14A/B	CCF OF DISCH. CV 1010A/10B/14A/14B (FAIL TO OPEN)	277
SXCVWQ4-V1001/2/3/4	4/4 CCF OF ESW PUMP DISCH. CHECK VALVE V1001/2/3/4 TO OPEN (DEMAND)	277
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	272
SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START	251
DOCVWO8-V1005/7ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP CV V1005/1007 A/B/C/D FAIL TO OPEN	251
SIMPKQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A, PP01B TO RUN	249
VGCVWQ4-Y1002A/B/11A/B	4/4 DEMAND CCF OF ESW PP ROOM DAMPER Y1002A/B, Y1011A/B	249
PELXKO8-LX06A04B03C03D	8/8 CCF OF LOOP CONTROLLER LX06A 12, LX04B 12, LX03C 12, LX03D 12	248
PELXKO8-LX05AB3CD	8/8 CCF OF LOOP CONTROLLER LX05A LX05B, LX03C, LX03D	248
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 SC CV 159/160	238
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCH LINE 1001, 1002 AND SCP DISCH. LINE CV 568,569	238
SIHEKQ4-HE01A/B-CS&SC	4/4 CCF OF SC HE01A/B, CS HE01A/B	237
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	178
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	175

Table 19.1-59 (4 of 10)

Basic Event	Description	RAW
WOCHKQ3-CH03A/4A/3B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B	171
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	159
VKHVKQ3-HV13A/13B/14A	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A	152
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	152
WOCHKQ3-CH01A/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/2B	152
WOCHKQ3-CH03A/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/4B	152
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	152
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	149
VGAHKQ3-AH01A/2A/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A, 02B	147
WOMPKQ3-PP04A/5A/4B	RUNNING CCF OF ECW PUMPS 4A/5A/4B	146
WOMPKQ3-PP01A/2A/1B	RUNNING CCF OF ECW PUMPS 1A/2A/1B	145
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1C FAIL TO OPEN	142
VKHVKQ3-HV13A/14A/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 14A, 14B	139
CCMPKQ3-PP01A/2A/B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (RUNNING)	136
WOMPKQ3-PP01A/2A/2B	RUNNING CCF OF ECW PUMPS 1A/2A/2B	136
WOMPKQ3-PP04A/5A/5B	RUNNING CCF OF ECW PUMPS 4A/5A/5B	136
SXMPKQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (RUNNING)	135
WOCHKQ2-CH01A/2A	RUNNING CCF OF ECW CHILLERS 1A/2A	132
WOCHKQ2-CH03A/4A	RUNNING CCF OF ECW CHILLERS 3A/4A	132
VGAHKQ2-AH01A/2A	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A	129

Table 19.1-59 (5 of 10)

Basic Event	Description	RAW
CCMVXO4-143/5/7/9	4/4 CCF(DEMAND) OF MOV 143, 145, 147, 149 IN NON-SAFETY LOAD LINE	128
WOMPKQ2-PP01A/2A	RUNNING CCF OF ECW PUMPS 1A AND 2A	127
WOMPKQ2-PP04A/5A	RUNNING CCF OF ECW PUMPS 4A AND 5A	127
CCMPKQ2-PP01/2A	2/4 CCF OF CCW PUMPS PP01A/2A (RUNNING)	127
SXMPKQ2-PP01/2A	2/4 CCF OF ESW PUMPS PP01A, PP02A (RUNNING)	127
VKHVKQ2-HV13A/14A	2/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 14A	126
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C, 1D FAIL TO OPEN	121
DCBTKQ4-BT01ABCD	4/4 CCF OF FAULTS ON BATTERY BT01A/01B/01C/01D	116
SXAHKQ3-AH01A/02A/01B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B	112
SXAHKQ3-AH01A/02A/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 02B	112
SXAHKQ2-AH01A/02A	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A	111
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A, 1C FAIL TO OPEN	97
AFPVKQ3-TP01A/B/MP02A	3/4 RUNNING CCF OF AFW TDP01A/B AND MDP02A DUE TO THE VOLUTE FAILURE	90
SXFLKE2-FT02A/2B	2/6 CCF OF ESW DEBRIS FILTER 2A/2B	85
SXFLKE2-FT02A/1B	2/6 CCF OF ESW DEBRIS FILTER 2A/1B	85
SXFLKE2-FT01A/2B	2/6 CCF OF ESW DEBRIS FILTER 1A/2B	85
SXFLKE2-FT01A/B	2/6 CCF OF ESW DEBRIS FILTER 1A/1B	85
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	82
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	81
WOCHKQ3-CH04A/3B/4B	RUNNING CCF OF ECW CHILLERS 4A/3B/4B	68

Table 19.1-59 (6 of 10)

Basic Event	Description	RAW
WOCHKQ3-CH02A/1B/2B	RUNNING CCF OF ECW CHILLERS 2A/1B/2B	67
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1D FAIL TO OPEN	67
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	67
AFPVKQ3-TP01A/MP02A/B	3/4 RUNNING CCF OF AFW TDP01A, MDP02A/B DUE TO THE VOLUTE FAILURE	66
AFCVWQ3-V1003A/4A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1003A & 4A/B	66
AFCVWQ3-V1007A/8A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1007A & 8A/B	66
PFHBWQ3-SW1OSATABC	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	62
DCBTKQ3-BT01BCD	3/4 CCF OF FAULTS ON BATTERY BT01B/01C/01D	62
VGAHKQ3-AH01B/2A/2B	3/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A, 02B	62
DCBTKQ3-BT01ACD	3/4 CCF OF FAULTS ON BATTERY BT01A/01C/01D	61
VKHVKQ3-HV13A/13B/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14B	60
PFHBWQ3-SW1DGABC	3/4 CCF OF SW01A&1B&1C FEED BREAKER FROM DG A&B FAIL TO CLOSE	60
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	59
WOMPKQ3-PP01A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/1B/2B	59
WOMPKQ3-PP04A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/4B/5B	59
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	58
VKHVKQ3-HV13B/14A/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13B, 14A, 14B	57
WOMPKQ3-PP05A/4B/5B	RUNNING CCF OF ECW PUMPS 5A/4B/5B	57
AFPVKQ3-TP01A/B/MP02B	3/4 RUNNING CCF OF AFW TDP01A/B, MDP02B DUE TO THE VOLUTE FAILURE	57
CCMPKQ3-PP01B/2A/B	3/4 CCF OF CCW PUMPS PP01B/2A/2B (RUNNING)	55

Table 19.1-59 (7 of 10)

Basic Event	Description	RAW
WOMPKQ3-PP02A/1B/2B	RUNNING CCF OF ECW PUMPS 2A/1B/2B	55
AFCVWQ3-V1012A/4A/B	3/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A & 4A/B	54
SXMPKQ3-PP01B/2A/B	3/4 CCF OF ESW PUMPS PP02A, PP01B, PP02B (RUNNING)	54
PFHBWQ3-SW1OSATABD	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	53
DGDGKQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO RUN	53
DGDGKQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO RUN	53
AFCVWQ3-V1007A/B/8A	3/4 CCF OF AFW DISCH. CHECK VALVE V1007A/B & 8A	52
AFCVWQ3-V1003A/B/4A	3/4 CCF OF AFW DISCH. CHECK VALVE V1003A/B & 4A	52
PFHBWQ3-SW1DGABD	3/4 CCF OF SW01A&1B&1D FEED BREAKER FROM DG B FAIL TO CLOSE	51
WOCHKQ2-CH01B/2B	RUNNING CCF OF ECW CHILLERS 1B/2B	51
WOCHKQ2-CH03B/4B	RUNNING CCF OF ECW CHILLERS 3B/4B	51
VGAHKQ2-AH01B/2B	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02B	48
CCMVXO4-144/6/8/50	4/4 CCF(DEMAND) OF MOV 144, 146, 148, 150 IN NON-SAFETY LOAD LINE	47
WOMPKQ2-PP01B/2B	RUNNING CCF OF ECW PUMPS 1B AND 2B	47
CCMPKQ2-PP01/2B	2/4 CCF OF CCW PUMPS PP01B/2B (RUNNING)	47
WOMPKQ2-PP04B/5B	RUNNING CCF OF ECW PUMPS 4B AND 5B	47
SXMPKQ2-PP01/2B	2/4 CCF OF ESW PUMPS PP01B, PP02B (RUNNING)	47
DGSQWQ3-LOADSQABD	CCF OF LOAD SEQUNCER A, B, D	47
VKHVKQ2-HV13B/14B	2/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13B, 14B	47
DGSQWQ3-LOADSQABC	CCF OF LOAD SEQUNCER A, B, C	46

Table 19.1-59 (8 of 10)

Basic Event	Description	RAW
DGDGWQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO START	46
DGDGWQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO START	45
WOCHWQ3-CH01A/2A/1B	DEMAND CCF OF ECW CHILLERS 1A/2A/1B	45
DGDGWQ3-DG01ABD-LOAD	CCF OF EDG 01A/01B/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	44
DGDGWQ3-DG01ABC-LOAD	CCF OF EDG 01A/01B/01C FAIL TO LOAD AND RUN DURING 1ST 1HOUR	44
AFCVWQ3-V1012A/B/4A	3/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 4A	41
DGDGKQ3-DG01BCD	CCF OF EDG 01B/01C/01D FAIL TO RUN	41
SXAHKQ3-AH02A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B, 02B	38
SXAHKQ3-AH01A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 01B, 02B	38
SXAHKQ2-AH01B/02B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01B, 02B	38
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C, 1D FAIL TO OPEN	37
AFCVWQ3-V1007B/8A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1007B & 8A/B	36
AFCVWQ3-V1003B/4A/B	3/4 CCF OF AFW DISCH. CHECK VALVE V1003B & 4A/B	36
AFPVKQ3-TP01B/MP02A/B	3/4 RUNNING CCF OF AFW TDP01B, MDP02A/B DUE TO THE VOLUTE FAILURE	36
DGSQWQ3-LOADSQBCD	CCF OF LOAD SEQUNCER B, C, D	36
WOCHWQ3-CH03A/4A/3B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B	36
DGDGWQ3-DG01BCD	CCF OF EDG 01B/01C/01D FAIL TO START	35
DGDGKQ3-DG01ACD	CCF OF EDG 01A/01C/01D FAIL TO RUN	35
DGDGWQ3-DG01BCD-LOAD	CCF OF EDG 01B/01C/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	34
CCMPWQ3-PP01A/2A/1B	3/4 CCF OF CCW PUMPS PP01A/2A/1B (DEMAND)	34

Table 19.1-59 (9 of 10)

Basic Event	Description	RAW
SXMPWQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (START)	34
PFHBWQ3-SW1OSATBCD	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	33
DCBTKQ2-BT01CD	2/4 CCF OF FAULTS ON BATTERY BT01C/01D	33
PFHBWQ3-SW1DGBCD	3/4 CCF OF SW01B&1C&1D FEED BREAKER FROM DG B FAIL TO CLOSE	32
MSRVWE6-MSSV-ALL	20/20 CCF OF MSSVS 1301~1320 ON SG 1/2	32
WOCHWQ3-CH01A/1B/2B	DEMAND CCF OF ECW CHILLERS 1A/1B/2B	31
WOCHWQ3-CH03A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/3B/4B	31
PFHBWQ3-SW1OSATACD	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	31
DGSQWQ3-LOADSQACD	CCF OF LOAD SEQUNCER A, C, D	30
PFHBWQ3-SW1DGACD	3/4 CCF OF SW01A&1C&1D FEED BREAKER FROM DG B FAIL TO CLOSE	30
DGDGWQ3-DG01ACD	CCF OF EDG 01A/01C/01D FAIL TO START	30
WOMPWQ3-PP01A/2A/1B	DEMAND CCF OF ECW PUMPS 1A/2A/1B	29
DGDGWQ3-DG01ACD-LOAD	CCF OF EDG 01A/01C/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	28
WOCHWQ3-CH03A/4A/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/4B	28
AFCVWQ3-V1012B/4A/B	3/4 CCF OF AFW MINI FLOW CHECK VALVE V1012B & 4A/B	27
WOCHWQ3-CH01A/2A/2B	DEMAND CCF OF ECW CHILLERS 1A/2A/2B	27
CCMVWQ3-192/181/2	3/4 CCF OF CCW MOV 192, 181, 182 FOR EDG01B/C/D INLET	27
WOCHWQ3-CH04A/3B/4B	DEMAND CCF OF ECW CHILLERS 4A/3B/4B	26
WOMPWQ3-PP04A/5A/4B	DEMAND CCF OF ECW PUMPS 4A/5A/4B	26
WOCHWQ3-CH02A/1B/2B	DEMAND CCF OF ECW CHILLERS 2A/1B/2B	25

Table 19.1-59 (10 of 10)

Basic Event	Description	RAW
IPINKQ3-IN01ACD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/C/D	25
AFCVWQ3-V1003A/B/4B	3/4 CCF OF AFW DISCH. CHECK VALVE V1003A/B & 4B	24
AFCVWQ3-V1007A/B/8B	3/4 CCF OF AFW DISCH. CHECK VALVE V1007A/B & 8B	24
AFPVKQ2-TP01A/MP02A	2/4 RUNNING CCF OF AFW TDP01A, MDP02A DUE TO THE VOLUTE FAILURE	23
AXCVWD2-V1628/9	2/2 CCF OF CT SYSTEM CHECK VALVE V1628/1629	23
VDTTKD2-TE013C/14D	CCF OF EDG ROOM TEMPERATURE TE-013C, 014D	23
VDTTKD2-TE015C/16D	CCF OF EDG ROOM TEMPERATURE TE-015C, 016D	23
WOMPWQ3-PP04A/5A/5B	DEMAND CCF OF ECW PUMPS 4A/5A/5B	22
PFHBWQ2-SW2OUATAB	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B FAIL TO OPEN	22
PELXKQ4-LX04CD	4/4 CCF OF LOOP CONTROLLER 745-LX04C, LX04D	21
CCMPWQ3-PP01A/2A/2B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (DEMAND)	21
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	21
CCMVWQ3-191/181/2	3/4 CCF OF CCW MOV 191, 181, 182 FOR EDG01A/C/D INLET	21
WOMPWQ3-PP01A/2A/2B	DEMAND CCF OF ECW PUMPS 1A/2A/2B	21
CCMVWQ3-191/2/181	3/4 CCF OF CCW MOV 191, 192, 181 FOR EDG01A/B/C INLET	20
WOMPWQ3-PP01A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/1B/2B	20
WOMPWQ3-PP05A/4B/5B	DEMAND CCF OF ECW PUMPS 5A/4B/5B	20
WOMPWQ3-PP04A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/4B/5B	20

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-60

Internal Fire PRA Key CCF Events by FV (LRF)

Basic Event	Description	FV
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	1.5%
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	1.5%
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	1.5%
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A, 1B, 1C, 1D FAIL TO OPEN	0.9%
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A, 1B, 1C, 1D FAIL TO OPEN	0.8%
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A, 1C FAIL TO OPEN	0.6%

Table 19.1-61

Internal Fire PRA Key Operator Actions by RAW (LRF)

Basic Event	Description	RAW
CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)	4
RPOPU-S-PT102ABCD	OPERATOR ERROR: COMMON MISCALIBRATION OF LO PZR PR. CH.A/B/C/D	3
RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)	3
DAOPH-S-AACTG	OPERATOR FAILS TO PROVIDE 1E 4.16kV SW01A,B,C,D	2
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	2

Table 19.1-62

Internal Fire PRA Key Operator Actions by FV (LRF)

Basic Event	Description	FV
H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)	14.9%
RCOPH-S-SDSE-SL	FAILURE OF SDS VALVES EARLY PHASE OPEN (2/4)	4.8%
CCOPV-S-NSMV	OPERATOR FAILS TO CLOSE CC MOV 143~150 (NON-ESSENTIAL LOAD)	2.7%
EFOPV-S-SIAS	OPERATOR FAILS TO MANUALLY INITIATE ALL CHANNELS VIA MCR FOR SIAS	2.5%
CDOPH-S-ALIGN	OPERATOR FAILS TO START FOR PP01, 02, 03 BY HAND SWITCH	2.4%
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	2.3%
DAOPH-S-AACTG	OPERATOR FAILS TO PROVIDE 1E 4.16kV SW01A,B,C,D	1.8%
CCOPH-S-HX-ALIGN	OPERATOR FAILS TO OPEN CCW HX3A/B ISOLATION V1145 /6 /ESW SUPPLYING V1027/8, 3014/5	1.2%
H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE	1.2%
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	0.8%
WOOPH-S-CROSSTIE	OPERATOR FAILS TO OPEN 1025A/B, 1079A/B AND ALIGN FLOW PATH	0.7%

Table 19.1-63 (1 of 5)

Internal Flooding Initiating Event Summary

Initiating Event	Total IE Frequency (/yr)	Maximum EF	Adjusted IE Frequency (/yr)
IE-050A-CS-M	3.76E-08	11	3.96E-08
IE-050A-CS-X	2.02E-08	11	2.12E-08
IE-050A-SI-M	2.76E-07	11	2.91E-07
IE-050A-SI-X	6.76E-08	11	7.11E-08
IE-050B-CS-M	2.96E-08	11	3.12E-08
IE-050B-CS-X	1.58E-08	11	1.66E-08
IE-050B-SI-M	3.05E-07	11	3.21E-07
IE-050B-SI-X	3.64E-08	11	3.84E-08
IE-050C-CS-M	5.05E-07	11	5.32E-07
IE-050C-CS-X	1.12E-07	11	1.18E-07
IE-050D-CS-M	4.81E-07	11	5.06E-07
IE-050D-CS-X	1.09E-07	11	1.15E-07
IE-055C-CS-M	1.51E-07	12	1.58E-07
IE-055C-CS-X	3.28E-08	12	3.45E-08
IE-055D-CS-M	1.83E-07	12	1.92E-07
IE-055D-CS-X	3.97E-08	12	4.18E-08
IE-055-03C-FP-M	1.25E-05	5	1.32E-05
IE-055-03D-FP-M	1.06E-05	5	1.11E-05
IE-055-05C-FP-X	3.60E-05	5	3.79E-05
IE-055-14C-CS-M	1.34E-04	2	1.41E-04
IE-055-14D-CS-M	1.29E-04	2	1.36E-04
IE-055-18B-FP-X	2.14E-06	5	2.25E-06
IE-055-19A-FP-M	1.00E-04	6	1.05E-04
IE-055-19B-FP-M	3.42E-05	5	3.60E-05
IE-055-20A-FP-M	1.71E-05	5	1.80E-05
IE-055-20B-FP-M	1.75E-05	5	1.84E-05
IE-055-21A-CS-M	0.00E+00	0	0.00E+00

Table 19.1-63 (2 of 5)

Initiating Event	Total IE Frequency (/yr)	Maximum EF	Adjusted IE Frequency (/yr)
IE-055-21A-CS-X	1.33E-08	11	1.40E-08
IE-055-21A-IW-S	3.27E-05	2	3.44E-05
IE-055-21A-SI-M	1.76E-07	11	1.85E-07
IE-055-21A-SI-X	3.13E-08	11	3.30E-08
IE-055-21B-CS-M	0.00E+00	0	0.00E+00
IE-055-21B-CS-X	1.79E-08	11	1.88E-08
IE-055-21B-CV-S	9.73E-05	2	1.02E-04
IE-055-21B-IW-S	3.17E-05	2	3.34E-05
IE-055-21B-SI-M	2.05E-07	11	2.16E-07
IE-055-21B-SI-X	2.54E-08	11	2.67E-08
IE-055-22A-IW-S	0.00E+00	0	0.00E+00
IE-055-50B-FP-M	1.71E-04	5	1.80E-04
IE-078-01D-FP-M	5.52E-05	6	5.81E-05
IE-078-01D-FP-X	1.71E-04	6	1.80E-04
IE-078-02C-WO-S	1.29E-05	4	1.36E-05
IE-078-02D-WI-S	8.59E-06	4	9.04E-06
IE-078-02D-WO-S	2.08E-05	4	2.19E-05
IE-078-03C-WO-S	7.46E-05	4	7.86E-05
IE-078-03D-WI-S	8.28E-06	4	8.71E-06
IE-078-03D-WO-S	7.35E-05	4	7.73E-05
IE-78-05C-WO-S	1.53E-05	4	1.62E-05
IE-78-05D-WO-S	1.76E-05	4	1.85E-05
IE-78-07C-WD-S	3.25E-06	4	3.42E-06
IE-78-07D-WD-S	3.59E-06	4	3.78E-06
IE-078-10C-FP-M	1.04E-04	6	1.09E-04
IE-078-10C-FP-X	3.51E-04	6	3.69E-04
IE-078-15C-AF-M	1.27E-07	12	1.34E-07
IE-078-15C-AF-X	3.76E-07	12	3.96E-07

Table 19.1-63 (3 of 5)

Initiating Event	Total IE Frequency (/yr)	Maximum EF	Adjusted IE Frequency (/yr)
IE-078-15C-MS-S	1.91E-04	4	2.01E-04
IE-078-15D-AF-M	1.13E-07	12	1.19E-07
IE-078-15D-AF-X	1.98E-05	12	2.08E-05
IE-078-15D-MS-S	2.43E-04	4	2.56E-04
IE-078-19A-FP-M	8.31E-05	5	8.75E-05
IE-078-19A-FP-X	2.98E-04	5	3.14E-04
IE-078-19B-FP-M	1.34E-04	5	1.41E-04
IE-078-19B-FP-X	3.49E-04	5	3.68E-04
IE-078-19B-WM-M	1.79E-06	8	1.88E-06
IE-078-20A-AF-M	2.69E-07	12	2.83E-07
IE-078-20A-AF-X	8.19E-07	12	8.62E-07
IE-078-20B-AF-M	1.58E-06	10	1.67E-06
IE-078-20B-AF-X	1.43E-06	10	1.51E-06
IE-078-21A-SI-M	3.18E-07	11	3.35E-07
IE-078-21A-SI-X	3.13E-08	11	3.30E-08
IE-078-21B-SI-M	2.05E-07	11	2.16E-07
IE-078-21B-SI-X	2.54E-08	11	2.67E-08
IE-078-25A-WO-S	6.55E-05	4	6.90E-05
IE-078-25B-WO-S	6.77E-05	4	7.13E-05
IE-078-29B-CC-M	6.90E-07	7	7.26E-07
IE-078-29B-CC-X	1.33E-06	7	1.40E-06
IE-078-29C-CC-M	1.50E-07	11	1.58E-07
IE-078-29C-CC-X	3.92E-07	11	4.13E-07
IE-078-31A-FP-M	6.70E-05	6	7.05E-05
IE-078-31A-FP-X	2.49E-04	6	2.62E-04
IE-078-44B-FP-X	2.18E-04	6	2.30E-04
IE-078-57D-CT-M	6.54E-09	11	6.89E-09
IE-100-H2A-CC-M	2.39E-07	7	2.51E-07

Table 19.1-63 (4 of 5)

Initiating Event	Total IE Frequency (/yr)	Maximum EF	Adjusted IE Frequency (/yr)
IE-100-H2B-CC-M	1.93E-07	7	2.04E-07
IE-100-02C-DG-S	1.12E-05	4	1.17E-05
IE-100-02D-DG-S	2.38E-06	4	2.51E-06
IE-100-05C-WI-S	1.60E-05	4	1.69E-05
IE-100-05D-WI-S	2.22E-05	4	2.34E-05
IE-100-08C-WI-S	2.53E-05	4	2.67E-05
IE-100-08C-WO-S	1.14E-05	4	1.20E-05
IE-100-08D-WI-S	1.09E-05	4	1.15E-05
IE-100-08D-WO-S	5.96E-06	4	6.27E-06
IE-100-10B-FP-X	5.71E-05	5	6.01E-05
IE-100-10B-WM-M	1.81E-07	9	1.91E-07
IE-100-10B-WM-X	5.39E-07	9	5.67E-07
IE-100-11B-WD-S	2.18E-06	8	2.29E-06
IE-100-20A-FP-M	7.13E-05	6	7.50E-05
IE-100-20A-FP-X	3.35E-04	6	3.53E-04
IE-100-20A-WM-M	3.93E-07	9	4.14E-07
IE-100-22A-FP-S	6.88E-06	5	7.25E-06
IE-100-22A-FP-M	4.89E-05	5	5.15E-05
IE-100-22A-FP-X	4.24E-05	5	4.46E-05
IE-100-32B-WM-M	2.91E-06	8	3.06E-06
IE-100-37B-FP-X	9.94E-05	6	1.05E-04
IE-120-06C-CC-M	2.00E-07	6	2.11E-07
IE-120-06D-FP-M	6.42E-07	5	6.76E-07
IE-120-11A-WM-M	3.65E-07	9	3.84E-07
IE-120-11B-FP-X	1.79E-05	5	1.88E-05
IE-120-15B-WO-S	4.48E-05	4	4.71E-05
IE-137-02C-WD-M	8.70E-08	11	9.16E-08
IE-137-09C-FP-M	7.89E-06	6	8.30E-06

Table 19.1-63 (5 of 5)

Initiating Event	Total IE Frequency (/yr)	Maximum EF	Adjusted IE Frequency (/yr)
IE-137-09C-FP-X	2.56E-05	6	2.69E-05
IE-137-09D-FP-M	0.00E+00	0	0.00E+00
IE-137-09D-FP-X	0.00E+00	0	0.00E+00
IE-137-10C-WO-S	3.51E-05	4	3.70E-05
IE-137-10D-WO-S	2.83E-05	4	2.97E-05
IE-137-13B-FP-M	1.47E-05	5	1.55E-05
IE-137-13B-FP-X	0.00E+00	0	0.00E+00
IE-137-15A-WO-S	2.64E-05	4	2.77E-05
IE-137-15B-WO-S	1.23E-05	4	1.29E-05
IE-137-20A-FP-M	1.18E-05	5	1.25E-05
IE-137-23A-WO-S	3.70E-05	4	3.89E-05
IE-137-29B-FP-M	2.66E-06	6	2.80E-06
IE-137-29B-FP-X	1.22E-05	6	1.29E-05
IE-157-01D-CC-S	1.30E-06	6	1.37E-06
IE-157-01D-CC-M	1.27E-07	6	1.33E-07
IE-157-01D-WM-S	8.40E-06	5	8.84E-06
IE-157-01D-WM-M	2.32E-07	6	2.44E-07
IE-157-01D-WM-X	9.38E-07	6	9.88E-07
IE-157-01D-WO-S	4.67E-05	4	4.92E-05
IE-157-13C-FP-M	4.30E-05	4	4.53E-05
IE-157-16C-WM-M	3.03E-07	8	3.19E-07
IE-157-16D-WL-M	2.37E-07	10	2.49E-07
IE-157-19C-WO-S	2.13E-05	4	2.24E-05
IE-157-19D-WO-S	2.37E-05	4	2.49E-05
IE-157-25C-WIM-S	1.28E-05	4	1.35E-05
IE-157-P01-FP-M	1.66E-05	5	1.75E-05
IE-TB-MISC	1.23E-02	12	1.30E-02
IE-TB-CW-X	8.13E-05	8	8.55E-05

Table 19.1-64 (1 of 2)

Internal Flooding PRA CDF Contribution by Top Flooding Induced Initiators

#	Basic Event ID	Freqency (/yr)	Contribution	Description
1	#IE-78-19B-FP-X	3.49E-04	20.2%	Major break of FP piping in room 078-A19B, 078-A20B, or 100-A10B. Flow greater than 690 gpm in 078-A19B or 078-A20B. Flow between 935 gpm and 1,445 gpm in 100- A10B.
2	#IE-100-20A-FP-X	3.35E-04	18.5%	Major break of FP piping in room 100-A20A, 100-A23A, 100-P06, 100-P07, 100-P08, 100-P14, 100-P19, 100-P20, 100-P21, 100-P22, 100-P23, 100-P24, 100-P25, 100-P27, 100-P28, 100-P31, 100-P33, 100-P34, 100-P35, 100-P43, 100-P45, 100-P46, 100-P47, 100-P50, 100-P51, 100-P52, 100-P53, 100-P54, 100-P55, and 100-P56. Flow greater than 2,000 gpm in 100-A20A or 100-A23A. Flow greater than 2,500 gpm in other areas.
3	#IE-78-19A-FP-X	2.98E-04	17.2%	Major break of FP piping in room 078-A19A 120-P22, 120-P25, 120-P27, and 120-P32. Flow greater than 2,000gpm in 078-A19A. Flow greater than 2,500 gpm in 120-P22, 120-P25, 120-P27, or 120-P32.
4	#IE-78-44B-FP-X	2.18E-04	13.1%	Major break of FP piping in room 078-A44B or 078 A49B with flow greater than 1,690 gpm or in 100-A30B, 100-A35B, 100-A36B, 100-A37B, 120-A29B, or 120-A31B with a flow rate between 1,690 gpm and 2,500 gpm.
5	#IE-78-19B-FP-M	1.34E-04	7.0%	Moderate break of FP piping in room 078- A19B, 078-A20B, 100-A10B, 120-A11B, or 120-A13B. Flow between 400 gpm and 690 gpm in 078-A19B or 078-A20B. Flow between 645 gpm and 935 gpm in 100-A10B. Flow between 890 gpm and 1,180 gpm in 120 -A11B or 120-A13B.
6	#IE-78-01D-FP-X	1.71E-04	5.6%	Major break of FP piping in room 078-A10D. Flow greater than 3,700gpm in 078-A10D.

Table 19.1-64 (2 of 2)

#	Basic Event ID	Freqency (/yr)	Contribution	Description
7	#IE-78-19A-FP-M	8.31E-05	4.2%	Moderate break of FP piping in room 078-A19A, 120-A11A, 120-P22, 120-P25, 120-P27, or 120-P32. Flow rate between 1,200 gpm and 2,000 gpm in 078-A19A, flow greater than 1,200 gpm in 120-A11A, or flow between 1,700 gpm and 2,500 gpm in 120-P22, 120-P25, 120-P27, and 120-P32.
8	#IE-100-10B-FP-X	5.71E-06	2.8%	Major break of FP piping in room 100-A10B. Flow greater 1,445 gpm
9	#IE-137-29B-FP-M	2.66E-06	2.0%	Moderate break of FP piping in 137-A29B. Flow between 1,690 gpm and 2,500 gpm.
10	#IE-78-10C-FP-X	8.31E-05	1.8%	Moderate break of FP piping in room 078- A19A, 120-A11A, 120-P22, 120-P25, 120-P27, and 120-P32. Flow between 1,200 gpm and 2,000gpm in 078-A19A, or 120-A11A. Flow between 1,700 gpm and 2,500 gpm in 120-P22, 120-P25, 120-P27, or 120-P32.
11	#IE-78-01D-FP-M	2.66E-06	1.7%	Moderate break of FP piping in room 137-A29B. Flow between 1,690 gpm and 2,500 gpm.
12	#IE-100-37B-FP-X	5.76E-06	1.3%	Major break of FP piping in 100-A37B is named IE-100- 37B-FP-X and represents any break in FP piping with a flow rate greater than 2,500 gpm. This event includes FP pipe breaks in 100-A30B, 100-A35B, 120-A29B, or 120-A31B with a flow rate greater than 2,500 gpm.
13	#IE-TB-MISC	1.16E-02	1.3%	Flooding event in Turbine Building with flow less than 400,000 gpm
14	#IE-120-11B-FP-X	1.79E-05	0.9%	Major break of FP piping in room 120-A11B or 120-A13B. Flow greater than 1,180 gpm.
15	#IE-78-15D-AF-X	1.98E-05	0.6%	Major break of AFW piping in room 078- A15D. Flow greater than 3,200gpm.

Table 19.1-65 (1 of 2)

Internal Flooding PRA LRF Contribution by Top Flooding Induced Initiators

Number	Basic Event ID	Frequency (per year)	Contribution to CDF	Description
1	#IE-78-19B-FP-X	3.49E-04	20.5%	Major break of FP piping in room 078-A19B, 078-A20B, or 100-A10B. Flow greater than 690 gpm in 078-A19B or 078-A20B. Flow between 935 gpm and 1,445 gpm in 100 A10B.
2	#IE-100-20A-FP-X	3.35E-04	19.4%	Major break of FP piping in room 100-A20A, 100-A23A, 100-P06, 100-P07, 100-P08, 100-P14, 100-P19, 100-P20, 100-P21, 100-P22, 100-P23, 100-P24, 100-P25, 100-P27, 100-P28, 100-P31, 100-P33, 100-P34, 100-P35, 100-P43, 100-P45, 100-P46, 100-P47, 100-P50, 100-P51, 100-P52, 100-P53, 100-P54, 100-P55, and 100-P56. Flow greater than 2,000 gpm in 100-A20A or 100-A23A. Flow greater than 2,500 gpm in other areas.
3	#IE-78-19A-FP-X	2.98E-04	17.8%	Major break of FP piping in room 078-A19A 120-P22, 120-P25, 120-P27, and 120-P32. Flow greater than 2,000gpm in 078-A19A. Flow greater than 2,500 gpm in 120-P22, 120-P25, 120-P27, or 120-P32.
4	#IE-78-44B-FP-X	2.18E-04	12.9%	Major break of FP piping in room 078-A44B or 078-A49B with flow greater than 1,690 gpm or in 100-A30B, 100-A35B, 100- A36B, 100-A37B, 120-A29B, or 120-A31B with a flow rate between 1,690 gpm and 2,500 gpm.
5	#IE-78-19B-FP-M	1.34E-04	7.2%	Moderate break of FP piping in room 078-A19B, 078-A20B, 100-A10B, 120-A11B, or 120-A13B. Flow between 400 gpm and 690 gpm in 078-A19B or 078-A20B. Flow between 645 gpm and 935 gpm in 100-A10B. Flow between 890 gpm and 1,180 gpm in 120 -A11B or 120-A13B.
6	#IE-78-01D-FP-X	1.71E-04	4.5%	Major break of FP piping in room 078-A10D. Flow greater than 3,700gpm in 078-A10D.

Table 19.1-65 (2 of 2)

Number	Basic Event ID	Frequency (per year)	Contribution to CDF	Description
7	#IE-78-19A-FP-M	8.31E-05	4.3%	Moderate break of FP piping in room 078-A19A, 120-A11A, 120-P22, 120-P25, 120-P27, or 120-P32. Flow rate between 1,200 gpm and 2,000 gpm in 078-A19A. Flow rate greater than 1,200 gpm in 120-A11A. Flow rate between 1,700 gpm and 2,500 gpm in 120-P22, 120-P25, 120-P27, or 120-P32.
8	#IE-100-10B-FP-X	5.71E-05	2.8%	Major break of FP piping in room 100-A10B. Flow greater 1,445 gpm
9	#IE-137-29B-FP-M	2.66E-06	1.8%	Moderate break of FP piping in 137-A29B. Flow rate between 1,690 gpm and 2,500 gpm
10	#IE-78-10C-FP-X	3.51E-04	1.6%	Major break of FP piping in room 078-A10C. Flow greater than 3,700gpm in 078-A10D.
11	#IE-78-01D-FP-M	5.52E-05	1.3%	Moderate break of FP piping in room 078-A01D, 078-A10D, 120-A07D, or 137-A01D. Flow greater than 2,180 gpm in 078-A01D. Flow between 2,180 gpm and 3,700 gpm in 078-A10D. Flow greater than 5,100 gpm in 120-A07D.
12	#IE-100-37B-FP-X	5.76E-06	1.2%	Major break of FP piping in 100-A37B, 100-A30B, 100-A35B, 120-A29B, or 120-A31B with a flow rate greater than 2,500 gpm.
13	#IE-TB-MISC	1.16E-02	1.1%	Flooding event in Turbine Building with flow less than 400,000 gpm
14	#IE-120-11B-FP-X	1.79E-05	0.8%	Major break of FP piping in room 120-A11B or 120-A13B. Flow greater than 1,180 gpm.

Table 19.1-66 (1 of 22)

Internal Flooding PRA Top 100 CDF Cutsets

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	9.46E-09	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	4.20	4.2
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
2	9.08E-09	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	4.1	8.3
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
3	8.08E-09	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	3.6	11.9
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
4	5.91E-09	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	2.7	14.6
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
5	5.74E-09	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	2.6	17.2
		PFHBWQ3-SW2OUATAC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
6	5.51E-09	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	2.5	19.6
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
7	4.90E-09	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	2.2	21.8
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		

Table 19.1-66 (2 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	4.64E-09	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	2.1	23.9
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
9	3.63E-09	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	1.6	25.5
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
10	3.59E-09	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	1.6	27.1
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
11	2.81E-09	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	1.3	28.4
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
12	2.25E-09	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	1.0	29.4
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
13	2.21E-09	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	1.0	30.4
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
14	1.55E-09	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A10B	0.7	31.1
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-66 (3 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	1.50E-09	#IE-78-01D-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A01D	0.7	31.8
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
16	1.37E-09	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	0.6	32.4
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
17	1.20E-09	#IE-78-10C-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10C	0.5	32.9
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
18	1.20E-09	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.5	33.5
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
19	1.02E-09	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.5	33.9
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		

Table 19.1-66 (4 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
20	9.40E-10	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A10B	0.4	34.3
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
21	9.08E-10	#IE-78-01D-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A01D	0.4	34.8
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
22	8.83E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.4	35.1
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
23	7.54E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.3	35.5
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		

Table 19.1-66 (5 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
24	5.53E-10	#IE-TB-MISC	THE FLOOD INITIATING EVENT FOR A SIGNIFICANT FLOOD IN THE TURBINE ROOM	0.2	35.7
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
25	5.37E-10	#IE-78-15D-AF-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF AF-RELATED PIPING IN ROOM 078-A15D	0.2	36.0
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
26	5.23E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.2	36.2
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
27	5.02E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.2	36.4
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
28	4.85E-10	#IE-120-11B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 120-A11B	0.2	36.7
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
29	4.47E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.2	36.9
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		

Table 19.1-66 (6 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	4.35E-10	#IE-TB-MISC	THE FLOOD INITIATING EVENT FOR A SIGNIFICANT FLOOD IN THE TURBINE ROOM	0.2	37.0
		AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN		
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
31	4.15E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.2	37.2
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
32	3.98E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.2	37.4
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
33	3.86E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.2	37.6
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-66 (7 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	3.71E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.2	37.8
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
35	3.57E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.2	37.9
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
36	3.54E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.2	38.1
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
37	3.50E-10	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.2	38.2
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
38	3.47E-10	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A37B	0.2	38.4
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-66 (8 of 22)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
39	3.43E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.2	38.5
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
40	3.30E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	38.7
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
41	3.27E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.8
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
42	3.27E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	39.0
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
43	3.26E-10	#IE-78-15D-AF-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF AF-RELATED PIPING IN ROOM 078-A15D	0.1	39.1
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		

Table 19.1-66 (9 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	3.06E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	39.3
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
45	3.05E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	39.4
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
46	3.02E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	39.5
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
47	2.95E-10	#IE-120-11B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 120-A11B	0.1	39.7
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		

Table 19.1-66 (10 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
48	2.94E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	39.8
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
49	2.90E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	39.9
		DGDGR-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
50	2.80E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	40.1
		FPOPH-1-ISO-FL	OPERATOR`S FAILURE TO ISOLATE A FP BREAK WITH LESS THAN 20 MINUTE AVAILABLE		
		PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN		
51	2.77E-10	#IE-78-19B-FP-X	F122-T01 UNSUPPRESSED FIRES	0.1	40.2
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
52	2.73E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	40.3
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-66 (11 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	2.66E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	40.4
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
54	2.63-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	40.5
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
55	2.62E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	40.7
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
56	2.61E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	40.8
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-66 (12 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	2.59E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	40.9
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
58	2.58E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	41.0
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
59	2.56E-10	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	0.1	41.1
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
60	2.56E-10	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A37B	0.1	41.2
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-66 (13 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	2.53E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	41.3
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
62	2.41E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	41.5
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
63	2.37E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	41.6
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
64	2.34E-10	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	41.7
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		

Table 19.1-66 (14 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	2.33E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	41.8
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
66	2.30E-10	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	41.9
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
67	2.25E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	42.0
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
68	2.23E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	42.1
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		

Table 19.1-66 (15 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	2.23E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	42.2
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
70	2.14E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	42.3
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
71	2.05E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	42.4
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
72	2.01E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	42.5
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-66 (16 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	2.01E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.1	42.5
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
74	1.96E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	42.6
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
75	1.93E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	42.7
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
76	1.91E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	42.8
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-66 (17 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	1.91E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	42.9
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
78	1.89E-10	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	0.1	43.0
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
79	1.89E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	43.1
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
80	1.75E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	43.1
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		

Table 19.1-66 (18 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	1.73E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	43.2
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
82	1.72E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	43.3
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
83	1.70E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	43.4
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
84	1.65E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	43.4
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		

Table 19.1-66 (19 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	1.61E-10	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	43.5
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN		
86	1.60E-10	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	43.7
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
87	1.59E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.1	43.7
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
88	1.56E-10	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A37B	0.1	43.7
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
89	1.48E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.1	43.8
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-66 (20 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	1.48E-10	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	0.1	43.9
		DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
91	1.45E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	43.9
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M		
92	1.43E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	44.0
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
93	1.40E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	44.1
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		PFHBWQ2-SW2OUATAD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1D FAIL TO OPEN		
94	1.40E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	44.1
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-66 (21 of 22)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
95	1.40E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	44.2
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBWQ2-SW2OUATCD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01C,1D FAIL TO OPEN		
96	1.39E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	44.2
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
97	1.39E-10	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A37B	0.1	44.3
		AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
98	1.39E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	44.4
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-66 (22 of 22)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	1.37E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	44.4
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN		
100	1.37E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.1	44.5
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		

Table 19.1-67 (1 of 31)

Internal Flooding PRA Top 100 LRF Cutsets

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	5.13E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	3.0	3.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
2	4.93E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	2.9	5.9
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
3	4.38E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	2.6	8.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
4	3.21E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	1.9	10.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-67 (2 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	2.99E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	1.8	14.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
6	2.66E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	1.6	15.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
7	2.66E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	1.6	15.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
8	2.51E-10	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10D	1.5	17.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-67 (3 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
9	2.46E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	1.4	18.5
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
10	2.36E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	1.4	19.8
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
11	2.10E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	1.2	21.1
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
12	1.97E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	1.2	22.2
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-67 (4 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	1.95E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	1.1	23.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
14	1.54E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.9	24.3
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
15	1.53E-10	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.9	25.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
16	1.49E-10	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.9	26.1
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		

Table 19.1-67 (5 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
17	1.43E-10	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.8	26.9
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
18	1.28E-10	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.8	27.7
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
19	1.22E-10	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	0.7	28.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
20	1.20E-10	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.7	29.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		

Table 19.1-67 (6 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	9.45E-11	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19B	0.6	29.6
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
22	9.33E-11	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.5	30.2
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
23	8.40E-11	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10B	0.5	30.7
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
24	8.12E-11	#IE-78-01D-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A01D	0.5	31.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-67 (7 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	9.34E-11	#IE-TB-MISC	THE FLOOD INITIATING EVENT FOR A SIGNIFICANT FLOOD IN THE TURBINE ROOM	0.5	31.7
		I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES		
		PDS_2	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-2		
		PI-SGTR	PRESSURE INDUECD SGTR PROBABILITY		
26	7.42E-11	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	0.4	32.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
27	6.53E-11	#IE-78-10C-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10C	0.4	32.5
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
28	6.49E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.4	32.9
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-67 (8 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	5.86E-11	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	0.3	33.3
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
30	5.73E-11	#IE-78-19B-FP-M	BASED ON THE ABOVE DISCUSSIONS, TWO SCENARIOS ARE DEFINED FOR FP BREAKS IN 078-A19B	0.3	33.6
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
31	5.54E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.3	33.9
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
32	5.10E-11	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10B	0.3	34.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		

Table 19.1-67 (9 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	4.93E-11	#IE-78-01D-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A01D	0.3	34.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
34	4.79E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.3	34.8
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
35	4.09E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.2	35.0
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		

Table 19.1-67 (10 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	4.03E-11	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10B	0.2	35.3
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
37	3.56E-11	#IE-78-19A-FP-M	THE FLOOD INITIATING EVENT FOR A MODERATE BREAK OF FP PIPING IN ROOM 078-A19A	0.2	35.5
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN		
38	2.91E-11	#IE-78-15D-AF-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF AF-RELATED PIPING IN ROOM 078-A15D	0.2	35.7
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
39	2.84E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.2	35.8
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-67 (11 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	2.72E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.2	36.0
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
41	2.63E-11	#IE-120-11B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 120-A11B	0.2	36.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
42	2.44E-11	#IE-100-10B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A10B	0.1	36.3
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
43	2.42E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	36.4
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		

Table 19.1-67 (12 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	2.25E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	36.6
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
45	2.16E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	36.7
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
46	2.09E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	36.8
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-67 (13 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	2.01E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	36.9
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
48	1.94E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	37.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		
49	1.92E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	37.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-67 (14 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	1.90E-11	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A29B	0.1	37.3
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
51	1.88E-11	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A37B	0.1	37.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
52	1.86E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	37.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		

Table 19.1-67 (15 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	1.79E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	37.6
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
54	1.78E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	37.7
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
55	1.77E-11	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	37.8
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		

Table 19.1-67 (16 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
56	1.77E-11	#IE-78-15D-AF-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A15D	0.1	37.9
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN		
57	1.66E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
58	1.65E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	38.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		

Table 19.1-67 (17 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
59	1.64E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.2
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
60	1.60E-11	#IE-120-11B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 120-A11B	0.1	38.3
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN		
61	1.59E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	38.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-67 (18 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
62	1.57E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	38.5
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
63	1.52E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	38.6
		ERVC	FAILURE OF ERVC SYSTEM		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE THE FP LINE BREAK		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN		
64	1.50E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.6
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		

Table 19.1-67 (19 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	1.48E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.7
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
66	1.44E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	38.8
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
67	1.43E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	38.9
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		

Table 19.1-67 (20 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
68	1.42E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	39.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
69	1.42E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	39.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
70	1.41E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	39.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-67 (21 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	1.40E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19A	0.1	39.2
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
72	1.39E-11	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A01D	0.1	39.3
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
73	1.39E-11	#IE-100-37B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A37B	0.1	39.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-67 (22 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
74	1.37E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	39.5
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
75	1.36E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A19B	0.1	39.6
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
76	1.31E-11	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-A44B	0.1	39.6
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-67 (23 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	1.31E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	39.7
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
78	1.28E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19A	0.1	39.8
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
79	1.27E-11	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A29B	0.1	39.9
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		

Table 19.1-67 (24 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
80	1.26E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19A	0.1	39.9
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		
81	1.26E-11	#IE-120-11B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 120-11B	0.1	40.0
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
82	1.25E-11	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A29B	0.1	40.1
		CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE		
		PDS_7	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-7		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
83	1.25E-11	#IE-137-29B-FP-M	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 137-A29B	0.1	40.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-67 (25 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
84	1.22E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19A	0.1	40.2
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A		
85	1.21E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.3
		DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
86	1.21E-11	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-44B	0.1	40.4
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B		

Table 19.1-67 (26 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
87	1.16E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19A	0.1	40.4
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
88	1.16E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	40.5
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
89	1.13E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.6
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO CLOSE		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		

Table 19.1-67 (27 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	1.11E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.6
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M		
91	1.09E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.7
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-67 (28 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	1.09E-11	#IE-78-19B-FP-M	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.8
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
93	1.08E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	40.8
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO CLOSE		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN		
94	1.08E-11	#IE-78-19B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19B	0.1	40.9
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-67 (29 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	1.06E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	41.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M		
96	1.05E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	41.0
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-67 (30 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
97	1.04E-11	#IE-78-44B-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-44B	0.1	41.1
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		
		WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M		
98	1.04E-11	#IE-100-20A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 100-A20A	0.1	41.1
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		PDS_6	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-6		
		PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN		
		WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M		

Table 19.1-67 (31 of 31)

Rank	Frequency (/yr)	Cutsets		Contribution to LRF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	1.03E-11	#IE-78-19A-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-19A	0.1	41.2
		DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN		
		PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN		
100	1.03E-11	#IE-78-01D-FP-X	THE FLOOD INITIATING EVENT FOR A MAJOR BREAK OF FP PIPING IN ROOM 078-01D	0.1	41.3
		DGDGR-B-DGB	FAILS TO RUN OF EDG B		
		ERVC	FAILURE OF ERVC SYSTEM		
		PDS_14	CONDITONAL LARGE RELEASE PROBABILITY FOR PDS-14		
		PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT		
		PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN		

Table 19.1-68 (1 of 12)

Internal Flooding PRA Key Basic Events by RAW (CDF)

Basic Event	Description	RAW
I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES	1.6E+04
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	258
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	246
SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED	86
SXMVR-A-MV072	LOSS OF SX DIV.II DUE TO THE MOV072 SPURIOUS OPEN (FLOW DIVERSION)	66
SXMVR-A-MV071	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	66
CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING	57
CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING	57
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	49
SXMVR-B-MV073	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	47
SXMVR-B-MV074	LOSS OF SX DIV.II DUE TO THE MOV074 SPURIOUS OPEN (FLOW DIVERSION)	47
CCHEY02B-HE02B	CCW HX HE02B FAILS WHILE OPERATING	43
CCHEY01B-HE01B	CCW HX HE01B FAILS WHILE OPERATING	43
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	28
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	23
PALXKD2-PA06CD	2/2 CCF OF LOOP CONTROLLER PA06C, PA06D	20
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	11
PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS	11
NPXHM-N-SAT02N	SAT TR02N UNAVAILABLE DUE TO MAINTENANCE	9

Table 19.1-68 (2 of 12)

Basic Event	Description	RAW
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	9
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	9
NPXHM-M-SAT02M	SAT TR02M UNAVAILABLE DUE TO MAINTENANCE	9
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	9
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	8
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	8
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	8
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	8
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	8
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	7
PELXKD2-LX05AB	2/2 CCF OF LOOP CONTROLLER 745-LX05A, LX05B	7
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	7
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	7
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	7
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	7
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	7
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	7
SXMPR1A-PP01A	ESW PUMP PP01A FAILS TO RUN	7
VOHVKD2-HV33A/33B	2/2 CCF OF FOR CUBICLE COOLER HV33A/33B	6
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	6

Table 19.1-68 (3 of 12)

Basic Event	Description	RAW
PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C	6
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	6
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	6
VGAHR1A-AH01A	ESW PUMP ROOM I. FAN AH01A FAILS TO RUN	6
CCMPR1A-PP01A	CCW PUMP PP01A FAILS TO RUN	6
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	6
VOHVWD2-HV33A/33B	2/2 CCF OF START FOR CUBICLE COOLER HV33A/33B	6
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	6
SXMPR1B-PP01B	ESW PUMP PP01B FAILS TO RUN	5
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	5
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	5
SXAHR-A-AH01A	ESW COOLING TOWER FAN AH01A FAILS TO RUN	5
PELXY-D-LX02D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02D	5
AFMPWD2-MDP02A/B	2/2 CCF OF FOR AFW MDP PP02/A/B FAIL TO START	5
PEDOY-D-LX02D04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02D BRANCH 04	5
PGBSY1A-LC02A	BUS FAULT ON 480V LC LC02A	5
CCMPR1B-PP01B	CCW PUMP PP01B FAILS TO RUN	5
VGAHR1B-AH01B	ESW PUMP ROOM II. FAN AH01B FAILS TO RUN	5
PGBSY2B-LC01D	BUS FAULT ON 480V LC LC01D	5
PFBSY2B-SW01D	BUS FAULT ON 4.16kV SWGR SW01D	5

Table 19.1-68 (4 of 12)

Basic Event	Description	RAW
PGXMY1A-TR02A	480V LC TRANSFORMER LC-TR02A FAULT	5
SXAHR-B-AH01B	ESW COOLING TOWER FAN AH01B FAILS TO RUN	5
PGXMY2B-TR01D	480V LC TRANSFORMER LC-TR01D FAULT	5
PGBSY1B-LC02B	BUS FAULT ON 480V LC LC02B	4
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	4
RCPVO-C-201	POSRV V201 FAILS TO OPEN (HARDWARE FAULT)	4
RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAULT)	4
PGXMY1B-TR02B	480V LC TRANSFORMER LC-TR02B FAULT	4
RCPVO-B-202	POSRV V202 FAILS TO OPEN (HARDWARE FAULT)	4
RCPVO-D-203	POSRV V203 FAILS TO OPEN (HARDWARE FAULT)	4
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	4
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	4
RCMVO-A-132	MV 132 FAILS TO OPEN	4
RCMVO-C-133	MV 133 FAILS TO OPEN	4
RCMVO-C-131	MV 131 FAILS TO OPEN	4
RCMVO-A-130	MV 130 FAILS TO OPEN	4
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	4
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	4
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	4
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1011A TRANSFER CLOSED	4

Table 19.1-68 (5 of 12)

Basic Event	Description	RAW
PHBSY1A-MC02A	BUS FAULT ON 480V MCC MC02A	4
VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M	4
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	4
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	4
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	4
RCMVO-D-135	MV 135 FAILS TO OPEN	3
RCMVO-B-134	MV 134 FAILS TO OPEN	3
RCMVO-B-136	MV 136 FAILS TO OPEN	3
RCMVO-D-137	MV 137 FAILS TO OPEN	3
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	3
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	3
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	3
VOHVR2B-HV33B	FAILS TO RUN OF MAFP ROOM B CUBICLE COOLER HV33B	3
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	3
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	3
AFMPS2B-MDP02B	FAILS TO START AFW MDP PP02B	3
PFHBC1B-SW01B-A2	FAILS TO CLOSE OF PCB SW01B-A2 OF 4.16kV SWGR SW01B	3
SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M	3
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	3
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO T&M	3

Table 19.1-68 (6 of 12)

Basic Event	Description	RAW
VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B	3
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	3
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	3
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	3
PHBSY1B-MC02B	BUS FAULT ON 480V MCC MC02B	3
CCMPM2B-PP02B	CCW PUMP PP02B UNAVAILABLE DUE TO T&M	3
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	3
DCBTT-A-BT01A	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	3
VGAHM2A-AH02A	ESW PUMP A FAN 605-VG-AH02A UNAVAILABLE DUE TO T&M	3
VOHVM2A-HV32A	CUBICLE COOLER HV32A UNAVAILABLE DUE TO T&M	3
SXAHM-A-AH02A	ESW COOLING FAN AH02A UNAVAILABLE DUE TO T&M	3
VGAHM2B-AH02B	ESW PUMP B FAN 605-VG-AH02B UNAVAILABLE DUE TO T&M	3
CCMPS2A-PP02A	CCW PUMP PP02A FAILS TO START	3
VOHVM2B-HV32B	CUBICLE COOLER HV32B UNAVAILABLE DUE TO T&M	3
SXMPS2A-PP02A	ESW PUMP PP02A FAILS TO START	3
WOMPS2A-PP02A	FAILS TO START OF ECW PUMP 02A	3
VKHVM2A-HV14A	CUBICLE COOLER HV14A UNAVAILABLE DUE TO T&M	3
SXAHM-B-AH02B	ESW COOLING FAN AH02B UNAVAILABLE DUE TO T&M	3
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	3
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	3

Table 19.1-68 (7 of 12)

Basic Event	Description	RAW
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	3
DCBTT-B-BT01B	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	3
CCMPS2B-PP02B	CCW PUMP PP02B FAILS TO START	3
WOMPS2B-PP02B	FAILS TO START OF ECW PUMP 02B	3
SXMPS2B-PP02B	ESW PUMP PP02B FAILS TO START	3
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	3
CCMVO-A-131	CCW MOV 131 FOR ECW CHILLER CH02A OUTLET FAIL TO OPEN	3
AFTPWD2-TDP01A/B	2/2 CCF OF FOR AFW TDP PP01/A/B FAIL TO START	3
PELXKD2-LX01A02B	2/2 CCF OF LOOP CONTROLLER 745-LX01A, LX02B	3
VKHVM2B-HV14B	CUBICLE COOLER HV14B UNAVAILABLE DUE TO T&M	3
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	3
CCMVO-B-132	CCW MOV 132 FOR ECW CHILLER CH02B OUTLET FAIL TO OPEN	3
DCBTM-D-BT01D	CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M	3
WOCHR2A-CH02A	ECW CHILLER 02A FAILS TO RUN FOR 24 HOURS	3
IPINM-D-IN01D	CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M	3
VGAHS2A-AH02A	FAILS TO START OF EWS PUMP ROOM I. SUPPLY FAN AH02A	3
WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS	3
VOHVS2A-HV32A	FAILS TO START OF ECW ROOM CUBICLE COOLER HV32A	3
DGDGR-D-DGD	FAILS TO RUN OF EDG D	3
WOCHR2B-CH02B	ECW CHILLER 02B FAILS TO RUN FOR 24 HOURS	3

Table 19.1-68 (8 of 12)

Basic Event	Description	RAW
VKHVS2A-HV14A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14A	3
VOHVS2B-HV32B	FAILS TO START OF ECW ROOM B CUBICLE COOLER HV32B	3
VGAHS2B-AH02B	EWS PUMP ROOM II. SUPPLY FAN AH02B FAILS TO START	3
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	3
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	3
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	3
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	3
DGDGKQ2-DG01BC	2/4 CCF OF EDG 01B/01C FAIL TO RUN	3
DCBTM-C-BT01C	CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M	2
IPINM-C-IN01C	CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M	2
AFMPR2B-MDP02B	FAILS TO RUN AFW MDP PP02B	2
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	2
RCINY1C-IN01C	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V131/V133/441-V653 FAILS	2
RCINY1A-IN01A	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V130/V132 FAILS	2
RCPVC-A-200	POSRV V200 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-C-201	POSRV V201 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-D-203	POSRV V203 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-B-202	POSRV V202 FAILS TO CLOSE (HARDWARE FAIL)	2
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	2
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	2

Table 19.1-68 (9 of 12)

Basic Event	Description	RAW
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	2
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	2
VKHVS2B-HV14B	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14B	2
DGDGR-C-DGC	FAILS TO RUN OF EDG C	2
RCINY1D-IN01D	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V135/V137/441-V654 FAILS	2
RCINY1B-IN01B	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V134/V136 FAILS	2
VOHVR1A-HV31A	FAILS TO RUN ECW ROOM CUBICLE COOLER HV31A	2
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2
IPINY-B-IN01B	120V AC POWER SUPPLY INVERTER IN01B FAILS WHILE OPERATING	2
DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
WOMPR1A-PP01A	FAILS TO RUN OF ECW PUMP 01A	2
SIMPM2A-PP02C	SI PUMP 2C UNAVAILABLE DUE TO T&M	2
DGDGS-D-DGD	FAILS TO START OF EDG D	2
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	2
AFCVO2A-V1003A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1003A	2
AFCVO2A-V1007A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1017A	2
AFCVO2A-V1012A	FAILS TO OPEN AFW MDP02A MINI FLOW CHECK VALVE V1012A	2
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	2
VDHVM-D-HV13D	CUBICLE COOLER HV13D UNAVAILABLE DUE TO T&M	2
VDHVM-D-HV12D	CUBICLE COOLER HV12D UNAVAILABLE DUE TO T&M	2

Table 19.1-68 (10 of 12)

Basic Event	Description	RAW
PELXY-C-LX05C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05C	2
PELXY-A-LX08A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX08A	2
DGDGL-C-DGC	DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	2
AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	2
DGDGS-C-DGC	FAILS TO START OF EDG C	2
CCCVC1A-V1001	CCW PP01A DISCH. CHECK VALVE V1001 FAILS TO CLOSE	2
SXCVC1A-V1001	ESW PP01A DISCH. CHECK VALVE V1001 FAIL TO RECLOSE	2
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	2
PELXY-D-LX05D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05D	2
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	2
NPXHY-N-SAT02N	SAT TR02N FAULT	2
SIOPU2A-V254	SI PUMP PP02C MINI FLOW VV 254 NOT RESTORED AFTER T&M	2
CCMVO-A-097	CS HX HE01A INLET MOV 097 FAILS TO OPEN	2
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	2
CSMVO1A-003	CS ISOL. MOV 003 IN CS TRAIN A DISCH. PATH FAILS TO OPEN	2
VDHVM-C-HV12C	CUBICLE COOLER HV12C UNAVAILABLE DUE TO T&M	2
VDHVM-C-HV13C	CUBICLE COOLER HV13C UNAVAILABLE DUE TO T&M	2
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	2
SXCVC1B-V1002	ESW PP01B DISCH. CHECK VALVE V1002 FAIL TO RECLOSE	2

Table 19.1-68 (11 of 12)

Basic Event	Description	RAW
CCCVC1B-V1002	CCW PP01B DISCH. CHECK VALVE V1002 FAILS TO CLOSE	2
VDHVL-D-HV12D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12D FOR 1HR	2
VDHVL-D-HV13D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13D FOR 1HR	2
VDHVR-D-HV13D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13D	2
VDHVR-D-HV12D	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12D	2
AFMPL2B-MDP02B	FAILS TO RUN FOR 1HR AFW MDP PP02B FOR 1HR	2
CCMVO-D-182	CCW MOV 182 FOR EDG01D INLET FAILS TO OPEN	2
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	2
CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE	2
VDHVS-D-HV13D	FAILS TO START EDG ROOM CUBICLE COOLER HV13D	2
VDHVS-D-HV12D	FAILS TO START EDG ROOM CUBICLE COOLER HV12D	2
AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION	2
AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	2
VGAHR2A-AH02A	FAILS TO RUN OF ESW PUMP ROOM I. FAN AH02A	2
VKHVR2A-HV14A	FAILS TO RUN CCW PUMP ROOM CUBICLE COOLER HV14A	2
VOHVR2A-HV32A	FAILS TO RUN ECW ROOM CUBICLE COOLER HV32A	2
PELXY-C-LX03C-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	2
PELXY-C-LX01C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01C	2
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	2

Table 19.1-68 (12 of 12)

Basic Event	Description	RAW
VDHVL-C-HV13C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13C FOR 1HR	2
VDHVL-C-HV12C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12C FOR 1HR	2
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	2
VDHVR-C-HV13C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13C	2
VDHVR-C-HV12C	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12C	2

Table 19.1-69 (1 of 3)

Internal Flooding PRA Key Basic Events by FV (CDF)

Basic Event	Description	FV
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	18.3%
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	14.8%
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	7.3%
AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	7.3%
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	6.7%
AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION	6.4%
AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	6.4%
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	4.8%
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	4.7%
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	4.5%
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	4.5%
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	4.2%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	4.0%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	3.6%
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	3.1%
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	3.0%
SXMPM2B-PP02B	ESW PUMP PP02B UNAVAILABLE DUE TO T&M	3.0%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	2.9%
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	2.3%

Table 19.1-69 (2 of 3)

Basic Event	Description	FV
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	2.2%
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	2.2%
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2.0%
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	1.9%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	1.9%
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	1.7%
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	1.7%
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	1.5%
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO T&M	1.5%
PFHBC1B-SW01B-A2	FAILS TO CLOSE OF PCB SW01B-A2 OF 4.16kV SWGR SW01B	1.5%
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	1.5%
NPXHM-N-SAT02N	SAT TR02N UNAVAILABLE DUE TO MAINTENANCE	1.5%
NPXHM-M-SAT02M	SAT TR02M UNAVAILABLE DUE TO MAINTENANCE	1.4%
RCPVO-C-201	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)	1.2%
RCPVO-A-200	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)	1.2%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	1.1%
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	1.0%
RCPVO-B-202	POSRV V202 FAILS TO OPEN (HARDWARE FAIL)	1.0%
RCPVO-D-203	POSRV V203 FAILS TO OPEN (HARDWARE FAIL)	1.0%
DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	1.0%

Table 19.1-69 (3 of 3)

Basic Event	Description	FV
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	1.0%
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	1.0%
CCMPM2B-PP02B	CCW PUMP PP02B UNAVAILABLE DUE TO T&M	1.0%
CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE	0.7%
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	0.7%
AFTPS1B-TDP01B	FAILS TO START AFW TDP PP01B	0.6%
CSMPM2B-PP01B	CS PUMP PP01B UNAVAILABLE DUE TO MAINTENANCE	0.6%
DGDGM-A-DGA	DG 01A UNAVAILABLE DUE TO MAINTENANCE	0.6%
AFTPM1A-TDP01A	AFW TDP PP01A UNAVAILABLE DUE TO T&M	0.5%
DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	0.5%
VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M	0.5%
PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16kV SWGR SW01C	0.5%

Table 19.1-70 (1 of 6)

Internal Flooding PRA Key CCF Events by RAW (CDF)

Basic Event	Description	RAW
RPRBWO8-TCBALL	CCF FAILURE OF ALL TRIP CIRCUIT BRAKER TCB	1.2E+04
RPRBWO4-TCB-AB1AC2	4/8 CCF OF TCB A-1, B-1, A-2, C-2	1.2E+04
RPRBWO4-TCB-AB1BD2	4/8 CCF OF TCB A-1, B-1, B-2 D-2	1.2E+04
RPRBWO4-TCB-CD1BD2	4/8 CCF OF TCB C-1, D-1, B-2, D-2	1.2E+04
RPRBWO4-TCB-CD1AC2	4/8 CCF OF TCB C-1, D-1, A-2 C-2	1.2E+04
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	8000
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	3650
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	3290
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	1950
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	1870
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	1830
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	1800
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	1720
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	919
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN	831
PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN	763
VGAHKQ3-AH01A/2A/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A, 02B	685
AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN	670
CCMPKQ3-PP01A/2A/B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (RUNNING)	670

Table 19.1-70 (2 of 6)

Basic Event	Description	RAW
SXMPKQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (RUNNING)	668
SXAHKQ3-AH01A/02A/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 02B	646
AFCVWO4-V1007AB/8AB	4/8 CCF OF AF DISCH. CHECK VALVE V1007AB/8AB FAIL TO OPEN	640
AFCVWO4-V1003AB/4AB	4/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB FAIL TO OPEN	640
VGAHKQ3-AH01B/2A/2B	3/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A, 02B	626
CCMPKQ3-PP01B/2A/B	3/4 CCF OF CCW PUMPS PP01B/2A/2B (RUNNING)	615
AFCVWO8-V1003AB/4AB/7AB/8AB	8/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB/7AB/8AB FAIL TO OPEN	614
SXMPKQ3-PP01B/2A/B	3/4 CCF OF ESW PUMPS PP02A, PP01B, PP02B (RUNNING)	614
SXAHKQ3-AH02A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B, 02B	591
AFCVWQ4-V1012A/B/4A/B	4/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 1014A/B FAIL TO OPEN	514
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	270
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	250
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	245
SXAHKQ3-AH01A/02A/01B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B	226
DCBTWQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS UPON DEMAND	130
PFHBWQ2-SW2OUATBC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C FAIL TO OPEN	117
PFHBWQ2-SW2OUATAD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1D FAIL TO OPEN	116
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	107
AFPVKQ3-TP01A/B/MP02A	3/4 CCF OF AFW TDP01A/B, MDP02A DUE TO THE VOLUTE FAIL TO RUN	76

Table 19.1-70 (3 of 6)

Basic Event	Description	RAW
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	75
VOHVKQ4-HV32A/32B/31A/31B	4/4 CCF OF RUN FOR CUBICLE COOLER HV32A/32B/31A/31B	75
AFPVKQ3-TP01A/B/MP02B	3/4 CCF OF AFW TDP01A/B, MDP02B DUE TO THE VOLUTE FAIL TO RUN	72
PFHBWQ2-SW2OUATCD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01C,1D FAIL TO OPEN	67
SXMPKQ2-PP01/2A	2/4 CCF OF ESW PUMPS PP01A, PP02A (RUNNING)	66
CCMPKQ2-PP01/2A	2/4 CCF OF CCW PUMPS PP01A/2A (RUNNING)	66
VGAHKQ2-AH01A/2A	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A	61
AFPVKQ3-TP01A/MP02A/B	3/4 CCF OF AFW TDP01A, MDP02A/B DUE TO THE VOLUTE FAIL TO RUN	61
PFHBWQ2-SW2OUATAB	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B FAIL TO OPEN	56
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	55
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	55
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	49
CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	49
SIMVWQ4-616/26/36/46	4/4 CCF OF DVI LINEMOV 616,626,636,646	49
SICVWO8-DVIS	8/8 CCF OF SI LINE CHECK VALVES 123,143,217,227,237,247,541,543 TO OPEN	49
SICVWO8-SIPUMPS	8/8 CCF OF SI PUMP DISCHARGE LINE CV 113,133,404,405,434,446,540,542 TO OPEN	49
SICVWO4-V123/217/37/47	4/8 CCF OF SI LINE CHECK VALVES 123,217,237,247	49
SICVWO4-V123/217/37/543	4/8 CCF OF SI LINE CHECK VALVES 123,217,237,543	49
SICVWO4-V123/43/217/37	4/8 CCF OF SI LINE CHECK VALVES 123,143,217,237	49

Table 19.1-70 (4 of 6)

Basic Event	Description	RAW
SICVWO4-V113/404/05/34	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,404,405,434	49
SICVWO4-V113/33/404/05	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,133,404,405	49
SICVWO4-V404/05/540/42	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,540,542	49
SICVWO4-V113/404/05/542	4/8 CCF OF SI PUMP DISCHARGE LINE CV 113,404,405,542	49
SICVWO4-V217/37/47/541	4/8 CCF OF SI LINE CHECK VALVES 217,237,247,541	49
SICVWO4-V143/217/27/37	4/8 CCF OF SI LINE CHECK VALVES 143,217,227,237	49
SICVWO4-V217/37/541/43	4/8 CCF OF SI LINE CHECK VALVES 217,237,541,543	49
SICVWO4-V143/217/37/541	4/8 CCF OF SI LINE CHECK VALVES 143,217,237,541	49
SICVWO4-V217/27/37/47	4/8 CCF OF SI LINE CHECK VALVES 217,227,237,247	49
SICVWO4-V217/27/37/543	4/8 CCF OF SI LINE CHECK VALVES 217,227,237,543	49
SICVWO4-V404/05/46/542	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,446,542	49
SICVWO4-V133/404/05/46	4/8 CCF OF SI PUMP DISCHARGE LINE CV 133,404,405,446	49
SICVWO4-V133/404/05/540	4/8 CCF OF SI PUMP DISCHARGE LINE CV 133,404,405,540	49
SICVWO4-V404/05/34/46	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,434,446	49
SICVWO4-V404/05/34/540	4/8 CCF OF SI PUMP DISCHARGE LINE CV 404,405,434,540	49
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 SC CV 159/160	49
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCH LINE 1001, 1002 AND SCP DISCH. LINE CV 568,569	49
SICVWQ4-V424/26/48/51	4/4 CCF OF SI LINE C/V 424,426,448,451 TO OPEN	49
SICVWD2-V100/01	2/2 CCF OF CV 100/101 IN TRAIN A&B IRWST RETURN LINES	49
PELXKQ4-LX8A/12B/1C/1D	4/4 CCF OF LOOP CONTROLLER LX08A 12, LX12B 12, LX01C 12, LX01D 12	49

Table 19.1-70 (5 of 6)

Basic Event	Description	RAW
PELXKQ4-LX1A/1B/1C/1D	4/4 CCF OF LOOP CONTROLLER LX01A, LX01B, LX01C, LX01D	49
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	49
SIMPZQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D FOR 1HR	49
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	49
CCMPKQ2-PP01/2B	2/4 CCF OF CCW PUMPS PP01B/2B (RUNNING)	47
SXMPKQ2-PP01/2B	2/4 CCF OF ESW PUMPS PP01B, PP02B (RUNNING)	46
VGAHKQ2-AH01B/2B	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02B	44
AFPVKQ3-TP01B/MP02A/B	3/4 CCF OF AFW TDP01B, MDP02A/B DUE TO THE VOLUTE FAIL TO RUN	40
DCBTWQ3-BT01BCD	3/4 CCF OF 125V DC BATTERY BT01B/01C/01D FAILS UPON DEMAND	39
WOCHKQ3-CH01A/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/2B	38
DCBTWQ3-BT01ABD	3/4 CCF OF 125V DC BATTERY BT01A/01B/01D FAILS UPON DEMAND	36
SXAHKQ3-AH01A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 01B, 02B	34
SXMPKQ2-PP01A/2B	2/4 CCF OF ESW PUMPS PP01A, PP02B (RUNNING)	28
SXMPKQ2-PP02A/1B	2/4 CCF OF ESW PUMPS PP02A, PP01B (RUNNING)	28
WOCHKQ3-CH02A/1B/2B	RUNNING CCF OF ECW CHILLERS 2A/1B/2B	25
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	25
VDHVZO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR	24
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	24
SXAHKQ2-AH01A/02B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02B	24
CCMPKQ2-PP01A/2B	2/4 CCF OF CCW PUMPS PP01A/2B (RUNNING)	24

Table 19.1-70 (6 of 6)

Basic Event	Description	RAW
VGAHKQ2-AH01A/2B	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02B	24
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	23
SXAHKQ2-AH02A/01B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B	22
CCMPKQ2-PP01B/2A	2/4 CCF OF CCW PUMPS PP01B/2A (RUNNING)	22
VGAHKQ2-AH01B/2A	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A	22
DCBTWQ3-BT01ACD	3/4 CCF OF 125V DC BATTERY BT01A/01C/01D FAILS UPON DEMAND	22
SXAHKQ2-AH01A/02A	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A	21
DCBTKQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS TO RUN	21
DGSQWQ4-LOADSQABCD	4/4 CCF OF LOAD SEQUNCER A, B, C, D FAIL TO OPERATE	20
DGDGWQ4-DG01ABCD	4/4 CCF OF EDGS FAIL TO START	20

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-71

Internal Flooding PRA Key CCF Events by FV (CDF)

Basic Event	Description	FV
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	21.7%
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	6.0%
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	5.4%
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN	5.0%
PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN	4.6%
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	3.2%
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	1.5%
PFHBWQ2-SW2OUATBC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C FAIL TO OPEN	0.7%
PFHBWQ2-SW2OUATAD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1D FAIL TO OPEN	0.7%

Table 19.1-72

Internal Flooding PRA Key Operator Actions by RAW (CDF)

Basic Event	Description	RAW
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	8
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGN FOR SUPPLYING AN ALTERNATE SOURCE	6
WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B	2
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	2
SIOPU2A-V254	SI PUMP PP02C MINI FLOW VV 254 NOT RESTORED AFTER T&M	2

Table 19.1-73

Internal Flooding PRA Key Operator Actions by FV (CDF)

Basic Event	Description	FV
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	6.1%
FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE A FIRE PROTECTION BREAK IN LESS THAN 20 MINUTES	2.5%
WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B	2.4%
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	2.2%

Table 19.1-74 (1 of 11)

Internal Flooding PRA Key Basic Events by RAW (LRF)

Basic Event	Description	RAW
I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES	2.5E+04
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	317
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	304
SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED	114
SXMVR-A-MV072	LOSS OF SX DIV.II DUE TO THE MOV072 SPURIOUS OPEN (FLOW DIVERSION)	86
SXMVR-A-MV071	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	86
CCHEY01A-HE01A	CCW HX HE01A FAILS WHILE OPERATING	74
CCHEY02A-HE02A	CCW HX HE02A FAILS WHILE OPERATING	74
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	64
SXMVR-B-MV073	LOSS OF SX DIV. I DUE TO THE MOV071 SPURIOUS CLOSURE	62
SXMVR-B-MV074	LOSS OF SX DIV.II DUE TO THE MOV074 SPURIOUS OPEN (FLOW DIVERSION)	62
CCHEY02B-HE02B	CCW HX HE02B FAILS WHILE OPERATING	57
CCHEY01B-HE01B	CCW HX HE01B FAILS WHILE OPERATING	57
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	26
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	22
PALXKD2-PA06CD	2/2 CCF OF LOOP CONTROLLER PA06C, PA06D	13
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	12
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	12
PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS	11

Table 19.1-74 (2 of 11)

Basic Event	Description	RAW
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	11
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	11
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	11
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	9
NPXHM-N-SAT02N	SAT TR02N UNAVAILABLE DUE TO MAINTENANCE	9
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	8
NPXHM-M-SAT02M	SAT TR02M UNAVAILABLE DUE TO MAINTENANCE	8
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	8
SXMPR1A-PP01A	ESW PUMP PP01A FAILS TO RUN	7
SXMPR1B-PP01B	ESW PUMP PP01B FAILS TO RUN	7
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO CLOSE	7
DEAVC-S-006	CTMT. ISOL. AOV DE-006 FAIL TO CLOSE	7
PEDOY-D-LX02D04	FAILURE OF DIGITAL OUTPUT MODULE 745-PE-LX02D BRANCH 04	7
VGAHR1A-AH01A	ESW PUMP ROOM I. FAN AH01A FAILS TO RUN	6
CCMPR1A-PP01A	CCW PUMP PP01A FAILS TO RUN	6
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	6
CCMPR1B-PP01B	CCW PUMP PP01B FAILS TO RUN	6
VGAHR1B-AH01B	ESW PUMP ROOM II. FAN AH01B FAILS TO RUN	6
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	6
SXAHR-A-AH01A	ESW COOLING TOWER FAN AH01A FAILS TO RUN	6

Table 19.1-74 (3 of 11)

Basic Event	Description	RAW
SXAHR-B-AH01B	ESW COOLING TOWER FAN AH01B FAILS TO RUN	6
PGBSY1A-LC02A	BUS FAULT ON 480V LC LC02A	6
PGBSY1B-LC02B	BUS FAULT ON 480V LC LC02B	5
RCPVO-C-201	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)	5
RCPVO-A-200	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)	5
PELXKD2-LX05AB	2/2 CCF OF LOOP CONTROLLER 745-LX05A, LX05B	5
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	5
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	5
CVAVWD2-505/6	2/2 CCF OF AV 505, 506	5
CVAVWD2-522/3	2/2 CCF OF AV 522, 523	5
CVAVWD2-560/1	2/2 CCF OF AV 560, 561	5
CI-HATCH	HATCH FAILS TO ISOLATE	5
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	5
PGXMY1A-TR02A	480V LC TRANSFORMER LC-TR02A FAULT	5
PGXMY1B-TR02B	480V LC TRANSFORMER LC-TR02B FAULT	5
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	5
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	5
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	5
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	5
RCPVO-B-202	POSRV V202 FAILS TO OPEN (HARDWARE FAIL)	5

Table 19.1-74 (4 of 11)

Basic Event	Description	RAW
RCPVO-D-203	POSRV V203 FAILS TO OPEN (HARDWARE FAIL)	5
RCMVO-C-131	MV 131 FAILS TO OPEN	5
RCMVO-C-133	MV 133 FAILS TO OPEN	5
RCMVO-A-130	MV 130 FAILS TO OPEN	5
RCMVO-A-132	MV 132 FAILS TO OPEN	5
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	5
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	5
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	4
PELXY-D-LX02D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02D	4
RCMVO-B-136	MV 136 FAILS TO OPEN	4
RCMVO-B-134	MV 134 FAILS TO OPEN	4
RCMVO-D-137	MV 137 FAILS TO OPEN	4
RCMVO-D-135	MV 135 FAILS TO OPEN	4
PELXY-C-LX02C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX02C	4
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	4
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	4
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	4
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	4
AFTPKD2-TDP01A/B	2/2 CCF OF FOR AFW TDP PP01/A/B FAIL TO RUN	4
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	4

Table 19.1-74 (5 of 11)

Basic Event	Description	RAW
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	4
PHBSY1A-MC02A	BUS FAULT ON 480V MCC MC02A	4
PHBSY1B-MC02B	BUS FAULT ON 480V MCC MC02B	4
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	4
PGBSY2B-LC01D	BUS FAULT ON 480V LC LC01D	4
PFBSY2B-SW01D	BUS FAULT ON 4.16kV SWGR SW01D	4
PFHBC1B-SW01B-A2	FAILS TO CLOSE OF PCB SW01B-A2 OF 4.16kV SWGR SW01B	4
DCBTT-A-BT01A	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	4
AFTPZD2-TDP01A/B	2/2 CCF OF FOR AFW TDP PP01/A/B FAIL TO RUN FOR 1HR	4
PGXMY2B-TR01D	480V LC TRANSFORMER LC-TR01D FAULT	4
DCBTT-B-BT01B	CLASS 1E 125V DC BATTERY BT01A FAILS BETWEEN TEST INTERVAL	3
CVAVC-S-505	CTMT. ISOL. AOV CV-505 FAIL TO CLOSE	3
CVAVC-S-523	CTMT. ISOL. AOV CV-523 FAIL TO CLOSE	3
CVAVC-S-561	CTMT. ISOL. AOV CV-561 FAIL TO CLOSE	3
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	3
VOHVKD2-HV33A/33B	2/2 CCF OF FOR CUBICLE COOLER HV33A/33B	3
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	3
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	3
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	3
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	3

Table 19.1-74 (6 of 11)

Basic Event	Description	RAW
RCINY1A-IN01A	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V130/V132 FAILS	3
RCINY1C-IN01C	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V131/V133/441-V653 FAILS	3
SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M	3
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	3
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	3
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO T&M	3
DCBTM-C-BT01C	CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M	3
IPINM-C-IN01C	CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M	3
DCBTM-D-BT01D	CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M	3
IPINM-D-IN01D	CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M	3
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	3
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	3
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	3
RCINY1B-IN01B	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V134/V136 FAILS	3
RCINY1D-IN01D	INVERTER FOR POSRV MOTOR OPERTAED PILOT VVs 431-V135/V137/441-V654 FAILS	3
IPINY-B-IN01B	120V AC POWER SUPPLY INVERTER IN01B FAILS WHILE OPERATING	3
CCMPM2B-PP02B	CCW PUMP PP02B UNAVAILABLE DUE TO T&M	3
SICVWD2-V100/01	2/2 CCF OF CV 100/101 IN TRAIN A&B IRWST RETURN LINES	3
VOHVM1B-HV33B	CUBICLE COOLER HV33B UNAVAILABLE DUE TO T&M	3
PELXY-C-LX05C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05C	3

Table 19.1-74 (7 of 11)

Basic Event	Description	RAW
PELXY-A-LX08A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX08A	3
VGAHM2A-AH02A	ESW PUMP A FAN 605-VG-AH02A UNAVAILABLE DUE TO T&M	3
VOHVM2A-HV32A	CUBICLE COOLER HV32A UNAVAILABLE DUE TO T&M	3
SXAHM-A-AH02A	ESW COOLING FAN AH02A UNAVAILABLE DUE TO T&M	3
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	3
PELXY-D-LX05D-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05D	3
AFMPL2A-MDP02A	FAILS TO RUN FOR 1HR AFW MDP PP02A	3
VKHVM2A-HV14A	CUBICLE COOLER HV14A UNAVAILABLE DUE TO T&M	3
VGAHM2B-AH02B	ESW PUMP B FAN 605-VG-AH02B UNAVAILABLE DUE TO T&M	3
VOHVM2B-HV32B	CUBICLE COOLER HV32B UNAVAILABLE DUE TO T&M	3
VOHVR2B-HV33B	FAILS TO RUN OF MAFP ROOM B CUBICLE COOLER HV33B	3
SXAHM-B-AH02B	ESW COOLING FAN AH02B UNAVAILABLE DUE TO T&M	3
CCMPS2A-PP02A	CCW PUMP PP02A FAILS TO START	3
SXMPS2A-PP02A	ESW PUMP PP02A FAILS TO START	3
WOMPS2A-PP02A	FAILS TO START OF ECW PUMP 02A	3
DGDGR-D-DGD	FAILS TO RUN OF EDG D	3
AFMPS2B-MDP02B	FAILS TO START AFW MDP PP02B	3
PEDOY-C-LX05C01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX05C BRANCH 01	3
PEDOY-A-LX08A01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX08A BRANCH 01	3
VOHVS2B-HV33B	FAILS TO START OF MAFP ROOM B CUBICLE COOLER HV33B	2

Table 19.1-74 (8 of 11)

Basic Event	Description	RAW
CCMPS2B-PP02B	CCW PUMP PP02B FAILS TO START	2
WOMPS2B-PP02B	FAILS TO START OF ECW PUMP 02B	2
SXMPS2B-PP02B	ESW PUMP PP02B FAILS TO START	2
CCMVO-A-097	CS HX HE01A INLET MOV 097 FAILS TO OPEN	2
CSMVO1A-003	CS ISOL. MOV 003 IN CS TRAIN A DISCH. PATH FAILS TO OPEN	2
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	2
VKHVM2B-HV14B	CUBICLE COOLER HV14B UNAVAILABLE DUE TO T&M	2
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	2
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	2
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1011A TRANSFER CLOSED	2
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	2
CCMVO-A-131	CCW MOV 131 FOR ECW CHILLER CH02A OUTLET FAIL TO OPEN	2
DGDGR-C-DGC	FAILS TO RUN OF EDG C	2
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	2
CSMPM2A-PP01A	CS PUMP 1 PP01A UNAVAILABLE DUE TO MAINTENANCE	2
PEDOY-D-LX05D01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX05D BRANCH 01	2
PEDOY-B-LX09B01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX09B BRANCH 01	2
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2
CCMVO-B-132	CCW MOV 132 FOR ECW CHILLER CH02B OUTLET FAIL TO OPEN	2
WOCHR2A-CH02A	ECW CHILLER 02A FAILS TO RUN FOR 24 HOURS	2

Table 19.1-74 (9 of 11)

Basic Event	Description	RAW
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	2
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	2
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	2
VGAHS2A-AH02A	FAILS TO START OF EWS PUMP ROOM I. SUPPLY FAN AH02A	2
VOHVS2A-HV32A	FAILS TO START OF ECW ROOM CUBICLE COOLER HV32A	2
VKHVS2A-HV14A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14A	2
DGDGL-D-DGD	DG D FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
WOCHR2B-CH02B	ECW CHILLER 02B FAILS TO RUN FOR 24 HOURS	2
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	2
VGAHS2B-AH02B	EWS PUMP ROOM II. SUPPLY FAN AH02B FAILS TO START	2
VOHVS2B-HV32B	FAILS TO START OF ECW ROOM B CUBICLE COOLER HV32B	2
VKHVM1A-HV10A	CUBICLE COOLER HV10A UNAVAILABLE DUE TO T&M	2
DGDGS-D-DGD	FAILS TO START OF EDG D	2
WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS	2
RCPVC-D-203	POSRV V203 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-A-200	POSRV V200 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-C-201	POSRV V201 FAILS TO CLOSE (HARDWARE FAIL)	2
RCPVC-B-202	POSRV V202 FAILS TO CLOSE (HARDWARE FAIL)	2
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	2
DGDGL-C-DGC	DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2

Table 19.1-74 (10 of 11)

Basic Event	Description	RAW
VKHVS2B-HV14B	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14B	2
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	2
DGDGS-C-DGC	FAILS TO START OF EDG C	2
VDHVM-D-HV12D	CUBICLE COOLER HV12D UNAVAILABLE DUE TO T&M	2
VDHVM-D-HV13D	CUBICLE COOLER HV13D UNAVAILABLE DUE TO T&M	2
VKHVL1A-HV10A	FAILS TO RUN CS PUMP 01A ROOM CUBICLE COOLER HV10A FOR 1HR	2
VKHVR1A-HV10A	FAILS TO RUN CS PUMP 01A ROOM CUBICLE COOLER HV10A	2
CSMPS2A-PP01A	CS PUMP 1 PP01A FAILS TO START	2
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	2
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	2
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	2
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	2
AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	2
VKHVS1A-HV10A	FAILS TO START CS PUMP 01A ROOM CUBICLE COOLER HV10A	2
CSMPM2B-PP01B	CS PUMP PP01B UNAVAILABLE DUE TO MAINTENANCE	2
VDHVM-C-HV13C	CUBICLE COOLER HV13C UNAVAILABLE DUE TO T&M	2
VDHVM-C-HV12C	CUBICLE COOLER HV12C UNAVAILABLE DUE TO T&M	2
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	2
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	2
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	2

Table 19.1-74 (11 of 11)

Basic Event	Description	RAW
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	2
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	2
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	2

Table 19.1-75 (1 of 3)

Internal Flooding PRA Key Basic Events by FV (LRF)

Basic Event	Description	FV
ERVC	EXTERNAL REACTOR VESSEL COOLING FAILS	51.3%
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	16.7%
PFHBO1B-SW01B-H2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01B-H2 (UAT) FAILS TO OPEN	13.8%
AFMVC1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO CLOSE	6.6%
AFMVO1A-045	AF TURBINE-DRIVEN PUMP 1A DISCHARGE ISOLATION VALVE 045 FAIL TO OPEN	6.6%
PFHBO2A-SW01C-C2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01C-C2 (UAT) FAILS TO OPEN	6.4%
AFMVC1B-046	AFW ISOL. MOV 046 FAILS TO OPEN FOR CYCLING OPERATION	5.9%
AFMVO1B-046	AFW ISOL. MOV 046 FAILS TO CLOSE FOR CYCLING OPERATION	5.9%
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	4.7%
WOCHM2A-CH02A	ECW CHILLER 02A TRAIN UNAVAILABLE DUE TO T&M	4.6%
WOCHM2B-CH02B	ECW CHILLER 02B TRAIN UNAVAILABLE DUE TO T&M	4.4%
AFTPR1A-TDP01A	AFW PUMP 1A FAILS TO RUN	4.1%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	4.0%
AFTPR1B-TDP01B	AFW PUMP 1B FAIL TO RUN	3.8%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	3.7%
DCBTM-A-BT01A	CLASS 1E 125V DC BATTERY BT01A UNAVAILABLE DUE TO T&M	3.1%
DCBTM-B-BT01B	CLASS 1E 125V DC BATTERY BT01B UNAVAILABLE DUE TO T&M	3.0%
SXMPM2A-PP02A	ESW PUMP PP02A UNAVAILABLE DUE TO T&M	3.0%
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	2.9%

Table 19.1-75 (2 of 3)

Basic Event	Description	FV
SXMPM2B-PP02B	ESW PUMP 2B UNAVAILABLE DUE TO T&M	2.8%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	2.8%
PFLOOP-TRANS	CONDITIONAL LOOP UPON TRANSIENTS	2.5%
IPINM-A-IN01A	CLASS 1E 120V AC INVERTER IN01A UNAVAILABLE DUE TO T&M	2.3%
DGDGM-D-DGD	EDG D UNAVAILABLE DUE TO T&M	2.2%
IPINM-B-IN01B	CLASS 1E 120V AC INVERTER IN01B UNAVAILABLE DUE TO T&M	2.1%
DGDGM-C-DGC	EDG C UNAVAILABLE DUE TO T&M	2.0%
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	2.0%
PFHBC1B-SW01B-A2	FAILS TO CLOSE OF PCB SW01B-A2 OF 4.16kV SWGR SW01B	1.8%
RCPVO-C-201	POSRV V200 FAILS TO OPEN (HARDWARE FAIL)	1.6%
RCPVO-A-200	POSRV V201 FAILS TO OPEN (HARDWARE FAIL)	1.6%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	1.5%
WOMPM2A-PP02A	ECW PP02A TRAIN UNAVAILABLE DUE TO T&M	1.5%
WOMPM2B-PP02B	ECW PUMP 2B UNAVAILABLE DUE TO T&M	1.4%
RCPVO-B-202	POSRV V202 FAILS TO OPEN (HARDWARE FAIL)	1.4%
RCPVO-D-203	POSRV V203 FAILS TO OPEN (HARDWARE FAIL)	1.4%
AFMPM2A-MDP02A	AFW PUMP 2A UNAVAILABLE DUE TO T&M	1.4%
NPXHM-N-SAT02N	SAT TR02N UNAVAILABLE DUE TO MAINTENANCE	1.3%
NPXHM-M-SAT02M	SAT TR02M UNAVAILABLE DUE TO MAINTENANCE	1.3%
CSMPM2A-PP01A	CCW PUMP PP01A UNAVAILABLE DUE TO T&M	1.0%

Table 19.1-75 (3 of 3)

Basic Event	Description	FV
DGDGR-A-DGA	FAILS TO RUN OF EDG A	1.0%
CCMPM2A-PP02A	CCW PUMP PP02A UNAVAILABLE DUE TO T&M	0.9%
CCMPM2B-PP02B	CCW PUMP PP02B UNAVAILABLE DUE TO T&M	0.9%
DGDGM-B-DGB	EDG B UNAVAILABLE DUE TO T&M	0.8%
AFMPM2B-MDP02B	AFW MDP PP02B UNAVAILABLE DUE TO T&M	0.8%
CSMPM2B-PP01B	CS PUMP PP01B UNAVAILABLE DUE TO MAINTENANCE	0.8%
I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES	0.7%
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO CLOSE	0.7%
VOHVM2A-HV33A	CUBICLE COOLER HV33A UNAVAILABLE DUE TO T&M	0.7%
SXFLP-S-FT0123AB	ESW DEBRIS FILTERS PLUGGED	0.6%
DCBTM-C-BT01C	CLASS 1E 125V DC BATTERY BT01C UNAVAILABLE DUE TO T&M	0.6%
DCBTM-D-BT01D	CLASS 1E 125V DC BATTERY BT01D UNAVAILABLE DUE TO T&M	0.6%
AFTPS1A-TDP01A	FAILS TO START AFW TDP PP01A	0.6%
IPINM-C-IN01C	CLASS 1E 120V AC INVERTER IN01C UNAVAILABLE DUE TO T&M	0.6%
IPINM-D-IN01D	CLASS 1E 120V AC INVERTER IN01D UNAVAILABLE DUE TO T&M	0.6%
DEAVC-S-006	CTMT. ISOL. AOV DE-006 FAIL TO CLOSE	0.5%
AFTPS1B-TDP01B	AFTPS1B-TDP01B	0.5%

Table 19.1-76 (1 of 4)

Internal Flooding PRA Key CCF Events by RAW (LRF)

Basic Event	Description	RAW
RPRBWO8-TCBALL	CCF FAILURE OF ALL TRIP CIRCUIT BRAKER TCB	1.9E+04
RPRBWO4-TCB-CD1AC2	4/8 CCF OF TCB C-1, D-1, A-2 C-2	1.9E+04
RPRBWO4-TCB-CD1BD2	4/8 CCF OF TCB C-1, D-1, B-2, D-2	1.9E+04
RPRBWO4-TCB-AB1AC2	4/8 CCF OF TCB A-1, B-1, A-2, C-2	1.9E+04
RPRBWO4-TCB-AB1BD2	4/8 CCF OF TCB A-1, B-1, B-2 D-2	1.9E+04
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	8870
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	4140
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	3870
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	2450
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	2390
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	2340
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	2250
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	1730
VGAHKQ3-AH01A/2A/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A, 02B	889
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	889
CCMPKQ3-PP01A/2A/B	3/4 CCF OF CCW PUMPS PP01A/2A/2B (RUNNING)	869
SXMPKQ3-PP01A/2A/B	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP02B (RUNNING)	868
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN	844
SXAHKQ3-AH01A/02A/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 02B	840

Table 19.1-76 (2 of 4)

Basic Event	Description	RAW
VGAHKQ3-AH01B/2A/2B	3/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A, 02B	820
CCMPKQ3-PP01B/2A/B	3/4 CCF OF CCW PUMPS PP01B/2A/2B (RUNNING)	806
SXMPKQ3-PP01B/2A/B	3/4 CCF OF ESW PUMPS PP02A, PP01B, PP02B (RUNNING)	804
PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN	777
SXAHKQ3-AH02A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B, 02B	775
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	354
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	328
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	322
SXAHKQ3-AH01A/02A/01B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B	297
AFPVKQ4-TP01A/B/MP02A/B	CCF OF ALL AF PUMPS FAIL DUE TO THE VOLUTE FAIL TO RUN	248
AFCVWO4-V1003AB/4AB	4/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB FAIL TO OPEN	212
AFCVWO4-V1007AB/8AB	4/8 CCF OF AF DISCH. CHECK VALVE V1007AB/8AB FAIL TO OPEN	212
AFCVWO8-V1003AB/4AB/7AB/8AB	8/8 CCF OF AF DISCH. CHECK VALVE V1003AB/4AB/7AB/8AB FAIL TO OPEN	178
DCBTWQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS UPON DEMAND	159
PFHBWQ2-SW2OUATBC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C FAIL TO OPEN	108
PFHBWQ2-SW2OUATAD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1D FAIL TO OPEN	107
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	93
CCMPKQ2-PP01/2A	2/4 CCF OF CCW PUMPS PP01A/2A (RUNNING)	86
SXMPKQ2-PP01/2A	2/4 CCF OF ESW PUMPS PP01A, PP02A (RUNNING)	86

Table 19.1-76 (3 of 4)

Basic Event	Description	RAW
AFCVWQ4-V1012A/B/4A/B	4/4 CCF OF AFW MINI FLOW CHECK VALVE V1012A/B & 1014A/B FAIL TO OPEN	83
VGAHKQ2-AH01A/2A	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02A	80
PFHBWQ2-SW2OUATCD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01C,1D FAIL TO OPEN	70
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	66
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	66
CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	64
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 SC CV 159/160	64
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCH LINE 1001, 1002 AND SCP DISCH. LINE CV 568,569	64
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	63
CCMPKQ2-PP01/2B	2/4 CCF OF CCW PUMPS PP01B/2B (RUNNING)	62
SXMPKQ2-PP01/2B	2/4 CCF OF ESW PUMPS PP01B, PP02B (RUNNING)	60
VGAHKQ2-AH01B/2B	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02B	57
AFPVKQ3-TP01A/B/MP02A	3/4 CCF OF AFW TDP01A/B, MDP02A DUE TO THE VOLUTE FAIL TO RUN	54
AFPVKQ3-TP01A/B/MP02B	3/4 CCF OF AFW TDP01A/B, MDP02B DUE TO THE VOLUTE FAIL TO RUN	53
DCBTWQ3-BT01BCD	3/4 CCF OF 125V DC BATTERY BT01B/01C/01D FAILS UPON DEMAND	48
DCBTWQ3-BT01ABD	3/4 CCF OF 125V DC BATTERY BT01A/01B/01D FAILS UPON DEMAND	45
PFHBWQ2-SW2OUATAB	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B FAIL TO OPEN	43
VOHVKQ4-HV32A/32B/31A/31B	4/4 CCF OF RUN FOR CUBICLE COOLER HV32A/32B/31A/31B	40
SXAHKQ3-AH01A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 01B, 02B	38

Table 19.1-76 (4 of 4)

Basic Event	Description	RAW
SXMPKQ2-PP02A/1B	2/4 CCF OF ESW PUMPS PP02A, PP01B (RUNNING)	37
SXMPKQ2-PP01A/2B	2/4 CCF OF ESW PUMPS PP01A, PP02B (RUNNING)	33
SXAHKQ2-AH02A/01B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B	29
CCMPKQ2-PP01B/2A	2/4 CCF OF CCW PUMPS PP01B/2A (RUNNING)	29
VGAHKQ2-AH01B/2A	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A	29
SXAHKQ2-AH01A/02A	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A	27
SXAHKQ2-AH01A/02B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02B	27
CCMPKQ2-PP01A/2B	2/4 CCF OF CCW PUMPS PP01A/2B (RUNNING)	27
VGAHKQ2-AH01A/2B	2/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 02B	27
DCBTWQ3-BT01ACD	3/4 CCF OF 125V DC BATTERY BT01A/01C/01D FAILS UPON DEMAND	27
AFPVKQ3-TP01A/MP02A/B	3/4 CCF OF AFW TDP01A, MDP02A/B DUE TO THE VOLUTE FAIL TO RUN	26
WOCHKQ3-CH01A/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/2B	25
DCBTKQ4-BT01ABCD	4/4 CCF OF 125V DC BATTERY BT01A/01B/01C/01D FAILS TO RUN	25
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	23
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	21
VDHVZO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN FOR 1HR	20
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	20

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-77

Internal Flooding PRA Key CCF Events by FV (LRF)

Basic Event	Description	FV
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	24.0%
PFHBWQ3-SW2OUATACD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C,1D FAIL TO OPEN	6.8%
PFHBWQ3-SW2OUATBCD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C,1D FAIL TO OPEN	6.4%
PFHBWQ2-SW2OUATAC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1C FAIL TO OPEN	5.1%
PFHBWQ2-SW2OUATBD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1D FAIL TO OPEN	4.7%
PFHBWQ3-SW2OUATABC	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	2.9%
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1D FAIL TO OPEN	1.5%
PFHBWQ2-SW2OUATBC	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01B,1C FAIL TO OPEN	0.6%
PFHBWQ2-SW2OUATAD	2/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1D FAIL TO OPEN	0.6%

Table 19.1-78

Internal Flooding PRA Key Operator Actions by RAW (LRF)

Basic Event	Description	RAW
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	7
AFOPH-S-ALT-LT	OPERATOR FAIL TO ALIGNE FOR SUPPLYING AN ALTERNATE SOURCE	5
WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B	2
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	2
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	2
CSOPU1A-1015	OPERATORS FAIL TO OPEN V-1015 AFTER IN-SERVICE TEST FOR CSP 01A	2

Table 19.1-79

Internal Flooding PRA Key Operator Actions by FV (LRF)

Basic Event	Description	FV
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	17.3%
WOOPH-B-1/2B	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2B	2.5%
WOOPH-A-1/2A	OPERATOR FAILS TO OPERATE ECW PUMPS PP01/2A	2.2%
FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE A FIRE PROTECTION BREAK IN LESS THAN 20 MINUTES	1.8%
H-SDR-POSRV-3WAY	OPERATOR FAILS TO OPERATION (POSRV & 3-WAY V/V)	1.1%
RCOPH-S-SDSE-FW	FAILURE OF POSRVS EARLY PHASE OPEN	1.0%
H-SDR-3WAY	OPERATOR FAILS TO OPEN 3-WAY VALVE	0.6%

Table 19.1-80 (1 of 5)

Summary of External Hazard Dispositions

External Hazard	Typical Screening Criteria[(1)]	ASME Standard Remarks	APR1400 Treatment
Aircraft Impacts	N/A	Site specific, requires detailed study	COL Action Item added to address this issue on a site-specific basis.
Avalanche	3	Can be excluded for most US locations	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Biological Events	1, 5	Includes events such as detritus and zebra mussels	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier.
Coastal Erosion	4, 5	Included in the effects of external flooding	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Drought	1, 5	Can often be excluded where the ultimate heat sink water level is designed for at least 30 days of operation, taking into account evaporation, drift, seepage, and other waste-loss mechanisms	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
External Flooding	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Extreme Winds and Tornadoes	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Dam Failure	N/A	Not Mentioned in ASME Standard	Issue addressed as part of external flooding evaluation. COL action item to assess if site is susceptible to this failure mode.

Table 19.1-80 (2 of 5)

External Hazard	Typical Screening Criteria[(1)]	ASME Standard Remarks	APR1400 Treatment
Fog	1	Could increase the frequency of man-made hazard involving surface vehicles or aircraft; accident data include the effects of fog.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Forest Fire	1, 3	Fire cannot propagate to the site because the site is cleared; plant design and fire-protection provisions are adequate to mitigate the effects.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Frost	1	Snow and ice govern	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Hail	1	Other missiles govern.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
High Summer Temperature	1	Can often be excluded where the ultimate heat sink temperature is designed for at least 30 days of operation, taking into account evaporation, drift, seepage, and other water-loss mechanisms. Evaluation is needed of possible loss of air cooling due to high temperatures.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
High Tide	4	Included under external flooding.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Hurricane	4	Included under external flooding; wind forces are covered under extreme winds and tornadoes.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Ice Cover	1, 4	Ice blockage of river included in flood; loss of cooling-water flow is considered in plant design.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.

Table 19.1-80 (3 of 5)

External Hazard	Typical Screening Criteria[(1)]	ASME Standard Remarks	APR1400 Treatment
Industrial or Military Facility	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Internal Flooding	N/A	Site specific, requires detailed study	Issue discussed in Chapter 19 of the DCD for standard design.
Landslide	3	Can be excluded for most nuclear plant sites in the U.S.; confirm through walkdown.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Lightning	1	Considered in plant design.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Low Lake/River Water Level	1, 5	Can often be excluded where the ultimate heat sink water level is designed for at least 30 days of operation, taking into account evaporation,	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Low Winter Temperature	1, 5	Thermal stresses and embrittlement are usually insignificant or covered by design codes and standards for plant design; generally, there is adequate warning of icing on the ultimate heat sink so that remedial action can be taken.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Meteorite/Satellite Strikes	2	All sites have approximately the same frequency of occurrence.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Pipeline Accident	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Intense Precipitation	4	Included under external and internal flooding. Roof loading and its effect on building integrity must be checked.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Release of Chemicals from Onsite Storage	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.

Table 19.1-80 (4 of 5)

External Hazard	Typical Screening Criteria[(1)]	ASME Standard Remarks	APR1400 Treatment
River Diversion	1, 4	Considered in the evaluation of the ultimate heat sink; should diversion become a hazard, adequate storage is usually provided. Requires detailed site/ plant study.	COL Action Item added to address this issue.
Sandstorm	1, 4	Included under tornadoes and winds; potential blockage of air intakes with particulate matter is	COL Action Item added to address this issue.
Seiche	4	Included under external flooding	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Seismic Activity	N/A	Site specific, requires detailed study	Issue discussed in Chapter 19 of the DCD for standard design.
Snow	1, 4	Plant designed for higher loading; snow melt causing river flooding is included under external flooding.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Soil Shrink / Swell	1, 5	Site-suitability evaluation and site development for the plant are designed to preclude the effects of this hazard.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Storm Surge	4	Included under external flooding.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.
Toxic Gas	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Transportation Accidents	N/A	Site specific, requires detailed study	COL Action Item added to address this issue.
Tsunami	4	Included under external flooding.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.

Table 19.1-80 (5 of 5)

External Hazard	Typical Screening Criteria(1)	ASME Standard Remarks	APR1400 Treatment
Turbine-Generated Missiles	1, 2	Plant specific; requires detailed study.	For APR1400 standard plants, critical structures (e.g., the auxiliary building) will be located along or within close proximity to the longitudinal centerline of the turbine. This alignment makes the potential for a turbine-generated missile to strike critical structures or equipment negligible. In addition, the safety-related equipment is housed in structures constructed of reinforced concrete. Therefore, this event can be excluded from quantitative evaluation based on a low occurrence frequency, location of critical structures and equipment along the longitudinal centerline of the turbine, and protection of critical equipment.
Volcanic Activity	3	Can be excluded for most sites in the United States.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria. COL Action item entered to ensure the site specific susceptibility is not an outlier with respect to this item.
Waves	4	Included under external flooding.	Issue screened from consideration in Chapter 19 of the DCD based upon ASME Standard Screening Criteria.

(1) (Reference 2)

Criterion 1: The event is of equal or lesser damage potential than the events for which the plant has been designed. This requires an evaluation of plant design bases in order to estimate the resistance of plant structures and systems to a particular external hazard.

Criterion 2: The event has a significantly lower mean frequency of occurrence than another event, taking into account the uncertainties in the estimates of both frequencies, and the event could not result in worse consequences than the consequences from the other event.

Criterion 3: The event cannot occur close enough to the plant to affect it. This criterion must be applied taking into account the range of magnitudes of the event for the recurrence frequencies of interest.

Criterion 4: The event is included in the definition of another event.

Criterion 5: The event is slow in developing, and it can be demonstrated that there is sufficient time to eliminate the source of the threat or to provide an adequate response.

Table 19.1-81

LPSD Plant Operating States

POS	Description	Tech Spec Mode	Decay Heat
1	Reactor trip and Subcritical operation	1, 2	High
2	Cooldown with Steam Generators to 177°C (350°F)	3	High
3A	Cooldown with Shutdown Cooling System to 100°C (212°F)	4	High
3B	Cooldown with Shutdown Cooling System from 100°C (212°F) to 60°C (140°F)	5	High
4A	Reactor Coolant System drain-down (Pressurizer manway closed)	5	High
4B	Reactor Coolant System drain-down (manway open)	5	High
5	Reduced Inventory operation and nozzle dam installation	5	High
6	Fill for refueling	5	High
7	Offload	6	High
8	Defueled	Defueled	High
9	Onload	6	Low
10	Reactor Coolant System drain-down to Reduced Inventory after refueling	5	Low
11	Reduced Inventory operation with steam generator manway closure	5	Low
12A	Refill Reactor Coolant System (pressurizer manway open)	5	Low
12B	Refill Reactor Coolant System (pressurizer manway closed)	5	Low
13	Reactor Coolant System heat-up with Shutdown Cooling System isolation at 177°C (350°F)	4, 5	Low
14	Reactor Coolant System heat-up with steam generators	3	Low
15	Reactor startup	2,1	Low

Table 19.1-82

LPSD PRA Loss of SCS Initiators

POS	Duration (hr)	Conversion factor	Frequency (/yr) (2)			
			S1	S2	SL	SO(3)
BASE(1)	-	-	1.40E-01	2.20E-02	2.90E-01	2.90E-03 (/demand)
POS3A	4.6	3.36E-04	4.70E-05	7.39E-06	-	-
POS3B	37.6	2.74E-03	3.84E-04	6.03E-05	-	-
POS4A	1.3	9.50E-05	1.33E-05	2.09E-06	-	-
POS4B	20.3	1.49E-03	2.08E-04	3.27E-05	-	-
POS5	16.8	1.23E-03	1.72E-04	2.71E-05	3.57E-04	1.93E-03
POS6	54.9	4.01E-03	5.62E-04	8.82E-05	-	-
POS10	85.7	6.26E-03	8.77E-04	1.38E-04	-	-
POS11	13.2	9.66E-04	1.35E-04	2.13E-05	2.80E-04	1.93E-03
POS12A	4.2	3.07E-04	4.29E-05	6.75E-06	-	-
POS13	33.5	2.44E-03	3.42E-04	5.38E-05	-	-

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency ×conversion factor

(3) POS frequency = base event frequency (/demand) × 1 demand/outage × 1 outage/18months × 12 month/yr

Table 19.1-83

LPSD PRA General LOCA Initiators

POS	Duration (hr)	Conversion factor	Frequency (/yr)[(2)]			
			LLOCA	MLOCA	SLOCA	SGTR
BASE[(1)]	-	-	1.26E-06	4.83E-04	1.98E-03	1.96E-03
POS1	3.6	2.66E-04	3.35E-10	1.28E-07	5.26E-07	5.21E-07
POS2	32.9	2.40E-03	3.02E-09	1.16E-06	4.75E-06	4.70E-06
POS14	42.7	3.12E-03	3.93E-09	1.51E-06	6.17E-06	6.11E-06
POS15	42.4	3.10E-03	3.91E-09	1.50E-06	6.14E-06	6.08E-06

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency × conversion factor

Table 19.1-84

LPSD PRA Shutdown-Specific LOCA Initiators

POS	Duration (hr)	Conv factor	Frequency (/yr)[2]				
			JL	RL[3]	PL[4]	SL1	SL2
BASE[1]	-	-	5.00E-03	4.38E-03	2.29E-04	1.60E-01	3.50E-02
POS2	32.9	2.40E-03	-	-	2.44E-03	-	-
POS3A	4.6	3.36E-04	1.68E-06	2.94E-06	-	5.38E-05	-
POS3B	37.6	2.74E-03	1.37E-05	2.40E-05	-	4.39E-04	-
POS4A	1.3	9.50E-05	4.75E-07	-	-	1.52E-05	-
POS4B	20.3	1.49E-03	7.43E-06	-	-	2.38E-04	-
POS5	16.8	1.23E-03	6.15E-06	-	-	-	2.15E-07
POS6	54.9	4.01E-03	2.01E-05	-	-	6.42E-04	-
POS10	85.7	6.26E-03	3.13E-05	-	-	1.00E-03	-
POS11	13.2	9.66E-04	4.83E-06	-	-	-	1.69E-07
POS12A	4.2	3.07E-04	1.53E-06	-	-	4.91E-05	-
POS13	33.5	2.44E-03	1.22E-05	2.14E-05	-	3.91E-04	-

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency ×conversion factor

(3) POS frequency = base event frequency ×conversion factor × 2 (number of LTOP V/V)

(4) POS frequency = base event frequency ×conversion factor × 4 (number of LTOP V/V) × 4 (the number of popping test / POSRV) × 1 outage / 18month × 12month/yr

Table 19.1-85 (1 of 2)

LPSD PRA (LOOP)(SBO) Initiators

POS	Duration (hr)	Conv. Factor	O/H Component	Frequency (/yr)[2]						
				Plant-centered	Switchyard-centered	Grid-related	Weather-related	Total LP	Maintenance component (EDG)	LX[3]
BASE[1]	-	-	-	5.28E-02	6.39E-02	1.15E-02	3.67E-02	-	-	-
POS1	3.6	2.66E-04	-	1.40E-05	1.70E-05	3.06E-06	9.76E-06	4.38E-05	-	3.60E-09
POS2	32.9	2.40E-03	-	1.27E-04	1.53E-04	2.76E-05	8.81E-05	3.96E-04	-	4.76E-08
POS3A	4.6	3.36E-04	UAT	1.77E-05	2.15E-05	3.86E-06	1.23E-05	5.54E-05	EDG D	1.58E-07
POS3B	37.6	2.74E-03	UAT	1.45E-04	1.75E-04	3.15E-05	1.01E-04	4.52E-04	EDG D	1.32E-06
POS4A	1.3	9.50E-05	UAT	5.01E-06	6.07E-06	1.09E-06	3.48E-06	1.57E-05	EDG D	4.34E-08
POS4B	20.3	1.49E-03	UAT	7.84E-05	9.49E-05	1.71E-05	5.45E-05	2.45E-04	EDG D	7.10E-07
POS5	16.8	1.23E-03	UAT	6.50E-05	7.86E-05	1.42E-05	4.52E-05	2.03E-04	EDG D	5.87E-07
POS6	54.9	4.01E-03	UAT	2.12E-04	2.56E-04	4.61E-05	1.47E-04	6.61E-04	EDG D	1.93E-06
POS10	85.7	6.26E-03	SAT	3.31E-04	4.00E-04	7.20E-05	2.30E-04	1.03E-03	EDG C	3.02E-06

Table 19.1-85 (2 of 2)

POS	Duration (hr)	Conv. Factor	O/H Component	Frequency (/yr)[2]						
				Plant-centered	Switchyard-centered	Grid-related	Weather-related	Total LP	Maintenance component (EDG)	LX[3]
POS11	13.2	9.66E-04	-	5.10E-05	6.17E-05	1.11E-05	3.55E-05	1.59E-04	-	2.33E-07
POS12A	4.2	3.07E-04	-	1.62E-05	1.96E-05	3.53E-06	1.13E-05	5.06E-05	-	6.99E-08
POS13	33.5	2.44E-03	-	1.29E-04	1.56E-04	2.81E-05	8.97E-05	4.03E-04	-	6.07E-07
POS14	42.7	3.12E-03	-	1.65E-04	1.99E-04	3.58E-05	1.14E-04	5.14E-04	-	6.39E-08
POS15	42.4	3.10E-03	-	1.64E-04	1.98E-04	3.56E-05	1.14E-04	5.11E-04	-	6.35E-08

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency × conversion factor

(3) POS frequency = the sum of minimal cutsets for EDG failure in LOOP initiating event at each POS.

Table 19.1-86

LPSD PRA Loss of Supporting System Initiators

POS	Duration (hr)	Conv. Factor	Frequency (mean, /yr)(2)						
			LOKV	LODCA(3)	LODCB(3)	PLOCCW(3)	TLOCCW(3)	PLOESW(3)	TLOESW(3)
BASE(1)	-	-	3.50E-02	6.98E-04	6.98E-04	6.75E-03	3.59E-04	1.86E-02	5.46E-04
POS1	3.6	2.66E-04	9.31E-06	1.86E-07	1.86E-07	1.80E-06	9.55E-08	4.96E-06	1.45E-07
POS2	32.9	2.40E-03	8.40E-05	1.68E-06	1.68E-06	1.62E-05	8.61E-07	4.47E-05	1.31E-06
POS3A	4.6	3.36E-04	1.18E-05	-	-	2.27E-06	1.21E-07	6.26E-06	1.83E-07
POS3B	37.6	2.74E-03	9.60E-05	-	-	1.85E-05	9.85E-07	5.11E-05	1.50E-06
POS4A	1.3	9.50E-05	3.32E-06	-	-	6.41E-07	3.41E-08	1.77E-06	5.18E-08
POS4B	20.3	1.49E-03	5.20E-05	-	-	1.00E-05	5.33E-07	2.77E-05	8.11E-07
POS5	16.8	1.23E-03	4.31E-05	-	-	8.31E-06	4.42E-07	2.29E-05	6.72E-07
POS6	54.9	4.01E-03	1.40E-04	-	-	2.71E-05	1.44E-06	7.48E-05	2.19E-06
POS10	85.7	6.26E-03	2.19E-04	-	-	4.23E-05	2.25E-06	1.17E-04	3.42E-06
POS11	13.2	9.66E-04	3.38E-05	-	-	6.53E-06	3.47E-07	1.80E-05	5.28E-07
POS12A	4.2	3.07E-04	1.07E-05	-	-	2.07E-06	1.10E-07	5.72E-06	1.68E-07
POS13	33.5	2.44E-03	8.56E-05	-	-	1.65E-05	8.78E-07	4.56E-05	1.33E-06
POS14	42.7	3.12E-03	1.09E-04	2.18E-06	2.18E-06	2.11E-05	1.12E-06	5.81E-05	1.70E-06
POS15	42.4	3.10E-03	1.08E-04	2.16E-06	2.16E-06	2.09E-05	1.11E-06	5.78E-05	1.69E-06

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency × conversion factor

(3) Base event frequency = quantification via a related fault tree (except for events due to T&M.)

Table 19.1-87

LPSD PRA Transient Events Initiators

POS	Duration (hr)	Conv factor	Frequency (mean, /yr)[2]									
			PR-A-SL	GTRN	LOFW	FWLB	LOIA	LOCV	LSSB-U	LSSB-D	ATWS	RVR
BASE[1]	-	-	7.61E-04	6.54E-01	1.73E-03	1.73E-03	1.82E-02	5.55E-02	3.48E-04	7.29E-03	-	3.05E-08
POS1	3.6	2.66E-04	2.02E-07	1.74E-04	4.60E-07	4.60E-07	4.84E-06	1.48E-05	9.25E-08	1.94E-06	1.37E-09	8.11E-12
POS2	32.9	2.40E-03	1.83E-06	1.57E-03	4.15E-06	4.15E-06	4.37E-05	1.33E-04	8.35E-07	1.75E-05	-	7.32E-11
POS14	42.7	3.12E-03	2.37E-06	2.04E-03	5.39E-06	5.39E-06	5.67E-05	1.73E-04	1.08E-06	2.27E-05	-	9.51E-11
POS15	42.4	3.10E-03	2.36E-06	2.03E-03	5.36E-06	5.36E-06	5.64E-05	1.72E-04	1.08E-06	2.26E-05	1.60E-08	9.45E-11

(1) BASE case is based on shutdown year.

(2) POS frequency = base event frequency × conversion factor

Table 19.1-88 (1 of 7)

LPSD PRA Accident Sequences Summary

POS	Sequence Description
S1 – Recoverable Loss of Shutdown Cooling	
3A	SCS recovery and secondary cooling both fail. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	SCS recovery and secondary cooling both fail. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	SCS recovery and secondary cooling both fail. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	SCS recovery and secondary cooling both fail. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is open to containment so that secondary cooling is unavailable. Feed fails, leading to core damage.
S2 – Unrecoverable Loss of Shutdown Cooling	
3A	Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is open to containment so that secondary cooling is unavailable. Feed fails, leading to core damage.
SO – Overdrain Event	
5, 11	Primary inventory makeup is successful but SCS recovery fails. Feed fails, leading to core damage.
5, 11	Primary inventory makeup fails so that the SCS cannot be recovered. Feed fails, leading to core damage.

Table 19.1-88 (2 of 7)

POS	Sequence Description
SL – Level Control Failure During Reduced Inventory Operation	
5, 11	Primary inventory makeup is successful but SCS recovery fails. Feed fails, leading to core damage.
5, 11	Primary inventory makeup fails so that the SCS cannot be recovered. Feed fails, leading to core damage.
JL – Unrecoverable LOCA (CVCS Letdown Line)	
SL1 – SLOCA at Reduced Inventory Operation	
SL2 - SLOCA above Reduced Inventory Operation	
3A	Primary inventory makeup is successful but SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup is successful but SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup is successful but SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup is successful but SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup is successful but SCS recovery fails. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup is successful but SCS recovery fails. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup is successful but SCS recovery fails. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup is successful but SCS recovery fails. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.

Table 19.1-88 (3 of 7)

POS	Sequence Description
3A	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 4A, 13	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Rupture isolation fails and renders the secondary system unavailable for core cooling. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is open to containment so that secondary cooling is unavailable. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	Inventory makeup fails so that a SCS recovery cannot be attempted. The RCS is open to containment so that secondary cooling is unavailable. Feed fails, leading to core damage.

Table 19.1-88 (4 of 7)

POS	Sequence Description
PL – POSRV Fails to Reclose	
2	Safety Injection and secondary heat removal are both successful. IRWST cooling failure leads to core damage.
2	Safety Injection is successful but secondary heat removal fails. Bleed & feed are both successful. IRWST cooling failure leads to core damage.
2	Safety Injection is successful but secondary heat removal fails. Bleed is successful but feed fails, leading to core damage.
2	Safety Injection is successful but secondary heat removal fails. Bleed fails, leading to core damage.
2	Safety Injection fails but an Aggressive Secondary Cooldown is successful. SCS injection fails, leading to core damage.
2	Safety Injection and an Aggressive Secondary Cooldown both fail, leading to core damage.
RL – LTOP Safety Valve Spurious Opening	
3A	Inventory makeup is successful but the SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 13	Inventory makeup is successful but the SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3A	Inventory makeup is successful but the SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 13	Inventory makeup is successful but the SCS recovery fails. Secondary cooling also fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
3A	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3A, 3B, 13	Primary inventory makeup fails so that a SCS recovery cannot be attempted. Feed & bleed fails, leading to core damage.

Table 19.1-88 (5 of 7)

POS	Sequence Description
	LP – Loss of Offsite Power
3 A	The EDGs energize at least one class 1E bus. SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	The EDGs energize at least one class 1E bus. SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3 A	The EDGs energize at least one class 1E bus. SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	The EDGs energize at least one class 1E bus. SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	The RCS is open to containment so that secondary cooling is unavailable. SCS recovery fails. Feed fails, leading to core damage.
	LX – Station Blackout
3 A, 3B, 4A	The AAC gas turbine generator fails. Secondary cooling is successful, but offsite power is not recovered before core damage occurs.
3 A, 3B, 4A	The AAC gas turbine generator fails. Secondary cooling fails. Offsite power is not recovered before core damage occurs.
4B, 5, 6, 10, 11, 12A, 13	The AAC gas turbine generator fails. The RCS is not intact and secondary cooling cannot be attempted; or decay heat is very low (POS 13). Offsite power is not recovered before core damage occurs.
	CC – Partial Loss of Component Cooling
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is not intact and secondary cooling cannot be attempted. Feed fails, leading to core damage.

Table 19.1-88 (6 of 7)

POS	Sequence Description
TC – Total Loss of Component Cooling	
3A	This event leads directly to core damage.
3B, 4A, 13	The LTOP relief valves open and re-close. Feed and bleed fails, leading to core damage.
3B, 4A, 13	The LTOP relief valves open fail to re-close. Feed and bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	Feed fails, leading to core damage.
1, 2, 14, 15	These LPSD sequences are similar to their at-power counterparts.
ES – Partial Loss of Essential Service Water	
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is not intact and secondary cooling cannot be attempted. Feed fails, leading to core damage.
TS – Total Loss of Essential Service Water	
3A	This event leads directly to core damage.
3B, 4A, 13	The LTOP relief valves open and re-close. Feed and bleed fails, leading to core damage.
3B, 4A, 13	The LTOP relief valves open fail to re-close. Feed and bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	Feed fails, leading to core damage.
1, 2, 14, 15	These LPSD sequences are similar to their at-power counterparts.

Table 19.1-88 (7 of 7)

POS	Sequence Description
KV – Loss of 4 kV Emergency Bus (SCS Power Supply)	
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and re-closes. Feed & bleed fails, leading to core damage.
3 A	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed is successful but containment heat removal via IRWST cooling fails, leading to core damage.
3 A, 3B, 4A, 13	SCS recovery fails. Secondary cooling fails. The LTOP valve lifts and fails open. Feed & bleed fails, leading to core damage.
4B, 5, 6, 10, 11, 12A	SCS recovery fails. The RCS is not intact and secondary cooling cannot be attempted. Feed fails, leading to core damage.

Table 19.1-89 (1 of 9)

LPSD PRA Success Criteria Summary for Events Involving Loss of Operating SCS Train

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event EA - Supply Electrical Power from EDGs				
3A 3B 4A 4B 5 6 10 11 12A 13	LPP03AEA-EDG LPP03BEA-EDG LPP04AEA-EDG LPP04BEA-EDG LPP05EA-EDG LPP06EA-EDG LPP10EA-EDG LPP11EA-EDG LPP12AEA-EDG LPP13EA-EDG	Power available from 1 of 4 Class 1E 4.16 kVAC buses.	Not Applicable. Following a LOOP, EDGs must start and load automatically to the buses of the event transfers to the SBO event tree.	Top Event EA is included only for LOOP events.

Table 19.1-89 (2 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event RS - Restore SCS				
3A 3B	S1P03ARS S2P03ARS LPP03ARS KVP03ARS ESP03ARS CCP03ARS S1P03BRS S2P03BRS LPP03BRS KVP03BRS ESP03BRS CCP03BRS	Cooling provided by 1 of 2 SCS trains.	SCS operating pressure limit of 31.6 kg/cm2A (450 psia) reached 4 minutes after initial SCS loss in POS3A. Timing for POS 3B is assumed to be the same as in POS3A.	Initiating events S2, KV, ES, and CC render one SCS train unavailable. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	S1P04ARS S2P04ARS LPP04ARS KVP04ARS ESP04ARS CCP04ARS	Cooling provided by 1 of 2 SCS trains.	SCS operating temperature limit of 177°C (350°F) is reached 7.6 hours after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
4B	S1P04BRS S2P04BRS LPP04BRS KVP04BRS ESP04BRS CCP04BRS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 30 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.

Table 19.1-89 (3 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
5	S1P05RS S2P05RS LPP05RS KVP05RS ESP05RS CCP05RS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 6.7 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
6	S1P06RS S2P06RS LPP06RS KVP06RS ESP06RS CCP06RS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 52 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
10	S1P10RS S2P10RS LPP10RS KVP10RS ESP10RS CCP10RS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 1.6 hours after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
11	S1P11RS S2P11RS LPP11RS KVP11RS ESP11RS CCP11RS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 21 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.

Table 19.1-89 (3 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
12A	S1P12ARS S2P12ARS LPP12ARS KVP12ARS ESP12ARS CCP12ARS	Cooling provided by 1 of 2 SCS trains.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 7.6 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
13	S1P13RS S2P13RS LPP13RS KVP13RS ESP13RS CCP13RS	Cooling provided by 1 of 2 SCS trains.	SCS operating pressure limit of 31.6 kg/cm2A (450 psia) is reached 45 minutes after initial loss.	Initiating events S2, KV, ES, and CC render one SCS train unavailable.
Top Event SG - Steam Removal Using MSADV with AFW				
3A 3B	S1P03ASG S2P03ASG LPP03ASG KVP03ASG ESP03ASG CCP03ASG S1P03BSG S2P03BSG LPP03BSG KVP03BSG ESP03BSG CCP03BSG	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	LTOP relief valve first lift occurs at 1.6 hours	Initiating events S2, KV, ES, and CC render one motor-driven AFW pump unavailable. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-89 (4 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	S1P04ASG S2P04ASG LPP04ASG KVP04ASG ESP04ASG CCP04ASG	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	LTOP relief valve first lift occurs at 12.8 hours	Initiating events S2, KV, ES, and CC render one motor-driven AFW pump unavailable.
13	S1P13SG S2P13SG LPP13SG KVP13SG ESP13SG CCP13SG	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	LTOP relief valve first lift occurs at 5.9 hours	Initiating events S2, KV, ES, and CC render one motor-driven AFW pump unavailable.
Top Event LT - LTOP Relief Valve Closes				
3A 3B	S1P03ALT S2P03ALT LPP03ALT KVP03ALT ESP03ALT CCP03ALT S1P03BLT S2P03BLT LPP03BLT KVP03BLT ESP03BLT CCP03BLT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling.

Table 19.1-89 (5 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	S1P04ALT S2P04ALT LPP04ALT KVP04ALT ESP04ALT CCP04ALT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling
13	S1P13LT S2P13LT LPP13LT KVP13LT ESP13LT CCP13LT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling
Top Event FB - Feed and Bleed Cooling				
3A 3B	S1P03AFB1 S2P03AFB1 LPP03AFB1 KVP03AFB1 ESP03AFB1 CCP03AFB1 S1P03BFB1 S2P03BFB1 LPP03BFB1 KVP03BFB1 ESP03BFB1 CCP03BFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 6 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable. This timing is based on LTOP relief valves closing after pressure is reduced. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-89 (6 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
3A 3B	S1P03AFB2 S2P03AFB2 LPP03AFB2 KVP03AFB2 ESP03AFB2 CCP03AFB2 S1P03BFB2 S2P03BFB2 LPP03BFB2 KVP03BFB2 ESP03BFB2 CCP03BFB2	Injection with 1 of 4 SI trains	Core damage occurs at 2.7 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable. This timing is based on one LTOP valve sticking open after first lift at 1.6 hours. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	S1P04AFB1 S2P04AFB1 LPP04AFB1 KVP04AFB1 ESP04AFB1 CCP04AFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 13.9 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable. This timing is based on LTOP relief valves closing after pressure is reduced.

Table 19.1-89 (7 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	S1P04AFB2 S2P04AFB2 LPP04AFB2 KVP04AFB2 ESP04AFB2 CCP04AFB2	Injection with 1 of 4 SI trains	Core damage occurs at 13.9 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable. This timing is based on one LTOP valve sticking open after first lift at 12.8 hours. Core damage is assumed to occur 1.1 hours after first LTOP lift at 12.8 hrs. This timing is based on the thermal-hydraulic analysis for POS3A.
4B	S1P04BFB S2P04BFB LPP04BFB KVP04BFB ESP04BFB CCP04BFB	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.3 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.
5	S1P05FB S2P05FB LPP05FB KVP05FB ESP05FB CCP05FB	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.2 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.

Table 19.1-89 (8 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
6	S1P06FB S2P06FB LPP06FB KVP06FB ESP06FB CCP06FB	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.2 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.
10	S1P10FB S2P10FB LPP10FB KVP10FB ESP10FB CCP10FB	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 3.6 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.
11	S1P11FB S2P11FB LPP11FB KVP11FB ESP11FB CCP11FB	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 4.4 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.
12A	S1P12AFB S2P12AFB LPP12AFB KVP12AFB ESP12AFB CCP12AFB	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 7.4 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.

Table 19.1-89 (9 of 9)

POS	Equation Name	System Success Criteria	Timing Information	Comments
13	S1P13FB1 S2P13FB1 LPP13FB1 KVP13FB1 ESP13FB1 CCP13FB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 19.6 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable.
13	S1P13FB2 S2P13FB2 LPP13FB2 KVP13FB2 ESP13FB2 CCP13FB2	Injection with 1 of 4 SI trains	Core damage occurs at 7.0 hours	Initiating event KV renders one SI pump unavailable. Initiating events ES and CC render two SI pumps unavailable. This timing is based on one LTOP valve sticking open after first lift at 5.9 hours. Core damage is assumed to occur 1.1 hours after first LTOP lift at 7.0 hrs. This timing is based on the thermal-hydraulic analysis for POS3A.
Top Event CH - Containment Heat Removal				
3A	S1P03ACH S2P03ACH LPP03ACH KVP03ACH ESP03ACH CCP03ACH	1 of 2 CS trains aligned for IRWST cooling.	Containment pressure is 2.2kg/cm^2 (31 psig) at 24 hours. Operator action to begin IRWST cooling is assumed to be required before design pressure is exceeded.	Containment heat removal required to ensure safe, stable conditions.

Table 19.1-90 (1 of 14)

LPSD PRA Success Criteria Summary for Events Involving RCS Inventory

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event MK - Makeup of LOCA				
3A 3B	JLP03AMK JLP03BMK	Injection with 1 of 4 SI trains	SCS operating temperature limit of 177°C (350°F) reached 1.2 hours after beginning of event.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	JLP04AMK	Injection with 1 of 4 SI trains	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 7.2 hours after beginning of event.	
13	JLP13MK	Injection with 1 of 4 SI trains	SCS operating temperature limit of 177°C (350°F) reached 3.6 hours after beginning of event.	
Top Event IL - Isolation of LOCA				
3A 3B	JLP03AIL1 JLP03BIL1	Not Applicable	First lift of LTOP relief valve occurs 4.8 hours after beginning of event regardless of the status of RCS makeup.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	JLP03AIL2 JLP03BIL2	Not Applicable	First lift of LTOP relief valve occurs 4.8 hours after beginning of event regardless of the status of RCS makeup.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-90 (2 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	JLP04AIL1	Not Applicable	Limit of RCS level lowering to top of hot leg is reached 7.2 hours after beginning of event.	Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. Given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.
4A	JLP04AIL2	Not Applicable	Limit of RCS level lowering to top of hot leg is reached 7.2 hours after beginning of event.	
13	JLP13IL1	Not Applicable	Limit of RCS level lowering to top of hot leg is reached 10.4 hours after beginning of event.	Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. Given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.
13	JLP13IL2	Not Applicable	Limit of RCS level lowering to top of hot leg is reached 10.4 hours after beginning of event.	
Top Event MI – Inventory Makeup and Isolation				
3A 3B	RLP03AMI RLP03BMI	Injection with 1 of 4 SI trains	Core damage occurs 1.4 hours after initiation of event if injection is not successful.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-90 (3 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
13	RLP13MI	Injection with 1 of 4 SI trains	Core damage occurs 2.6 hours after initiation of event if injection is not successful.	
4B	JLP04BMI	Injection with 1 of 4 SI trains	Core damage occurs 2.3 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 16 minutes after stopping injection.	
5	JLP05MI	Injection with 1 of 4 SI trains	Core damage occurs 2.2 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 4.6 minutes after stopping injection.	
6	JLP06MI	Injection with 1 of 4 SI trains	Core damage occurs 2.2 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 53 minutes after stopping injection.	

Table 19.1-90 (4 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
10	JLP10MI	Injection with 1 of 4 SI trains	Core damage occurs 3.6 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 95 minutes after stopping injection.	
11	JLP11MI	Injection with 1 of 4 SI trains	Core damage occurs 4.4 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 9.0 minutes after stopping injection.	
12A	JLP12AMI	Injection with 1 of 4 SI trains	Core damage occurs 7.1 hours after initiation of event if injection is not successful. SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 49.0 minutes after stopping injection.	

Table 19.1-90 (5 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event RS – Start Standby SCS				
3A 3B	JLP03ARS JLP03BRS	Cooling provided by 1 of 1 SCS trains.	SCS operating pressure limit of 177°C (350°F) reached 1.2 hours after initial LOCA with makeup success. Timing for POS 3B is assumed to be the same as in POS3A.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	RLP03ARS RLP03BRS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 2.3 hours after initial lift with makeup success.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
13	RLP13RS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 2.3 hours after initial lift with makeup success.	Based on timing for POS3A
4A	JLP04ARS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 7.2 hours after initial LOCA with makeup success.	
4B	JLP04BRS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 16 minutes after initial LOCA with makeup success.	

Table 19.1-90 (6 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
5	JLP05RS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 4.6 minutes after initial LOCA with makeup success.	
6	JLP06RS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 53 minutes after initial LOCA with makeup success.	
10	JLP10RS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 2-inches above hot leg centerline is reached 95 minutes after initial LOCA with makeup success.	
11	JLP11RS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 9.0 minutes after initial LOCA with makeup success.	
12A	JLP12ARS	Cooling provided by 1 of 1 SCS trains.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 49 minutes after initial LOCA with makeup success.	

Table 19.1-90 (7 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event SG - Steam Removal Using MSADV with AFW				
3A 3B	JLP03ASG1 JLP03BSG1	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	LTOP relief valve first lift occurs at 4.8 hours with makeup success.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A. Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. However, given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.
3A 3B	JLP03ASG2 JLP03BSG2	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	LTOP relief valve first lift occurs at 4.8 hours with makeup failure.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	RLP03ASG RLP03BSG	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	SG operating level limit of top hot leg is reached 2.3 hours after initial lift with makeup success.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
13	RLP13SG	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	SG operating level limit of top hot leg is reached 2.3 hours after initial lift with makeup success.	Based on timing for POS3A

Table 19.1-90 (8 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	JLP04ASG1	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	Cooling must be initiated before level decreases below the top of RCS hot leg at 7.2 hours with makeup success.	One SG is assumed to be unavailable due to outage activities. Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. However, given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.
4A	JLP04ASG2	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	Cooling must be initiated before level decreases below the top of RCS hot leg at 7.2 hours with makeup failure.	One SG is assumed to be unavailable due to outage activities.
13	JLP13SG1	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	Cooling must be initiated before level decreases below the top of RCS hot leg at 10.4 hours.	Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. However, given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.
13	JLP13SG2	Heat removal from 1 of 2 steam generators: 1 of 2 motor-driven AFW pumps with 1 of 4 MSADVs	Cooling must be initiated before level decreases below the top of RCS hot leg at 10.4 hours.	

Table 19.1-90 (9 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event LT - LTOP Relief Valve Closes				
3A 3B	JLP03ALT JLP03BLT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling.
3A 3B	RLP03ALT RLP03BLT	1 of 1 LTOP relief valve close	Not applicable.	Valve opening on train B is definition of the initiating event. After isolation of B-train, the A-train valve is challenged.
4A	JLP04ALT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling
13	JLP13LT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling
13	RLP13LT	1 of 1 LTOP relief valve close	Not applicable.	Valve opening on train B is definition of the initiating event. After isolation of B-train, the A-train valve is challenged.
Top Event FB - Feed and Bleed Cooling				
3A 3B	JLP03AFB1 JLP03BFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 6.0 hours if LTOP relief valve closes.	This timing is based on LTOP relief valves closing after pressure is reduced. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	JLP03AFB2 JLP03BFB2	Injection with 1 of 4 SI trains	Core damage occurs at 5.9 hours if LTOP relief valve fails to close after lifting.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-90 (10 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
3A 3B	RLP03AFB1 RLP03BFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 7.6 hours with MI success if LTOP recloses.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A. Reclosing of LTOP not expected for spurious opening.
3A 3B	RLP03AFB2 RLP03BFB2	Injection with 1 of 4 SI trains	Core damage occurs at 7.2 hours with MI success.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	RLP03AFB3 RLP03BFB3	Injection with 1 of 4 SI trains	Core damage occurs at 1.4 hours after initial valve lift with MI failure.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	JLP04AFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 13.6 hours	This timing is based on LTOP relief valves closing after pressure is reduced.
4A	JLP04AFB2	Injection with 1 of 4 SI trains	Core damage occurs at 13.3 hours	This timing is based on one LTOP valve sticking open after first lift at 12.7 hours.
4B	JLP04BFB1	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 5.3 hours	Makeup successful

Table 19.1-90 (11 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4B	JLP04BFB2	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.3 hours	Makeup failure
5	JLP05FB1	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 3.7 hours	Makeup successful
5	JLP05FB2	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.2 hours	Makeup failure
6	JLP06FB1	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 3.3 hours	Makeup successful

Table 19.1-90 (12 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
6	JLP06FB2	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 2.2 hours	Makeup failure
10	JLP10FB1	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 5.4 hours	Makeup successful
10	JLP10FB2	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 3.6 hours	Makeup failure
11	JLP11FB1	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 7.1 hours	Makeup successful

Table 19.1-90 (13 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
11	JLP11FB2	Injection with 1 of 4 SI trains OR 1 of 2 SCS pumps injecting	Core damage occurs at 4.4 hours	Makeup failure
12A	JLP12AFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 13.5 hours	Makeup successful
12A	JLP12AFB2	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 7.1 hours	Makeup failure
13	JLP13FB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 18.9 hours	Makeup successful
13	JLP13FB2	Injection with 1 of 4 SI trains	Core damage occurs at 18.9 hours	Makeup failure Timing is based on failure of makeup node. Additional time would be available for the case where makeup is successful. However, given the expansive time available, this additional time is judged to be insignificant to developing the human error probability values associated with this event.

Table 19.1-90 (14 of 14)

POS	Equation Name	System Success Criteria	Timing Information	Comments
13	RLP13FB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 7.6 hours with MI success if LTOP recloses.	Reclosing of LTOP not expected for spurious opening. Based on timing for POS3A
13	RLP13FB2	Injection with 1 of 4 SI trains	Core damage occurs at 6.6 hours with MI success.	Based on timing for POS3A
13	RLP13FB3	Injection with 1 of 4 SI trains	Core damage occurs at 2.6 hours after initial valve lift with MI failure.	
Top Event CH - Containment Heat Removal				
3A	JLP03ACH RLP03ACH	1 of 2 CS trains aligned for IRWST cooling.	Containment pressure is 2.2kg/cm^2 (31 psig) at 24 hours. Operator action to begin IRWST cooling is assumed to be required before design pressure is exceeded.	Containment heat removal required to ensure safe, stable conditions.

Table 19.1-91 (1 of 3)

LPSD PRA Success Criteria Summary for SBO Events

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event AAC - Supply Electrical Power from AAC				
3A 3B	LX03AAAC LX03BAAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power before first lifting of LTOP relief valve at 1.6 hours	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	LXP04AAAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power by at 8.6 hours prior to RCS level decreasing below the top of the hot leg and precluding use of secondary cooling.	
4B	LXP04BAAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power before level decreased below SCS operating level limit of 5.1cm (2- inches) above hot leg center at 30 minutes.	
5	LXP05AAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	SCS operating level limit of 5.1cm (2- inches) above hot leg centerline is reached 6.7 minutes after initial loss.	
6	LXP06AAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power before level decreased below SCS operating level limit of 5.1cm (2- inches) above hot leg center at 52 minutes.	
10	LXP10AAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power before level decreased below SCS operating level limit of 5.1cm (2- inches) above hot leg center at 95 minutes.	

Table 19.1-91 (2 of 3)

POS	Equation Name	System Success Criteria	Timing Information	Comments
11	LXP11AAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 21 minutes after initial loss.	
12A	LXP12AAAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	SCS operating level limit of 5.1cm (2-inches) above hot leg centerline is reached 7.6 minutes after initial loss.	
13	LXP13AAC	Supply power to 1 of 4 Class 1E 4.16 kVAC buses from AAC source.	Recover power before exceeding SCS operating limit pressure limit of 31.6 kg/cm2A (450 psia) at 45 minutes.	
Top Event SG - Steam Removal Using MSADV without AFW				
3A 3B	LXP03A-ADV LXP03B-ADV	Heat removal from 1 of 2 steam generators using initial SG inventory and 1 of 4 MSADVs	LTO P relief valve first lift occurs at 1.6 hours.	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
4A	LXP04A-ADV	Heat removal from 1 of 2 steam generators using initial SG inventory and 1 of 4 MSADVs	Cooling must be initiated before level decreases below the top of RCS hot leg at 8.5 hours	One SG is assumed to be unavailable due to outage activities.
Top Event AC - Recover Offsite Power				
3A 3B	LXP03A-AC1 LXP03B-AC1	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 9.6 hours if ADV is success	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3A 3B	LXP03A-AC2 LXP03B-AC2	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 6.0 hours if ADV heat removal fails	The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-91 (3 of 3)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	LXP04A-AC1	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 18.9 hours if ADV is success	
4A	LXP04A-AC2	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 13.9 hours if ADV heat removal fails	
4B	LXP04B-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 2.4 hours.	
5	LXP05-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 2.2 hours.	
6	LXP06-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 2.2 hours.	
10	LXP10-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 3.6 hours.	
11	LXP11-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 4.4 hours.	
12A	LXP12A-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 7.4 hours	
13	LXP13-AC	Supply offsite power to 1 of 4 Class 1E 4.16 kVAC buses.	Core damage occurs at 19.6 hours	

Table 19.1-92 (1 of 3)

LPSD PRA Success Criteria Summary for TLOCCW/TLOESW Events

POS	Equation Name	System Success Criteria	Timing Information	Comments
Top Event LT - LTOP Relief Valve Closes				
3B	TCP03BLT TSP03BLT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling.
4A	TCP04ALT TSP04ALT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling.
13	TCP04ALT TSP04ALT	2 of 2 LTOP relief valves close	Not applicable.	Top event affects timing for feed and bleed cooling.
Top Event FB - Feed and Bleed Cooling				
3B	TCP03BFB1 TSP03BFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 6 hours	This timing is based on LTOP relief valves closing after pressure is reduced. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.
3B	TCP03BFB2 TSP03BFB2	Injection with 1 of 4 SI trains	Core damage occurs at 2.7 hours	This timing is based on one LTOP valve sticking open after first lift at 1.6 hours. The success criteria and available time for operator action in POS3B are assumed to be the same as in POS3A.

Table 19.1-92 (2 of 3)

POS	Equation Name	System Success Criteria	Timing Information	Comments
4A	TCP04AFB1 TSP04AFB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 13.9 hours	This timing is based on LTOP relief valves closing after pressure is reduced.
4A	TCP04AFB2 TSP04AFB2	Injection with 1 of 4 SI trains	Core damage occurs at 13.9 hours	This timing is based on one LTOP valve sticking open after first lift at 12.8 hours. Core damage is assumed to occur 1.1 hours after first LTOP lift at 12.8 hrs. This timing is based on the thermal-hydraulic analysis for POS3A.
4B	TCP04BFB TSP04BFB	Injection with 1 of 4 SI trains	Core damage occurs at 2.3 hours	
5	TCP05FB TSP05FB	Injection with 1 of 4 SI trains	Core damage occurs at 2.2 hours	
6	TCP06FB TSP06FB	Injection with 1 of 4 SI trains	Core damage occurs at 2.2 hours	
10	TCP10FB TSP10FB	Injection with 1 of 4 SI trains	Core damage occurs at 3.6 hours	
11	TCP11FB TSP11FB	Injection with 1 of 4 SI trains	Core damage occurs at 4.4 hours	

Table 19.1-92 (3 of 3)

POS	Equation Name	System Success Criteria	Timing Information	Comments
12A	TCP12AFB TSP12AFB	Injection with 1 of 4 SI trains	Core damage occurs at 7.4 hours	
13	TCP13FB1 TSP13FB1	Injection with 1 of 4 SI trains Bleed with 1 of 4 POSRVs	Core damage occurs at 19.6 hours	This timing is based on LTOP relief valves closing after pressure is reduced.
13	TCP13FB2 TSP13FB2	Injection with 1 of 4 SI trains	Core damage occurs at 7.0 hours	This timing is based on one LTOP valve sticking open after first lift at 5.9 hours. Core damage is assumed to occur 1.1 hours after first LTOP lift at 7.0 hrs. This timing is based on the thermal-hydraulic analysis for POS3A.

Table 19.1-93

LPSD PRA Internal Events CDF Contributions for Initiating Event - All POS

Initiating Event	CDF (/yr)	Contribution (%)
Over-Drainage during Reduced Inventory operation (SO)	1.49E-06	56.7
Failure to maintain water level during Reduced Inventory (SL)	2.56E-07	9.7
Unrecoverable LOCA (JL)	2.17E-07	8.2
Loss of Offsite Power (LP) + Station Black Out (LX)	2.08E-07	7.9
Total Loss of Essential Service Water (TS) plus Total Loss of Component Cooling Water (TC)	1.80E-07	6.8
POSRVs fail to reclose (PL)	9.70E-08	3.7
Recoverable Loss of Shutdown Cooling System (S1)	9.63E-08	3.7
Loss of 4.16 kV AC (KV)	2.78E-08	1.1
Partial Loss of Essential Service Water (ES)	1.93E-08	0.7
Unrecoverable Loss of Shutdown Cooling System (S2)	1.82E-08	0.7
Partial Loss of Component Cooling Water (CC)	6.97E-09	0.3
Medium Break Loss of Coolant Accident (MBLOCA)	4.89E-09	0.2
Anticipated Transient Without Scram (ATWS)	2.97E-09	0.1
LTOP's failing to reclose (RL)	2.51E-09	0.1
Small Break Loss of Coolant Accident (SBLOCA)	8.52E-10	< 0.1
Induced Small LOCA (PR-A-SL)	5.30E-10	< 0.1
Steam Generator Tube Rupture (SGTR)	3.85E-10	< 0.1
Reactor Vessel Rupture (RVR)	2.58E-10	< 0.1
General Transient (GTRN)	1.00E-10	< 0.1
Loss of Condense Vacuum (LOCV)	6.45E-11	< 0.1
Loss of Main Feedwater (LOFW)	5.90E-11	< 0.1
Main Steam Line Break downstream of MSIVs (LSSB-D)	4.06E-11	< 0.1
Main Feed Water Line Break(FWLB)	6.34E-12	< 0.1
Large Break Loss of Coolant Accident (LBLOCA)	2.55E-12	< 0.1
Total	2.63E-06	100

Table 19.1-94

LPSD PRA Internal Events CDF Contributions for Initiating Event – Reduced Inventory

Initiating Event	Plant Operating State	CDF Contribution
Over-drainage During Reduced Inventory Operation	5, 11	74.8%
Failure to Maintain Water Level During Reduced Inventory Operation	5, 11	12.8%
Unrecoverable LOCA	5, 11	7.3%
Loss of Offsite Power	5, 11	2.2%
Recoverable Loss of Shutdown Cooling System	5, 11	1.6%
Loss of 4 kV Bus	5, 11	0.4%
Unrecoverable Loss of Shutdown Cooling System	5, 11	0.3%
Partial Loss of Essential Service Water	5, 11	0.2%
Partial Loss of Component Cooling	5, 11	0.1%
Station Black Out	5, 11	0.1%

Table 19.1-95

LPSD Internal Events PRA CDF Contributions by Plant Operating State

POS	T/S Mode	Description	CDF (/yr)	Contribution (%)
1	1, 2	Reactor trip and subcritical state	5.33E-10	0.0
2	3	Steam Generator Cooldown to 177 °C (350 °F)	1.00E-07	3.8
3A	4	Cooldown with SCS to 100 °C (212 °F)	1.85E-07	7.0
3B	5	Cooldown with SCS to 60 °C (140 °F)	9.39E-08	3.6
4A	5	RCS Draindown (pressurizer manway closed)	6.43E-09	0.0
4B	5	RCS Draindown (manway open)	4.07E-08	1.5
5	5	Reduced Inventory Operation	1.39E-06	53.0
6	5	Fill for Refueling	7.63E-08	2.9
7-9	6	Refueling	-	-
10	5	RCS Draindown after Refueling	9.07E-08	3.4
11	5	Reduced Inventory Operation	6.03E-07	22.9
12A	5	Refill RCS (manway open)	2.24E-08	0.9
12B	5	Refill RCS (manway closed)	-	-
13	4,5	RCS Heatup with SCS Isolation at 177 °C (350 °F)	1.37E-08	0.5
14	3	RCS Heatup with Steam Generators	3.92E-09	0.1
15	2, 1	Reactor Startup	6.63E-09	0.3
Sum			2.63E-06	100

(1) The Overdrain initiating event has been binned with the reduced inventory states (POS 5 and 11.)

(2) The POSRVs are tested in POS 2 and contribute 3.5% of POS risk. No corresponding tests are performed in POS 14.

Table 19.1-96 (1 of 24)

LPSD Internal Events PRA Top 100 CDF Cutsets - All POS

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
1	7.56E-07	%SO	RCS Overdraining due to SCS	28.7	28.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01-DE	HRA Dependence for RS & FB at SO POS05		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
2	3.40E-07	%SO	RCS Overdraining due to SCS	12.9	41.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
3	2.34E-07	%SO	RCS Overdraining due to SCS	8.9	50.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
4	1.40E-07	%SL	Failure to Maintain Water Level at Reduced Inventory	5.3	55.9
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		

Table 19.1-96 (2 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	1.24E-07	%SO	RCS Overdraining due to SCS	4.7	60.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
6	7.86E-08	%TC	Total Loss of Component Cooling Water	3.0	63.6
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
7	7.86E-08	%TS	Total Loss of Essential Service Water	3.0	66.6
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
8	7.70E-08	%SL1	Small LOCA at Reduced Inventory	2.9	69.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
9	4.94E-08	%SL	Failure to Maintain Water Level at Reduced Inventory	1.9	71.4
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		

Table 19.1-96 (3 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	4.31E-08	%SL	Failure to Maintain Water Level at Reduced Inventory	1.6	73.0
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
11	2.98E-08	%PL	STUCK OPEN OF POSRV	1.1	74.2
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING		
12	2.97E-08	%S1	Loss of SCS (S1)	1.1	75.3
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
13	2.87E-08	%S1	Loss of SCS (S1)	1.1	76.4
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03 duration		
		HR-FB-S1P03B-01-DE	HRA Dependance for SG & FB at S1 POS03B		
		HR-RS-S1P03B	OPERATOR FAILS TO RESTORE SCS AT S1 POS03B		
		HR-SG-S1P03B-DE	HRA Dependance for RS & SG at S1 POS03B		

Table 19.1-96 (4 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
14	2.72E-08	%SL1	Small LOCA at Reduced Inventory	1.0	77.4
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
15	2.38E-08	%SL1	Small LOCA at Reduced Inventory	0.9	78.3
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
16	1.79E-08	%SL	Failure to Maintain Water Level at Reduced Inventory	0.7	79.0
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-02-DE	HRA Dependance for MI & FB at SL POS11		
		HR-MI-SLP11	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS11		
17	1.68E-08	%SL2	Small LOCA above Reduced Inventory	0.6	79.6
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		

Table 19.1-96 (5 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
18	1.41E-08	%SL2	RCS Overdraining due to SCS	0.5	80.2
		BE-RATE-P10	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-JLP10-02-DE	HRA Dependance for RS & FB at SO POS05		
		HR-MI-JLP10	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
19	1.36E-08	%LPSW	RCS Overdraining due to SCS	0.5	80.7
		BE-RATE-P05	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at SO POS11		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
20	1.31E-08	%LPSW	RCS Overdraining due to SCS	0.5	81.2
		BE-RATE-P03B	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-LPP03B-01-DE	HRA Dependance for MI & FB at SO POS05		
		HR-RS-LPP03B	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		HR-SG-LPP03B-DE	Failure to Maintain Water Level at Reduced Inventory		
21	1.22E-08	%PL	STUCK OPEN OF POSRV	0.5	81.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B		

Table 19.1-96 (6 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	1.22E-08	%PL	STUCK OPEN OF POSRV	0.5	82.1
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B		
23	1.12E-08	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.4	82.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
24	1.08E-08	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.4	83.0
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03 duration		
		HR-FB-LPP03B-01-DE	HRA Dependance for SG & FB at LP POS03B		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B-DE	HRA Dependance for RS & SG at LP POS03B		
25	1.04E-08	%SL2	Small LOCA above Reduced Inventory	0.4	83.3
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-JLP03B-01-DE	HRA Dependance for SG & FB at JL POS03B		
		HR-IL-JLP03B-02-DE	HRA Dependance for MK & IL at JL POS03B		
		HR-MK-JLP03B	OPERATOR FAILS TO MAKE UP INVENTORY AT JL POS03B		

Table 19.1-96 (7 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
26	1.04E-08	%S1	Loss of SCS (S1)	0.4	83.7
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-S1P10-DE	HRA Dependance for RS & FB at S1 POS10		
		HR-RS-S1P10	OPERATOR FAILS TO RESTORE SCS AT S1 POS10		
27	9.89E-09	%SL1	Small LOCA at Reduced Inventory	0.4	84.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-02-DE	HRA Dependance for MI & FB at JL POS11		
		HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11		
28	9.44E-09	%SO	RCS Overdraining due to SCS	0.4	84.5
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
29	9.44E-09	%SO	RCS Overdraining due to SCS	0.4	84.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		

Table 19.1-96 (8 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	8.93E-09	%PL	STUCK OPEN OF POSRV	0.3	85.2
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B		
31	8.93E-09	%PL	STUCK OPEN OF POSRV	0.3	85.5
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A/B, 05A/B		
32	8.54E-09	%PL	STUCK OPEN OF POSRV	0.3	85.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START		
33	7.79E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.3	86.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		

Table 19.1-96 (9 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	7.53E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.3	86.4
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-LPP03B-01-DE	HRA Dependance for SG & FB at LP POS03B		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B-DE	HRA Dependance for RS & SG at LP POS03B		
35	7.42E-09	%KV	Loss of Class 1E 4.16kV	0.3	86.7
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-KVP05-DE	HRA Dependance for RS & FB at KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
36	7.40E-09	%S1	Loss of SCS (S1)	0.3	87.0
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-S1P12A-DE	HRA Dependance for RS & FB at S1 POS12A		
		HR-RS-S1P12A	OPERATOR FAILS TO RESTORE SCS AT S1 POS12A		
37	6.67E-09	%S1	Loss of SCS (S1)	0.2	87.2
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-S1P06-DE	HRA Dependance for RS & FB at S1 POS06		
		HR-RS-S1P06	OPERATOR FAILS TO RESTORE SCS AT S1 POS06		

Table 19.1-96 (10 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
38	4.74E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.2	87.4
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-LPP10-DE	HRA Dependance for RS & FB at LP POS10		
		HR-RS-LPP10	OPERATOR FAILS TO RESTORE SCS AT LO POS10		
39	4.67E-09	%S2	Loss of SCS (S2)	0.2	87.6
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-S2P05-DE	HRA Dependance for RS & FB at S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
40	4.52E-09	%S2	Loss of SCS (S2)	0.2	87.8
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-S2P03B-01-DE	HRA Dependance for SG & FB at S2 POS03B		
		HR-RS-S2P03B	OPERATOR FAILS TO RESTORE SCS AT S2 POS03B		
		HR-SG-S2P03B-DE	HRA Dependance for RS & SG at S2 POS03B		
41	4.22E-09	%S1	Loss of SCS (S1)	0.2	87.9
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-S1P04B-DE	HRA Dependance for RS & FB at S1 POS04B		
		HR-RS-S1P04B	OPERATOR FAILS TO RESTORE SCS AT S1 POS04B		

Table 19.1-96 (11 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	3.95E-09	%ES	Loss of Essential Service Water	0.2	88.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-ESP05-DE	HRA Dependance for RS & FB at ES POS05		
		HR-RS-ESP05	OPERATOR FAILS TO RESTORE SCS AT ES POS05		
43	3.92E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1	88.2
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-LPP10-DE	HRA Dependance for RS & FB at LP POS10		
		HR-RS-LPP10	OPERATOR FAILS TO RESTORE SCS AT LO POS10		
44	3.89E-09	%SL2	Small LOCA above Reduced Inventory	0.1	88.4
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-JLP04B-02-DE	HRA Dependance for MI & FB at JL POS04B		
		HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B		
45	3.82E-09	%ES	Loss of Essential Service Water	0.1	88.5
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-ESP03B-01-DE	HRA Dependance for SG & FB at ES POS03B		
		HR-RS-ESP03B	OPERATOR FAILS TO RESTORE SCS AT ES POS03B		
		HR-SG-ESP03B-DE	HRA Dependance for RS & SG at ES POS03B		

Table 19.1-96 (12 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	3.52E-09	%S1	Loss of SCS (S1)	0.1	88.7
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		HR-FB-S1P03A-01-DE	HRA Dependance for SG & FB at S1 POS03A		
		HR-RS-S1P03A	OPERATOR FAILS TO RESTORE SCS AT S1 POS03A		
		HR-SG-S1P03A-DE	HRA Dependance for RS & SG at S1 POS03A		
47	3.39E-09	%PL	STUCK OPEN OF POSRV	0.1	88.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		MSOPH-S-ASC-SLOCA	OPERATOR FAILS TO PERFORM AGGRE. SEC. COOLING FOR SLOCA		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646		
48	3.38E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	88.9
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-LPP12A-DE	HRA Dependance for RS & FB at LP POS12A		
		HR-RS-LPP12A	OPERATOR FAILS TO RESTORE SCS AT LO POS12A		
49	3.38E-09	%SL2	Small LOCA above Reduced Inventory	0.1	89.0
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-JLP10-01_DE	HRA Dependance for RS & FB at JL POS10		
		HR-RS-JLP10	OPERATOR FAILS TO RESTORE SCS AT JL POS10		

Table 19.1-96 (13 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	3.35E-09	%SL2	Small LOCA above Reduced Inventory	0.1	89.2
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-JLP06-01-DE	HRA Dependance for RS & FB at JL POS06		
		HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06		
51	3.04E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	89.3
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-LPP06-DE	HRA Dependance for RS & FB at LP POS06		
		HR-RS-LPP06	OPERATOR FAILS TO RESTORE SCS AT LO POS06		
52	2.92E-09	%TS	Total Loss of Essential Service Water	0.1	89.4
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-TSP03B-01	OPERATOR FAILS TO OPERATE F&B AT TS POS03B 01		
53	2.92E-09	%TC	Total Loss of Component Cooling Water	0.1	89.5
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-TCP03B-01	OPERATOR FAILS TO OPERATE F&B AT TC POS03B 01		
54	2.79E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1.	89.6
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-LPP12A-DE	HRA Dependance for RS & FB at LP POS12A		
		HR-RS-LPP12A	OPERATOR FAILS TO RESTORE SCS AT LO POS12A		

Table 19.1-96 (14 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	2.75E-09	%S1	Loss of SCS (S1)	0.1	89.7
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-S1P11-DE	HRA Dependance for RS & FB at S1 POS11		
		HR-RS-S1P11	OPERATOR FAILS TO RESTORE SCS AT S1 POS11		
56	2.73E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.1	89.8
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-LPP10-DE	HRA Dependance for RS & FB at LP POS10		
		HR-RS-LPP10	OPERATOR FAILS TO RESTORE SCS AT LO POS10		
57	2.60E-09	%TC	Total Loss of Component Cooling Water	0.1	89.9
		BE-RATE-P13	Conversion factor (SD-yr → Calendar yr) for POS13 duration		
		HR-FB-TCP13-01	OPERATOR FAILS TO OPERATE F&B AT TC POS13 01		
58	2.60E-09	%TS	Total Loss of Essential Service Water	0.1	90.0
		BE-RATE-P13	Conversion factor (SD-yr → Calendar yr) for POS13 duration		
		HR-FB-TSP13-01	OPERATOR FAILS TO OPERATE F&B AT TS POS13 01		
59	2.60E-09	%KV	Loss of Class 1E 4.16kV	0.1	90.1
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-KVP10-DE	HRA Dependance for RS & FB at KV POS10		
		HR-RS-KVP10	OPERATOR FAILS TO RESTORE SCS AT KV POS10		

Table 19.1-96 (15 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	2.55E-09	%ATWS	ANTICIPATED TRANSIENT WITHOUT SCRAM	0.1	90.2
		BE-RATE-P15	Conversion factor (SD-yr → Calendar yr) for POS15 duration		
		MTC-ATWS	NO ADEVERSE MODERATE TEMPERATURE COEFFICIENT		
61	2.52E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1	90.3
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-LPP06-DE	HRA Dependance for RS & FB at LP POS06		
		HR-RS-LPP06	OPERATOR FAILS TO RESTORE SCS AT LO POS06		
62	2.44E-09	%LPGR	Loss of offsite power of Grid-related for LPSD	0.1	90.4
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
63	2.41E-09	%JL	Unrecoverable LOCA	0.1	90.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-01-DE	HRA Dependance for MI & FB at JL POS05		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
64	2.40E-09	%JL	Unrecoverable LOCA	0.1	90.6
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		

Table 19.1-96 (16 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	2.36E-09	%LPGR	Loss of offsite power of Grid-related for LPSD	0.1	90.7
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-LPP03B-01-DE	HRA Dependance for SG & FB at LP POS03B		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B-DE	HRA Dependance for RS & SG at LP POS03B		
66	2.36E-09	%SO	RCS Overdraining due to SCS	0.1	90.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
67	2.36E-09	%SO	RCS Overdraining due to SCS	0.1	90.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
68	2.32E-09	%SO	RCS Overdraining due to SCS	0.1	90.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START		

Table 19.1-96 (17 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	2.32E-09	%SO	RCS Overdraining due to SCS	0.1	91.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
70	2.25E-09	%PL	STUCK OPEN OF POSRV	0.1	91.1
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B		
71	2.02E-09	%JL	Unrecoverable LOCA	0.1	91.2
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-JLP10-02-DE	HRA Dependance for MI & FB at JL POS10		
		HR-MI-JLP10	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS10		
72	1.94E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.1	91.3
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-LPP12A-DE	HRA Dependance for RS & FB at LP POS12A		
		HR-RS-LPP12A	OPERATOR FAILS TO RESTORE SCS AT LO POS12A		

Table 19.1-96 (18 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	1.93E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	91.3
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-LPP04B-DE	HRA Dependance for RS & FB at LP POS04B		
		HR-RS-LPP04B	OPERATOR FAILS TO RESTORE SCS AT LO POS04B		
74	1.86E-09	%TC	Total Loss of Component Cooling Water	0.1	91.4
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-TCP10	OPERATOR FAILS TO OPERATE F&B AT TC POS10		
75	1.86E-09	%TS	Total Loss of Essential Service Water	0.1	91.5
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-TSP10	OPERATOR FAILS TO OPERATE F&B AT TS POS10		
76	1.85E-09	%KV	Loss of Class 1E 4.16kV	0.1	91.6
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-KVP12A-DE	HRA Dependance for RS & FB at KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
77	1.75E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.1	91.6
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-LPP06-DE	HRA Dependance for RS & FB at LP POS06		
		HR-RS-LPP06	OPERATOR FAILS TO RESTORE SCS AT LO POS06		

Table 19.1-96 (19 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
78	1.74E-09	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.7
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
79	1.67E-09	%KV	Loss of Class 1E 4.16kV	0.1	91.8
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-KVP06-DE	HRA Dependance for RS & FB at KV POS06		
		HR-RS-KVP06	OPERATOR FAILS TO RESTORE SCS AT KV POS06		
80	1.65E-09	%PL	STUCK OPEN OF POSRV	0.1	91.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SIMPKQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A , PP01B TO RUN		
81	1.63E-09	%S2	Loss of SCS (S2)	0.1	91.9
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-S2P10-DE	HRA Dependance for RS & FB at S2 POS10		
		HR-RS-S2P10	OPERATOR FAILS TO RESTORE SCS AT S2 POS10		

Table 19.1-96 (20 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	1.61E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	91.9
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		HR-FB-LPP03A-01-DE	HRA Dependance for SG & FB at LP POS03A		
		HR-RS-LPP03A	OPERATOR FAILS TO RESTORE SCS AT LO POS03A		
		HR-SG-LPP03A-DE	HRA Dependance for RS & SG at LP POS03A		
83	1.59E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1	92.0
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-LPP04B-DE	HRA Dependance for RS & FB at LP POS04B		
		HR-RS-LPP04B	OPERATOR FAILS TO RESTORE SCS AT LO POS04B		
84	1.49E-09	%JL	Unrecoverable LOCA	0.1	92.1
		BE-RATE-P03	Conversion factor (SD-yr → Calendar yr) for POS03 duration		
		HR-FB-JLP03B-01-DE	HRA Dependance for SG & FB at JL POS03B		
		HR-IL-JLP03B-02-DE	HRA Dependance for MK & IL at JL POS03B		
		HR-MK-JLP03B	OPERATOR FAILS TO MAKE UP INVENTORY AT JL POS03B		
85	1.43E-09	%CC	Loss of Component Cooling Water	0.1	92.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-CCP05-DE	HRA Dependance for RS & FB at CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		

Table 19.1-96 (21 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
86	1.39E-09	%CC	Loss of Component Cooling Water	0.1	92.2
		BE-RATE-P03B	Conversion factor (SD-yr → Calendar yr) for POS03B duration		
		HR-FB-CCP03B-01-DE	HRA Dependance for SG & FB at CC POS03B		
		HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B		
		HR-SG-CCP03B-DE	HRA Dependance for RS & SG at CC POS03B		
87	1.38E-09	%PL	STUCK OPEN OF POSRV	0.1	92.2
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN		
88	1.38E-09	%ES	Loss of Essential Service Water	0.1	92.3
		BE-RATE-P10	Conversion factor (SD-yr → Calendar yr) for POS10 duration		
		HR-FB-ESP10-DE	HRA Dependance for RS & FB at ES POS10		
		HR-RS-ESP10	OPERATOR FAILS TO RESTORE SCS AT ES POS10		
89	1.37E-09	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	92.3
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		

Table 19.1-96 (22 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	1.33E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1	92.4
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		HR-FB-LPP03A-01-DE	HRA Dependance for SG & FB at LP POS03A		
		HR-RS-LPP03A	OPERATOR FAILS TO RESTORE SCS AT LO POS03A		
		HR-SG-LPP03A-DE	HRA Dependance for RS & SG at LP POS03A		
91	1.28E-09	%SL2	Small LOCA above Reduced Inventory	0.1	92.4
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		HR-FB-JLP03A-01-DE	HRA Dependance for SG & FB at JL POS03A		
		HR-IL-JLP03A-02-DE	HRA Dependance for MK & IL at JL POS03A		
		HR-MK-JLP03A	OPERATOR FAILS TO MAKE UP INVENTORY AT JL POS03A		
92	1.26E-09	%PL	STUCK OPEN OF POSRV	0.0	92.4
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B		
93	1.25E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.0	92.5
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-LPP11-DE	HRA Dependance for RS & FB at LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		

Table 19.1-96 (23 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	1.24E-09	%SL2	Small LOCA above Reduced Inventory	0.0	92.5
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-JLP04B-01-DE	HRA Dependance for RS & FB at JL POS04B		
		HR-RS-JLP04B	OPERATOR FAILS TO RESTORE SCS AT JL POS04B		
95	1.19E-09	%TS	Total Loss of Essential Service Water	0.0	92.6
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-TSP06	OPERATOR FAILS TO OPERATE F&B AT TS POS06		
96	1.19E-09	%TC	Total Loss of Component Cooling Water	0.0	92.7
		BE-RATE-P06	Conversion factor (SD-yr → Calendar yr) for POS6 duration		
		HR-FB-TCP06	OPERATOR FAILS TO OPERATE F&B AT TC POS06		
97	1.19E-09	%S2	Loss of SCS (S2)	0.0	92.7
		BE-RATE-P12A	Conversion factor (SD-yr → Calendar yr) for POS12A duration		
		HR-FB-S2P12A-DE	HRA Dependance for RS & FB at S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
98	1.11E-09	%KV	Loss of Class 1E 4.16kV	0.0	92.7
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		

Table 19.1-96 (24 of 24)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	1.11E-09	%KV	Loss of Class 1E 4.16kV	0.0	92.8
		BE-RATE-P03A	Conversion factor (SD-yr → Calendar yr) for POS03A duration		
		PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B		
100	1.11E-09	%LPWE	Loss of offsite power of Weather-related for LPSD	0.0	92.8
		BE-RATE-P4B	Conversion factor (SD-yr → Calendar yr) for POS4B duration		
		HR-FB-LPP04B-DE	HRA Dependance for RS & FB at LP POS04B		
		HR-RS-LPP04B	OPERATOR FAILS TO RESTORE SCS AT LO POS04B		

Table 19.1-97 (1 of 21)

LPSD Internal Events PRA Top 100 CDF Cutsets - Reduced Inventory

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	7.56E-07	%SO	RCS Overdraining due to SCS	37.8	37.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
2	3.40E-07	%SO	RCS Overdraining due to SCS	17.0	54.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
3	2.34E-07	%SO	RCS Overdraining due to SCS	11.7	66.5
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
4	1.40E-07	%SL	Failure to Maintain Water Level at Reduced Inventory	7.0	73.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		

Table 19.1-97 (2 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	1.24E-07	%SO	RCS Overdraining due to SCS	6.2	79.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
6	7.70E-08	%SL1	OPERATOR FAILS TO RESTORE SCS AT LO POS04B	3.9	83.6
		BE-RATE-P05	Small LOCA at Reduced Inventory		
		HR-FB-JLP05-01-DE	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-RS-JLP05	HRA Dependance for RS & FB at JL POS05		
7	4.93E-08	%SL	OPERATOR FAILS TO RESTORE SCS AT JL POS05	2.5	86.0
		BE-RATE-P11	Failure to Maintain Water Level at Reduced Inventory		
		HR-FB-SLP11-01-DE	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-RS-SLP11	HRA Dependance for RS & FB at SL POS11		
8	4.31E-08	%SL	OPERATOR FAILS TO RESTORE SCS AT SL POS11	2.2	88.2
		BE-RATE-P05	Failure to Maintain Water Level at Reduced Inventory		
		HR-FB-SLP05-02-DE	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-MI-SLP05	HRA Dependance for MI & FB at SL POS05		
9	2.97E-08	%S1	OPERATOR FAILS TO RESTORE SCS AT LO POS04B	1.5	89.7
		BE-RATE-P05	Small LOCA at Reduced Inventory		
		HR-FB-S1P05-DE	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-RS-S1P05	HRA Dependance for RS & FB at JL POS05		

Table 19.1-97 (3 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	2.72E-08	%SL1	OPERATOR FAILS TO RESTORE SCS AT JL POS05	1.4	91.0
		BE-RATE-P11	Failure to Maintain Water Level at Reduced Inventory		
		HR-FB-JLP11-01-DE	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-RS-JLP11	HRA Dependance for RS & FB at SL POS11		
11	2.38E-08	%S1	OPERATOR FAILS TO RESTORE SCS AT SL POS11	1.2	92.2
		BE-RATE-P05	Failure to Maintain Water Level at Reduced Inventory		
		HR-FB-JLP05-02-DE	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-MI-JLP05	HRA Dependance for MI & FB at SL POS05		
12	1.79E-08	%SL	Failure to Maintain Water Level at Reduced Inventory	0.9	93.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-02-DE	HRA Dependance for MI & FB at SL POS11		
		HR-MI-SLP11	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS11		
13	1.36E-08	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.7	93.8
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
14	1.12E-08	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.6	94.3
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		

Table 19.1-97 (4 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	9.89E-09	%SL1 BE-RATE-P11 HR-FB-JLP11-02-DE HR-MI-JLP11	Small LOCA at Reduced Inventory Conversion factor (SD-yr → Calendar yr) for POS11 duration HRA Dependance for MI & FB at JL POS11 Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11	0.5	94.8
16	9.44E-09	%SO BE-RATE-OT HR-FB-SOP05-01 VKHVS2B-HV16B	RCS Overdraining due to SCS Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure OPERATOR FAILS TO OPERATE F&B AT SO POS05 01 FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	0.5	95.3
17	9.44E-09	%SO BE-RATE-OT HR-FB-SOP11-01 VKHVS2A-HV16A	RCS Overdraining due to SCS Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure OPERATOR FAILS TO OPERATE F&B AT SO POS11 01 FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	0.5	95.8
18	7.79E-09	%LPWE BE-RATE-P05 HR-FB-LPP05-DE HR-RS-LPP05	Loss of offsite power of Weather-related for LPSD Conversion factor (SD-yr → Calendar yr) for POS5 duration HRA Dependance for RS & FB at LP POS05 OPERATOR FAILS TO RESTORE SCS AT LO POS05	0.4	96.2
19	7.42E-09	%KV BE-RATE-P05 HR-FB-KVP05-DE HR-RS-KVP05	Loss of Class 1E 4.16kV Conversion factor (SD-yr → Calendar yr) for POS5 duration HRA Dependance for RS & FB at KV POS05 OPERATOR FAILS TO RESTORE SCS AT KV POS05	0.4	96.5

Table 19.1-97 (5 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
20	4.67E-09	%S2	Loss of SCS (S2)	0.2	96.8
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-S2P05-DE	HRA Dependance for RS & FB at S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
21	3.95E-09	%ES	Loss of Essential Service Water	0.2	97.0
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-ESP05-DE	HRA Dependance for RS & FB at ES POS05		
22	2.75E-09	%S1	Loss of SCS (S1)	0.1	97.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-S1P11-DE	HRA Dependance for RS & FB at S1 POS11		
		HR-RS-S1P11	OPERATOR FAILS TO RESTORE SCS AT S1 POS11		
23	2.44E-09	%LPGR	Loss of offsite power of Grid-related for LPSD	0.1	97.2
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
24	2.41E-09	%JL	Unrecoverable LOCA	0.1	97.4
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		

Table 19.1-97 (6 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	2.36E-09	%SO	RCS Overdraining due to SCS	0.1	97.5
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCMVO-B-352	SC Hx HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
26	2.36E-09	%SO	RCS Overdraining due to SCS	0.1	97.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
27	2.32E-09	%SO	RCS Overdraining due to SCS	0.1	97.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
28	2.32E-09	%SO	RCS Overdraining due to SCS	0.1	97.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START		
29	1.74E-09	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	97.9
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-97 (7 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	1.43E-09	%CC	Loss of Component Cooling Water	0.1	98.0
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-CCP05-DE	HRA Dependance for RS & FB at CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
31	1.37E-09	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	98.0
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
32	1.25E-09	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	98.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-LPP11-DE	HRA Dependance for RS & FB at LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
33	1.04E-09	%LPPL	Loss of offsite power of Plant-centered for LPSD	0.1	98.2
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-LPP11-DE	HRA Dependance for RS & FB at LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
34	9.61E-10	%SL1	Small LOCA at Reduced Inventory	0.0	98.2
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-97 (8 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
35	8.50E-10	%JL	Unrecoverable LOCA	0.0	98.3
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
36	7.55E-10	%SL1	Small LOCA at Reduced Inventory	0.0	98.3
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-01	OPERATOR FAILS TO OPERATE F&B AT JL POS11 01		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
37	7.44E-10	%JL	Unrecoverable LOCA	0.0	98.3
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
38	7.20E-10	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.0	98.4
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-LPP11-DE	HRA Dependance for RS & FB at LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
39	6.87E-10	%KV	Loss of Class 1E 4.16kV	0.0	98.4
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-KVP11-DE	HRA Dependance for RS & FB at KV POS11		
		HR-RS-KVP11	OPERATOR FAILS TO RESTORE SCS AT KV POS11		

Table 19.1-97 (9 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	6.10E-10	%SO	RCS Overdraining due to SCS	0.0	98.4
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN		
41	6.10E-10	%SO	RCS Overdraining due to SCS	0.0	98.5
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		SIMPR1A-SCPP01A	SC PUMP PP01A FAILS TO RUN		
42	4.35E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	98.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
43	4.32E-10	%S2	Loss of SCS (S2)	0.0	98.5
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-S2P11-DE	HRA Dependance for RS & FB at S2 POS11		
		HR-RS-S2P11	OPERATOR FAILS TO RESTORE SCS AT S2 POS11		
44	4.27E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	98.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		

Table 19.1-97 (10 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
45	3.66E-10	%TS	Total Loss of Essential Service Water	0.0	98.5
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-TSP05	OPERATOR FAILS TO OPERATE F&B AT TS POS05		
46	3.66E-10	%TC	Total Loss of Component Cooling Water	0.0	98.6
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-TCP05	OPERATOR FAILS TO OPERATE F&B AT TC POS05		
47	3.65E-10	%ES	Loss of Essential Service Water	0.0	98.6
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-ESP11-DE	HRA Dependance for RS & FB at ES POS11		
		HR-RS-ESP11	OPERATOR FAILS TO RESTORE SCS AT ES POS11		
48	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN		
49	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN		

Table 19.1-97 (11 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN		
51	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.6
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN		
52	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN		
53	3.64E-10	%SO	RCS Overdraining due to SCS	0.0	98.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-TCP03B-01	OPERATOR FAILS TO OPERATE F&B AT TC POS03B 01		
54	3.41E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	98.7
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		

Table 19.1-97 (12 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	3.36E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	98.7
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		
		SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START		
56	3.29E-10	%SO	RCS Overdraining due to SCS	0.0	98.7
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		VKHVR2A-HV16A	FAILS TO RUN SC PUMP 02A ROOM CUBICLE COOLER HV16A		
57	3.29E-10	%SO	RCS Overdraining due to SCS	0.0	98.8
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B		
58	3.09E-10	%JL	Unrecoverable LOCA	0.0	98.8
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-02-DE	HRA Dependance for MI & FB at JL POS11		
		HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11		
59	2.87E-10	%TS	Total Loss of Essential Service Water	0.0	98.8
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-TSP11	OPERATOR FAILS TO OPERATE F&B AT TS POS11		

Table 19.1-97 (13 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	2.87E-10	%TC BE-RATE-P11 HR-FB-TCP11	Total Loss of Component Cooling Water Conversion factor (SD-yr → Calendar yr) for POS11 duration OPERATOR FAILS TO OPERATE F&B AT TC POS11	0.0	98.8
61	2.40E-10	%SL1 BE-RATE-P05 CCMVO-B-352 HR-FB-JLP05-01	Small LOCA at Reduced Inventory Conversion factor (SD-yr → Calendar yr) for POS5 duration SC HX HE01B INLET MOV 352 FAILS TO OPEN OPERATOR FAILS TO OPERATE F&B AT JL POS05 01	0.0	98.8
62	2.36E-10	%SL1 BE-RATE-P05 HR-FB-JLP05-01 SIMPS1B-SCPP01B	Small LOCA at Reduced Inventory Conversion factor (SD-yr → Calendar yr) for POS5 duration OPERATOR FAILS TO OPERATE F&B AT JL POS05 01 SC PUMP 2 PP01B FAILS TO START	0.0	98.8
63	2.32E-10	%SO BE-RATE-OT HR-FB-SOP05-01 PELXY-B-LX02B-P	RCS Overdraining due to SCS Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure OPERATOR FAILS TO OPERATE F&B AT SO POS05 01 FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	0.0	98.8
64	2.32E-10	%SO BE-RATE-OT HR-FB-SOP11-01 PELXY-A-LX01A-P	RCS Overdraining due to SCS Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure OPERATOR FAILS TO OPERATE F&B AT SO POS11 01 FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	0.0	98.8

Table 19.1-97 (14 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	2.32E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PELXY-A-LX02A-P	PRIMARY LOOP CONTROLLER LX02A FAILS TO RUN		
66	2.32E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PELXY-A-LX04A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04A		
67	2.32E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B		
68	2.32E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B		
69	2.32E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		

Table 19.1-97 (15 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
70	2.26E-10	%LPGR	Loss of offsite power of Grid-related for LPSD	0.0	98.9
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-LPP11-DE	HRA Dependance for RS & FB at LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
71	2.25E-109	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED		
72	2.25E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
73	2.25E-10	%SO	RCS Overdraining due to SCS	0.0	98.9
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN		
74	2.25E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		CCVVT-A-V1511	SC HX HE01A OUTLET MANUAL VALVE V1511 TRANSFER CLOSED		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		

Table 19.1-97 (16 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	2.25E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		SIVVT1A-V578	VV V578 IN SC PUMP1 (PP02A) DISCH. PATH FAILS TO REMAIN OPEN		
76	2.25E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		SIVVT1A-V106	VV V106 IN SC PUMP1 (PP02A) SUC. LINE FAILS TO REMAIN OPEN		
77	2.10E-10	%KV	Loss of Class 1E 4.16kV	0.0	99.0
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
78	1.88E-10	%SL1	Small LOCA at Reduced Inventory	0.0	99.0
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN		
		HR-FB-JLP11-01	OPERATOR FAILS TO OPERATE F&B AT JL POS11 01		
79	1.85E-10	%SL1	Small LOCA at Reduced Inventory	0.0	99.0
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-JLP11-01	OPERATOR FAILS TO OPERATE F&B AT JL POS11 01		
		SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START		

Table 19.1-97 (17 of 21)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
80	1.65E-10	%KV	Loss of Class 1E 4.16kV	0.0	99.0
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-KVP11	OPERATOR FAILS TO OPERATE F&B AT KV POS11		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
81	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02		
82	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03		
83	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03		
84	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.0
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PEDOY-A-LX02A02	FAILURE OF DIGITAL OUTPUT MODULE LX02A BRANCH 02		

Table 19.1-97 (18 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PEDOY-A-LX04A02	FAILURE OF DIGITAL OUTPUT MODULE LX04A BRANCH 02		
86	1.56E-10	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr → Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PEDOY-A-LX01A02	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 02		
87	1.32E-10	%CC	Loss of Component Cooling Water	0.0	99.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-CCP11-DE	HRA Dependance for RS & FB at CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
88	1.32E-10	%S2	Loss of SCS (S2)	0.0	99.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
89	1.13E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	99.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN		

Table 19.1-97 (19 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	1.12E-10	%ES	Loss of Essential Service Water	0.0	99.1
		BE-RATE-P05	Conversion factor (SD-yr → Calendar yr) for POS5 duration		
		HR-FB-ESP05	OPERATOR FAILS TO OPERATE F&B AT ES POS05		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
91	1.04E-10	%S2	Loss of SCS (S2)	0.0	99.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
92	8.85E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.0	99.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-SLP11-01	HRA Dependance for RS & FB at SL POS11		
		SIMPR1A-SCPP01A	SC PUMP PP01A FAILS TO RUN		
93	8.78E-11	%ES	Failure to Maintain Water Level at Reduced Inventory	0.0	99.1
		BE-RATE-P11	Conversion factor (SD-yr → Calendar yr) for POS11 duration		
		HR-FB-ESP11	OPERATOR FAILS TO OPERATE F&B AT ES POS11		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM COOLER HV16A		
94	8.16E-11	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A		

Table 19.1-97 (20 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	8.16E-11	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B		
96	8.16E-11	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A		
97	8.16E-11	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B		
98	8.16E-11	%SO	RCS Overdraining due to SCS	0.0	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A		

Table 19.1-97 (21 of 21)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	8.16E-11	%SO	RCS Overdraining due to SCS	0.1	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B		
100	7.98E-11	%SO	RCS Overdraining due to SCS	0.1	99.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month))		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINE MOV 616, 626, 636, 646		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		

Table 19.1-98 (1 of 4)

LPSD Internal Events PRA Key Basic Events by RAW (CDF) - All POS

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	941
I-ATWS-RPMCF	FAILURE TO SCRAM DUE TO MECHANICAL FAILURES	20
SISPP-S-CHEMICAL	DEBRIS INDUCED LOSS OF LONG TERM COOLING (DOWNSTREAM/CHEMICAL EFFECT)	12
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	11
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	11
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	11
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	11
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	11
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	11
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	11
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	11
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	11
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	11
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	11
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	11
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	11
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	7
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	6
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	6
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	6
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	5
SICVO1A-V247	SI LINE 1 CHECK VALVE V247 FAILS TO OPEN	4
SICVO1A-V543	SI LINE 1 CHECK VALVE V543 FAILS TO OPEN	4
SICVO1A-V143	SI LINE 1 CHECK VALVE V143 FAILS TO OPEN	4
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	4
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	4
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	4

Table 19.1-98 (2 of 4)

Basic Event	Description	RAW
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	3
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	3
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	3
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	3
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	3
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	3
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	3
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	3
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	3
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	3
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	3
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	3
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	3
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	3
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	3
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	3
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	3
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	3
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	3
PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	3
SICVO2B-V569	CV V569 IN SC PUMP 2 DISCH. PATH FAILS TO OPEN	3
SIHEY1B-HE01B-SC	SC HX 2 HE01B FAILS WHILE OPERATING	3
PELXY-A-LX04A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04A	3
PEDOY-A-LX04A02	FAILURE OF DIGITAL OUTPUT MODULE LX04A BRANCH 02	3

Table 19.1-98 (3 of 4)

Basic Event	Description	RAW
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	3
CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN	3
SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START	3
PELXY-A-LX02A-P	PRIMARY LOOP CONTROLLER LX02A FAILS TO RUN	3
SIMPR1A-SCPP01A	SC PUMP PP01A FAILS TO RUN	3
VKHVR2A-HV16A	FAILS TO RUN SC PUMP 02A ROOM CUBICLE COOLER HV16A	3
SIVVT1A-V578	VV V578 IN SC PUMP1 (PP02A) DISCH. PATH FAILS TO REMAIN OPEN	3
CCVVT-A-V1511	SC HX HE01A OUTLET MANUAL VALVE V1511 TRANSFER CLOSED	3
SIVVT1A-V106	VV V106 IN SC PUMP1 (PP02A) SUCTION LINE FAILS TO REMAIN OPEN	3
SICVO2B-V168	CV 168 IN SCS TRAIN B HX DISCHARGE PATH FAILS TO OPEN	3
PEDOY-A-LX02A02	FAILURE OF DIGITAL OUTPUT MODULE LX02A BRANCH 02	3
PEDOY-A-LX01A02	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 02	3
SICVO1A-V178	CV 178 IN SCS TRAIN A HX DISCHARGE PATH FAILS TO OPEN	3
SICVO1A-V568	SCS PUMP 1 DISCH. CHECK VALVE V568 FAILS TO OPEN	3
SIHEY1A-HE01A-SC	SC HX 1 HE01A FAILS WHILE OPERATING	3
CSNZPA-PLUGNOZZ	CONTAINMENT SPRAY HEADER PIPE/NOZZLE PLUGGED (ECSBS)	3
VKHVS2A-HV11A	FAILS TO START SI PUMP ROOM CUBICLE COOLER HV11A	2
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	2
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	2
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	2
SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C	2
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	2
VKHVR2A-HV11A	FAILS TO RUN SI PUMP ROOM CUBICLE COOLER HV11A	2
NPXHY-N-SAT02N	SAT TR02N FAULT	2
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	2
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	2
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	2

Table 19.1-98 (4 of 4)

Basic Event	Description	RAW
SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN	2
PEDOY-C-LX01C03	FAILURE OF DIGITAL OUTPUT MODULE LX01C BRANCH 03	2
VKHVS2B-HV11B	FAILS TO START SI PUMP ROOM CUBICLE COOLER HV11B	2
SIMPS2B-PP02D	FAILS TO START SI PUMP PP02D	2
SIVVT2B-V447	SI PUMP 4 DISCHARGE VV 447 FAILS TO REMAIN OPEN	2
SIMVO1B-616	SI PUMP 4 INJECTION LINE MOV 616 FAILS TO OPEN	2
SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN	2
SIMPR2B-PP02D	FAILS TO RUN SI PUMP PP02D	2
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	2
VKHVR2B-HV11B	FAILS TO RUN SI PUMP ROOM CUBICLE COOLER HV11B	2
SIVVT1B-V131	SI PUMP 4 SUCTION VV 131 FAILS TO REMAIN OPEN	2
PEDOY-D-LX01D01	FAILURE OF DIGITAL OUTPUT MODULE LX01D BRANCH 01	2

Table 19.1-99 (1 of 3)

LPSD Internal Events PRA Key Basic Events by RAW (CDF) - Reduced Inventory

Basic Event	Description	RAW
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	3
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	3
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	3
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	3
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	3
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	3
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	3
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	3
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	3
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	3
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	3
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	3
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	3
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	3
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	3
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	3
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	3
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	3
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	3
PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	3
SICVO2B-V569	CV V569 IN SC PUMP 2 DISCH. PATH FAILS TO OPEN	3
SICVO2B-V168	CV 168 IN SCS TRAIN B HX DISCH. PATH FAILS TO OPEN	3
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	3
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	3
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	3

Table 19.1-99 (2 of 3)

Basic Event	Description	RAW
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	3
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	3
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	3
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	3
SIHEY1B-HE01B-SC	SC HX 2 HE01B FAILS WHILE OPERATING	3
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	3
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	3
SICVO1A-V543	SI LINE 1 CHECK VALVE V543 FAILS TO OPEN	3
SICVO1A-V247	SI LINE 1 CHECK VALVE V247 FAILS TO OPEN	3
SICVO1A-V143	SI LINE 1 CHECK VALVE V143 FAILS TO OPEN	3
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	3
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	3
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	3
SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START	3
CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN	3
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	3
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	3
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	3
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	3
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	3
SIMPR1A-SCPP01A	SC PUMP PP01A FAILS TO RUN	3
VKHVR2A-HV16A	FAILS TO RUN SC PUMP 02A ROOM CUBICLE COOLER HV16A	3
SIVVT1A-V578	VV V578 IN SC PUMP1 (PP02A) DISCH. PATH FAILS TO REMAIN OPEN	3
CCVVT-A-V1511	SC HX HE01A OUTLET MANUAL VALVE V1511 TRANSFER CLOSED	3
SIVVT1A-V106	VV V106 IN SC PUMP1 (PP02A) SUC. LINE FAILS TO REMAIN OPEN	3
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	3
PELXY-A-LX02A-P	PRIMARY LOOP CONTROLLER LX02A FAILS TO RUN	3

Table 19.1-99 (3 of 3)

Basic Event	Description	RAW
PELXY-A-LX04A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04A	3
PEDOY-A-LX02A02	FAILURE OF DIGITAL OUTPUT MODULE LX02A BRANCH 02	3
PEDOY-A-LX04A02	FAILURE OF DIGITAL OUTPUT MODULE LX04A BRANCH 02	3
PEDOY-A-LX01A02	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 02	3
SICVO1A-V178	CV 178 IN SCS TRAIN A HX DISCH. PATH FAILS TO OPEN	3
SICVO1A-V568	SCS PUMP 1 DISCH. CHECK VALVE V568 FAILS TO OPEN	3
SIHEY1A-HE01A-SC	SC HX 1 HE01A FAILS WHILE OPERATING	3

Table 19.1-100

LPSD Internal Events PRA Key Basic Events by FV (CDF) - All POS

Basic Event	Description	FV
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	1.2%
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	0.7%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	0.7%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	0.7%
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	0.6%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	0.6%

Table 19.1-101

LPSD Internal Events PRA Key Basic Events by FV (CDF) - Reduced Inventory

Basic Event	Description	FV
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	0.6%
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	0.6%

Table 19.1-102 (1 of 4)

LPSD Internal Events PRA Key CCF Events by RAW (CDF)

Basic Event	Description	RAW
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	5068
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	5068
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	5068
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	1013
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	1013
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	1012
VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	1012
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	1008
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	1005
VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B	1005
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOLATION VALVES	1000
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	999
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	999
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	999
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	994
CCMVXO8-143-150	8/8 CCF (DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	992
SIMPWQ4-CSP1A/B/SCP1A/B	CCF OF CS AND SC PUMPS FAIL TO START	938

Table 19.1-102 (2 of 4)

Basic Event	Description	RAW
SIMPKQ4-CSP1A/B/SCP1A/B	4/4 CCF OF CSP PP01A, PP01B AND SCP PP01A, PP01B TO RUN	937
SICVWQ4-V568/569/1001/1002	CCF TO OPEN CSP DISCHARGE LINE 1001/1002 AND SCP DISCHARGE LINE CV 568/569	933
SICVWQ4-V157/158/159/160	4/4 CCF OF CS CV 157/158 SC CV 159/160	931
SIHEKQ4-HE01A/B-CS&SC	4/4 CCF OF SC HE01A/B, CS HE01A/B	931
SICVWQ3-V541/42/43	3/4 CCF OF DVI LINE CHECK VALVES 541,542,543	441
SICVWQ3-V123/33/43	SI LINE C/V 123,133,143 CCF TO OPEN	441
SICVWQ3-V227/37/47	3/4 CCF OF DVI LINE CHECK VALVES 227,237,247	441
SICVWQ3-V217/27/47	3/4 CCF OF DVI LINE CHECK VALVES 217,227,247	407
SICVWQ3-V540/41/43	3/4 CCF OF DVI LINE CHECK VALVES 540,541,543	407
SICVWQ3-V113/23/43	SI LINE C/V 113,123,143 CCF TO OPEN	407
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINE MOV 616,626,636,646	168
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	164
SICVWQ4-V404/05/34/46	SI PUMP DISCHARGE C/V 404,405,434,446 CCF TO OPEN	156
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	146
SICVWQ3-V113/33/43	SI LINE C/V 113,133,143 CCF TO OPEN	118
SICVWQ3-V217/37/47	3/4 CCF OF DVI LINE CHECK VALVES 217,237,247	118
SICVWQ3-V540/42/43	3/4 CCF OF DVI LINE CHECK VALVES 540,542,543	118
SICVWQ3-V217/27/37	3/4 CCF OF DVI LINE CHECK VALVES 217,227,237	107
SICVWQ3-V113/23/33	SI LINE C/V 113,123,133 CCF TO OPEN	107

Table 19.1-102 (3 of 4)

Basic Event	Description	RAW
SICVWQ3-V540/41/42	3/4 CCF OF DVI LINENCHECK VALVES 540,541,542	107
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	53
PAGXKO8-PA03ABCD	8/8 CCF OF GROUP CONTROLLER 752-PA03A,03B,03C,03D	51
PELXKO8-LX08A12B01C01D	8/8 CCF OF LOOP CONTROLLER LX08A 12, LX12B 12, LX01C 12, LX01D 12	40
EFGXKO8-PA03ABCD	CCF OF GC TO LC PM646 MODULES	39
EFCIKO8-PA03ABCD	CCF OF GC CI MODULES	38
PELXKO8-LX01ABCD	8/8 CCF OF LOOP CONTROLLER LX01A, LX01B, LX01C, LX01D	38
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	30
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	30
WOCHKQ3-CH03A/4A/3B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B	30
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	30
CCMVWQ3-191/2/181	3/4 CCF OF CCW MOV 191, 192, 181 FOR EDG01A/B/C INLET	27
SICVWQ2-V123/43	SI LINE CHECK VALVES 123,143 CCF TO OPEN	26
SICVWQ2-V227/47	2/4 CCF OF DVI LINE CHECK VALVES 227,247	26
SICVWQ2-V541/43	2/4 CCF OF DVI LINE CHECK VALVES 541,543	26
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	25
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	25
VGAHWQ4-AH04A/4B/5A/5B	4/4 START CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	24
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	23

Table 19.1-102 (4 of 4)

Basic Event	Description	RAW
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	23
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	23
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	23
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	23
CCMVWQ2-191/2	2/4 CCF OF CCW MOV 191, 192 FOR EDG01A/B INLET	22
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	21
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	23
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	23
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	23
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	23
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	23
CCMVWQ2-191/2	2/4 CCF OF CCW MOV 191, 192 FOR EDG01A/B INLET	22
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	21

(1) The cutoff threshold chosen for this table is based upon guidance presented in NEI 00-04 (Reference 51).

Table 19.1-103

LPSD Internal Events PRA Key CCF Events by FV (CDF)

Basic Event	Description	FV
No Events met the 0.5% cutoff.		

Table 19.1-104 (1 of 2)

LPSD Internal Events PRA Key Operator Actions by RAW (CDF)

Basic Event	Description	RAW
HR-MI-SOP05	OPERATOR FAILS TO ISOLATE AND MAKEUP OVER-DRAINAGE (SO) PATH AT POS05	48
HR-MI-SOP11	OPERATOR FAILS TO ISOLATE AND MAKEUP OVER-DRAINAGE (SO) PATH AT POS11	39
HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11	39
HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05	38
HR-RS-LPP10	OPERATOR FAILS TO RESTORE SCS AT LO POS10	21
HR-RS-S1P10	OPERATOR FAILS TO RESTORE SCS AT S1 POS10	18
HR-RS-LPP06	OPERATOR FAILS TO RESTORE SCS AT LO POS06	14
HR-RS-S1P06	OPERATOR FAILS TO RESTORE SCS AT S1 POS06	12
HR-MI-SLP05	OPERATOR FAILS TO ISOLATE AND MAKEUP FAILING TO MAINTAIN WATER LEVEL (SL) PATH AT POS05	10
HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05	8
HR-MI-SLP11	OPERATOR FAILS TO ISOLATE AND MAKEUP FAILING TO MAINTAIN WATER LEVEL (SL) PATH AT POS11	6
HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01	6
HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11	6
HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01	6
HR-FB-SOP05-01-DE	HRA DEPENDANCE FOR RS & FB AT SO POS05	6
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	6
HR-MI-JLP05	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS05	6
HR-RS-JLP10	OPERATOR FAILS TO RESTORE SCS AT JL POS10	6
HR-RS-LPP04B	OPERATOR FAILS TO RESTORE SCS AT LO POS04B	6
HR-RS-KVP10	OPERATOR FAILS TO RESTORE SCS AT KV POS10	5
HR-RS-S1P04B	OPERATOR FAILS TO RESTORE SCS AT S1 POS04B	5
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	5
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	5

Table 19.1-104 (2 of 2)

Basic Event	Description	RAW
HR-MI-JLP06	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS06	5
HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05	4
HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06	4
HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11	4
HR-MI-JLP11	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS11	4
HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11	4
HR-RS-KVP06	OPERATOR FAILS TO RESTORE SCS AT KV POS06	4
HR-RS-S2P10	OPERATOR FAILS TO RESTORE SCS AT S2 POS10	4
HR-RS-S1P11	OPERATOR FAILS TO RESTORE SCS AT S1 POS11	4
HR-FB-SOP11-01-DE	HRA DEPENDANCE FOR RS & FB AT SO POS11	3
HR-RS-ESP10	OPERATOR FAILS TO RESTORE SCS AT ES POS10	3
HR-RS-S2P06	OPERATOR FAILS TO RESTORE SCS AT S2 POS06	3
HR-RS-ESP06	OPERATOR FAILS TO RESTORE SCS AT ES POS06	3
HR-MI-JLP04B	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS04B	2
HR-FB-SOP05-02-DE	HRA DEPENDANCE FOR MI & FB AT SO POS05	2
HR-RS-JLP04B	OPERATOR FAILS TO RESTORE SCS AT JL POS04B	2
HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B	2
HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01	2
HR-FB-SLP05-01-DE	HRA DEPENDANCE FOR RS & FB AT SL POS05	2
HR-RS-LPP12A	OPERATOR FAILS TO RESTORE SCS AT LO POS12A	2

Table 19.1-105 (1 of 2)

LPSD Internal Events PRA Key Operator Actions by FV (CDF)

Basic Event	Description	FV
HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05	28.8%
HR-FB-SOP05-01-DE	HRA DEPENDANCE FOR RS & FB AT SO POS05	28.8%
HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11	12.9%
HR-FB-SOP11-01-DE	HRA DEPENDANCE FOR RS & FB AT SO POS11	12.9%
HR-MI-SOP05	OPERATOR FAILS TO ISOLATE AND MAKEUP OVER-DRAINAGE (SO) PATH AT POS05	8.9%
HR-FB-SOP05-02-DE	HRA DEPENDANCE FOR MI & FB AT SO POS05	8.9%
HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05	5.3%
HR-FB-SLP05-01-DE	HRA DEPENDANCE FOR RS & FB AT SL POS05	5.3%
HR-MI-SOP11	OPERATOR FAILS TO ISOLATE AND MAKEUP OVER-DRAINAGE (SO) PATH AT POS11	4.7%
HR-FB-SOP11-02-DE	HRA DEPENDANCE FOR MI & FB AT SO POS11	4.7%
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	3.0%
HR-FB-JLP05-01-DE	HRA DEPENDANCE FOR RS & FB AT JL POS05	3.0%
HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11	1.9%
HR-FB-SLP11-01-DE	HRA DEPENDANCE FOR RS & FB AT SL POS11	1.9%
HR-MI-SLP05	OPERATOR FAILS TO ISOLATE AND MAKEUP FAILING TO MAINTAIN WATER LEVEL (SL) PATH AT POS05	1.6%
HR-FB-SLP05-02-DE	HRA DEPENDANCE FOR MI & FB AT SL POS05	1.6%
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	1.3%
HR-FB-LPP05-DE	HRA DEPENDANCE FOR RS & FB AT LP POS05	1.3%
HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B	1.3%
HR-SG-LPP03B-DE	HRA DEPENDANCE FOR RS & SG AT LP POS03B	1.3%
HR-FB-LPP03B-01-DE	HRA DEPENDANCE FOR SG & FB AT LP POS03B	1.3%
HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05	1.1%
HR-FB-S1P05-DE	HRA DEPENDANCE FOR RS & FB AT S1 POS05	1.1%
HR-RS-S1P03B	OPERATOR FAILS TO RESTORE SCS AT S1 POS03B	1.1%

Table 19.1-105 (2 of 2)

Basic Event	Description	FV
HR-SG-S1P03B-DE	HRA DEPENDANCE FOR RS & SG AT S1 POS03B	1.1%
HR-FB-S1P03B-01-DE	HRA DEPENDANCE FOR SG & FB AT S1 POS03B	1.1%
HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11	1.1%
HR-FB-JLP11-01-DE	HRA DEPENDANCE FOR RS & FB AT JL POS11	1.1%
HR-MI-JLP05	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS05	0.9%
HR-FB-JLP05-02-DE	HRA DEPENDANCE FOR MI & FB AT JL POS05	0.9%
HR-MI-JLP06	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS06	0.7%
HR-FB-JLP06-02-DE	HRA DEPENDANCE FOR MI & FB AT JL POS06	0.7%
HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01	0.7%
HR-MI-SLP11	OPERATOR FAILS TO ISOLATE AND MAKEUP FAILING TO MAINTAIN WATER LEVEL (SL) PATH AT POS11	0.7%
HR-FB-SLP11-02-DE	HRA DEPENDANCE FOR MI & FB AT SL POS11	0.7%
HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01	0.7%
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	0.6%
HR-FB-JLP10-02-DE	HRA DEPENDANCE FOR MI & FB AT JL POS10	0.6%

Table 19.1-106

LPSD Internal Flooding PRA CDF Contributions for Initaiting Events - All POS

Initiating Event	Plant Operating States	CDF Contribution
Major FP break in room 078-A44B during LPSD	3-13	72.4%
Large break of FP piping in room 100-A37B	3-13	20.0%
Large break of FP piping in room 137-A29B	3-13	2.4%
Large break of FP piping in room 078-A10C	3-6	0.8%
Large break of FP piping in room 100-A20A	3-6	0.7%
Large break of FP piping in room 078-A19A	3-6	0.7%
Moderate break of FP piping in room 137-A29B	3-13	0.5%
Large break of FP piping in room 078-A31A	3-6	0.5%
Large break of FP piping in room 078-A19B	10-13	0.3%
Moderate break of FP piping in room 055-A50B	3-13	0.2%
Moderate break of FP piping in room 100-A20A	3-6	0.2%
Large break of FP piping in room 078-A01D	10-13	0.2%
Moderate break of FP piping in room 078-A10C	3-6	0.2%
Moderate break of FP piping in room 078-A19A	3-6	0.2%
Large break of FP piping in room 100-A10B	10-13	0.1%
Moderate FP break in room 137-A09C during LPSD	3-6	0.1%
Large break of FP piping in room 137-A09C	3-6	0.1%
Moderate break of FP piping in room 078-A19B	10-13	0.1%
Moderate break of WO piping in room 078-A25A	3-6	0.1%
Moderate break of WO piping in room 078-A25B	10-13	0.1%

Table 19.1-107

LPSD Internal Flooding PRA CDF Contributions for Initaiting Events - Reduced Inventory

Initiating Event	Plant Operating States	CDF Contribution
MajorFP break in room 078-A44B during LPSD	11	72.1%
Large break of FP piping in room 100-A37B	11	19.9%
Large break of FP piping in room 137-A29B	11	2.4%
Large break of FP piping in room 100-A20A	11	0.8%
Large break of FP piping in room 078-A10C	11	0.8%
Large break of FP piping in room 078-A19A	11	0.7%
Large break of FP piping in room 078-A31A	11	0.6%
Moderate break of FP piping in room 137-A29B	11	0.5%
Large break of FP piping in room 078-A19B	11	0.4%
Moderate break of FP piping in room 055-A50B	5, 11	0.3%
Moderate break of FP piping in room 100-A20A	5	0.2%
Large break of FP piping in room 078-A01D	11	0.2%
Moderate break of FP piping in room 078-A10C	5	0.2%
Moderate break of FP piping in room 078-A19A	5	0.2%
Large break of FP piping in room 100-A10B	11	0.1%
Large break of FP piping in room 100-A22A	5, 11	0.1%
Moderate FP break in room 137-A09C during LPSD	5	0.1%
Large break of FP piping in room 137-A09C	5	0.1%
Moderate break of FP piping in room 078-A19B	11	0.1%
Moderate break of WO piping in room 078-A25A	5	0.1%
Moderate break of WO piping in room 078-A25B	11	0.1%

Table 19.1-108

LPSD Internal Flooding PRA CDF Contributions by Plant Operating State

POS	T/S Mode	Description	CDF(/yr)	Contribution (%)
01	1, 2	Reactor trip and subcritical state	N/A	0.0%
02	3	Steam Generator Cooldown to 350°F	N/A	0.0%
03A	4	Cooldown with SCS to 212°F	1.53E-09	8.3%
3B	5	Cooldown with SCS to 140°F	1.94E-10	1.1%
04A	5	RCS Draindown (pressurizer manway closed)	2.34E-10	1.3%
04B	5	RCS Draindown (manway open)	1.02E-09	5.5%
05	5	Reduced Inventory Operation	8.50E-10	4.6%
06	5	Fill for Refueling	9.65E-09	52.4%
07-09	6	Refueling	N/A -	0.0%
10	5	RCS Draindown after Refueling	4.06E-09	22.0%
11	5	Reduced Inventory Operation	6.21E-10	3.4%
12A	5	Refill RCS (manway open)	1.98E-10	1.1%
12B	5	Refill RCS (manway closed)	N/A	0.0%
13	4, 5	RCS Heatup with SCS Isolation at 350°F	7.53E-11	0.4%
14	3	RCS Heatup with Steam Generators	N/A	0.0%
15	2, 1	Reactor Startup	N/A	0.0%
TOTAL	-	-	1.84E-08	100%

Table 19.1-109 (1 of 36)

LPSD Internal Flooding PRA CDF Top 100 Cutsets – All POS

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.86E-09	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	15.6	15.6
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
2	1.93E-09	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	10.5	26.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
3	1.39E-09	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	7.6	33.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		

Table 19.1-109 (2 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
4	1.37E-09	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	7.5	41.0
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
5	7.98E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	4.4	45.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN		
6	7.90E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	4.3	49.7
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		

Table 19.1-109 (3 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	6.81E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	3.7	53.4
		BE-RATE-P4B	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS4B DURATION		
		HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P04B-03	S2 POS 4B SEQUENCE 03 IDENTIFIER		
8	5.62E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	3.1	56.4
		BE-RATE-P05	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS5 DURATION		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
9	5.34E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	2.9	59.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (4 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	4.67E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	2.6	61.9
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
		VOHVS2A-HV33A	FAILS TO START OF MAFP RM A CUBICLE COOLER HV33A		
11	4.42E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	2.4	64.3
		BE-RATE-P11	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS11 DURATION		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
12	3.84E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	2.1	66.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		

Table 19.1-109 (5 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	3.77E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	2.0	68.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
14	3.61E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	2.0	70.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C		
15	2.51E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	1.4	71.7
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (6 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	2.20E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	1.2	72.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN		
17	1.88E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	1.0	74.0
		BE-RATE-P4B	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS4B DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P04B-03	S2 POS 4B SEQUENCE 03 IDENTIFIER		
18	1.56E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.9	74.8
		BE-RATE-P4A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS4A DURATION		
		HR-FB-S2P04A-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS04A 01		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P04A-04	S2 POS 4A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (7 of 36)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
19	1.55E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.8	75.7
		BE-RATE-P05	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS5 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
20	1.40E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.8	76.4
		BE-RATE-P12A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS12A DURATION		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
21	1.37E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.7	77.2
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (8 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	1.33E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.7	77.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN		
23	1.29E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.7	78.6
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
		VOHVS2A-HV33A	FAILS TO START OF MAFP RM A CUBICLE COOLER HV33A		
24	1.23E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.7	79.3
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		HR-SG-S2P03A	OPERATOR FAILS SHR WITH AFW AT S2 POS03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (9 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	1.22E-10	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.7	79.9
		BE-RATE-P11	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS11 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
26	1.15E-10	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.6	80.5
		AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
27	9.96E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.5	81.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C		

Table 19.1-109 (10 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
28	9.70E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.5	81.6
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
29	6.93E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.4	82.0
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGDGR-C-DGC	FAILS TO RUN OF EDG C		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (11 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	6.56E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.4	82.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
31	6.40E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	82.7
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		PFHBC2A-SW01C-F2	FAILS TO CLOSE OF FEEDER BRK SW01C-F2 TO EDG A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
32	6.40E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	83.0
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		PFHBO2A-SW01C-A2	PCB SW01C-A2 OF 4.16KV SWGR SW01C FAILS TO OPEN		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (12 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	5.36E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	83.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN		
34	4.82E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	83.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PFBSY2A-SW01C	BUS FAULT ON 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
35	4.82E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	83.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (13 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	4.82E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.3	84.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
37	4.71E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.3	84.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
38	4.63E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.3	84.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		

Table 19.1-109 (14 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	4.30E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	84.9
		BE-RATE-P4A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS4A DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P04A-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS04A 01		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P04A-04	S2 POS 4A SEQUENCE 04 IDENTIFIER		
40	3.88E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	85.1
		BE-RATE-P12A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS12A DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (15 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
41	3.78E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	85.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
42	3.71E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	85.5
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		VDHVS-C-HV12C	FAILS TO START EDG ROOM COOLER HV12C		
43	3.71E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	85.7
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		VDHVS-C-HV13C	FAILS TO START EDG ROOM COOLER HV13C		

Table 19.1-109 (16 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	3.68E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	85.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN		
45	3.63E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	86.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGDGL-C-DGC	DG 01C FAILS TO LOAD & RUN DURING 1ST 1HR		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (17 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	3.41E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	86.3
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		HR-SG-S2P03A	OPERATOR FAILS SHR WITH AFW AT S2 POS03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
47	3.28E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	86.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
48	3.16E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.2	86.6
		AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (18 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	3.02E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	86.8
		AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
50	2.78E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.2	86.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGDGS-C-DGC	FAILS TO START OF EMER DIESEL GENERATOR DG01C		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
51	2.71E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	87.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		

Table 19.1-109 (19 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
52	2.41E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	87.2
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINE MOV 616, 626, 636, 646		
53	2.31E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	87.3
		BE-RATE-P4B	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS4B DURATION		
		HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P04B-03	S2 POS 4B SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
54	2.23E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	87.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		VKDMT-A-Y0001A	AU01A OPPOSED BD Y0001A TRANSFERS CLOSED		
		VKHVS2A-HV11A	FAILS TO START SI PUMP ROOM COOLER HV11A		

Table 19.1-109 (20 of 36)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
55	2.21E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	87.6
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINE MOV 636, 646		
56	2.11E-11	IE-137-29B-FP-M	MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	87.7
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
57	2.10E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	87.8
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		DGDGR-A-DGA	FAILS TO RUN OF EMER DIESEL GENERATOR DG01A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16KV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (21 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	1.91E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	87.9
		BE-RATE-P05	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS5 DURATION		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
59	1.77E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	88.0
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		PFHBC2A-SW01C-F2	FAILS TO CLOSE OF FEEDER BRK SW01C-F2 TO EDG A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (22 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	1.77E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	88.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		PFHBO2A-SW01C-A2	PCB SW01C-A2 OF 4.16KV SWGR SW01C FAILS TO OPEN		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
61	1.73E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.2
		BE-RATE-P03B	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03B DURATION		
		HR-FB-S2P03B-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS03B 01		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03B-04	S2 POS 3B SEQUENCE 04 IDENTIFIER		
		VOHVS2A-HV33A	FAILS TO START OF MAFP RM A CUBICLE COOLER HV33A		

Table 19.1-109 (23 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
62	1.69E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGSQA-C-LOADSQ	LOAD SEQUNCER C FAILS TO OPERATE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
63	1.63E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.4
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
		VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A		
64	1.58E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	88.5
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
		VOHVS2A-HV33A	FAILS TO START OF MAFP RM A CUBICLE COOLER HV33A		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		

Table 19.1-109 (24 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	1.55E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.5
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SICVO2A-V133	SI PUMP DVI2A INJECTION LINE CV 133 FAILS TO OPEN		
66	1.55E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SICVO2A-V237	SI LINE DVI 2A CHECK VALVE SI-237 FAILS TO OPEN		
67	1.55E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.7
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SICVO2A-V434	SI PUMP 3 DISCHARGE LINE CV 434 FAILS TO OPEN		

Table 19.1-109 (25 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
68	1.55E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.8
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SICVO2A-V542	SI PUMP DVI2A INJECTION LINE CV 542 FAILS TO OPEN		
69	1.55E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	88.9
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINE MOV 616, 626, 636, 646		
70	1.54E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.0
		BE-RATE-P13	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS13 DURATION		
		HR-FB-S2P13-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS13 01		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P13-04	S2 POS 13 SEQUENCE 04 IDENTIFIER		
		VOHVS2A-HV33A	FAILS TO START OF MAFP RM A CUBICLE COOLER HV33A		

Table 19.1-109 (26 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	1.50E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	89.0
		BE-RATE-P11	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS11 DURATION		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
72	1.48E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	89.1
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN		
73	1.43E-11	IE-137-29B-FP-M	MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	89.2
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (27 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
74	1.42E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.3
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-616/36	CCF OF 2/4 DVI LINE MOV 616, 636		
75	1.42E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-626/36	CCF OF 2/4 DVI LINE MOV 626, 636		
76	1.42E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.4
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINE MOV 636, 646		

Table 19.1-109 (28 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	1.33E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	89.5
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFBSY2A-SW01C	BUS FAULT ON 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
78	1.33E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	89.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (29 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	1.33E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	89.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
80	1.28E-11	IE-055-50B-FP-M	MODERATE BREAK OF FP PIPING IN ROOM 055-A50B	0.1	89.7
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		FPOPH-4-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH MORE THAN 80 MIN AVAILABLE		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		

Table 19.1-109 (30 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	1.22E-11	IE-137-29B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	89.8
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
82	1.15E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.8
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CTLR OF 745-PE-LX01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
83	1.15E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	89.9
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CTLR OF 745-PE-LX03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (31 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
84	1.12E-11	IE-78-10C-FP-X	LARGE BREAK OF FP PIPING IN ROOM 078-A10C	0.1	90.0
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
85	1.12E-11	IE-78-10C-FP-X	LARGE BREAK OF FP PIPING IN ROOM 078-A10C	0.1	90.0
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CTLRS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
86	1.12E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.1
		AFVVT2A-V1001A	AFW MDP02A SUCT. MAN VALVE V1001A XFR CLOSED		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (32 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
87	1.12E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.1
		AFVVT2A-V1005A	AFW MDP01A DISCH. MAN VALVE V1005A XFR CLOSED		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
88	1.12E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.2
		AFVVT2A-V1011A	AFW MDP02A MIN FLO MAN VALVE V1011A XFR CLOSED		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
89	1.12E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.3
		AFVVT2A-V1603	AFW MDP02A MIN FLO MAN VALVE V1603 XFR CLOSED		
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-109 (33 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	1.09E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.3
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646, 636, 616		
91	1.09E-11	IE-78-44B-FP-X-L	MAJOR FP BREAK IN ROOM 078-A44B DURING LPSD	0.1	90.4
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626, 636, 646		
92	1.07E-11	IE-78-19B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 078-A19B	0.1	90.4
		BE-RATE-P10	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS10 DURATION		
		HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P10-03	S2 POS 10 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM COOLER HV16A		

Table 19.1-109 (34 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
93	1.07E-11	IE-100-20A-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A20A	0.1	90.4
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
94	1.07E-11	IE-100-20A-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A20A	0.1	90.5
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CTLRS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		
95	1.03E-11	IE-137-29B-FP-M	MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	90.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		

Table 19.1-109 (35 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
96	1.03E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	90.6
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		VDHVS-C-HV12C	FAILS TO START EDG ROOM COOLER HV12C		
97	1.03E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	90.7
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		VDHVS-C-HV13C	FAILS TO START EDG ROOM COOLER HV13C		

Table 19.1-109 (36 of 36)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	1.01E-11	IE-137-29B-FP-M	MODERATE BREAK OF FP PIPING IN ROOM 137-A29B	0.1	90.8
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
99	1.00E-11	IE-100-37B-FP-X	LARGE BREAK OF FP PIPING IN ROOM 100-A37B	0.1	90.8
		BE-RATE-P06	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS6 DURATION		
		DGDGL-C-DGC	DG 01C FAILS TO LOAD AND RUN DURING 1ST 1HR		
		FPOPH-1-ISO-FL	OPERATOR FAILS TO ISOLATE FP BREAK WITH LESS THAN 20 MIN AVAILABLE		
		PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 4.16KV SWGR SW01C		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P06-03	S2 POS 6 SEQUENCE 03 IDENTIFIER		
100	9.49E-12	IE-78-19A-FP-X	LARGE BREAK OF FP PIPING IN ROOM 078-A19A	0.1	90.8
		BE-RATE-P03A	CONVERSION FACTOR (SD-YR -> CALENDAR YR) FOR POS03A DURATION		
		PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P03A-04	S2 POS 3A SEQUENCE 04 IDENTIFIER		

Table 19.1-110 (1 of 33)

LPSD Internal Flooding PRA CDF Top 100 Cutsets – Reduced Inventory

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	5.62E-10	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	38.2	38.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
2	4.42E-10	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	30.0	68.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
3	1.55E-10	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	10.6	78.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-110 (2 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
4	1.22E-10	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	8.3	87.1
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
5	1.91E-11	IE-137-29B-FP-X	Large break of FP piping in room 137-A29B	1.3	88.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
6	1.50E-11	IE-137-29B-FP-X	Large break of FP piping in room 137-A29B	1.0	89.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		

Table 19.1-110 (3 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	4.74E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.3	89.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646		
8	4.35E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.3	90.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINEMOV 636,646		
9	4.16E-12	IE-137-29B-FP-M	Moderate break of FP piping in room 137-A29B	0.3	90.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
10	3.72E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.3	90.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646		

Table 19.1-110 (4 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
11	3.42E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.2	90.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINEMOV 636,646		
12	3.26E-12	IE-137-29B-FP-M	Moderate break of FP piping in room 137-A29B	0.2	91.0
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
13	2.51E-12	IE-055-50B-FP-M	Moderate break of FP piping in room 055-A50B	0.2	91.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-4-ISO-FL	Operator fails to isolate FP break with more than 80 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
14	2.14E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	91.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646,636,616		

Table 19.1-110 (5 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	2.14E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	91.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626,636,646		
16	2.12E-12	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.1	91.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
17	2.02E-12	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.1	91.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-110 (6 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
18	1.97E-12	IE-055-50B-FP-M	Moderate break of FP piping in room 055-A50B	0.1	91.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-4-ISO-FL	Operator fails to isolate FP break with more than 80 minurtes available		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
19	1.85E-12	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.1	92.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
20	1.80E-12	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.1	92.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-110 (7 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	1.76E-12	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.1	92.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
22	1.68E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	92.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646,636,616		
23	1.68E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	92.5
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626,636,646		

Table 19.1-110 (8 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
24	1.65E-12	IE-78-19B-FP-X	Large break of FP piping in room 078-A19B	0.1	92.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
25	1.57E-12	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.1	92.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
26	1.50E-12	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.1	92.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		

Table 19.1-110 (9 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
27	1.31E-12	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.1	92.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		
28	1.31E-12	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.1	93.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646		
29	1.20E-12	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.1	93.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINEMOV 636,646		

Table 19.1-110 (10 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	1.03E-12	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.1	93.1
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646		
31	1.00E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	93.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		
32	1.00E-12	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	93.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		

Table 19.1-110 (11 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	9.43E-13	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.1	93.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ2-636/46	CCF OF 2/4 DVI LINEMOV 636,646		
34	8.10E-13	IE-78-01D-FP-X	Large break of FP piping in room 078-A01D	0.1	93.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
35	7.70E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.1	93.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2A-AH05A	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH01A BY ROOM TEMP.		

Table 19.1-110 (12 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	6.35E-13	IE-78-19B-FP-M	Moderate break of FP piping in room 078-A19B	0.0	93.5
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
37	6.27E-13	IE-78-10C-FP-M	Moderate break of FP piping in room 078-A10C	0.0	93.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
38	6.16E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	93.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPWQ2-PP02A/C	2/4 CCF OF START FOR SI PUMP PP02A/C		

Table 19.1-110 (13 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	5.93E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	93.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D		
40	5.92E-13	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.0	93.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646,636,616		
41	5.92E-13	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.0	93.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626,636,646		

Table 19.1-110 (14 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	5.76E-13	IE-100-22A-FP-X	Large break of FP piping in room 100-A22A	0.0	93.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-3-ISO-FL	Operator fails to isolate FP break with 40-80 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
43	5.48E-13	IE-78-10C-FP-M	Moderate break of FP piping in room 078-A10C	0.0	93.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
44	5.46E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	93.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND		

Table 19.1-110 (15 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
45	5.46E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	93.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4A-CH04A	ECW CHILLER CH04A FAILS TO START ON DEMAND		
46	5.32E-13	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.0	93.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
47	5.32E-13	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.0	93.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND		

Table 19.1-110 (16 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
48	5.28E-13	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.0	94.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
49	5.19E-13	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.0	94.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
50	5.08E-13	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.0	94.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		

Table 19.1-110 (17 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	5.08E-13	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.0	94.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND		
52	5.04E-13	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.0	94.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
53	5.01E-13	IE-78-19A-FP-M	Moderate break of FP piping in room 078-A19A	0.0	94.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-110 (18 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
54	4.96E-13	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.0	94.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
55	4.83E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPWQ2-PP02A/C	2/4 CCF OF START FOR SI PUMP PP02A/C		
56	4.66E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D		

Table 19.1-110 (19 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	4.65E-13	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.0	94.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646,636,616		
58	4.65E-13	IE-100-37B-FP-X	Large break of FP piping in room 100-A37B	0.0	94.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minurtes available		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626,636,646		
59	4.53E-13	IE-100-22A-FP-X	Large break of FP piping in room 100-A22A	0.0	94.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		FPOPH-3-ISO-FL	Operator fails to isolate FP break with 40-80 minurtes available		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-110 (20 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	4.52E-13	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.0	94.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
61	4.52E-13	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.0	94.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND		
62	4.52E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPKQ2-PP02A/C	2/4 CCF OF RUN FOR SI PUMP PP02A/C		

Table 19.1-110 (21 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	4.48E-13	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.0	94.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
64	4.41E-13	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.0	94.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
65	4.38E-13	IE-78-19A-FP-M	Moderate break of FP piping in room 078-A19A	0.0	94.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-110 (22 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
66	4.30E-13	IE-100-20A-FP-M	Moderate break of FP piping in room 100-A20A	0.0	94.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
67	4.20E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2A-AH05A	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH01A BY ROOM TEMP.		
68	4.12E-13	IE-78-19B-FP-X	Large break of FP piping in room 078-A19B	0.0	94.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		CCMVO-A-351	SC HX HE01A INLET MOV 351 FAILS TO OPEN		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-110 (23 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	4.11E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMVO1A-646	FAILS TO OPEN SI PUMP 1 INJECTION LINE MOV 646		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		
70	4.09E-13	IE-78-10C-FP-X	Large break of FP piping in room 078-A10C	0.0	94.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2B-AH05B	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH05B BY ROOM TEMP.		
71	4.06E-13	IE-78-19B-FP-X	Large break of FP piping in room 078-A19B	0.0	94.7
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPS1A-SCPP01A	SC PUMP PP01A FAILS TO START		

Table 19.1-110 (24 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
72	4.04E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1A-PP02A	FAILS TO START SI PUMP PP02A		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		
73	4.04E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
		SIMVO1A-646	FAILS TO OPEN SI PUMP 1 INJECTION LINE MOV 646		
74	3.97E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1A-PP02A	FAILS TO START SI PUMP PP02A		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		

Table 19.1-110 (25 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	3.95E-13	IE-78-25A-WO-S	Moderate break of WO piping in room 078-A25A	0.0	94.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
76	3.91E-13	IE-100-20A-FP-X	Large break of FP piping in room 100-A20A	0.0	94.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2B-AH05B	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH05B BY ROOM TEMP.		
77	3.77E-13	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.0	94.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		

Table 19.1-110 (26 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
78	3.77E-13	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.0	94.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		
79	3.77E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPWQ3-PP02A/B/C	3/4 CCF OF START FOR SI PUMP PP02A/B/C		
80	3.77E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	94.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPWQ3-PP02A/C/D	3/4 CCF OF START FOR SI PUMP PP02A/C/D		

Table 19.1-110 (27 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	3.75E-13	IE-100-20A-FP-M	Moderate break of FP piping in room 100-A20A	0.0	94.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
82	3.75E-13	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.0	95.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		

Table 19.1-110 (28 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
83	3.68E-13	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.0	95.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		
84	3.55E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.0
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPKQ2-PP02A/C	2/4 CCF OF RUN FOR SI PUMP PP02A/C		
85	3.48E-13	IE-78-19A-FP-X	Large break of FP piping in room 078-A19A	0.0	95.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2B-AH05B	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH05B BY ROOM TEMP.		

Table 19.1-110 (29 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
86	3.45E-13	IE-78-25A-WO-S	Moderate break of WO piping in room 078-A25A	0.0	95.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
87	3.41E-13	IE-055-20B-FP-M-L	Moderate FP Break in room 055-A20B during LPSD	0.0	95.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-4-ISO-FL	Operator fails to isolate FP break with more than 80 minurtes available		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
88	3.23E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.1
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMVO1A-646	FAILS TO OPEN SI PUMP 1 INJECTION LINE MOV 646		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		

Table 19.1-110 (30 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
89	3.21E-13	IE-78-25B-WO-S	Moderate break of WO piping in room 078-A25B	0.0	95.1
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		SC-PP-B-BUS-FLOOD	FLAG TO DENOTE SC PUMP B POWER SUPPLY FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
90	3.17E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPS1A-PP02A	FAILS TO START SI PUMP PP02A		
		SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN		
91	3.17E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
		SIMVO1A-646	FAILS TO OPEN SI PUMP 1 INJECTION LINE MOV 646		

Table 19.1-110 (31 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	3.12E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPS1A-PP02A	FAILS TO START SI PUMP PP02A		
		SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C		
93	2.97E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV11A	FAILS TO START SI PUMP ROOM CUBICLE COOLER HV11A		
94	2.97E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2A-HV14A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV14A		

Table 19.1-110 (32 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	2.96E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPWQ3-PP02A/B/C	3/4 CCF OF START FOR SI PUMP PP02A/B/C		
96	2.96E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		
		SIMPWQ3-PP02A/C/D	3/4 CCF OF START FOR SI PUMP PP02A/C/D		
97	2.91E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPKQ3-PP02A/B/C	3/4 CCF OF RUN FOR SI PUMP PP02A/B/C		
98	2.91E-13	IE-78-44B-FP-X-L	MajorFP break in room 078-A44B during LPSD	0.0	95.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		SC-PP-A-B-FLOOD	FLAG TO DENOTE SC PUMPS A & B FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SIMPKQ3-PP02A/C/D	3/4 CCF OF RUN FOR SI PUMP PP02A/C/D		

Table 19.1-110 (33 of 33)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	2.90E-13	IE-78-31A-FP-X	Large break of FP piping in room 078-A31A	0.0	95.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minurtes available		
		PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VGSKA2B-AH05B	AUTO SINGNAL FAILURE OF EWS PUMP ROOM FAN AH05B BY ROOM TEMP.		
		FPOPH-3DEP-ISO-FL	OPERATOR FAILS TO ISOLATE MAJOR BREAK OF FP PIPING IN 078-A31A BEFORE 18 INCHES OF ACCUMULATION		
100	2.85E-13	IE-137-09C-FP-M-L	Moderate FP break in room 137-A09C during LPSD	0.0	95.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		SC-PP-A-BUS-FLOOD	FLAG TO DENOTE SC PUMP A POWER SUPPLY FLOOD		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-111 (1 of 5)

LPSD Internal Flooding PRA Key Basic Events by RAW (CDF) – All POS

Basic Event	Description	RAW
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	289
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	255
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	108
SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C	105
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	105
SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN	105
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	105
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	105
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	105
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	105
SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN	105
PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C	105
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	105
SICVO2A-V133	SI PUMP DVI2A INJECTION LINE CV 133 FAILS TO OPEN	105
SICVO2A-V237	SI LINE DVI 2A CHECK VALVE SI-237 FAILS TO OPEN	105
SICVO2A-V434	SI PUMP 3 DISCHARGE LINE CV 434 FAILS TO OPEN	105

Table 19.1-111 (2 of 5)

Basic Event	Description	RAW
SICVO2A-V542	SI PUMP DVI2A INJECTION LINE CV 542 FAILS TO OPEN	105
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	104
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	90
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	88
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	68
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	58
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	57
NPXHY-N-SAT02N	SAT TR02N FAULT	54
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	37
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	37
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	37
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	37
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	37
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	37
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	36
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	36
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	33
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	33

Table 19.1-111 (3 of 5)

Basic Event	Description	RAW
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	30
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	30
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	26
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	18
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	18
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	18
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	18
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	18
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	18
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	11
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	11
VOHVWD2-HV33A/33B	2/2 CCF OF START FOR CUBICLE COOLER HV33A/33B	10
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	10
AFMPR2A-MDP02A	FAILS TO RUN AFW MDP PP02A	10
VOHVR2A-HV33A	FAILS TO RUN OF MAFP ROOM A CUBICLE COOLER HV33A	10
AFVVT2A-V1001A	AFW MDP02A SUCT. MANUAL VALVE V1001A TRANSFER CLOSED	10
AFVVT2A-V1005A	AFW MDP01A DISCH. MANUAL VALVE V1005A TRANSFER CLOSED	10
AFVVT2A-V1011A	AFW MDP02A MINI FLOW LINE MAN VALVE V1011A TRANSFER CLOSED	10

Table 19.1-111 (4 of 5)

Basic Event	Description	RAW
AFVVT2A-V1603	AFW MDP02A MINI FLOW LINE MANUAL VALVE V1603 TRANSFER CLOSED	10
PEDOY-A-LX01A04	FAILURE OF DIGITAL OUTPUT MODULE LX01A BRANCH 04	10
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	10
AFMVT2A-043	AF MOTOR-DRIVEN PUMP 2A DISCHARGE ISOLATION VALVE 043 TRANSFER CLOSED	10
AFCVO2A-V1003A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1003A	10
AFCVO2A-V1007A	FAILS TO OPEN AFW MDP02A DISCH. CHECK VALVE V1017A	10
AFCVO2A-V1012A	FAILS TO OPEN AFW MDP02A MINI FLOW CHECK VALVE V1012A	10
AFSVI2A-0035	AFW MDP02A DISCH. MOD. VALVE 035 FAILS SPURIOUSLY CLOSED	10
NPXHY-M-SAT02M	STANDBY AUX XFMR A FAILS WHILE OPERATING	8
PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16kV SWGR SW01C	7
PHBSY1A-MC03A	BUS FAULT ON 480V MCC MC03A	5
PELXY-A-LX08A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX08A	5
PELXY-C-LX05C-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX05C	5
PEDOY-A-LX08A01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX08A BRANCH 01	4
PEDOY-C-LX05C01	FAILURE OF DIGITAL OUTPUT MODULE 745-LX05C BRANCH 01	4
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	4
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	3

Table 19.1-111 (5 of 5)

Basic Event	Description	RAW
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	3
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	3
SICVO1A-V143	SI LINE 1 CHECK VALVE V143 FAILS TO OPEN	3
SICVO1A-V247	SI LINE 1 CHECK VALVE V247 FAILS TO OPEN	3
SICVO1A-V543	SI LINE 1 CHECK VALVE V543 FAILS TO OPEN	3
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	3
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	2
PHBSY2A-MC01C	BUS FAULT ON 480V MCC MC01C	2
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	2
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM COOLER HV16B	2
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	2
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	2
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	2
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	2
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM COOLER HV16B	2
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	2
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	2
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	2
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	2
PEDOY-B-LX01B02	FALURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	2

Table 19.1-112 (1 of 4)

LPSD Internal Flooding PRA Key Basic Events by RAW (CDF) – Reduce Inventory

Basic Event	Description	RAW
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	90
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	87
NPXHY-N-SAT02N	SAT TR02N FAULT	81
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	73
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	40
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	39
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	33
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	32
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	31
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	26
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	11
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	9
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	9
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	9
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	9
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	9
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	9

Table 19.1-112 (2 of 4)

Basic Event	Description	RAW
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	9
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	9
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	9
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	9
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	9
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	9
PHBSY1A-MC03A	BUS FAULT ON 480V MCC MC03A	8
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	7
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	6
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	6
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	6
SICVO1A-V143	SI LINE 1 CHECK VALVE V143 FAILS TO OPEN	4
SICVO1A-V247	SI LINE 1 CHECK VALVE V247 FAILS TO OPEN	4
SICVO1A-V543	SI LINE 1 CHECK VALVE V543 FAILS TO OPEN	4
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	3
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	3
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	3
SIMPS1A-PP02A	FAILS TO START SI PUMP PP02A	3

Table 19.1-112 (3 of 4)

Basic Event	Description	RAW
SIMVO1A-646	FAILS TO OPEN SI PUMP 1 INJECTION LINE MOV 646	3
SIVVT1A-V476	SI PUMP 1 DISCHARGE VV 476 FAILS TO REMAIN OPEN	3
SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C	3
SIMPR1A-PP02A	FAILS TO RUN SI PUMP PP02A	3
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	3
SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN	3
SIVVT1A-V470	SI PUMP 1 SUCTION VV 470 FAILS TO REMAIN OPEN	3
PFBSY2A-SW01C	BUS FAULT ON 4.16kV SWGR SW01C	3
PGBSY2A-LC01C	BUS FAULT ON 480V LC LC01C	3
PHBSY2A-MC04C	BUS FAULT ON 480V MCC MC04C	3
SIMVT1A-304	MOV 304 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN	3
SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN	3
PGXMY2A-TR01C	480V LC TRANSFORMER LC-TR01C FAULT	3
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	3
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	3
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	3
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	3
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	3

Table 19.1-112 (4 of 4)

Basic Event	Description	RAW
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	3
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	3
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	3
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	3
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	3
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	3
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	3
SICVO2B-V168	CV 168 IN SCS TRAIN B HX DISCH. PATH FAILS TO OPEN	3
SICVO2B-V569	CV V569 IN SC PUMP 2 DISCH. PATH FAILS TO OPEN	3
SIHEY1B-HE01B-SC	SC HX 2 HE01B FAILS WHILE OPERATING	3
SICVO1A-V404	SI PUMP 1 DISCHARGE LINE C/V 404 FAILS TO OPEN	3
SICVO2A-V133	SI PUMP DVI2A INJECTION LINE CV 133 FAILS TO OPEN	3
SICVO2A-V237	SI LINE DVI 2A CHECK VALVE SI-237 FAILS TO OPEN	3
SICVO2A-V434	SI PUMP 3 DISCHARGE LINE CV 434 FAILS TO OPEN	3
SICVO2A-V542	SI PUMP DVI2A INJECTION LINE CV 542 FAILS TO OPEN	3
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	2
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	2
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	2

Table 19.1-113

LPSD Internal Flooding PRA Key Basic Events by FV (CDF) – All POS

Basic Event	Description	FV
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	10.0%
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	9.9%
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	5.8%
PFHBC2A-SW01C-A2	FAILS TO CLOSE OF PCB SW01C-A2 OF 4.16kV SWGR SW01C	4.1%
VOHVS2A-HV33A	FAILS TO START OF MAFP ROOM A CUBICLE COOLER HV33A	3.6%
SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C	2.6%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	1.8%
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	1.0%
SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN	1.0%
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	0.9%
AFMPS2A-MDP02A	FAILS TO START AFW MDP PP02A	0.9%
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	0.8%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	0.5%
PFHBC2A-SW01C-F2	FAILS TO CLOSE OF FEEDER BRK SW01C-F2 TO EDG A	0.5%
PFHBO2A-SW01C-A2	PCB SW01C-A2 OF 4.16kV SWGR SW01C FAILS TO OPEN	0.5%

Table 19.1-114

LPSD Internal Flooding PRA Key Basic Events by FV (CDF) – Reduced Inventory

Basic Event	Description	FV
PFHBC1A-SW01A-A2	FAILS TO CLOSE OF PCB SW01A-A2 OF 4.16kV SWGR SW01A	0.9%
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	0.8%
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM COOLER HV16B	0.7%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	0.5%

Table 19.1-115 (1 of 6)

LPSD Internal Flooding PRA Key CCF by RAW (CDF)

Basic Event	Description	RAW
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	1363
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	1363
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	1363
SICVWQ3-V113/23/33	SI LINE C/V 113,123,133 CCF TO OPEN	718
SICVWQ3-V217/27/37	3/4 CCF OF DVI LINE CHECK VALVES 217,227,237	718
SICVWQ3-V540/41/42	3/4 CCF OF DVI LINE CHECK VALVES 540,541,542	718
SICVWQ3-V113/33/43	SI LINE C/V 113,133,143 CCF TO OPEN	715
SICVWQ3-V217/37/47	3/4 CCF OF DVI LINE CHECK VALVES 217,237,247	715
SICVWQ3-V540/42/43	3/4 CCF OF DVI LINE CHECK VALVES 540,542,543	715
SICVWQ3-V123/33/43	SI LINE C/V 123,133,143 CCF TO OPEN	651
SICVWQ3-V227/37/47	3/4 CCF OF DVI LINE CHECK VALVES 227,237,247	651
SICVWQ3-V541/42/43	3/4 CCF OF DVI LINE CHECK VALVES 541,542,543	651
SICVWQ2-V133/43	SI LINE C/V 133,143 CCF TO OPEN	630
SICVWQ2-V237/47	2/4 CCF OF DVI LINE CHECK VALVES 237,247	630
SICVWQ2-V542/43	2/4 CCF OF DVI LINE CHECK VALVES 542,543	630
SICVWQ2-V113/23	SI LINE C/V 113,123 CCF TO OPEN	577
SICVWQ2-V217/27	2/4 CCF OF DVI LINE CHECK VALVES 217,227	577

Table 19.1-115 (2 of 6)

Basic Event	Description	RAW
SICVWQ2-V540/41	2/4 CCF OF DVI LINE CHECK VALVES 540,541	577
SICVWQ3-V113/23/43	SI LINE C/V 113,123,143 CCF TO OPEN	577
SICVWQ3-V217/27/47	3/4 CCF OF DVI LINE CHECK VALVES 217,227,247	577
SICVWQ3-V540/41/43	3/4 CCF OF DVI LINE CHECK VALVES 540,541,543	577
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINE MOV 616, 626, 636, 646	379
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	377
SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646, 636, 616	375
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	375
SIMPWQ3-PP02A/C/D	3/4 CCF OF START FOR SI PUMP PP02A/C/D	373
SIMPKQ3-PP02A/C/D	3/4 CCF OF RUN FOR SI PUMP PP02A/C/D	373
SIMVWQ2-636/46	CCF OF 2/4 DVI LINE MOV 636, 646	373
SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626, 636, 646	373
SIMPWQ2-PP02A/C	2/4 CCF OF START FOR SI PUMP PP02A/C	372
SIMPKQ2-PP02A/C	2/4 CCF OF RUN FOR SI PUMP PP02A/C	372
SIMPWQ3-PP02A/B/C	3/4 CCF OF START FOR SI PUMP PP02A/B/C	372
SIMPKQ3-PP02A/B/C	3/4 CCF OF RUN FOR SI PUMP PP02A/B/C	372
SICVWQ4-V404/05/34/46	SI PUMP DISCHARGE C/V 404,405,434,446 CCF TO OPEN	371
SICVWQ2-V404/34	2/4 CCF OF SI PUMP DISCH. LINE CVs 404,434	370

Table 19.1-115 (3 of 6)

Basic Event	Description	RAW
SICVWQ3-V404/05/34	SI PUMP DISCHARGE C/V 404,405,434 CCF TO OPEN	368
SICVWQ3-V404/34/46	SI PUMP DISCHARGE C/V 404,434,446 CCF TO OPEN	368
SIMVWQ3-616/26/36	CCF OF 3/4 DVI LINE MOV 636, 626, 616	110
SIMPWQ3-PP02B/C/D	3/4 CCF OF START FOR SI PUMP PP02B/C/D	108
SIMPKQ3-PP02B/C/D	3/4 CCF OF RUN FOR SI PUMP PP02B/C/D	107
SIMVWQ2-616/36	CCF OF 2/4 DVI LINE MOV 616, 636	106
SIMPKQ2-PP02C/D	2/4 CCF OF RUN FOR SI PUMP PP02C/D	106
SIMPWQ2-PP02C/D	2/4 CCF OF START FOR SI PUMP PP02C/D	106
SICVWQ2-V113/33	SI LINE C/V 113,133 CCF TO OPEN	105
SICVWQ2-V217/37	2/4 CCF OF DVI LINE CHECK VALVES 217,237	105
SICVWQ2-V434/46	2/4 CCF OF SI PUMP DISCH. LINE CVs 434,446	105
SICVWQ2-V540/42	2/4 CCF OF DVI LINE CHECK VALVES 540,542	105
SIMVWQ2-626/36	CCF OF 2/4 DVI LINE MOV 626, 636	105
PELXKO8-LX06ABCD	8/8 CCF OF LOOP CONTROLLER LX06A/B/C/D	105
SIMPKQ2-PP02B/C	2/4 CCF OF RUN FOR SI PUMP PP02B/C	105
SIMPWQ2-PP02B/C	2/4 CCF OF START FOR SI PUMP PP02B/C	105
SICVWQ2-V123/33	SI LINE C/V 123,133 CCF TO OPEN	104
SICVWQ2-V227/37	2/4 CCF OF DVI LINE CHECK VALVES 227,237	104

Table 19.1-115 (4 of 6)

Basic Event	Description	RAW
SICVWQ2-V405/34	2/4 CCF OF SI PUMP DISCH. LINE CVs 405,434	104
SICVWQ2-V541/42	2/4 CCF OF DVI LINE CHECK VALVES 541,542	104
SICVWQ3-V405/34/46	SI PUMP DISCHARGE C/V 405,434,446 CCF TO OPEN	104
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	74
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	55
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	55
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	55
VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	55
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PP RM CUBICLE COOLER HV13A, 13B, 14A, 14B	51
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	49
VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B	49
PAGXKO8-PA03ABCD	8/8 CCF OF GROUP CONTROLLER 752-PA03A,03B,03C,03D	44
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOL. VALVES	44
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	44
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	44
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	44

Table 19.1-115 (5 of 6)

Basic Event	Description	RAW
CCMVXO8-143-150	8/8 CCF(DEMAND) MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LINE	39
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	39
VGAHKQ2-AH04B/5B	RUNNING CCF OF ESW PUMP ROOM FAN AH04B, 05B	38
WOCHKQ2-CH01B/2B	RUNNING CCF OF ECW CHILLERS 1B/2B	37
WOCHKQ2-CH03B/4B	RUNNING CCF OF ECW CHILLERS 3B/4B	37
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	37
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	37
WOCHKQ3-CH02A/1B/2B	RUNNING CCF OF ECW CHILLERS 2A/1B/2B	36
WOCHKQ3-CH04A/3B/4B	RUNNING CCF OF ECW CHILLERS 4A/3B/4B	36
VGAHKQ3-AH04A/4B/5B	RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05B	36
VGAHKQ2-AH01B/2B	2/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02B	36
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	36
VGAHKQ3-AH01B/2A/2B	3/4 CCF (RUNNING) OF ESW PUMP ROOM FAN AH01B, 02A, 02B	36
VGAHKQ3-AH04B/5A/5B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04B, 05A, 05B	36
CCMVXO4-144/6/8/50	4/4 CCF(DEMAND) OF MOV 144,146,148,150 IN NON-SAFETY LOAD LINE	35
CCMPKQ2-PP01/2B	2/4 CCF OF CCW PUMPS PP01B/2B (RUNNING)	35
WOMPKQ2-PP01B/2B	RUNNING CCF OF ECW PUMPS 1B AND 2B	35

Table 19.1-115 (6 of 6)

Basic Event	Description	RAW
WOMPKQ2-PP04B/5B	RUNNING CCF OF ECW PUMPS 4B AND 5B	35
SXMPKQ2-PP01/2B	2/4 CCF OF ESW PUMPS PP01B, PP02B (RUNNING)	35
VKHVKQ2-HV13B/14B	2/4 CCF OF RUN FOR CCW PUMP ROOM COOLER HV13B, 14B	35
VKHVKQ3-HV13B/14A/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM COOLER HV13B, 14A, 14B	34
CCMPKQ3-PP01B/2A/B	3/4 CCF OF CCW PUMPS PP01B/2A/2B (RUNNING)	34
VKHVKQ3-HV13A/13B/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM COOLER HV13A, 13B, 14B	34
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	33
WOMPKQ3-PP01A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/1B/2B	33
WOMPKQ3-PP02A/1B/2B	RUNNING CCF OF ECW PUMPS 2A/1B/2B	33
WOMPKQ3-PP04A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/4B/5B	33
WOMPKQ3-PP05A/4B/5B	RUNNING CCF OF ECW PUMPS 5A/4B/5B	33
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	33
SXMPKQ3-PP01B/2A/B	3/4 CCF OF ESW PUMPS PP02A, PP01B, PP02B (RUNNING)	33
SXAHKQ2-AH01B/02B	2/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01B, 02B	30
SXAHKQ3-AH01A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 01B, 02B	29
SXAHKQ3-AH02A/01B/02B	3/4 RUNNING CCF OF ESW COOLING TOWER FANS AH02A, 01B, 02B	29

Table 19.1-116

LPSD Internal Flooding PRA Key CCF by FV (CDF)

Basic Event	Description	FV
No Events met the 0.5% cutoff.		

Table 19.1-117

LPSD Internal Flooding PRA Key Operator Actions by RAW (CDF)

Basic Event	Description	RAW
HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10	165
HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06	107
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	41
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	34
HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11	26
HR-SG-S2P03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03A	10
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	9.1
HR-FB-S2P04A-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS04A 01	3.4

Table 19.1-118

LPSD Internal Flooding PRA Key Operator Actions by FV (CDF)

Basic Event	Description	FV
FPOPH-1-ISO-FL	Operator fails to isolate FP break with less than 20 minutes available	22.5%
HR-FB-S2P10	OPERATOR FAILS TO OPERATE F&B AT S2 POS10	20.9%
HR-FB-S2P06	OPERATOR FAILS TO OPERATE F&B AT S2 POS06	14.3%
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	5.0%
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	4.2%
HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11	3.2%
HR-FB-S2P04A-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS04A 01	1.1%
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	1.0%
HR-SG-S2P03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03A	0.9%
FPOPH-2-ISO-FL	Operator fails to isolate FP break with 20-40 minutes available	0.9%

Table 19.1-119

LPSD Fire PRA CDF Contributions by Plant Operating State

POS	T/S Mode	Description	CDF(/yr)	Contribution (%)
3A	4	Cooldown with Shutdown Cooling System to 212^{o}F	4.61E-08	2.7%
3B	5	Cooldown with Shutdown Cooling System from 212^{o}F to 140^{o}F	1.74E-07	10.0%
4A	5	Reactor Coolant System Drain-down (with PZR manway closed)	2.68E-09	0.2%
4B	5	Reactor Coolant System Drain-down (with PZR manway open)	1.42E-07	8.2%
5	5	Mid-Loop Operation with nozzle dam installation	7.96E-07	45.7%
6	5	Fill for Refueling	8.62E-08	5.0%
10	5	Reactor Coolant System drain-down to Reduced Inventory after refueling	2.24E-07	12.9%
11	5	Reduced Inventory Operation with Steam Generator (primary side) manway closed	2.02E-08	1.2%
12A	5	Refill Reactor Coolant System (Pressurizer manway open)	2.19E-07	12.6%
13	4	Reactor Coolant System Heat-up with Shutdown Cooling System isolation at 350^{o}F	2.92E-08	1.7%

Table 19.1-120 (1 of 10)

LPSD PRA CDF Contributions for Internal Fire Initiating Events – All POS

Initiating Event	CDF (/yr)	Contribution
%F000-ADGC - FIRE IN DIESEL GENERATOR ROOM	3.40E-07	19.5%
%F078-AGAC - FIRE IN GENERAL ACCESS AREA	1.25E-07	7.2%
%F000-ADGD - FIRE IN DIESEL GENERATOR ROOM	8.10E-08	4.7%
%FK-K01 - FIRE IN ESW STRUCTURE "A" BUILDING	6.63E-08	3.8%
%F137-ANEA - FIRE IN ELECTRICAL EQUIPMENT ROOM	6.20E-08	3.6%
%F078-A19B - FIRE IN CORRIDOR	4.74E-08	2.7%
%F120-AGAC - FIRE IN GENERAL ACCESS AREA-120' C	4.71E-08	2.7%
%F078-A04C - FIRE IN MISC. ELECTRICAL EQUIP RM	4.65E-08	2.7%
%F055-AGAC - FIRE IN GENERAL ACCESS AREA-55' C	4.52E-08	2.6%
%F120-AGAD - FIRE IN GENERAL ACCESS AREA-120' D	3.84E-08	2.2%
%FD-D01A - FIRE IN CCW HEAT EXCHANGER "A" BUILDING	3.55E-08	2.0%
%F078-AGAD - FIRE IN GENERAL ACCESS AREA	3.37E-08	1.9%
%F157-AMCR - FIRE IN MAIN CONTROL ROOM	2.95E-08	1.7%
%F078-A05C - FIRE IN CHANNEL-C DC & IP EQUIP RM	2.81E-08	1.6%
%F100-AEEA - FIRE IN 480V CLASS 1E MCC 01A RM	2.80E-08	1.6%
%F078-A03C - FIRE IN CLASS 1E LOADCENTER 01C RM	2.77E-08	1.6%
%F000-TB - FIRE IN TURBINE GENERATOR AREA	2.66E-08	1.5%
%F078-AEEB - FIRE IN CLASS 1E SWITCHGEAR 01B ROOM	2.12E-08	1.2%
%F100-AGAC - FIRE IN GENERAL ACCESS AREA	2.08E-08	1.2%

Table 19.1-120 (2 of 10)

Initiating Event	CDF (/yr)	Contribution
%F137-AEPA - FIRE IN ELECTRICAL PENETRATION ROOM (A)	2.03E-08	1.2%
%F078-A19A - FIRE IN CORRIDOR	1.89E-08	1.1%
%F137-A11C - FIRE IN ELECTRICAL PENETRATION RM (C)	1.80E-08	1.0%
%F000-ACVU - FIRE IN CVCS SYSTEM AREA	1.72E-08	1.0%
%F157-A19C - FIRE IN I&C EQUIPMENT RM	1.70E-08	1.0%
%F055-AGAD - FIRE IN GENERAL ACCESS AREA-55' D	1.65E-08	1.0%
%F067-T02 - FIRE IN UNDERGROUND COMMON TUNNEL	1.61E-08	0.9%
%F157-A25C - FIRE IN I&C EQUIPMENT RM	1.57E-08	0.9%
%F137-A10C - FIRE IN 480V CLASS 1E MCC 03C RM	1.52E-08	0.9%
%F078-A25A - FIRE IN CLASS 1E SWITCHGEAR 01A RM	1.41E-08	0.8%
%F050-A01C - FIRE IN CS PUMP & MINI FLOW HX RM	1.28E-08	0.7%
%F050-A02C - FIRE IN SI PUMP RM	1.25E-08	0.7%
%F100-A08D - FIRE IN N1E DC & IP EQUIPMENT RM	1.17E-08	0.7%
%F078-A11C - FIRE IN ESSENTIAL CHILLER RM	1.07E-08	0.6%
%F050-A04A - FIRE IN SC PUMP & MINI FLOW HX RM	1.06E-08	0.6%
%F055-A02C - FIRE IN CCW PUMP RM	1.06E-08	0.6%
%F100-AEEB - FIRE IN 480V CLASS 1E MCC 01B ROOM	1.06E-08	0.6%
%F055-AGAA - FIRE IN GENERAL ACCESS AREA-55' A	1.04E-08	0.6%
%F055-A02A - FIRE IN CCW PUMP RM	1.04E-08	0.6%
%F120-A09C - FIRE IN ELECTRICAL PENETRATION ROOM (C)	9.80E-09	0.6%

Table 19.1-120 (3 of 10)

Initiating Event	CDF (/yr)	Contribution
%F157-AMAX - FIRE IN MEETING ROOM	9.69E-09	0.6%
%F078-A04D - FIRE IN MISC. ELECTRICAL EQUIP RM	9.24E-09	0.5%
%F000-AC - FIRE IN ACCESS AREA	8.98E-09	0.5%
%FK-K02 - FIRE IN ESW STRUCTURE "B" BUILDING	8.67E-09	0.5%
%F120-AGAA - FIRE IN GENERAL ACCESS AREA-120' A	8.58E-09	0.5%
%F120-A09D - FIRE IN ELECTRICAL PENETRATION ROOM (D)	8.46E-09	0.5%
%F137-A09D - FIRE IN GENERAL ACCESS AREA	8.16E-09	0.5%
%FK-K03 - FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA	7.55E-09	0.4%
%F000-ACVL - FIRE IN CVCS ACCESS AREA	7.41E-09	0.4%
%F078-A52D - FIRE IN 480V N1E MCC RM	7.36E-09	0.4%
%F100-A13A - FIRE IN MECHANICAL PENETRATION RM	6.99E-09	0.4%
%F100-A14A - FIRE IN PERSONNEL AIR LOCK ENTRANCE	6.65E-09	0.4%
%F078-A05D - FIRE IN CHANNEL-D DC & IP EQUIP RM	6.46E-09	0.4%
%F120-A11B - FIRE IN GENERAL ACCESS AREA-120' B	6.42E-09	0.4%
%FD-D01B - FIRE IN CCW HEAT EXCHANGER "B" BUILDING	6.42E-09	0.4%
%F100-A10A - FIRE IN GENERAL ACCESS AREA	6.35E-09	0.4%
%F137-A02D - FIRE IN ELECTRICAL EQUIP. RM	6.28E-09	0.4%
%F000-RW - FIRE IN ACCESS AREA	6.23E-09	0.4%
%F078-A56B - FIRE IN CHANNEL-B DC & IP EQUIP. RM	6.21E-09	0.4%
%F120-A15B - FIRE IN 480V CLASS 1E MCC 03B RM	6.21E-09	0.4%

Table 19.1-120 (4 of 10)

Initiating Event	CDF (/yr)	Contribution
%F137-A20A - FIRE IN GENERAL ACCESS AREA	6.21E-09	0.4%
%F157-A01D - FIRE IN I&C EQUIPMENT RM	5.99E-09	0.3%
%F000-ACV - FIRE IN CVCS ACCESS AREA	5.97E-09	0.3%
%F100-A08C - FIRE IN N1E DC & IP EQUIPMENT RM	5.69E-09	0.3%
%F078-A03D - FIRE IN CLASS 1E LOADCENTER 01D RM	5.19E-09	0.3%
%F157-ACPX - FIRE IN COMPUTER RM PACU RM	5.17E-09	0.3%
%F122-T01 - FIRE IN SWITCHGEAR RM	5.05E-09	0.3%
%F050-A04B - FIRE IN SC PUMP & MINI FLOW HX RM	4.87E-09	0.3%
%F055-A14C - FIRE IN PIPE CHASE & VALVE RM	4.87E-09	0.3%
%F157-ATOC - FIRE IN TSC EQUIP. REPAIR & MAINT ROOM	4.80E-09	0.3%
%F157-A16C - FIRE IN GENERAL ACCESS AREA	4.77E-09	0.3%
%F100-T15 - FIRE IN SWITCHGEAR RM	4.11E-09	0.2%
%F137-A11D - FIRE IN ELECTRICAL PENETRATION RM (D)	3.85E-09	0.2%
%F157-A19D - FIRE IN I&C EQUIPMENT RM	3.58E-09	0.2%
%F137-A15B - FIRE IN 480V CLASS 1E MCC 04B RM	3.31E-09	0.2%
%F137-AEPB - FIRE IN ELECTRICAL PENETRATION ROOM (B)	3.31E-09	0.2%
%F120-A14A - FIRE IN SG BLOWDOWN REGEN HX RM	3.17E-09	0.2%
%F078-A02C - FIRE IN CLASS 1E SWITCHGEAR 01C RM	3.13E-09	0.2%
%F137-A10D - FIRE IN 480V CLASS 1E MCC 03D RM	2.99E-09	0.2%
%F078-A02D - FIRE IN CLASS 1E SWITCHGEAR 01D RM	2.89E-09	0.2%

Table 19.1-120 (5 of 10)

Initiating Event	CDF (/yr)	Contribution
%F078-A12D - FIRE IN ESSENTIAL WATER CHILLER RM	2.87E-09	0.2%
%F157-A17C - FIRE IN CORRIDOR	2.87E-09	0.2%
%F100-A10B - FIRE IN GENERAL ACCESS AREA	2.84E-09	0.2%
%F120-A05C - FIRE IN ELECTRICAL EQUIP. RM	2.77E-09	0.2%
%F120-AMPB - FIRE IN MECHANICAL PENETRATION ROOM	2.45E-09	0.1%
%F055-A02B - FIRE IN CCW PUMP RM	2.40E-09	0.1%
%F055-A02D - FIRE IN CCW PUMP RM	2.40E-09	0.1%
%F050-A03B - FIRE IN SI PUMP RM	2.37E-09	0.1%
%F050-A01D - FIRE IN CS PUMP & MINI FLOW HX RM	2.35E-09	0.1%
%F050-A02D - FIRE IN SI PUMP RM	2.35E-09	0.1%
%F120-A05D - FIRE IN ELECTRICAL EQUIP. RM	2.16E-09	0.1%
%F100-A20A - FIRE IN GENERAL ACCESS AREA	2.05E-09	0.1%
%F120-A16A - FIRE IN MECHANICAL PENETRATION RM	2.05E-09	0.1%
%F055-AGAB - FIRE IN GENERAL ACCESS AREA-55' B	1.98E-09	0.1%
%F078-AAFC - FIRE IN TERBINE DRIVEN AUX FEEDWATER PUMP ROOM	1.91E-09	0.1%
%F157-A16D - FIRE IN GENERAL ACCESS AREA	1.91E-09	0.1%
%F137-A05D - FIRE IN PCS RM	1.69E-09	0.1%
%F137-ANEC - FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	1.69E-09	0.1%
%F137-A01C - FIRE IN CABLE SPREADING AREA	1.67E-09	0.1%
%F137-A31C - FIRE IN MAIN STEAM VALVE RM	1.65E-09	0.1%

Table 19.1-120 (6 of 10)

Initiating Event	CDF (/yr)	Contribution
%F100-A06D - FIRE IN GENERAL ACCESS AREA	1.53E-09	0.1%
%F000-AFHL - FIRE IN FUEL HANDLING LOWER AREA	1.51E-09	0.1%
%FK-K04 - FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1B AREA	1.44E-09	0.1%
%F100-A04C - FIRE IN CABLE ACCESS AREA	1.20E-09	0.1%
%F100-A24A - FIRE IN SFP COOLING HX RM	1.08E-09	0.1%
%F157-A21D - FIRE IN INSTRUMENT MAINTENANCE SHOP	1.08E-09	0.1%
%F100-A05C - FIRE IN ELECTRICAL EQUIPMENT RM	9.57E-10	0.1%
%F055-A14D - FIRE IN PIPE CHASE & VALVE RM	9.40E-10	0.1%
%F100-A05D - FIRE IN ELECTRICAL EQUIPMENT RM	9.22E-10	0.1%
%F100-A11A - FIRE IN CHANNEL-A BATTERY RM	7.66E-10	0.0%
%F120-A01D - FIRE IN PIPING CABLE AREA	7.48E-10	0.0%
%F120-A24A - FIRE IN FUEL HANDLING AREA EMER. EXHAUST ACU RM	6.61E-10	0.0%
%F137-A01D - FIRE IN CABLE SPREADING AREA	6.61E-10	0.0%
%F120-A01C - FIRE IN PIPING CABLE AREA	6.44E-10	0.0%
%FY-SAT1 - FIRE IN STAND-BY AUX. TRANSFORMER 1 AREA	6.44E-10	0.0%
%F137-A30D - FIRE IN MAIN STEAM ENCLOSURE	6.26E-10	0.0%
%F157-A23D - FIRE IN AEB RM	6.26E-10	0.0%
%F137-A31D - FIRE IN MAIN STEAM VALVE RM	6.09E-10	0.0%
%F000-AFHU - FIRE IN FUEL HANDLING UPPER AREA	5.92E-10	0.0%
%F172-AGAD - FIRE IN GENERAL ACCESS AREA-172' D	5.74E-10	0.0%

Table 19.1-120 (7 of 10)

Initiating Event	CDF (/yr)	Contribution
%FY-MTR1 - FIRE IN MAIN TRANSFORMER 1 AREA	5.57E-10	0.0%
%FY-MTR2 - FIRE IN MAIN TRANSFORMER 2 AREA	5.57E-10	0.0%
%FY-MTR3 - FIRE IN MAIN TRANSFORMER 3 AREA	5.57E-10	0.0%
%FY-UAT1 - FIRE IN UNIT AUX. TRANSFORMER 1 AREA	5.57E-10	0.0%
%FY-UAT2 - FIRE IN UNIT AUX. TRANSFORMER 2 AREA	5.57E-10	0.0%
%F055-A55B - FIRE IN CHARGING PUMP RM	5.22E-10	0.0%
%F078-ANEC - FIRE IN 480V N1E MCC RM	5.22E-10	0.0%
%F100-A37B - FIRE IN GENERAL ACCESS AREA	5.22E-10	0.0%
%F172-AGAC - FIRE IN GENERAL ACCESS AREA-172' C	4.87E-10	0.0%
%F055-A42A - FIRE IN CHARGING PUMP RM	4.70E-10	0.0%
%F157-A20C - FIRE IN I&C EQUIPMENT RM	3.83E-10	0.0%
%F120-A31B - FIRE IN GENERAL ACCESS AREA-120' B	3.65E-10	0.0%
%F100-A13B - FIRE IN MECHANICAL PENETRATION RM	3.31E-10	0.0%
%F100-A04D - FIRE IN CABLE ACCESS AREA	2.78E-10	0.0%
%F100-A23A - FIRE IN AUX. BLDG. CONTROLLED AREA I SUPPLY AHU ROOM	2.78E-10	0.0%
%F073-T11 - FIRE IN SWITCHGEAR AREA	2.61E-10	0.0%
%F078-A01C - FIRE IN PNS SWGR RM	2.61E-10	0.0%
%F100-A38A - FIRE IN FUEL HANDLING AREA NORMAL EXHAUST ACU RM	2.26E-10	0.0%
%F137-A09C - FIRE IN GENERAL ACCESS AREA	2.09E-10	0.0%
%F078-A01D - FIRE IN PNS SWGR RM	1.91E-10	0.0%

Table 19.1-120 (8 of 10)

Initiating Event	CDF (/yr)	Contribution
%F078-A12C - FIRE IN ESSENTIAL WATER CHILLER RM	1.74E-10	0.0%
%F137-A15A - FIRE IN 480V CLASS 1E MCC 04A RM	1.74E-10	0.0%
%F078-AAFD - FIRE IN TERBINE DRIVEN AUX FEEDWATER PUMP ROOM	1.57E-10	0.0%
%F172-A13C - FIRE IN 480V N1E MCC RM	1.57E-10	0.0%
%F078-A20A - FIRE IN MOTOR DRIVEN AUX. FEEDWATER PUMP RM	1.39E-10	0.0%
%F100-P48 - FIRE IN ACCESS AREA	1.39E-10	0.0%
%F120-A08C - FIRE IN 480V N1E MCC RM	1.39E-10	0.0%
%F078-A20B - FIRE IN MOTOR DRIVEN AUX. FEEDWATER PUMP RM	1.22E-10	0.0%
%F078-A56A - FIRE IN CHANNEL-A DC & IP EQUIP. RM	1.22E-10	0.0%
%F050-A03A - FIRE IN SI PUMP RM	1.04E-10	0.0%
%F055-A04C - FIRE IN SEISMIC CAT-1 FIRE WATER TANK RM	1.04E-10	0.0%
%F078-A11D - FIRE IN ESSENTIAL CHILLER RM	1.04E-10	0.0%
%F157-A20D - FIRE IN I&C EQUIPMENT RM	1.04E-10	0.0%
%F137-A35C - FIRE IN REACTOR TRIP SWITCHGEAR RM	8.70E-11	0.0%
%F055-A01C - FIRE IN CS HX RM	6.96E-11	0.0%
%F055-A21B - FIRE IN PIPE CHASE & VALVE RM	6.96E-11	0.0%
%F078-A47B - FIRE IN ELECTRICAL EQUIPMENT RM	6.96E-11	0.0%
%F120-A03C - FIRE IN DIESEL FUEL OIL DAY TANK RM	6.96E-11	0.0%
%F137-A41A - FIRE IN REMOTE CONTROL CONSOLE ROOM	6.96E-11	0.0%
%F055-A10C - FIRE IN TENDON GALLERY ENTRANCE AREA	5.22E-11	0.0%

Table 19.1-120 (9 of 10)

Initiating Event	CDF (/yr)	Contribution
%F055-A21A - FIRE IN PIPE CHASE & VALVE RM	5.22E-11	0.0%
%F100-A11B - FIRE IN CHANNEL-B BATTERY RM	5.22E-11	0.0%
%F137-ASTD - FIRE IN STAIR	5.22E-11	0.0%
%F157-A13C - FIRE IN VESTIBULE	5.22E-11	0.0%
%F172-A01C - FIRE IN EDG RM NORMAL EXHAUST FAN RM	5.22E-11	0.0%
%F073-T01 - FIRE IN STAIR	3.48E-11	0.0%
%F078-A06C - FIRE IN N1E BATTERY RM	3.48E-11	0.0%
%F078-A53C - FIRE IN 480V N1E LOADCENTER RM	3.48E-11	0.0%
%F120-A02C - FIRE IN LUBE OIL MAKE-UP TANK RM	3.48E-11	0.0%
%F120-A08D - FIRE IN 480V N1E MCC RM	3.48E-11	0.0%
%F137-A36C - FIRE IN REACTOR TRIP SWITCHGEAR RM	3.48E-11	0.0%
%F137-AGAB - FIRE IN GENERAL ACCESS AREA	3.48E-11	0.0%
%F157-A18C - FIRE IN CLEAN AGENT RM	3.48E-11	0.0%
%F157-A27C - FIRE IN GENERAL ACCESS AREA	3.48E-11	0.0%
%F055-A04D - FIRE IN SEISMIC CAT-1 FIRE WATER TANK RM	1.74E-11	0.0%
%F055-A05C - FIRE IN STAIR	1.74E-11	0.0%
%F073-T08 - FIRE IN STAIR	1.74E-11	0.0%
%F078-A06D - FIRE IN N1E BATTERY RM	1.74E-11	0.0%
%F078-A07C - FIRE IN CHANNEL-C BATTERY RM	1.74E-11	0.0%
%F078-A07D - FIRE IN CHANNEL-D BATTERY RM	1.74E-11	0.0%

Table 19.1-120 (10 of 10)

Initiating Event	CDF (/yr)	Contribution
%F078-A09C - FIRE IN HVAC CHASE	1.74E-11	0.0%
%F078-A13D - FIRE IN DUCT RM	1.74E-11	0.0%
%F078-A14C - FIRE IN BUTTRESS OPNG	1.74E-11	0.0%
%F078-A16C - FIRE IN HVAC CHASE	1.74E-11	0.0%
%F078-A23A - FIRE IN BUTTRESS OPNG	1.74E-11	0.0%
%F078-A40B - FIRE IN BORIC ACID CONC. RM	1.74E-11	0.0%
%F078-A53D - FIRE IN 480V N1E LOADCENTER RM	1.74E-11	0.0%
%F078-A55C - FIRE IN ELEV. HALL	1.74E-11	0.0%
%F100-A32B - FIRE IN SFP COOLING HX RM	1.74E-11	0.0%
%F100-A43C - FIRE IN D/G OIL STORAGE ENTRANCE	1.74E-11	0.0%
%F100-A46C - FIRE IN ELEV. HALL	1.74E-11	0.0%
%F100-T17 - FIRE IN BATTERY RM	1.74E-11	0.0%
%F120-A03D - FIRE IN DIESEL FUEL OIL DAY TANK RM	1.74E-11	0.0%
%F137-A04C - FIRE IN CEDM POWER CONTROL CABINET RM	1.74E-11	0.0%
%F137-A19A - FIRE IN SG BLOWDOWN FLASH TANK RM	1.74E-11	0.0%
%F137-A24B - FIRE IN 480V N1E MCC RM	1.74E-11	0.0%
%F137-A37C - FIRE IN REACTOR TRIP SWITCHGEAR RM	1.74E-11	0.0%
%F157-A13D - FIRE IN VESTIBULE	1.74E-11	0.0%
%F172-A01D - FIRE IN EDG RM NORMAL EXHAUST FAN RM	1.74E-11	0.0%

Table 19.1-121 (1 of 10)

LPSD PRA CDF Contributions for Internal Fire Initiating Events – Reduced Inventory

Initiating Event	CDF (/yr)	Contribution
%F000-ADGC - FIRE IN DIESEL GENERATOR ROOM	2.91E-07	35.7%
%F137-ANEA - FIRE IN ELECTRICAL EQUIPMENT ROOM	4.60E-08	5.6%
%FK-K01 - FIRE IN ESW STRUCTURE "A" BUILDING	4.56E-08	5.6%
%F055-AGAC - FIRE IN GENERAL ACCESS AREA-55' C	3.91E-08	4.8%
%F078-A04C - FIRE IN MISC. ELECTRICAL EQUIP RM	3.39E-08	4.2%
%FD-D01A - FIRE IN CCW HEAT EXCHANGER "A" BUILDING	2.59E-08	3.2%
%F078-A05C - FIRE IN CHANNEL-C DC & IP EQUIP RM	2.45E-08	3.0%
%F078-A03C - FIRE IN CLASS 1E LOADCENTER 01C RM	2.02E-08	2.5%
%F100-AEEA - FIRE IN 480V CLASS 1E MCC 01A RM	2.02E-08	2.5%
%F078-AGAC - FIRE IN GENERAL ACCESS AREA	1.50E-08	1.8%
%F137-AEPA - FIRE IN ELECTRICAL PENETRATION ROOM (A)	1.48E-08	1.8%
%F100-AGAC - FIRE IN GENERAL ACCESS AREA	1.45E-08	1.8%
%F137-A11C - FIRE IN ELECTRICAL PENETRATION RM (C)	1.31E-08	1.6%
%F157-A19C - FIRE IN I&C EQUIPMENT RM	1.26E-08	1.6%
%F157-A25C - FIRE IN I&C EQUIPMENT RM	1.13E-08	1.4%
%F137-A10C - FIRE IN 480V CLASS 1E MCC 03C RM	1.13E-08	1.4%
%F078-A11C - FIRE IN ESSENTIAL CHILLER RM	9.26E-09	1.1%

Table 19.1-121 (2 of 10)

Initiating Event	CDF (/yr)	Contribution
%F050-A04A - FIRE IN SC PUMP & MINI FLOW HX RM	9.24E-09	1.1%
%F055-A02C - FIRE IN CCW PUMP RM	9.24E-09	1.1%
%F050-A01C - FIRE IN CS PUMP & MINI FLOW HX RM	9.19E-09	1.1%
%F055-A02A - FIRE IN CCW PUMP RM	9.05E-09	1.1%
%F050-A02C - FIRE IN SI PUMP RM	8.95E-09	1.1%
%F055-AGAA - FIRE IN GENERAL ACCESS AREA-55' A	7.53E-09	0.9%
%F120-AGAC - FIRE IN GENERAL ACCESS AREA-120' C	7.22E-09	0.9%
%F157-AMAX - FIRE IN MEETING ROOM	6.88E-09	0.8%
%F157-AMCR - FIRE IN MAIN CONTROL ROOM	6.23E-09	0.8%
%FK-K03 - FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA	5.51E-09	0.7%
%F100-A13A - FIRE IN MECHANICAL PENETRATION RM	4.99E-09	0.6%
%F100-A14A - FIRE IN PERSONNEL AIR LOCK ENTRANCE	4.95E-09	0.6%
%F000-AC - FIRE IN ACCESS AREA	4.80E-09	0.6%
%F137-A20A - FIRE IN GENERAL ACCESS AREA	4.62E-09	0.6%
%F100-A10A - FIRE IN GENERAL ACCESS AREA	4.58E-09	0.6%
%F078-A19A - FIRE IN CORRIDOR	4.32E-09	0.5%
%F137-ANEC - FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	3.73E-09	0.5%
%F055-A14C - FIRE IN PIPE CHASE & VALVE RM	3.57E-09	0.4%

Table 19.1-121 (3 of 10)

Initiating Event	CDF (/yr)	Contribution
%F157-ATOC - FIRE IN TSC EQUIP. REPAIR & MAINT ROOM	3.47E-09	0.4%
%F157-A16C - FIRE IN GENERAL ACCESS AREA	3.46E-09	0.4%
%F078-A25A - FIRE IN CLASS 1E SWITCHGEAR 01A RM	3.24E-09	0.4%
%F078-AGAD - FIRE IN GENERAL ACCESS AREA	3.16E-09	0.4%
%F000-ACVU - FIRE IN CVCS SYSTEM AREA	3.11E-09	0.4%
%F120-AGAD - FIRE IN GENERAL ACCESS AREA-120' D	2.95E-09	0.4%
%F000-TB - FIRE IN TURBINE GENERATOR AREA	2.39E-09	0.3%
%F120-A14A - FIRE IN SG BLOWDOWN REGEN HX RM	2.29E-09	0.3%
%F120-A09C - FIRE IN ELECTRICAL PENETRATION ROOM (C)	2.24E-09	0.3%
%F000-ADGD - FIRE IN DIESEL GENERATOR ROOM	2.02E-09	0.3%
%F120-AGAA - FIRE IN GENERAL ACCESS AREA-120' A	1.55E-09	0.2%
%F067-T02 - FIRE IN UNDERGROUND COMMON TUNNEL	1.43E-09	0.2%
%F000-ACV - FIRE IN CVCS ACCESS AREA	1.35E-09	0.2%
%F137-A01C - FIRE IN CABLE SPREADING AREA	1.21E-09	0.2%
%F100-A08C - FIRE IN N1E DC & IP EQUIPMENT RM	1.18E-09	0.1%
%F000-RW - FIRE IN ACCESS AREA	1.13E-09	0.1%
%F157-A17C - FIRE IN CORRIDOR	1.09E-09	0.1%
%F137-A31C - FIRE IN MAIN STEAM VALVE RM	1.05E-09	0.1%

Table 19.1-121 (4 of 10)

Initiating Event	CDF (/yr)	Contribution
%F100-A04C - FIRE IN CABLE ACCESS AREA	1.05E-09	0.1%
%F000-ACVL - FIRE IN CVCS ACCESS AREA	9.72E-10	0.1%
%F078-A19B - FIRE IN CORRIDOR	7.76E-10	0.1%
%F078-A02C - FIRE IN CLASS 1E SWITCHGEAR 01C RM	7.35E-10	0.1%
%F122-T01 - FIRE IN SWITCHGEAR RM	4.82E-10	0.1%
%F100-A20A - FIRE IN GENERAL ACCESS AREA	4.74E-10	0.1%
%F055-AGAD - FIRE IN GENERAL ACCESS AREA-55' D	4.00E-10	0.1%
%F100-T15 - FIRE IN SWITCHGEAR RM	3.92E-10	0.1%
%F120-A05C - FIRE IN ELECTRICAL EQUIP. RM	3.84E-10	0.1%
%F172-AGAC - FIRE IN GENERAL ACCESS AREA-172' C	3.68E-10	0.1%
%F078-AEEB - FIRE IN CLASS 1E SWITCHGEAR 01B ROOM	3.35E-10	0.0%
%F120-A05D - FIRE IN ELECTRICAL EQUIP. RM	3.35E-10	0.0%
%F100-A08D - FIRE IN N1E DC & IP EQUIPMENT RM	3.10E-10	0.0%
%F078-ANEC - FIRE IN 480V N1E MCC RM	3.02E-10	0.0%
%F157-A20C - FIRE IN I&C EQUIPMENT RM	2.86E-10	0.0%
%F100-AEEB - FIRE IN 480V CLASS 1E MCC 01B ROOM	2.70E-10	0.0%
%F120-A15B - FIRE IN 480V CLASS 1E MCC 03B RM	2.70E-10	0.0%
%F078-AAFC - FIRE IN TERBINE DRIVEN AUX FEEDWATER PUMP ROOM	2.61E-10	0.0%

Table 19.1-121 (5 of 10)

Initiating Event	CDF (/yr)	Contribution
%F000-AFHU - FIRE IN FUEL HANDLING UPPER AREA	2.53E-10	0.0%
%F100-A05C - FIRE IN ELECTRICAL EQUIPMENT RM	2.53E-10	0.0%
%F120-A11B - FIRE IN GENERAL ACCESS AREA-120' B	2.37E-10	0.0%
%F078-A04D - FIRE IN MISC. ELECTRICAL EQUIP RM	2.29E-10	0.0%
%FK-K02 - FIRE IN ESW STRUCTURE "B" BUILDING	2.12E-10	0.0%
%FY-SAT1 - FIRE IN STAND-BY AUX. TRANSFORMER 1 AREA	2.04E-10	0.0%
%F100-A05D - FIRE IN ELECTRICAL EQUIPMENT RM	1.88E-10	0.0%
%F100-A06D - FIRE IN GENERAL ACCESS AREA	1.80E-10	0.0%
%F078-A05D - FIRE IN CHANNEL-D DC & IP EQUIP RM	1.55E-10	0.0%
%F078-A56B - FIRE IN CHANNEL-B DC & IP EQUIP. RM	1.55E-10	0.0%
%F100-A10B - FIRE IN GENERAL ACCESS AREA	1.55E-10	0.0%
%F120-A01C - FIRE IN PIPING CABLE AREA	1.55E-10	0.0%
%F137-A05D - FIRE IN PCS RM	1.55E-10	0.0%
%F157-ACPX - FIRE IN COMPUTER RM PACU RM	1.55E-10	0.0%
%FD-D01B - FIRE IN CCW HEAT EXCHANGER "B" BUILDING	1.55E-10	0.0%
%F078-A52D - FIRE IN 480V N1E MCC RM	1.47E-10	0.0%
%F157-A01D - FIRE IN I&C EQUIPMENT RM	1.47E-10	0.0%
%F120-AMPB - FIRE IN MECHANICAL PENETRATION ROOM	1.39E-10	0.0%

Table 19.1-121 (6 of 10)

Initiating Event	CDF (/yr)	Contribution
%F137-A09C - FIRE IN GENERAL ACCESS AREA	1.39E-10	0.0%
%F078-A03D - FIRE IN CLASS 1E LOADCENTER 01D RM	1.31E-10	0.0%
%F137-A15A - FIRE IN 480V CLASS 1E MCC 04A RM	1.23E-10	0.0%
%F050-A04B - FIRE IN SC PUMP & MINI FLOW HX RM	1.14E-10	0.0%
%F172-A13C - FIRE IN 480V N1E MCC RM	1.14E-10	0.0%
%F000-AFHL - FIRE IN FUEL HANDLING LOWER AREA	1.06E-10	0.0%
%F100-A11A - FIRE IN CHANNEL-A BATTERY RM	1.06E-10	0.0%
%F120-A09D - FIRE IN ELECTRICAL PENETRATION ROOM (D)	1.06E-10	0.0%
%F137-A09D - FIRE IN GENERAL ACCESS AREA	1.06E-10	0.0%
%F055-A04C - FIRE IN SEISMIC CAT-1 FIRE WATER TANK RM	9.80E-11	0.0%
%F100-P48 - FIRE IN ACCESS AREA	9.80E-11	0.0%
%F137-A11D - FIRE IN ELECTRICAL PENETRATION RM (D)	9.80E-11	0.0%
%F172-AGAD - FIRE IN GENERAL ACCESS AREA-172' D	9.80E-11	0.0%
%F078-A20A - FIRE IN MOTOR DRIVEN AUX. FEEDWATER PUMP RM	8.99E-11	0.0%
%F120-A31B - FIRE IN GENERAL ACCESS AREA-120' B	8.17E-11	0.0%
%F137-A15B - FIRE IN 480V CLASS 1E MCC 04B RM	8.17E-11	0.0%
%F137-AEPB - FIRE IN ELECTRICAL PENETRATION ROOM (B)	8.17E-11	0.0%
%F157-A19D - FIRE IN I&C EQUIPMENT RM	8.17E-11	0.0%

Table 19.1-121 (7 of 10)

Initiating Event	CDF (/yr)	Contribution
%F050-A03A - FIRE IN SI PUMP RM	7.35E-11	0.0%
%F078-A12D - FIRE IN ESSENTIAL WATER CHILLER RM	7.35E-11	0.0%
%F100-A24A - FIRE IN SFP COOLING HX RM	7.35E-11	0.0%
%F120-A16A - FIRE IN MECHANICAL PENETRATION RM	7.35E-11	0.0%
%F137-A10D - FIRE IN 480V CLASS 1E MCC 03D RM	7.35E-11	0.0%
%F078-A01C - FIRE IN PNS SWGR RM	6.54E-11	0.0%
%F050-A01D - FIRE IN CS PUMP & MINI FLOW HX RM	5.72E-11	0.0%
%F050-A02D - FIRE IN SI PUMP RM	5.72E-11	0.0%
%F050-A03B - FIRE IN SI PUMP RM	5.72E-11	0.0%
%F055-A02B - FIRE IN CCW PUMP RM	5.72E-11	0.0%
%F055-A02D - FIRE IN CCW PUMP RM	5.72E-11	0.0%
%F100-A37B - FIRE IN GENERAL ACCESS AREA	5.72E-11	0.0%
%F120-A03C - FIRE IN DIESEL FUEL OIL DAY TANK RM	5.72E-11	0.0%
%F137-A41A - FIRE IN REMOTE CONTROL CONSOLE ROOM	5.72E-11	0.0%
%F055-AGAB - FIRE IN GENERAL ACCESS AREA-55' B	4.90E-11	0.0%
%F120-A08C - FIRE IN 480V N1E MCC RM	4.90E-11	0.0%
%F137-A02D - FIRE IN ELECTRICAL EQUIP. RM	4.90E-11	0.0%
%F157-A16D - FIRE IN GENERAL ACCESS AREA	4.90E-11	0.0%

Table 19.1-121 (8 of 10)

Initiating Event	CDF (/yr)	Contribution
%F055-A01C - FIRE IN CS HX RM	4.09E-11	0.0%
%F055-A10C - FIRE IN TENDON GALLERY ENTRANCE AREA	4.09E-11	0.0%
%F055-A42A - FIRE IN CHARGING PUMP RM	4.09E-11	0.0%
%F078-A12C - FIRE IN ESSENTIAL WATER CHILLER RM	4.09E-11	0.0%
%F120-A24A - FIRE IN FUEL HANDLING AREA EMER. EXHAUST ACU RM	4.09E-11	0.0%
%F157-A13C - FIRE IN VESTIBULE	4.09E-11	0.0%
%F078-A02D - FIRE IN CLASS 1E SWITCHGEAR 01D RM	3.27E-11	0.0%
%F078-A56A - FIRE IN CHANNEL-A DC & IP EQUIP. RM	3.27E-11	0.0%
%F120-A02C - FIRE IN LUBE OIL MAKE-UP TANK RM	3.27E-11	0.0%
%F157-A27C - FIRE IN GENERAL ACCESS AREA	3.27E-11	0.0%
%F172-A01C - FIRE IN EDG RM NORMAL EXHAUST FAN RM	3.27E-11	0.0%
%FK-K04 - FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1B AREA	3.27E-11	0.0%
%F055-A14D - FIRE IN PIPE CHASE & VALVE RM	2.45E-11	0.0%
%F055-A55B - FIRE IN CHARGING PUMP RM	2.45E-11	0.0%
%F073-T11 - FIRE IN SWITCHGEAR AREA	2.45E-11	0.0%
%F078-A53C - FIRE IN 480V N1E LOADCENTER RM	2.45E-11	0.0%
%F100-A23A - FIRE IN AUX. BLDG. CONTROLLED AREA I SUPPLY AHU ROOM	2.45E-11	0.0%
%F137-A35C - FIRE IN REACTOR TRIP SWITCHGEAR RM	2.45E-11	0.0%

Table 19.1-121 (9 of 10)

Initiating Event	CDF (/yr)	Contribution
%F157-A18C - FIRE IN CLEAN AGENT RM	2.45E-11	0.0%
%F055-A05C - FIRE IN STAIR	1.63E-11	0.0%
%F100-A38A - FIRE IN FUEL HANDLING AREA NORMAL EXHAUST ACU RM	1.63E-11	0.0%
%F137-A01D - FIRE IN CABLE SPREADING AREA	1.63E-11	0.0%
%F137-A30D - FIRE IN MAIN STEAM ENCLOSURE	1.63E-11	0.0%
%F137-A31D - FIRE IN MAIN STEAM VALVE RM	1.63E-11	0.0%
%F137-A36C - FIRE IN REACTOR TRIP SWITCHGEAR RM	1.63E-11	0.0%
%F137-A37C - FIRE IN REACTOR TRIP SWITCHGEAR RM	1.63E-11	0.0%
%F055-A21A - FIRE IN PIPE CHASE & VALVE RM	8.17E-12	0.0%
%F068-A05A - FIRE IN HVAC CHASE	8.17E-12	0.0%
%F078-A06C - FIRE IN N1E BATTERY RM	8.17E-12	0.0%
%F078-A07C - FIRE IN CHANNEL-C BATTERY RM	8.17E-12	0.0%
%F078-A09C - FIRE IN HVAC CHASE	8.17E-12	0.0%
%F078-A14C - FIRE IN BUTTRESS OPNG	8.17E-12	0.0%
%F078-A16C - FIRE IN HVAC CHASE	8.17E-12	0.0%
%F078-A21A - FIRE IN PIPE CHASE	8.17E-12	0.0%
%F078-A23A - FIRE IN BUTTRESS OPNG	8.17E-12	0.0%
%F078-A40B - FIRE IN BORIC ACID CONC. RM	8.17E-12	0.0%

Table 19.1-121 (10 of 10)

Initiating Event	CDF (/yr)	Contribution
%F078-A55C - FIRE IN ELEV. HALL	8.17E-12	0.0%
%F100-A04D - FIRE IN CABLE ACCESS AREA	8.17E-12	0.0%
%F100-A13B - FIRE IN MECHANICAL PENETRATION RM	8.17E-12	0.0%
%F100-A43C - FIRE IN D/G OIL STORAGE ENTRANCE	8.17E-12	0.0%
%F100-A46C - FIRE IN ELEV. HALL	8.17E-12	0.0%
%F120-A01D - FIRE IN PIPING CABLE AREA	8.17E-12	0.0%
%F120-A21A - FIRE IN FUEL HANDLING AREA EMER. EXHAUST ACU ROOM	8.17E-12	0.0%
%F137-A19A - FIRE IN SG BLOWDOWN FLASH TANK RM	8.17E-12	0.0%
%F137-ASTD - FIRE IN STAIR	8.17E-12	0.0%
%F157-A13D - FIRE IN VESTIBULE	8.17E-12	0.0%
%F157-A21D - FIRE IN INSTRUMENT MAINTENANCE SHOP	8.17E-12	0.0%
%F157-A23D - FIRE IN AEB RM	8.17E-12	0.0%

Table 19.1-122 (1 of 32)

LPSD PRA CDF Internal Fire Top 100 Cutsets – All POS

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.90E-07	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	16.7	16.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
2	7.25E-08	%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM	4.2	20.8
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
3	4.59E-08	%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM	2.6	23.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (2 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
4	4.56E-08	%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING	2.6	26.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
5	4.04E-08	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	2.3	28.4
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_112	HEP DEPENDENCY FACTOR FOR HR-RS-KVP04B AND HR-FB-KVP04B		
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
6	3.90E-08	%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C	2.2	30.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (3 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	3.29E-08	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	1.9	32.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
8	3.03E-08	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	1.7	34.3
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
9	2.59E-08	%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING	1.5	35.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (4 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	2.44E-08	%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM	1.4	37.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
11	2.00E-08	%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM	1.1	38.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
12	1.96E-08	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	1.1	39.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (5 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	1.94E-08	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	1.1	40.6
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
14	1.46E-08	%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)	0.8	41.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
15	1.46E-08	%F055-AGAD	FIRE IN GENERAL ACCESS AREA-55' D	0.8	42.2
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (6 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	1.43E-08	%F100-AGAC	FIRE IN GENERAL ACCESS AREA	0.8	43.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
17	1.33E-08	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.8	43.8
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
18	1.31E-08	%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)	0.8	44.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (7 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	1.29E-08	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.7	45.3
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
20	1.26E-08	%F157-A19C	FIRE IN I&C EQUIPMENT RM	0.7	46.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
21	1.18E-08	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.7	46.7
		BE-RATE-P13	Conversion factor (SD-yr -> Calendar yr) for POS13 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P13-04	LP POS 13 SEQUENCE 04 IDENTIFIER		
		%F157-AMCR	FIRE IN MAIN CONTROL ROOM		

Table 19.1-122 (8 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	1.14E-08	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.7	47.4
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P06-02	AS POS 6 SEQUENCE 02 IDENTIFIER		
		%F137-A10C	FIRE IN 480V CLASS 1E MCC 03C RM		
23	1.13E-08	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	48.0
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F157-A19C	FIRE IN I&C EQUIPMENT RM		
24	1.13E-08	%F157-A25C	FIRE IN I&C EQUIPMENT RM	0.6	48.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (9 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	1.09E-08	%F100-A08D	FIRE IN N1E DC & IP EQUIPMENT RM	0.6	49.3
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
26	1.04E-08	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.6	49.9
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
27	1.01E-08	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.6	50.5
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (10 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
28	9.97E-09	%F078-A19A	FIRE IN CORRIDOR	0.6	51.1
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
29	9.23E-09	%F050-A04A	FIRE IN SC PUMP & MINI FLOW HX RM	0.5	51.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
30	9.23E-09	%F055-A02C	FIRE IN CCW PUMP RM	0.5	52.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (11 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
31	9.23E-09	%F078-A11C	FIRE IN ESSENTIAL CHILLER RM	0.5	52.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
32	9.04E-09	%F055-A02A	FIRE IN CCW PUMP RM	0.5	53.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
33	8.94E-09	%F050-A01C	FIRE IN CS PUMP & MINI FLOW HX RM	0.5	53.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (12 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	8.94E-09	%F050-A02C	FIRE IN SI PUMP RM	0.5	54.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
35	8.83E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.5	54.7
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
36	8.53E-09	%F078-A04D	FIRE IN MISC. ELECTRICAL EQUIP RM	0.5	55.2
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (13 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
37	8.22E-09	%FK-K02	FIRE IN ESW STRUCTURE "B" BUILDING	0.5	55.7
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
38	7.95E-09	BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration	0.5	56.1
		HR-FB-CCP03B-01	OPERATOR FAILS TO OPERATE F&B AT CC POS03B 01		
		HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B		
		HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B		
		SEQ-CC-P03B-04	CC POS 3B SEQUENCE 04 IDENTIFIER		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_16	HEP DEPENDENCY FACTOR FOR HR-RS-CCP03B, HR-SG-CCP03B AND HR-FB-CCP03B-01		
39	7.93E-09	%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM	0.5	56.6
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_159	HEP DEPENDENCY FACTOR FOR HR-RS-S2P03B, HR-SG-S2P03B AND HR-FB-S2P03B-01		
		HR-FB-S2P03B-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS03B 01		
		HR-RS-S2P03B	OPERATOR FAILS TO RESTORE SCS AT S2 POS03B		
		HR-SG-S2P03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03B		
		SEQ-S2-P03B-04	S2 POS 3B SEQUENCE 04 IDENTIFIER		

Table 19.1-122 (14 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	7.48E-09	%F055-AGAA	FIRE IN GENERAL ACCESS AREA-55' A	0.4	57.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
41	7.47E-09	%F078-A25A	FIRE IN CLASS 1E SWITCHGEAR 01A RM	0.4	57.4
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
42	7.22E-09	%F000-ACVU	FIRE IN CVCS SYSTEM AREA	0.4	57.9
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		

Table 19.1-122 (15 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
43	7.21E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.4	58.3
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P04B-03	LP POS 4B SEQUENCE 03 IDENTIFIER		
44	6.80E-09	%F157-AMAX	FIRE IN MEETING ROOM	0.4	58.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
45	6.42E-09	%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM	0.4	59.0
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_170	HEP DEPENDENCY FACTOR FOR HR-RS-S2P04B AND HR-FB-S2P04B		
		HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B		
		HR-RS-S2P04B	OPERATOR FAILS TO RESTORE SCS AT S2 POS04B		
		SEQ-S2-P04B-03	S2 POS 4B SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (16 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	6.37E-09	%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING	0.4	59.4
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_23	HEP DEPENDENCY FACTOR FOR HR-RS-CCP04B AND HR-FB-CCP04B		
		HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B		
		HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B		
		SEQ-CC-P04B-03	CC POS 4B SEQUENCE 03 IDENTIFIER		
47	6.16E-09	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.4	59.8
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		
48	6.13E-09	%F078-A05D	FIRE IN CHANNEL-D DC & IP EQUIP RM	0.4	60.1
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (17 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	6.10E-09	%FD-D01B	FIRE IN CCW HEAT EXCHANGER "B" BUILDING	0.4	60.5
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
50	5.95E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.3	60.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
51	5.95E-09	%F078-A19B	FIRE IN CORRIDOR	0.3	61.1
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
52	5.76E-09	%F078-A56B	FIRE IN CHANNEL-B DC & IP EQUIP. RM	0.3	61.5
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (18 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	5.74E-09	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.3	61.8
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_16	HEP DEPENDENCY FACTOR FOR HR-RS-CCP03B, HR-SG-CCP03B AND HR-FB-CCP03B-01		
		HR-FB-CCP03B-01	OPERATOR FAILS TO OPERATE F&B AT CC POS03B 01		
		HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B		
		HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B		
		SEQ-CC-P03B-04	CC POS 3B SEQUENCE 04 IDENTIFIER		
54	5.66E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.3	62.1
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
55	5.55E-09	%F078-A52D	FIRE IN 480V N1E MCC RM	0.3	62.4
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (19 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
56	5.51E-09	%FK-K03	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA	0.3	62.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
57	5.44E-09	%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C	0.3	63.1
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_112	HEP DEPENDENCY FACTOR FOR HR-RS-KVP04B AND HR-FB-KVP04B		
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
58	5.39E-09	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.3	63.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (20 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
59	5.18E-09	%F120-A09C	FIRE IN ELECTRICAL PENETRATION ROOM (C)	0.3	63.7
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		
60	5.01E-09	%F100-AEEB	FIRE IN 480V CLASS 1E MCC 01B ROOM	0.3	64.0
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
61	4.95E-09	%F100-A13A	FIRE IN MECHANICAL PENETRATION RM	0.3	64.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (21 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
62	4.94E-09	%F100-A14A	FIRE IN PERSONNEL AIR LOCK ENTRANCE	0.3	64.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
63	4.88E-09	%F078-A03D	FIRE IN CLASS 1E LOADCENTER 01D RM	0.3	64.8
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
64	4.88E-09	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.3	65.1
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-JL-P10-05	JL POS 10 SEQUENCE 05 IDENTIFIER		

Table 19.1-122 (22 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	4.68E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.3	65.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P11-03	LP POS 11 SEQUENCE 03 IDENTIFIER		
66	4.61E-09	%F137-A20A	FIRE IN GENERAL ACCESS AREA	0.3	65.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
67	4.61E-09	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.3	65.9
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-KV-P10-03	KV POS 10 SEQUENCE 03 IDENTIFIER		
68	4.60E-09	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.3	66.2
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_23	HEP DEPENDENCY FACTOR FOR HR-RS-CCP04B AND HR-FB-CCP04B		
		HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B		
		HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B		
		SEQ-CC-P04B-03	CC POS 4B SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (23 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	4.56E-09	%F100-A10A	FIRE IN GENERAL ACCESS AREA	0.3	66.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
70	4.52E-09	%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING	0.3	66.7
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_16	HEP DEPENDENCY FACTOR FOR HR-RS-CCP03B, HR-SG-CCP03B AND HR-FB-CCP03B-01		
		HR-FB-CCP03B-01	OPERATOR FAILS TO OPERATE F&B AT CC POS03B 01		
		HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B		
		HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B		
		SEQ-CC-P03B-04	CC POS 3B SEQUENCE 04 IDENTIFIER		
71	4.34E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.2	66.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (24 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
72	4.23E-09	%F157-AMCR	FIRE IN MAIN CONTROL ROOM	0.2	67.2
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P04B-02	AS POS 4B SEQUENCE 02 IDENTIFIER		
73	4.18E-09	%F000-AC	FIRE IN ACCESS AREA	0.2	67.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-AC_F137-A20A	BARRIER FAILURE BETWEEN F000-AC AND F137-A20A		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
74	4.17E-09	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.2	67.7
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (25 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	4.16E-09	%F078-A19A	FIRE IN CORRIDOR	0.2	67.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
76	4.12E-09	%F137-A09D	FIRE IN GENERAL ACCESS AREA	0.2	68.1
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		BF_F137-A09D_F157-A17C	BARRIER FAILURE BETWEEN F137-A09D AND F157-A17C		
		HR-RS-S2P03B	OPERATOR FAILS TO RESTORE SCS AT S2 POS03B		
		SEQ-S2-P03B-04	S2 POS 3B SEQUENCE 04 IDENTIFIER		
77	3.95E-09	%F078-A19B	FIRE IN CORRIDOR	0.2	68.4
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
78	3.87E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.2	68.6
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		

Table 19.1-122 (26 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	3.63E-09	%F137-A11D	FIRE IN ELECTRICAL PENETRATION RM (D)	0.2	68.8
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
80	3.62E-09	%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING	0.2	69.0
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_23	HEP DEPENDENCY FACTOR FOR HR-RS-CCP04B AND HR-FB-CCP04B		
		HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B		
		HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B		
		SEQ-CC-P04B-03	CC POS 4B SEQUENCE 03 IDENTIFIER		
81	3.60E-09	%F120-AGAA	FIRE IN GENERAL ACCESS AREA-120' A	0.2	69.2
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B AND HR-FB-LPP03B-01		
		HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01		
		HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B		
		HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B		
		SEQ-LP-P03B-04	LP POS 3B SEQUENCE 04 IDENTIFIER		

Table 19.1-122 (27 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	3.55E-09	%F157-AMCR	FIRE IN MAIN CONTROL ROOM	0.2	69.4
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-LT	LONG TERM ALTERNATE SHUTDOWN CCDP EST. (> 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P10-02	AS POS 10 SEQUENCE 02 IDENTIFIER		
83	3.54E-09	%F055-A14C	FIRE IN PIPE CHASE & VALVE RM	0.2	69.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
84	3.49E-09	%F157-AMCR	FIRE IN MAIN CONTROL ROOM	0.2	69.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P05-02	AS POS 5 SEQUENCE 02 IDENTIFIER		

Table 19.1-122 (28 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	3.45E-09	%F157-ATOC	FIRE IN TSC EQUIP. REPAIR & MAINT ROOM	0.2	70.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
86	3.45E-09	%F157-A16C	FIRE IN GENERAL ACCESS AREA	0.2	70.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
87	3.44E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.2	70.4
		BE-RATE-P13	Conversion factor (SD-yr -> Calendar yr) for POS13 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P13-04	LP POS 13 SEQUENCE 04 IDENTIFIER		
88	3.44E-09	%F000-ACVU	FIRE IN CVCS SYSTEM AREA	0.2	70.6
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (29 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
89	3.42E-09	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	0.2	70.8
		BE-RATE-P03B	Conversion factor (SD-yr -> Calendar yr) for POS03B duration		
		COMBINATION_16	HEP DEPENDENCY FACTOR FOR HR-RS-CCP03B, HR-SG-CCP03B AND HR-FB-CCP03B-01		
		HR-FB-CCP03B-01	OPERATOR FAILS TO OPERATE F&B AT CC POS03B 01		
		HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B		
		HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B		
		SEQ-CC-P03B-04	CC POS 3B SEQUENCE 04 IDENTIFIER		
90	3.41E-09	%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM	0.2	71.0
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		COMBINATION_112	HEP DEPENDENCY FACTOR FOR HR-RS-KVP04B AND HR-FB-KVP04B		
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
91	3.22E-09	%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM	0.2	71.2
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (30 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	3.17E-09	%F157-A19D	FIRE IN I&C EQUIPMENT RM	0.2	71.4
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
93	3.14E-09	%F137-A15B	FIRE IN 480V CLASS 1E MCC 04B RM	0.2	71.5
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
94	3.12E-09	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.2	71.7
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (31 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	3.12E-09	%F078-A25A	FIRE IN CLASS 1E SWITCHGEAR 01A RM	0.2	71.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
96	3.06E-09	%F137-AEPB	FIRE IN ELECTRICAL PENETRATION ROOM (B)	0.2	72.1
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A		
		HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A		
		HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A		
		SEQ-S2-P12A-03	S2 POS 12A SEQUENCE 03 IDENTIFIER		
97	3.01E-09	%F000-ACVU	FIRE IN CVCS SYSTEM AREA	0.2	72.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-122 (32 of 32)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	2.95E-09	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.2	72.4
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
99	2.89E-09	%F120-A15B	FIRE IN 480V CLASS 1E MCC 03B RM	0.2	72.6
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
100	2.84E-09	%F157-A01D	FIRE IN I&C EQUIPMENT RM	0.2	72.8
		BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration		
		COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (1 of 48)

LPSD PRA CDF Internal Fire Top 100 Cutsets – Reduced Inventory

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.90E-07	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	35.5	35.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
2	4.59E-08	%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM	5.6	41.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (2 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
3	4.56E-08	%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING	5.6	46.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
4	3.90E-08	%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C	4.8	51.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (3 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	3.29E-08	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	4.0	55.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
6	2.59E-08	%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING	3.2	58.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (4 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	2.44E-08	%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM	3.0	61.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
8	2.00E-08	%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM	2.4	64.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (5 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
9	1.96E-08	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	2.4	66.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
10	1.46E-08	%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)	1.8	68.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (6 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
11	1.43E-08	%F100-AGAC	FIRE IN GENERAL ACCESS AREA	1.8	70.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
12	1.31E-08	%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)	1.6	71.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (7 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	1.26E-08	%F157-A19C	FIRE IN I&C EQUIPMENT RM	1.5	73.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
14	1.13E-08	%F137-A10C	FIRE IN 480V CLASS 1E MCC 03C RM	1.4	74.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (8 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	1.13E-08	%F157-A25C	FIRE IN I&C EQUIPMENT RM	1.4	75.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
16	9.23E-09	%F050-A04A	FIRE IN SC PUMP & MINI FLOW HX RM	1.1	77.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (9 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
17	9.23E-09	%F055-A02C	FIRE IN CCW PUMP RM	1.1	78.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
18	9.23E-09	%F078-A11C	FIRE IN ESSENTIAL CHILLER RM	1.1	79.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (10 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	9.04E-09	%F055-A02A	FIRE IN CCW PUMP RM	1.1	80.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
20	8.94E-09	%F050-A01C	FIRE IN CS PUMP & MINI FLOW HX RM	1.1	81.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (11 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	8.94E-09	%F050-A02C	FIRE IN SI PUMP RM	1.1	82.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
22	7.48E-09	%F055-AGAA	FIRE IN GENERAL ACCESS AREA-55' A	0.9	83.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (12 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
23	6.80E-09	%F157-AMAX	FIRE IN MEETING ROOM	0.8	84.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
24	5.95E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.7	85.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (13 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	5.51E-09	%FK-K03	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA	0.7	85.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
26	5.39E-09	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.7	86.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (14 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
27	4.95E-09	%F100-A13A	FIRE IN MECHANICAL PENETRATION RM	0.6	87.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
28	4.94E-09	%F100-A14A	FIRE IN PERSONNEL AIR LOCK ENTRANCE	0.6	87.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
29	4.68E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.6	88.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P11-03	LP POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (15 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	4.61E-09	%F137-A20A	FIRE IN GENERAL ACCESS AREA	0.6	88.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
31	4.56E-09	%F100-A10A	FIRE IN GENERAL ACCESS AREA	0.6	89.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (16 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
32	4.34E-09	%F078-AGAC	FIRE IN GENERAL ACCESS AREA	0.5	89.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
33	4.18E-09	%F000-AC	FIRE IN ACCESS AREA	0.5	90.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-AC_F137-A20A	BARRIER FAILURE BETWEEN F000-AC AND F137-A20A		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (17 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	4.16E-09	%F078-A19A	FIRE IN CORRIDOR	0.5	90.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
35	3.54E-09	%F055-A14C	FIRE IN PIPE CHASE & VALVE RM	0.4	91.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (18 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	3.49E-09	%F157-AMCR	FIRE IN MAIN CONTROL ROOM	0.4	91.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P05-02	AS POS 5 SEQUENCE 02 IDENTIFIER		
37	3.45E-09	%F157-ATOC	FIRE IN TSC EQUIP. REPAIR & MAINT ROOM	0.4	92.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (19 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
38	3.45E-09	%F157-A16C	FIRE IN GENERAL ACCESS AREA	0.4	92.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
39	3.12E-09	%F078-A25A	FIRE IN CLASS 1E SWITCHGEAR 01A RM	0.4	93.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (20 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	3.01E-09	%F000-ACVU	FIRE IN CVCS SYSTEM AREA	0.4	93.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
41	2.74E-09	%F157-AMCR	FIRE IN MAIN CONTROL ROOM	0.3	93.7
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION		
		AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HOURS FOR RS AND SG HEPS)		
		SEQ-AS-P11-02	AS POS 11 SEQUENCE 02 IDENTIFIER		

Table 19.1-123 (21 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	2.28E-09	%F120-A14A	FIRE IN SG BLOWDOWN REGEN HX RM	0.3	94.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
43	2.16E-09	%F120-A09C	FIRE IN ELECTRICAL PENETRATION ROOM (C)	0.3	94.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (22 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	1.93E-09	%F137-ANEC	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	0.2	94.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-A01C_F137-ANEC	BARRIER FAILURE BETWEEN F137-A01C AND F137-ANEC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
45	1.83E-09	%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM	0.2	94.7
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_116	HEP DEPENDENCY FACTOR FOR HR-RS-KVP11 AND HR-FB-KVP11		
		HR-FB-KVP11	OPERATOR FAILS TO OPERATE F&B AT KV POS11		
		HR-RS-KVP11	OPERATOR FAILS TO RESTORE SCS AT KV POS11		
		SEQ-KV-P11-03	KV POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (23 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	1.74E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.2	94.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
47	1.50E-09	%F120-AGAA	FIRE IN GENERAL ACCESS AREA-120' A	0.2	95.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
48	1.36E-09	%F078-AGAD	FIRE IN GENERAL ACCESS AREA	0.2	95.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD		
		SEQ-LP-P11-03	LP POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (24 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	1.20E-09	%F137-A01C	FIRE IN CABLE SPREADING AREA	0.2	95.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
50	1.10E-09	%F000-RW	FIRE IN ACCESS AREA	0.1	95.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ACVU_F000-RW	BARRIER FAILURE BETWEEN F000-ACVU AND F000-RW		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (25 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	1.06E-09	%F157-A17C	FIRE IN CORRIDOR	0.1	95.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
52	1.05E-09	%F100-A04C	FIRE IN CABLE ACCESS AREA	0.1	95.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
53	9.58E-10	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.1	95.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		

Table 19.1-123 (26 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
54	9.06E-10	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.1	96.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
55	8.69E-10	%F100-A08C	FIRE IN N1E DC & IP EQUIPMENT RM	0.1	96.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F100-A08C_F100-AGAC	BARRIER FAILURE BETWEEN F100-A08C AND F100-AGAC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (27 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
56	7.70E-10	%F137-ANEC	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	0.1	96.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-ANEC_F157-ATOC	BARRIER FAILURE BETWEEN F137-ANEC AND F157-ATOC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
57	7.70E-10	%F137-ANEC	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	0.1	96.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F137-ANEC	BARRIER FAILURE BETWEEN F000-ADGC AND F137-ANEC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (28 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	7.52E-10	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.1	96.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-SL-P11-05	SL POS 11 SEQUENCE 05 IDENTIFIER		
59	7.37E-10	%F078-A02C	FIRE IN CLASS 1E SWITCHGEAR 01C RM	0.1	96.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
60	7.12E-10	%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C	0.1	96.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD		
		SEQ-SL-P11-05	SL POS 11 SEQUENCE 05 IDENTIFIER		

Table 19.1-123 (29 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	5.88E-10	%F000-AC	FIRE IN ACCESS AREA	0.1	96.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-AC_F120-AGAA	BARRIER FAILURE BETWEEN F000-AC AND F120-AGAA		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
62	5.70E-10	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.1	96.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (30 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	5.11E-10	%F000-ACVL	FIRE IN CVCS ACCESS AREA	0.1	96.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ACVL_F055-AGAA	BARRIER FAILURE BETWEEN F000-ACVL AND F055-AGAA		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
64	4.31E-10	%F000-ACV	FIRE IN CVCS ACCESS AREA	0.1	96.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (31 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	3.70E-10	%F055-AGAD	FIRE IN GENERAL ACCESS AREA-55' D	0.1	96.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_27	HEP DEPENDENCY FACTOR FOR HR-RS-CCP11 AND HR-FB-CCP11		
		HR-FB-CCP11	OPERATOR FAILS TO OPERATE F&B AT CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
		SEQ-CC-P11-03	CC POS 11 SEQUENCE 03 IDENTIFIER		
66	3.65E-10	%F078-A19B	FIRE IN CORRIDOR	0.0	96.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_144	HEP DEPENDENCY FACTOR FOR HR-RS-LPP11 AND HR-FB-LPP11		
		HR-FB-LPP11	OPERATOR FAILS TO OPERATE F&B AT LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
		SEQ-LP-P11-03	LP POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (32 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
67	3.51E-10	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	0.0	97.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F078-A01C	BARRIER FAILURE BETWEEN F000-ADGC AND F078-A01C		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
68	3.51E-10	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	0.0	97.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F078-A02C	BARRIER FAILURE BETWEEN F000-ADGC AND F078-A02C		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (33 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	3.36E-10	%F137-A31C	FIRE IN MAIN STEAM VALVE RM	0.0	97.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-A31C_F157-A16C	BARRIER FAILURE BETWEEN F137-A31C AND F157-A16C		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
70	3.36E-10	%F137-A31C	FIRE IN MAIN STEAM VALVE RM	0.0	97.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-A10C_F137-A31C	BARRIER FAILURE BETWEEN F137-A10C AND F137-A31C		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (34 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	3.36E-10	%F137-A31C	FIRE IN MAIN STEAM VALVE RM	0.0	97.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-A20A_F137-A31C	BARRIER FAILURE BETWEEN F137-A20A AND F137-A31C		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
72	2.99E-10	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.0	97.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_184	HEP DEPENDENCY FACTOR FOR HR-RS-SLP11 AND HR-FB-SLP11-01		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (35 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	2.82E-10	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.0	97.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-A04C_F100-AGAC	BARRIER FAILURE BETWEEN F078-A04C AND F100-AGAC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
74	2.82E-10	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.0	97.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F078-A04C	BARRIER FAILURE BETWEEN F000-ADGC AND F078-A04C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (36 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	2.82E-10	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.0	97.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F055-AGAC_F078-A04C	BARRIER FAILURE BETWEEN F055-AGAC AND F078-A04C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
76	2.76E-10	%F100-A08D	FIRE IN N1E DC & IP EQUIPMENT RM	0.0	97.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_174	HEP DEPENDENCY FACTOR FOR HR-RS-S2P11 AND HR-FB-S2P11		
		HR-FB-S2P11	OPERATOR FAILS TO OPERATE F&B AT S2 POS11		
		HR-RS-S2P11	OPERATOR FAILS TO RESTORE SCS AT S2 POS11		
		SEQ-S2-P11-03	S2 POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (37 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	2.68E-10	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	0.0	97.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-A03C_F078-A05C	BARRIER FAILURE BETWEEN F078-A03C AND F078-A05C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
78	2.67E-10	%F078-ANEC	FIRE IN 480V N1E MCC RM	0.0	97.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F055-A02C_F078-ANEC	BARRIER FAILURE BETWEEN F055-A02C AND F078-ANEC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (38 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	2.57E-10	%F137-ANEC	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM	0.0	97.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F137-ANEC_F157-AMAX	BARRIER FAILURE BETWEEN F137-ANEC AND F157-AMAX		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
80	2.37E-10	%F000-ACVL	FIRE IN CVCS ACCESS AREA	0.0	97.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_80	HEP DEPENDENCY FACTOR FOR HR-MI-JLP05 AND HR-FB-JLP05-02		
		HR-FB-JLP05-02	OPERATOR FAILS TO OPERATE F&B AT JL POS05 02		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		

Table 19.1-123 (39 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	2.31E-10	%F078-A19B	FIRE IN CORRIDOR	0.0	97.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_80	HEP DEPENDENCY FACTOR FOR HR-MI-JLP05 AND HR-FB-JLP05-02		
		HR-FB-JLP05-02	OPERATOR FAILS TO OPERATE F&B AT JL POS05 02		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
82	2.30E-10	%F000-AFHU	FIRE IN FUEL HANDLING UPPER AREA	0.0	97.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-AFHU_F137-A20A	BARRIER FAILURE BETWEEN F000-AFHU AND F137-A20A		
		COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (40 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
83	2.16E-10	%F078-A04D	FIRE IN MISC. ELECTRICAL EQUIP RM	0.0	97.5
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_27	HEP DEPENDENCY FACTOR FOR HR-RS-CCP11 AND HR-FB-CCP11		
		HR-FB-CCP11	OPERATOR FAILS TO OPERATE F&B AT CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
		SEQ-CC-P11-03	CC POS 11 SEQUENCE 03 IDENTIFIER		
84	2.09E-10	%F000-TB	FIRE IN TURBINE GENERATOR AREA	0.0	97.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (41 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	2.08E-10	%FK-K02	FIRE IN ESW STRUCTURE "B" BUILDING	0.0	97.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_27	HEP DEPENDENCY FACTOR FOR HR-RS-CCP11 AND HR-FB-CCP11		
		HR-FB-CCP11	OPERATOR FAILS TO OPERATE F&B AT CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
		SEQ-CC-P11-03	CC POS 11 SEQUENCE 03 IDENTIFIER		
86	1.96E-10	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	0.0	97.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F120-AGAC	BARRIER FAILURE BETWEEN F000-ADGC AND F120-AGAC		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (42 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
87	1.70E-10	%F050-A01C	FIRE IN CS PUMP & MINI FLOW HX RM	0.0	97.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F050-A01C_F055-AGAC	BARRIER FAILURE BETWEEN F050-A01C AND F055-AGAC		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
88	1.68E-10	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	0.0	97.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F078-A03C	BARRIER FAILURE BETWEEN F000-ADGC AND F078-A03C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (43 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
89	1.63E-10	%F078-AEEB	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM	0.0	97.7
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_144	HEP DEPENDENCY FACTOR FOR HR-RS-LPP11 AND HR-FB-LPP11		
		HR-FB-LPP11	OPERATOR FAILS TO OPERATE F&B AT LP POS11		
		HR-RS-LPP11	OPERATOR FAILS TO RESTORE SCS AT LO POS11		
		SEQ-LP-P11-03	LP POS 11 SEQUENCE 03 IDENTIFIER		
90	1.62E-10	%F120-A15B	FIRE IN 480V CLASS 1E MCC 03B RM	0.0	97.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-SLP05-01	OPERATOR FAILS TO OPERATE F&B AT SL POS05 01		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
91	1.62E-10	%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D	0.0	97.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_183	HEP DEPENDENCY FACTOR FOR HR-MI-SLP05 AND HR-FB-SLP05-02		
		HR-FB-SLP05-02	OPERATOR FAILS TO OPERATE F&B AT SL POS05 02		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		

Table 19.1-123 (44 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	1.60E-10	%F120-A05D	FIRE IN ELECTRICAL EQUIP. RM	0.0	97.7
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_184	HEP DEPENDENCY FACTOR FOR HR-RS-SLP11 AND HR-FB-SLP11-01		
		HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
93	1.57E-10	%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM	0.0	97.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F078-A04C_F100-A04C	BARRIER FAILURE BETWEEN F078-A04C AND F100-A04C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (45 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	1.57E-10	%F120-A01C	FIRE IN PIPING CABLE AREA	0.0	97.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
95	1.55E-10	%F000-ACVL	FIRE IN CVCS ACCESS AREA	0.0	97.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_86	HEP DEPENDENCY FACTOR FOR HR-MI-JLP11 AND HR-FB-JLP11-02		
		HR-FB-JLP11-02	OPERATOR FAILS TO OPERATE F&B AT JL POS11 02		
		HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11		
		SEQ-JL-P11-05	JL POS 11 SEQUENCE 05 IDENTIFIER		

Table 19.1-123 (46 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
96	1.55E-10	%F078-A05D	FIRE IN CHANNEL-D DC & IP EQUIP RM	0.0	97.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_27	HEP DEPENDENCY FACTOR FOR HR-RS-CCP11 AND HR-FB-CCP11		
		HR-FB-CCP11	OPERATOR FAILS TO OPERATE F&B AT CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
		SEQ-CC-P11-03	CC POS 11 SEQUENCE 03 IDENTIFIER		
97	1.54E-10	%FD-D01B	FIRE IN CCW HEAT EXCHANGER "B" BUILDING	0.0	97.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		COMBINATION_27	HEP DEPENDENCY FACTOR FOR HR-RS-CCP11 AND HR-FB-CCP11		
		HR-FB-CCP11	OPERATOR FAILS TO OPERATE F&B AT CC POS11		
		HR-RS-CCP11	OPERATOR FAILS TO RESTORE SCS AT CC POS11		
		SEQ-CC-P11-03	CC POS 11 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (47 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	1.51E-10	%F100-A08C	FIRE IN N1E DC & IP EQUIPMENT RM	0.0	97.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		COMBINATION_80	HEP DEPENDENCY FACTOR FOR HR-MI-JLP05 AND HR-FB-JLP05-02		
		HR-FB-JLP05-02	OPERATOR FAILS TO OPERATE F&B AT JL POS05 02		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
99	1.47E-10	%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM	0.0	97.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F000-ADGC_F120-A01C	BARRIER FAILURE BETWEEN F000-ADGC AND F120-A01C		
		COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05		
		HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-123 (48 of 48)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
100	1.47E-10	%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM	0.0	97.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		BF_F055-AGAC_F078-A03C	BARRIER FAILURE BETWEEN F055-AGAC AND F078-A03C		
		COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		

Table 19.1-124 (1 of 3)

LPSD Internal Fire PRA Key Basic Events by RAW (CDF) – All POS

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	65
UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES	27
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	21
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	19
BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD	15
BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD	8
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	8
DCBSY-D-MC01D	BUS FAULTS ON 1E 125VDC BUS MC01D	7
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	6
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	6
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	6
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	5
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	5
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	5
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	5
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	5
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	5

Table 19.1-124 (2 of 3)

Basic Event	Description	RAW
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	4
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	4
DCBSY-C-MC01C	BUS FAULTS ON 1E 125VDC BUS MC01C	4
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	4
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	4
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	3
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	3
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	3
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	3
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	3
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	3
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	2
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	2
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	2
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	2

Table 19.1-124 (3 of 3)

Basic Event	Description	RAW
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	2
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	2
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	2
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	2
DADGR-S-AACTG	AAC GTG FAILS TO RUN	2
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	2
PELXY-A-LX01A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01A	2
VUHVS-S-HV81	FAILS TO START OF HIGH VOLUME CUBICLE COOLER HV81	2
VUHVS-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO START	2
DADGS-S-AACTG	AAC GTG FAILS TO START	2

Table 19.1-125

LPSD Internal Fire PRA Key Basic Events by RAW (CDF) – Reduced Inventory

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	41
UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES	11
BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD	4
BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD	3

Table 19.1-126

LPSD Internal Fire PRA Key Basic Events by FV (CDF) – All POS

Basic Event	Description	FV
BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD	7.2%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	2.9%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	2.1%
BF_F120-AGAC_F120-AGAD	BARRIER FAILURE BETWEEN F120-AGAC AND F120-AGAD	1.7%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	0.9%
WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND	0.8%
WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND	0.8%
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	0.7%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	0.6%
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	0.5%

Table 19.1-127

LPSD Internal Fire PRA Key Basic Events by FV (CDF) – Reduced Inventory

Basic Event	Description	FV
BF_F078-AGAC_F078-AGAD	BARRIER FAILURE BETWEEN F078-AGAC AND F078-AGAD	1.7%
BF_F000-AC_F137-A20A	BARRIER FAILURE BETWEEN F000-AC AND F137-A20A	0.5%

Table 19.1-128 (1 of 4)

LPSD Internal Fire PRA Key CCF by RAW (CDF)

Basic Event	Description	RAW
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	257
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	257
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	257
SICVWQ3-V113/23/43	SI LINE C/V 113,123,143 CCF TO OPEN	49
SICVWQ3-V217/27/47	3/4 CCF OF DVI LINE CHECK VALVES 217,227,247	49
SICVWQ3-V540/41/43	3/4 CCF OF DVI LINE CHECK VALVES 540,541,543	49
SICVWQ2-V113/23	SI LINE C/V 113,123 CCF TO OPEN	46
SICVWQ2-V217/27	2/4 CCF OF DVI LINE CHECK VALVES 217,227	46
SICVWQ2-V540/41	2/4 CCF OF DVI LINE CHECK VALVES 540,541	46
SICVWQ3-V123/33/43	SI LINE C/V 123,133,143 CCF TO OPEN	46
SICVWQ3-V227/37/47	3/4 CCF OF DVI LINE CHECK VALVES 227,237,247	46
SICVWQ3-V541/42/43	3/4 CCF OF DVI LINE CHECK VALVES 541,542,543	46
SICVWQ3-V113/23/33	SI LINE C/V 113,123,133 CCF TO OPEN	43
SICVWQ3-V217/27/37	3/4 CCF OF DVI LINE CHECK VALVES 217,227,237	43
SICVWQ3-V540/41/42	3/4 CCF OF DVI LINE CHECK VALVES 540,541,542	43
SICVWQ3-V113/33/43	SI LINE C/V 113,133,143 CCF TO OPEN	43
SICVWQ3-V217/37/47	3/4 CCF OF DVI LINE CHECK VALVES 217,237,247	43

Table 19.1-128 (2 of 4)

Basic Event	Description	RAW
SICVWQ3-V540/42/43	3/4 CCF OF DVI LINE CHECK VALVES 540,542,543	43
SICVWQ2-V133/43	SI LINE C/V 133,143 CCF TO OPEN	38
SICVWQ2-V237/47	2/4 CCF OF DVI LINE CHECK VALVES 237,247	38
SICVWQ2-V542/43	2/4 CCF OF DVI LINE CHECK VALVES 542,543	38
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	35
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	35
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	35
VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	35
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	33
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	33
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	31
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	31
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	31
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	30
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	30
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	30
PFHBWQ4-SW1DG	CCF OF SW01A&1B&1C&1D FEED BREAKER FROM DG A&B FAIL TO CLOSE	29

Table 19.1-128 (3 of 4)

Basic Event	Description	RAW
VDHVWQ4-HV12ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	29
VDHVWQ4-HV13ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	29
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	29
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	29
DGSQWQ4-LOADSQABCD	CCF OF LOAD SEQUNCER A, B, C, D	29
VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B	28
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	28
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646	28
DGDGWQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	28
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG01A/B/C/D INLET	27
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	27
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	27
SXFLKE6-FT01AB/2AB/3AB	6/6 CCF OF ESW DEBRIS FILTER 1A/1B, 2A/B, 3A/3B IN TRAIN A/B	27
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	26
VDHVKQ4-HV12ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	26
VDHVKQ4-HV13ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	26
PALXKQ4-PA06CD	4/4 CCF OF LOOP CONTROLLER PA06C, PA06D	25

Table 19.1-128 (4 of 4)

Basic Event	Description	RAW
PAGXKO8-PA03ABCD	8/8 CCF OF GROUP CONTROLLER 752-PA03A,03B,03C,03D	25
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOLATION VALVES	25
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	25
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	25
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	25
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	25
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	24
PELXKO8-LX05AB3CD	8/8 CCF OF LOOP CONTROLLER LX05A LX05B, LX03C ,LX03D	24
PELXKO8-LX06A04B03C03D	8/8 CCF OF LOOP CONTROLLER LX06A 12, LX04B 12, LX03C 12, LX03D 12	24
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	23
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	22

Table 19.1-129

LPSD Internal Fire PRA Key CCF by FV (CDF)

Basic Event	Description	FV
No events meet FV cutoff of 0.5%.		

Table 19.1-130 (1 of 2)

LPSD Internal Fire PRA Key PRA Operator Actions by RAW (CDF)

Basic Event	Description	RAW
HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05	379
HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05	101
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	82
HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A	79
HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B	44
HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B	39
HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A	38
HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05	26
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	25
HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01	16
HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B	14
HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01	14
HR-SG-S2P03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03B	12
HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01	11
HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01	10
HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B	9
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	7

Table 19.1-130 (2 of 2)

Basic Event	Description	RAW
HR-SG-LPP03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03A	6
HR-FB-LPP12A	OPERATOR FAILS TO OPERATE F&B AT LP POS12A	6
HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01	4
HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01	4
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	4
HR-FB-JLP11-01	OPERATOR FAILS TO OPERATE F&B AT JL POS11 01	4
HR-SG-CCP03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03A	3
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	3
HR-FB-LPP03A-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03A 01	3
HR-SG-S2P03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03A	3
HR-RS-KVP10	OPERATOR FAILS TO RESTORE SCS AT KV POS10	2
HR-FB-JLP06-02	OPERATOR FAILS TO OPERATE F&B AT JL POS06 02	2

Table 19.1-131 (1 of 3)

LPSD Internal Fire PRA Key PRA Operator Actions by FV (CDF)

Basic Event	Description	FV
HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05	27.0%
HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05	27.0%
COMBINATION_113	HEP DEPENDENCY FACTOR FOR HR-RS-KVP05 AND HR-FB-KVP05	27.0%
HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05	8.7%
HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05	8.7%
COMBINATION_24	HEP DEPENDENCY FACTOR FOR HR-RS-CCP05 AND HR-FB-CCP05	8.7%
HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05	7.1%
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	7.1%
COMBINATION_171	HEP DEPENDENCY FACTOR FOR HR-RS-S2P05 AND HR-FB-S2P05	7.1%
HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A	6.8%
HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A	6.8%
COMBINATION_117	HEP DEPENDENCY FACTOR FOR HR-RS-KVP12A AND HR-FB-KVP12A	6.8%
HR-RS-LPP03B	OPERATOR FAILS TO RESTORE SCS AT LO POS03B	4.6%
HR-FB-LPP03B-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03B 01	4.6%
HR-SG-LPP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03B	4.3%
COMBINATION_130	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03B, HR-SG-LPP03B, HR-FB-LPP03B-01	4.3%
HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B	3.8%
HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B	3.8%
COMBINATION_112	HEP DEPENDENCY FACTOR FOR HR-RS-KVP04B AND HR-FB-KVP04B	3.8%

Table 19.1-131 (2 of 3)

Basic Event	Description	FV
HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A	3.2%
HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A	3.2%
COMBINATION_28	HEP DEPENDENCY FACTOR FOR HR-RS-CCP12A AND HR-FB-CCP12A	3.2%
HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A	2.1%
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	2.1%
COMBINATION_175	HEP DEPENDENCY FACTOR FOR HR-RS-S2P12A AND HR-FB-S2P12A	2.1%
HR-FB-CCP03B-01	OPERATOR FAILS TO OPERATE F&B AT CC POS03B 01	1.8%
HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05	1.8%
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	1.8%
COMBINATION_141	HEP DEPENDENCY FACTOR FOR HR-RS-LPP05 AND HR-FB-LPP05	1.8%
HR-RS-CCP03B	OPERATOR FAILS TO RESTORE SCS AT CC POS03B	1.8%
PROB-NON-SUPP-MCR	PROBABILITY OF NON-SUPPRESSION OF MCR FIRES RESULTING IN MCR EVACUATION	1.7%
HR-RS-S2P03B	OPERATOR FAILS TO RESTORE SCS AT S2 POS03B	1.6%
HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01	1.6%
HR-SG-CCP03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT CC POS03B	1.5%
COMBINATION_16	HEP DEPENDENCY FACTOR FOR HR-RS-CCP03B, HR-SG-CCP03B, HR-FB-CCP03B-01	1.5%
HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01	1.4%
HR-FB-S2P03B-01	OPERATOR FAILS TO OPERATE F&B AT S2 POS03B 01	1.4%
AS-CCDP-ST	SHORT TERM ALTERNATE SHUTDOWN CCDP EST. (< = 1.5 HRS FOR RS AND SG HEPS)	1.3%
HR-SG-S2P03B	OPERATOR FAILS TO OPERATE SHR WITH AFW AT S2 POS03B	1.3%

Table 19.1-131 (3 of 3)

Basic Event	Description	FV
COMBINATION_159	HEP DEPENDENCY FACTOR FOR HR-RS-S2P03B, HR-SG-S2P03B, HR-FB-S2P03B-01	1.3%
HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B	1.2%
HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B	1.2%
COMBINATION_23	HEP DEPENDENCY FACTOR FOR HR-RS-CCP04B AND HR-FB-CCP04B	1.2%
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	1.0%
HR-RS-S2P04B	OPERATOR FAILS TO RESTORE SCS AT S2 POS04B	1.0%
COMBINATION_170	HEP DEPENDENCY FACTOR FOR HR-RS-S2P04B AND HR-FB-S2P04B	1.0%
HR-FB-JLP10-02	OPERATOR FAILS TO OPERATE F&B AT JL POS10 02	1.0%
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE & MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	1.0%
COMBINATION_84	HEP DEPENDENCY FACTOR FOR HR-MI-JLP10 AND HR-FB-JLP10-02	1.0%
HR-RS-LPP03A	OPERATOR FAILS TO RESTORE SCS AT LO POS03A	0.6%
HR-SG-LPP03A	OPERATOR FAILS TO OPERATE SHR WITH AFW AT LP POS03A	0.6%
HR-FB-LPP03A-01	OPERATOR FAILS TO OPERATE F&B AT LP POS03A 01	0.6%
HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01	0.6%
COMBINATION_125	HEP DEPENDENCY FACTOR FOR HR-RS-LPP03A, HR-SG-LPP03A AND HR-FB-LPP03A-01	0.5%

Table 19.1-132

APR1400 Shutdown LRF Screening Methodology

POS	POS Description	CDF(/yr)*	CDF %	CPLR	LRF	Comment
1	Low power operation	5.33E-10	0.0%	8.40E-02	4.48E-11	Containment Closed (at-power CPLR)
2	SG Cooldown to 350F	1.00E-07	3.8%	8.40E-02	8.40E-09	Containment Closed (at-power CPLR)
3A	Cooldown with SCS to 212F	1.85E-07	7.0%	8.40E-02	1.55E-08	Containment Closed (at-power CPLR)
3B	Cooldown with SCS to 140F	9.39E-08	3.6%	1.35E-01		Hatch close HEP/(at-power CPLR) (0.051+0.084)
4A	RCS Draindown (manway closed)	6.43E-09	0.0%	1.35E-01		Hatch close HEP/(at-power CPLR) (0.051+0.084)
4B	RCS Draindown (manway open)	4.07E-08	1.5%	Detailed		Containment Closed
5	Reduced Inventory Operation	1.39E-06	53.0%	Detailed		Containment Closed
6	Fill for Refueling	7.63E-08	2.9%	Detailed		Containment Closed
7	Refueling (Core-alteration)	-	-	-	-	
8	Cavity drained	-	-	-	-	
9	Refueling (Core-alteration)	-	-	-	-	
10	RCS Draindown after Refueling	9.07E-08	3.4%	Detailed		Containment Closed
11	Reduced Inventory Operation	6.03E-07	22.9%	Detailed		Containment Closed
12A	Refill RCS (manway open)	2.24E-08	0.9%	Detailed		Containment Closed
12B	Refill RCS (manway closed)	-	-	-	-	
13	RCS Heatup/SCS Isolate at 350F	1.37E-08	0.5%	8.40E-02	1.15E-09	Containment Closed (at-power CPLR)
14	RCS Heatup with SGs	3.92E-09	0.1%	8.40E-02	3.29E-10	Containment Closed (at-power CPLR)
15	Reactor Startup	6.63E-09	0.3%	8.40E-02	5.57E-10	Containment Closed (at-power CPLR)
	Total	2.63E-06	100%			

*CDF taken from the internal events Level 1 analysis for LPSD operations (Table 19.1-95).

Table 19.1-133

APR1400 LPSD Internal Events Release Fractions

STC	Timing (Hr)	Noble Gas, FREL(1)	CsI, FREL(2)	TeO2, FREL(3)	SrO, FREL(4)	MoO2, FREL(5)	CsOH, FREL(6)	BaO, FREL(7)	La2O3, FREL(8)	CeO2, FREL(9)	Sb, FREL(10)	Te2, FREL(11)	UO2, FREL(12)
RC-1-LPSD	49.7	2.11E-3	2.38E-5	2.25E-5	3.93E-7	3.19E-7	1.49E-5	4.88E-7	1.27E-8	9.94E-8	1.50E-5	0.00E-0	0.00E-0
RC-2-LPSD	-	-	-	-	-	-	-	-	-	-	-	-	-
RC-3-LPSD	-	-	-	-	-	-	-	-	-	-	-	-	-
RC-4-LPSD	283.6	9.94E-1	8.82E-5	1.63E-5	1.38E-6	3.64E-6	5.92E-5	6.61E-5	4.20E-8	7.89E-7	7.28E-3	1.71E-5	1.40E-8

Notes:

(1) Release fractions for RC-1-LPSD (intact containment) are conservatively represented by the at-power release category 10 (intact containment).

(2) Release fractions for RC-4-LPSD (basemat melt-through) are conservatively represented by the at-power release category 11 (basemat melt-through)

Table 19.1-134 (1 of 2)

Internal Events LPSD LRF by POS

POS	LRF evaluation	CDF(/yr)*	CDF %	CPLR	LRF	% of total LRF
1	Containment Closed (at-power CPLR)	5.33E-10	0.0%	8.40E-02	4.48E-11	0.0%
2	Containment Closed (at-power CPLR)	1.00E-07	3.7%	8.40E-02	8.40E-09	7.1%
3A	Containment Closed (at-power CPLR)	1.85E-07	6.8%	8.40E-02	1.55E-08	13.2%
3B-JL	Containment bypass (ISLOCA)	1.26E-08	0.5%	1	1.26E-08	10.7%
3B-LX	Hatch open and no credit for closing without AC power	1.74E-09	0.1%	1	1.74E-09	1.5%
3B-other	Hatch close HEP/at-power CPLR (0.051+0.084)	8.03E-08	3.0%	1.35E-01	1.08E-08	9.2%
4A-JL	Containment bypass (ISLOCA)	1.12E-11	0.0%	1	1.12E-11	0.0%
4A-LX	Hatch open and no credit for closing without AC power	7.88E-12	0.0%	1	7.88E-12	0.0%
4A-other	Hatch close HEP/at-power CPLR (0.051+0.084)	1.09E-09	0.0%	1.35E-01	1.47E-10	0.1%
4B	RCS Draindown (manway open)	4.55E-08	1.7%	Detailed	2.79E-09	2.4%
5	Reduced Inventory Operation	1.40E-06	51.5%	Detailed	4.22E-08	35.9%
6	Fill for Refueling	9.71E-08	3.6%	Detailed	6.98E-09	5.9%
7	Refueling (Core-alteration)	-	-	-	-	-
8	Cavity drained	-	-	-	-	-
9	Refueling (Core-alteration)	-	-	-	-	-
10	RCS Draindown after Refueling	1.28E-07	4.7%	Detailed	3.28E-09	2.8%

Table 19.1-134 (2 of 2)

POS	LRF evaluation	CDF(/yr)*	CDF %	CPLR	LRF	% of total LRF
11	Reduced Inventory Operation	6.05E-07	22.3%	Detailed	1.10E-08	9.4%
12A	Refill RCS (manway open)	2.27E-08	0.8%	Detailed	1.14E-10	0.1%
12B	Refill RCS (manway closed)	-	-	-	-	-
13	RCS Heatup/SCS Isolate at 350F	1.37E-08	0.8%	8.40E-02	1.78E-09	1.0%
14	RCS Heatup with SGs	3.92E-09	0.1%	8.40E-02	3.29E-10	0.3%
15	Reactor Startup	6.63E-09	0.2%	8.40E-02	5.57E-10	0.5%
Total	Total	2.70E-06	100.0%	-	1.18E-07	100.0%

* CDF taken from the internal events Level 1 analysis for LPSD operations (Table 19.1-95).

Table 19.1-135 (1 of 54)

LPSD Internal Events PRA Top 100 Cutsets (LRF) – All POS

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF(%): Cutset	Contribution to CDF(%): Cumulative
1	7.70E-09	%SL1	Small LOCA at Reduced Inventory	11.6	11.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
2	4.22E-09	%SO	RCS Overdraining due to SCS	6.4	18.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (2 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
3	3.80E-09	%SO	RCS Overdraining due to SCS	5.7	23.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
4	2.38E-09	%SL1	Small LOCA at Reduced Inventory	3.6	27.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		

Table 19.1-135 (3 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	2.34E-09	%SO	RCS Overdraining due to SCS	3.5	30.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
6	2.34E-09	%SO	RCS Overdraining due to SCS	3.5	34.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of brnch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (4 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	2.09E-09	%SO	RCS Overdraining due to SCS	3.1	37.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (5 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	1.88E-09	%SO	RCS Overdraining due to SCS	2.8	40.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
9	1.68E-09	%SL2	Small LOCA above Reduced Inventory	2.5	42.8
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		
		SEQ-JL-P06-05	JL POS 6 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		

Table 19.1-135 (6 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	1.31E-09	%SO	RCS Overdraining due to SCS	2.0	44.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
11	1.17E-09	%SO	RCS Overdraining due to SCS	1.8	46.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		

Table 19.1-135 (7 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
11	(cont.)	LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
12	9.22E-10	%SO	RCS Overdraining due to SCS	1.4	48.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (8 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	7.78E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	1.2	49.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
14	7.59E-10	%SO	RCS Overdraining due to SCS	1.1	50.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		

Table 19.1-135 (9 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
14	(cont.)	LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
15	7.24E-10	%SO	RCS Overdraining due to SCS	1.1	51.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-135 (10 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	7.24E-10	%SO	RCS Overdraining due to SCS	1.1	52.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
17	7.20E-10	%SO	RCS Overdraining due to SCS	1.1	53.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (11 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
18	7.20E-10	%SO	RCS Overdraining due to SCS	1.1	54.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
19	7.20E-10	%SO	RCS Overdraining due to SCS	1.1	55.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (12 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
20	7.20E-10	%SO	RCS Overdraining due to SCS	1.1	56.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
21	7.00E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	1.1	57.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (13 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	6.83E-10	%SO	RCS Overdraining due to SCS	1.0	58.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
23	4.57E-10	%SO	RCS Overdraining due to SCS	0.7	59.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		

Table 19.1-135 (14 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
23	(cont.)	LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
24	4.32E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.7	60.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		

Table 19.1-135 (15 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	4.32E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.7	60.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
26	4.29E-10	%SL1	Small LOCA at Reduced Inventory	0.6	61.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (16 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
27	3.90E-10	%SL2	Small LOCA above Reduced Inventory	0.6	62.1
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B		
		SEQ-JL-P04B-05	JL POS 4B SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP04B-02-DE	HRA Dependance for MI & FB at JL POS04B		
28	3.86E-10	%SL1	Small LOCA at Reduced Inventory	0.6	62.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (17 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	3.35E-10	%SL2	Small LOCA above Reduced Inventory	0.5	63.2
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP06-01-DE	HRA Dependance for RS & FB at JL POS06		
30	3.24E-10	%SO	RCS Overdraining due to SCS	0.5	63.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-135 (18 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
31	3.24E-10	%SO	RCS Overdraining due to SCS	0.5	64.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
32	3.24E-10	%SO	RCS Overdraining due to SCS	0.5	64.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
33	3.24E-10	%SO	RCS Overdraining due to SCS	0.5	65.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-135 (19 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	3.03E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.5	65.6
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
35	2.85E-10	%SO	RCS Overdraining due to SCS	0.4	66.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (20 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	2.72E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.4	66.5
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (21 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
37	2.72E-10	%SL1	Small LOCA at Reduced Inventory	0.4	66.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
38	2.41E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.4	67.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (22 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	2.41E-10	%JL	Unrecoverable LOCA	0.4	67.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
40	2.40E-10	%JL	Unrecoverable LOCA	0.4	67.9
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		
		SEQ-JL-P06-05	JL POS 6 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		
41	2.23E-10	%SO	RCS Overdraining due to SCS	0.3	68.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-135 (23 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	2.23E-10	%SO	RCS Overdraining due to SCS	0.3	68.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
43	2.23E-10	%SO	RCS Overdraining due to SCS	0.3	69.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-135 (24 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	2.23E-10	%SO	RCS Overdraining due to SCS	0.3	69.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
45	2.17E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.3	69.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (25 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	2.11E-10	%SO	RCS Overdraining due to SCS	0.3	69.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (26 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	1.70E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.3	70.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
48	1.67E-10	%SL1	Small LOCA at Reduced Inventory	0.3	70.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (27 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	1.66E-10	%SO	RCS Overdraining due to SCS	0.3	70.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (28 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	1.66E-10	%S1	Loss of SCS (S1)	0.2	70.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
51	1.50E-10	%SL1	Small LOCA at Reduced Inventory	0.2	71.2
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		

Table 19.1-135 (29 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	(cont.)	SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
52	1.49E-10	%S1	Loss of SCS (S1)	0.2	71.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (30 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	1.41E-10	%SL2	Small LOCA above Reduced Inventory	0.2	71.6
		BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration		
		HR-MI-JLP10	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS10		
		SEQ-JL-P10-05	JL POS 10 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-JLP10-02-DE	HRA Dependance for MI & FB at JL POS10		
54	1.34E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	71.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		

Table 19.1-135 (31 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	1.34E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	72.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
56	1.33E-10	%SL1	Small LOCA at Reduced Inventory	0.2	72.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (32 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	72.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
58	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	72.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
59	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	72.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		

Table 19.1-135 (33 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	73.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
61	1.24E-10	%SL2	Small LOCA above Reduced Inventory	0.2	73.2
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		HR-RS-JLP04B	OPERATOR FAILS TO RESTORE SCS AT JL POS04B		
		SEQ-JL-P04B-03	JL POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP04B-01-DE	HRA Dependance for RS & FB at JL POS04B		

Table 19.1-135 (34 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
62	1.20E-10	%SL1	Small LOCA at Reduced Inventory	0.2	73.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
63	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	73.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		

Table 19.1-135 (35 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
64	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	73.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
65	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	73.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		

Table 19.1-135 (36 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
66	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	74.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
67	1.05E-10	%SO	RCS Overdraining due to SCS	0.2	74.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-135 (37 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
68	1.05E-10	%SO	RCS Overdraining due to SCS	0.2	74.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
69	1.04E-10	%SO	RCS Overdraining due to SCS	0.2	74.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		

Table 19.1-135 (38 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	(cont.)	LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
70	1.02E-10	%SO	RCS Overdraining due to SCS	0.2	74.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ECFH2-RUPTDET	Containment ruptures due to early H2 burn		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (39 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	9.89E-11	%SL1	Small LOCA at Reduced Inventory	0.1	74.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11		
		SEQ-JL-P11-05	JL POS 11 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-JLP11-02-DE	HRA Dependance for MI & FB at JL POS11		
72	9.65E-11	%SL1	Small LOCA at Reduced Inventory	0.1	75.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-135 (40 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	9.37E-11	%SL2	Small LOCA above Reduced Inventory	0.1	75.2
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P06-05	JL POS 6 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
74	9.19E-11	%S1	Loss of SCS (S1)	0.1	75.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-135 (41 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	9.19E-11	%S1	Loss of SCS (S1)	0.1	75.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-135 (42 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
76	8.43E-11	%SL2	Small LOCA above Reduced Inventory	0.1	75.6
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P06-05	JL POS 6 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
77	8.30E-11	%SO	RCS Overdraining due to SCS	0.1	75.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ECFH2-INT	Containment intact after early H2 burn		

Table 19.1-135 (43 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	(cont.)	LPSD-L2-ECFLH2B-RUP	Late H2 burn caused containment rupture		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
78	7.57E-11	%SO	RCS Overdraining due to SCS	0.1	75.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CI-HATCH	HATCH FAILS TO ISOLATE		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
79	7.57E-11	%SO	RCS Overdraining due to SCS	0.1	75.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (44 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
80	7.44E-11	%JL	Unrecoverable LOCA	0.1	76.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
81	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	76.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		

Table 19.1-135 (45 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	76.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
83	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	76.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
84	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	76.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		

Table 19.1-135 (46 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	7.04E-11	%SL2	Small LOCA above Reduced Inventory	0.1	76.6
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
86	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	76.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-505/6	2/2 CCF OF AV 505, 506		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
87	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	76.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-522/3	2/2 CCF OF AV 522, 523		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (47 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
88	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	76.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-560/1	2/2 CCF OF AV 560, 561		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
89	6.52E-11	%SO	RCS Overdraining due to SCS	0.1	77.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-135 (48 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
90	5.82E-11	%SO	RCS Overdraining due to SCS	0.1	77.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
91	5.58E-11	%JL	Unrecoverable LOCA	0.1	77.2
		BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration		
		HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B		
		SEQ-JL-P04B-05	JL POS 4B SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP04B-02-DE	HRA Dependance for MI & FB at JL POS04B		

Table 19.1-135 (49 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	5.29E-11	%SO	RCS Overdraining due to SCS	0.1	77.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-135 (50 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
93	5.26E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	77.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
94	5.23E-11	%SO	RCS Overdraining due to SCS	0.1	77.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		

Table 19.1-135 (51 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	(cont.)	LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
95	4.79E-11	%SO	RCS Overdraining due to SCS	0.1	77.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ALPHA-CF	Alpha-mode containment failure (low RCS pressure)		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-135 (52 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
96	4.79E-11	%SO	RCS Overdraining due to SCS	0.1	77.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-EVSE-MED	Ex-vessel steam explosion medium wtr lvl in cavity		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
97	4.78E-11	%JL	Unrecoverable LOCA	0.1	77.6
		BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration		
		HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP06-01-DE	HRA Dependance for RS & FB at JL POS06		

Table 19.1-135 (53 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	4.76E-11	%SO	RCS Overdraining due to SCS	0.1	77.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
99	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	77.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		

Table 19.1-135 (54 of 54)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF(%)	
		Basic Event	Cutset Description	Cutset	Cumulative
100	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	77.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		

Table 19.1-136 (1 of 47)

LPSD Internal Events PRA Top 100 Cutsets (LRF) – Reduced Inventory

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	7.70E-09	%SL1	Small LOCA at Reduced Inventory	14.5	14.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
2	4.22E-09	%SO	RCS Overdraining due to SCS	7.9	22.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Failure		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (2 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
3	3.80E-09	%SO	RCS Overdraining due to SCS	7.1	29.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
4	2.38E-09	%SL1	Small LOCA at Reduced Inventory	4.5	34.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		

Table 19.1-136 (3 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	2.34E-09	%SO	RCS Overdraining due to SCS	4.4	38.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
6	2.34E-09	%SO	RCS Overdraining due to SCS	4.4	42.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (4 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	2.09E-09	%SO	RCS Overdraining due to SCS	3.9	46.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
8	1.88E-09	%SO	RCS Overdraining due to SCS	3.5	50.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		

Table 19.1-136 (5 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	(cont.)	LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
9	1.31E-09	%SO	RCS Overdraining due to SCS	2.5	52.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (6 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	1.17E-09	%SO	RCS Overdraining due to SCS	2.2	55.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
11	9.22E-10	%SO	RCS Overdraining due to SCS	1.7	56.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (7 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
12	7.78E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	1.5	58.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
13	7.59E-10	%SO	RCS Overdraining due to SCS	1.4	59.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (8 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
14	7.24E-10	%SO	RCS Overdraining due to SCS	1.4	60.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
15	7.24E-10	%SO	RCS Overdraining due to SCS	1.4	62.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependndce for MI & FB at SO POS05		

Table 19.1-136 (9 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	7.20E-10	%SO	RCS Overdraining due to SCS	1.4	63.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
17	7.20E-10	%SO	RCS Overdraining due to SCS	1.4	65.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
18	7.20E-10	%SO	RCS Overdraining due to SCS	1.4	66.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (10 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	7.20E-10	%SO	RCS Overdraining due to SCS	1.4	67.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
20	7.00E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	1.3	69.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (11 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	6.83E-10	%SO	RCS Overdraining due to SCS	1.3	70.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
22	4.57E-10	%SO	RCS Overdraining due to SCS	0.9	71.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (12 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
23	4.32E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.8	72.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
24	4.32E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.8	72.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		

Table 19.1-136 (13 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	4.29E-10	%SL1	Small LOCA at Reduced Inventory	0.8	73.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
26	3.86E-10	%SL1	Small LOCA at Reduced Inventory	0.7	74.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (14 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
27	3.24E-10	%SO	RCS Overdraining due to SCS	0.6	74.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
28	3.24E-10	%SO	RCS Overdraining due to SCS	0.6	75.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
29	3.24E-10	%SO	RCS Overdraining due to SCS	0.6	76.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-136 (15 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	3.24E-10	%SO	RCS Overdraining due to SCS	0.6	76.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
31	3.03E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.6	77.3
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (16 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
32	2.85E-10	%SO	RCS Overdraining due to SCS	0.5	77.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
33	2.72E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.5	78.4
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (17 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	2.72E-10	%SL1	Small LOCA at Reduced Inventory	0.5	78.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
35	2.41E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.5	79.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (18 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	2.41E-10	%JL	Unrecoverable LOCA	0.5	79.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
37	2.23E-10	%SO	RCS Overdraining due to SCS	0.4	80.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
38	2.23E-10	%SO	RCS Overdraining due to SCS	0.4	80.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-136 (19 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	2.23E-10	%SO	RCS Overdraining due to SCS	0.4	81.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		
40	2.23E-10	%SO	RCS Overdraining due to SCS	0.4	81.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-136 (20 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
41	2.17E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.4	81.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late containment failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
42	2.11E-10	%SO	RCS Overdraining due to SCS	0.4	82.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		

Table 19.1-136 (21 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	(cont.)	LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
43	1.70E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.3	82.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (22 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	1.67E-10	%SL1	Small LOCA at Reduced Inventory	0.3	82.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
45	1.66E-10	%SO	RCS Overdraining due to SCS	0.3	83.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (23 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	1.66E-10	%S1	Loss of SCS (S1)	0.3	83.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
47	1.50E-10	%SL1	Small LOCA at Reduced Inventory	0.3	83.8
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P11-03	JL POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (24 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
48	1.49E-10	%S1	Loss of SCS (S1)	0.3	84.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
49	1.34E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.3	84.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		

Table 19.1-136 (25 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	(cont.)	LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
50	1.34E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.3	84.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		

Table 19.1-136 (26 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	1.33E-10	%SL1	Small LOCA at Reduced Inventory	0.2	84.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
52	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	85.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		

Table 19.1-136 (27 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	85.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
54	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	85.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		
55	1.33E-10	%SL	Failure to Maintain Water Level at Reduced Inventory	0.2	85.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SL-P05-03	SL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05		

Table 19.1-136 (28 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
56	1.20E-10	%SL1	Small LOCA at Reduced Inventory	0.2	86.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
57	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	86.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		

Table 19.1-136 (29 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	86.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
59	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	86.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		
60	1.18E-10	%SO	RCS Overdraining due to SCS	0.2	87.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SO-P05-11	SO POS 5 SEQUENCE 11 IDENTIFIER		
		HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11		

Table 19.1-136 (30 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	1.05E-10	%SO	RCS Overdraining due to SCS	0.2	87.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
62	1.05E-10	%SO	RCS Overdraining due to SCS	0.2	87.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-136 (31 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	1.04E-10	%SO	RCS Overdraining due to SCS	0.2	87.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
64	1.02E-10	%SO	RCS Overdraining due to SCS	0.2	87.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ECFH2-RUPTDET	Containment ruptures due to early H2 burn		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (32 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	9.89E-11	%SL1	Small LOCA at Reduced Inventory	0.2	87.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11		
		SEQ-JL-P11-05	JL POS 11 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		HR-FB-JLP11-02-DE	HRA Dependance for MI & FB at JL POS11		
66	9.65E-11	%SL1	Small LOCA at Reduced Inventory	0.2	88.1
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		

Table 19.1-136 (33 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
67	9.19E-11	%S1	Loss of SCS (S1)	0.2	88.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
68	9.19E-11	%S1	Loss of SCS (S1)	0.2	88.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S1-P05-03	S1 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-136 (34 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	8.30E-11	%SO	RCS Overdraining due to SCS	0.2	88.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ECFH2-INT	Containment intact after early H2 burn		
		LPSD-L2-ECFLH2B-RUP	Late H2 burn caused containment rupture		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
70	7.57E-11	%SO	RCS Overdraining due to SCS	0.1	88.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CI-HATCH	HATCH FAILS TO ISOLATE		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (35 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	7.57E-11	%SO	RCS Overdraining due to SCS	0.1	88.9
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
72	7.44E-11	%JL	Unrecoverable LOCA	0.1	89.0
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05		
73	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	89.2
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		

Table 19.1-136 (36 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
74	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	89.3
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
75	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	89.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		
76	7.32E-11	%SL1	Small LOCA at Reduced Inventory	0.1	89.6
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-JL-P05-03	JL POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05		

Table 19.1-136 (37 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	89.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-505/6	2/2 CCF OF AV 505, 506		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
78	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	89.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-522/3	2/2 CCF OF AV 522, 523		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
79	7.01E-11	%SO	RCS Overdraining due to SCS	0.1	90.0
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		CVAVWD2-560/1	2/2 CCF OF AV 560, 561		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (38 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
80	6.52E-11	%SO	RCS Overdraining due to SCS	0.1	90.1
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-05	SO POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05		

Table 19.1-136 (39 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	5.82E-11	%SO	RCS Overdraining due to SCS	0.1	90.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
82	5.29E-11	%SO	RCS Overdraining due to SCS	0.1	90.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (40 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
83	5.26E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	90.4
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
84	5.23E-11	%SO	RCS Overdraining due to SCS	0.1	90.5
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-136 (41 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	4.79E-11	%SO	RCS Overdraining due to SCS	0.1	90.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-ALPHA-CF	Alpha-mode containment failure (low RCS pressure)		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
86	4.79E-11	%SO	RCS Overdraining due to SCS	0.1	90.7
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-EVSE-MED	Ex-vessel steam explosion medium wtr lvl in cavity		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (42 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
87	4.76E-11	%SO	RCS Overdraining due to SCS	0.1	90.8
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
88	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	90.9
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		

Table 19.1-136 (43 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
89	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.0
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
90	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.0
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		
91	4.69E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.1
		BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration		
		HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-SL-P11-03	SL POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11		

Table 19.1-136 (44 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	4.61E-11	%SO	RCS Overdraining due to SCS	0.1	91.2
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-ECFH2-RUPTDET	Containment ruptures due to early H2 burn		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		
93	4.61E-11	%SO	RCS Overdraining due to SCS	0.1	91.3
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-ECFH2-INT	Containment intact after early H2 burn		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		

Table 19.1-136 (45 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
94	4.61E-11	%SO	RCS Overdraining due to SCS	0.1	91.4
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-ECFH2-INT	Containment intact after early H2 burn		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P05-03	SO POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05		
95	4.20E-11	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	91.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-136 (46 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
96	4.20E-11	%LPSW	Loss of offsite power of Switchyard-centered for LPSD	0.1	91.5
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P05-03	LP POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
97	4.11E-11	%SO	RCS Overdraining due to SCS	0.1	91.6
		BE-RATE-OT	Conversion factor (Outage-yr -> Calendar yr, 1/(18month/12month)) for Demand Fai		
		HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11		
		LPSD-L2-ECFH2-INT	Containment intact after early H2 burn		
		LPSD-L2-ECFLH2B-RUP	Late H2 burn caused containment rupture		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-SO-P11-03	SO POS 11 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11		

Table 19.1-136 (47 of 47)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	4.11E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.7
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
99	4.11E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.8
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		
100	4.11E-11	%SL	Failure to Maintain Water Level at Reduced Inventory	0.1	91.9
		BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration		
		HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05		

Table 19.1-137

LPSD Internal Events PRA LRF Contribution by Initiating Events – All POS

Initiator	Frequency	Contribution	Description
%SO	3.24E-08	48.9%	RCS Overdraining due to SCS
%SL1	1.28E-08	19.3%	Small LOCA at Reduced Inventory
%SL	5.28E-09	8.0%	Failure to Maintain Water Level at Reduced Inventory
%LPWE	3.55E-09	5.3%	Loss of offsite power of Weather-related for LPSD
%SL2	3.42E-09	5.2%	Small LOCA above Reduced Inventory
%LPSW	3.16E-09	4.8%	Loss of offsite power of Switchyard-centered for LPSD
%LPPL	2.20E-09	3.3%	Loss of offsite power of Plant-centered for LPSD
%S1	9.45E-10	1.4%	Loss of SCS (S1)
%JL	7.94E-10	1.2%	Unrecoverable LOCA
%LPGR	6.53E-10	1.0%	Loss of offsite power of Grid-related for LPSD
%KV	3.39E-10	0.5%	Loss of Class 1E 4.16kV
%ES	2.24E-10	0.3%	Loss of Essential Service Water
%TC	1.92E-10	0.3%	Total Loss of Component Cooling Water
%TS	1.92E-10	0.3%	Total Loss of Essential Service Water
%S2	1.19E-10	0.2%	Loss of SCS (S2)
%CC	6.81E-11	0.1%	Loss of Component Cooling Water

Table 19.1-138

LPSD Internal Events PRA LRF Contribution by Initiating Events – Reduced Inventory POS

Initiator	Frequency	Contribution	Description
%SO	3.24E-08	61.0%	RCS Overdraining due to SCS
%SL1	1.28E-08	24.1%	Small LOCA at Reduced Inventory
%SL	5.28E-09	9.9%	Failure to Maintain Water Level at Reduced Inventory
%S1	6.69E-10	1.3%	Loss of SCS (S1)
%LPSW	4.82E-10	0.9%	Loss of offsite power of Switchyard-centered for LPSD
%LPWE	4.77E-10	0.9%	Loss of offsite power of Weather-related for LPSD
%JL	3.49E-10	0.7%	Unrecoverable LOCA
%LPPL	3.50E-10	0.7%	Loss of offsite power of Plant-centered for LPSD
%KV	1.14E-10	0.2%	Loss of Class 1E 4.16kV
%LPGR	9.43E-11	0.2%	Loss of offsite power of Grid-related for LPSD
%ES	4.33E-11	0.1%	Loss of Essential Service Water
%S2	5.51E-11	0.1%	Loss of SCS (S2)
%CC	1.53E-11	0.0%	Loss of Component Cooling Water
%TC	1.96E-11	0.0%	Total Loss of Component Cooling Water
%TS	1.96E-11	0.0%	Total Loss of Essential Service Water

Table 19.1-139 (1 of 7)

LPSD Internal Events PRA Key Basic Events by RAW (LRF) – All POS

Basic Event	Description	RAW
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	45
NPBDY-S-IPB	ISOLATED PHASE BUS FAULT	40
NPXHY-M-UAT01M	UNIT AUX XFMR TR01M FAILS WHILE OPERATING	38
NPXHY-N-UAT01N	UNIT AUX XFMR TR01N FAILS WHILE OPERATING	38
NPXOY-S-MTR	MAIN TRANSFORMER FAULT	38
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	36
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	34
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	34
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	34
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	34
CI-HATCH	HATCH FAILS TO ISOLATE	32
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	32
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	31
IPBSY-A-MC01A	120V AC DIST. PANEL BUS 842-IN01A LOCAL FAULTS	29
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	27
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	22

Table 19.1-139 (2 of 7)

Basic Event	Description	RAW
IPINY-B-IN01B	120V AC POWER SUPPLY INVERTER IN01B FAILS WHILE OPERATING	22
IPBSY-B-MC01B	120V AC DIST. PANEL BUS 1-842-E-IN01B LOCAL FAULTS	21
DCBTY-B-BT01B	BAT. BT01B (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	20
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	10
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	8
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	8
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	8
SICVO1A-V143	SI LINE 1 CHECK VALVE V143 FAILS TO OPEN	8
SICVO1A-V543	SI LINE 1 CHECK VALVE V543 FAILS TO OPEN	8
SICVO1A-V247	SI LINE 1 CHECK VALVE V247 FAILS TO OPEN	8
CCMVXO8-143-150	8/8 CCF(DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	7
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	7
PEDOY-C-LX01C03	FAILURE OF DIGITAL OUTPUT MODULE LX01C BRANCH 03	6
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	5
VKHVS2A-HV11A	FAILS TO START SI PUMP ROOM CUBICLE COOLER HV11A	5
SIMVT2A-308	MOV 308 IN IRWST SUC. PATH A FAILS TO REMAIN OPEN	5
SIMVO2A-636	SI PUMP 1 INJECTION LINE MOV 636 FAILS TO OPEN	5

Table 19.1-139 (3 of 7)

Basic Event	Description	RAW
SIMPS2A-PP02C	FAILS TO START SI PUMP PP02C	5
SIVVT2A-V435	SI PUMP 3 DISCHARGE VV 435 FAILS TO REMAIN OPEN	4
SIMPR2A-PP02C	FAILS TO RUN SI PUMP PP02C	4
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	4
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	4
VKHVR2A-HV11A	FAILS TO RUN SI PUMP ROOM CUBICLE COOLER HV11A	4
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	4
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	4
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	4
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	4
VDHVS-A-HV12A	FAILS TO START EDG ROOM CUBICLE COOLER HV12A	3
VDHVS-A-HV13A	FAILS TO START EDG ROOM CUBICLE COOLER HV13A	3
SIVVT2A-V130	SI PUMP 3 SUCTION VV 130 FAILS TO REMAIN OPEN	3
VDHVR-A-HV12A	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12A	3
VDHVR-A-HV13A	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13A	3
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	3
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
SIMVT1B-309	MOV 309 IN IRWST SUC. PATH 1B FAILS TO REMAIN OPEN	3

Table 19.1-139 (4 of 7)

Basic Event	Description	RAW
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	3
CCVVT-A-V1291	EDG01A OUTLET MANUAL VALVE V1291 TRANSFER CLOSED	3
CCMVO-A-191	CCW MOV 191 FOR EDG01A INLET FAILS TO OPEN	3
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	3
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	3
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	3
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	3
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	3
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	3
WOMPS2A-PP02A	FAILS TO START OF ECW PUMP 02A	3
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	3
PELXY-B-LX10B-P	PRIMARY LOOP CONTROLLER LX10B FAILS TO RUN	3
PELXY-A-LX10A-P	PRIMARY LOOP CONTROLLER LX10A FAILS TO RUN	3
PHBSY1A-MC01A	BUS FAULT ON 480V MCC MC01A	3
CCMVO-A-131	CCW MOV 131 FOR ECW CHILLER CH02A OUTLET FAIL TO OPEN	3
PEDOY-A-LX10A03	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 03	3
PEDOY-A-LX10A02	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 02	3

Table 19.1-139 (5 of 7)

Basic Event	Description	RAW
PEDOY-B-LX09B03	FAILURE OF DIGITAL OUTPUT MODULE LX09B BRANCH 03	3
PEDOY-B-LX10B04	FAILURE OF DIGITAL OUTPUT MODULE LX10B BRANCH 04	3
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	3
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	3
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	3
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	3
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	3
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	3
WOCHR2A-CH02A	ECW CHILLER 02A FAILS TO RUN FOR 24 HOURS	2
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	2
VDHVR-B-HV13B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13B	2
VDHVR-B-HV12B	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12B	2
VDHVS-B-HV12B	FAILS TO START EDG ROOM CUBICLE COOLER HV12B	2
VDHVS-B-HV13B	FAILS TO START EDG ROOM CUBICLE COOLER HV13B	2
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B	2
PFHBC1B-SW01B-D2	FAILS TO CLOSE OF FEEDER BRK SW01B-D2 TO DG B	2
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	2
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	2

Table 19.1-139 (6 of 7)

Basic Event	Description	RAW
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	2
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	2
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	2
PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	2
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	2
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	2
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	2
PHBSY1A-MC05A	BUS FAULT ON 480V MCC MC05A	2
DGDGL-B-DGB	DG B FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
CCVVT-B-V1292	EDG01B OUTLET MANUAL VALVE V1292 TRANSFER CLOSED	2
DGDGR-B-DGB	FAILS TO RUN OF EDG B	2
DGDGS-B-DGB	FAILS TO START OG DG B	2
DGDGL-A-DGA	DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	2
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	2
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	2
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	2
SICVO2B-V168	CV 168 IN SCS TRAIN B HX DISCH. PATH FAILS TO OPEN	2
SICVO2B-V569	CV V569 IN SC PUMP 2 DISCH. PATH FAILS TO OPEN	2

Table 19.1-139 (7 of 7)

Basic Event	Description	RAW
NPXHY-N-SAT02N	SAT TR02N FAULT	2
SIHEY1B-HE01B-SC	SC HX 2 HE01B FAILS WHILE OPERATING	2
DADGR-S-AACTG	AAC GTG FAILS TO RUN	2
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	2
DGDGS-A-DGA	FAILS TO START OF EDG A	2
DGDGR-A-DGA	FAILS TO RUN OF EDG A	2
CCMVO-B-192	CCW MOV 192 FOR EDG01B INLET FAILS TO OPEN	2
DGSQA-B-LOADSQ	LOAD SEQUNCER A FAILS TO OPERATE	2
PFHBO1B-SW01B-A2	FAILS TO OPEN OF PCB SW01B-A2 OF 4.16kV SWGR SW01B FROM SAT	2
DGSQA-A-LOADSQ	LOAD SEQUNCER A FAILS TO OPERATE	2

Table 19.1-140 (1 of 3)

LPSD Internal Events PRA Key Basic Events by RAW (LRF) – Reduced Inventory

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	316
UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES	45
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	33
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	33
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	33
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	33
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	33
CI-HATCH	HATCH FAILS TO ISOLATE	33
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE	26
PEDOY-B-LX02B04	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 04	25
CVCVC-S-189	CONTAINMENT ISOLATION CHECK V/V 189 FAIL TO CLOSE	23
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	9
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	8

Table 19.1-140 (2 of 3)

Basic Event	Description	RAW
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	7
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	4
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	4
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	4
CVAVC-S-523	CTMT. ISOL. AOV CV-523 FAIL TO CLOSE	3
CVAVC-S-561	CTMT. ISOL. AOV CV-561 FAIL TO CLOSE	3
DEMVC-S-005	CTMT. ISOL. MOV 005 FAIL TO CLOSE	3
CVAVC-S-505	CTMT. ISOL. AOV CV-505 FAIL TO CLOSE	3
PEDOY-B-LX03B02	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 02	3
PEDOY-B-LX06B01	FAILURE OF DIGITAL OUTPUT MODULE LX06B BRANCH 01	3
PEDOY-B-LX03B03	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 03	3
PELXY-B-LX06B-P	PRIMARY LOOP CONTROLLER LX06B FAILS TO RUN	3
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	3
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	3
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	3

Table 19.1-140 (3 of 3)

Basic Event	Description	RAW
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	3
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	3
PELXY-A-LX10A-P	PRIMARY LOOP CONTROLLER LX10A FAILS TO RUN	3
PELXY-B-LX10B-P	PRIMARY LOOP CONTROLLER LX10B FAILS TO RUN	3
PEDOY-A-LX10A02	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 02	3
PEDOY-B-LX10B04	FAILURE OF DIGITAL OUTPUT MODULE LX10B BRANCH 04	3
PEDOY-B-LX09B03	FAILURE OF DIGITAL OUTPUT MODULE LX09B BRANCH 03	3
PEDOY-A-LX10A03	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 03	3
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	3
IPBSY-A-MC01A	120V AC DIST. PANEL BUS 842-IN01A LOCAL FAULTS	2
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	2
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	2
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	2
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	2
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2

Table 19.1-141 (1 of 2)

LPSD Internal Events PRA Key Basic Events by FV (LRF) – All POS

Basic Event	Description	FV
ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY	4.5%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	3.3%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	3.2%
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	3.1%
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	3.1%
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	3.1%
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	3.1%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	3.0%
WOCHS2A-CH02A	ECW CHILLER CH02A FAILS TO START ON DEMAND	2.6%
RAC-LXP06-AC-WE	Recovery Offsite Power within 1.8hr at SBO POS6 AC WE	1.9%
VKHVS2A-HV11A	FAILS TO START SI PUMP ROOM CUBICLE COOLER HV11A	1.6%
RAC-LXP10-AC-WE	Recovery Offsite Power within 3.0hr at SBO POS10 AC WE	1.5%
RAC-LXP06-AC-SW	Recovery Offsite Power within 1.8hr at SBO POS6 AC SW	1.4%
PFHBC1B-SW01B-D2	FAILS TO CLOSE OF FEEDER BRK SW01B-D2 TO DG B	0.9%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	0.9%

Table 19.1-141 (2 of 2)

Basic Event	Description	FV
VDHVS-A-HV12A	FAILS TO START EDG ROOM CUBICLE COOLER HV12A	0.9%
VDHVS-A-HV13A	FAILS TO START EDG ROOM CUBICLE COOLER HV13A	0.9%
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	0.9%
RAC-LXP06-AC-PL	Recovery Offsite Power within 1.8hr at SBO POS6 AC PL	0.9%
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	0.8%
RAC-LXP10-AC-SW	Recovery Offsite Power within 3.0hr at SBO POS10 AC SW	0.7%
PFHBO1B-SW01B-A2	FAILS TO OPEN OF PCB SW01B-A2 OF 4.16kV SWGR SW01B FROM SAT	0.7%
RAC-LXP04B-AC1-SW	Recover Power Offsite Power with ADV Opening-success at SBO-POS4B AC SW	0.7%
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	0.6%
PFHBO1A-SW01A-A2	FAILS TO OPEN OF PCB SW01A-A2 OF 4.16kV SWGR SW01A FROM SAT	0.6%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	0.6%
VDHVS-B-HV13B	FAILS TO START EDG ROOM CUBICLE COOLER HV13B	0.6%
VDHVS-B-HV12B	FAILS TO START EDG ROOM CUBICLE COOLER HV12B	0.6%
RAC-LXP04B-AC1-PL	Recover Power Offsite Power within 0.4 hours for RS after ADV Opening Failure	0.5%

Table 19.1-142 (1 of 3)

LPSD Internal Events PRA Key Basic Events by FV (LRF) – Reduced Inventory

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	316
UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES	45
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	33
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	33
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	33
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	33
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	33
CI-HATCH	HATCH FAILS TO ISOLATE	33
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE	26
PEDOY-B-LX02B04	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 04	25
CVCVC-S-189	CONTAINMENT ISOLATION CHECK V/V 189 FAIL TO CLOSE	23
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	9
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	8
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	7
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	4
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	4
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	4

Table 19.1-142 (2 of 3)

Basic Event	Description	RAW
CVAVC-S-523	CTMT. ISOL. AOV CV-523 FAIL TO CLOSE	3
CVAVC-S-561	CTMT. ISOL. AOV CV-561 FAIL TO CLOSE	3
DEMVC-S-005	CTMT. ISOL. MOV 005 FAIL TO CLOSE	3
CVAVC-S-505	CTMT. ISOL. AOV CV-505 FAIL TO CLOSE	3
PEDOY-B-LX03B02	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 02	3
PEDOY-B-LX06B01	FAILURE OF DIGITAL OUTPUT MODULE LX06B BRANCH 01	3
PEDOY-B-LX03B03	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 03	3
PELXY-B-LX06B-P	PRIMARY LOOP CONTROLLER LX06B FAILS TO RUN	3
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	3
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	3
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	3
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	3
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	3
PELXY-A-LX10A-P	PRIMARY LOOP CONTROLLER LX10A FAILS TO RUN	3
PELXY-B-LX10B-P	PRIMARY LOOP CONTROLLER LX10B FAILS TO RUN	3
PEDOY-A-LX10A02	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 02	3
PEDOY-B-LX10B04	FAILURE OF DIGITAL OUTPUT MODULE LX10B BRANCH 04	3
PEDOY-B-LX09B03	FAILURE OF DIGITAL OUTPUT MODULE LX09B BRANCH 03	3
PEDOY-A-LX10A03	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 03	3

Table 19.1-142 (3 of 3)

Basic Event	Description	RAW
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	3
IPBSY-A-MC01A	120V AC DIST. PANEL BUS 842-IN01A LOCAL FAULTS	2
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	2
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	2
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	2
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	2
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2

Table 19.1-143 (1 of 7)

LPSD Internal Events PRA Key CCF Events by RAW (LRF)

Basic Event	Description	RAW
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	1.2E+04
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	1.2E+04
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	1.2E+04
SICVWQ3-V227/37/47	3/4 CCF OF DVI LINE CHECK VALVES 227,237,247	1957
SICVWQ3-V541/42/43	3/4 CCF OF DVI LINE CHECK VALVES 541,542,543	1957
SICVWQ3-V123/33/43	SI LINE C/V 123,133,143 CCF TO OPEN	1957
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	1001
DCBTKQ4-BT01ABCD	4/4 CCF OF FAULTS ON BATTERY BT01A/01B/01C/01D	876
IPINKQ3-IN01ACD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/C/D	552
IPINKQ3-IN01ABD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/D	551
IPINKQ2-IN01AD	2/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/D	551
SICVWQ3-V540/41/43	3/4 CCF OF DVI LINE CHECK VALVES 540,541,543	543
SICVWQ3-V217/27/47	3/4 CCF OF DVI LINE CHECK VALVES 217,227,247	543
SICVWQ3-V113/23/43	SI LINE C/V 113,123,143 CCF TO OPEN	543
DCBTKQ2-BT01AD	2/4 CCF OF FAULTS ON BATTERY BT01A/01D	512
IPINKQ3-IN01BCD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01B/C/D	441
IPINKQ3-IN01ABC	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C	440
IPINKQ2-IN01BC	2/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01B/C	440
DCBTKQ2-BT01BC	2/4 CCF OF FAULTS ON BATTERY BT01B/01C	427

Table 19.1-143 (2 of 7)

Basic Event	Description	RAW
DCBTKQ3-BT01ACD	3/4 CCF OF FAULTS ON BATTERY BT01A/01C/01D	398
DCBTKQ3-BT01ABD	3/4 CCF OF FAULTS ON BATTERY BT01A/01B/01D	398
SICVWQ3-V540/41/42	3/4 CCF OF DVI LINE CHECK VALVES 540,541,542	395
SICVWQ3-V113/23/33	SI LINE C/V 113,123,133 CCF TO OPEN	395
SICVWQ3-V217/27/37	3/4 CCF OF DVI LINE CHECK VALVES 217,227,237	395
DCBTKQ3-BT01ABC	3/4 CCF OF FAULTS ON BATTERY BT01A/01B/01C	392
DCBTKQ3-BT01BCD	3/4 CCF OF FAULTS ON BATTERY BT01B/01C/01D	392
SICVWQ2-V227/47	2/4 CCF OF DVI LINE CHECK VALVES 227,247	226
SICVWQ2-V541/43	2/4 CCF OF DVI LINE CHECK VALVES 541,543	226
SICVWQ2-V123/43	SI LINE C/V 123,143 CCF TO OPEN	226
CCMVWQ2-191/2	2/4 CCF OF CCW MOV 191, 192 FOR EDG01A/B INLET	120
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	105
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	102
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	102
SICVWQ3-V217/37/47	3/4 CCF OF DVI LINE CHECK VALVES 217,237,247	101
SICVWQ3-V540/42/43	3/4 CCF OF DVI LINE CHECK VALVES 540,542,543	101
SICVWQ3-V113/33/43	SI LINE C/V 113,133,143 CCF TO OPEN	101
CCMVWQ3-191/2/181	3/4 CCF OF CCW MOV 191, 192, 181 FOR EDG01A/B/C INLET	100
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	99
PFHBWQ4-SW1DG	CCF OF SW01A&1B&1C&1D FEED BREAKER FROM DG A&B FAIL TO CLOSE	98

Table 19.1-143 (3 of 7)

Basic Event	Description	RAW
VDHVWQ4-HV13ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	98
VDHVWQ4-HV12ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	98
VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	96
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	96
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	94
DGSQWQ4-LOADSQABCD	CCF OF LOAD SEQUNCER A, B, C, D	93
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	90
DGDGWQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	86
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG01A/B/C/D INLET	81
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	80
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646	78
DGDGKQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO RUN	77
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	76
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	72
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	71
PFHBWQ3-SW1DGABC	3/4 CCF OF SW01A&1B&1C FEED BREAKER FROM DG A&B FAIL TO CLOSE	71
PFHBWQ3-SW1OSATABC	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	68
VDHVKQ4-HV13ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	65
VDHVKQ4-HV12ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	65

Table 19.1-143 (4 of 7)

Basic Event	Description	RAW
DGSQWQ3-LOADSQABC	CCF OF LOAD SEQUNCER A, B, C	65
DGDGWQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO START	63
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	61
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	60
DGDGWQ3-DG01ABC-LOAD	CCF OF EDG 01A/01B/01C FAIL TO LOAD AND RUN DURING 1ST 1HOUR	58
PALXKQ4-PA06CD	4/4 CCF OF LOOP CONTROLLER PA06C, PA06D	58
VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B	57
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	55
WOCHKQ3-CH03A/4A/3B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B	55
VDHVWD2-HV12A/B	2/2 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B	52
VDHVWD2-HV12B/13A	2/2 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12B, 13A	52
VDHVWD2-HV13A/B	2/2 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B	52
VDHVWD2-HV12A/13B	2/2 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 13B	52
DGDGKQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO RUN	50
VGAHKQ3-AH04A/4B/5A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A	49
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	49
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	45
PFHBWQ3-SW1DGABD	3/4 CCF OF SW01A&1B&1D FEED BREAKER FROM DG B FAIL TO CLOSE	44
VDHVKD2-HV12A/13B	2/2 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 13B	43
VDHVKD2-HV12A/B	2/2 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B	43

Table 19.1-143 (5 of 7)

Basic Event	Description	RAW
VDHVKD2-HV12B/13A	2/2 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12B, 13A	43
VDHVKD2-HV13A/B	2/2 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B	43
DGSQWQ3-LOADSQABD	CCF OF LOAD SEQUNCER A, B, D	40
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	39
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	39
DGDGWQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO START	39
DGDGWQ3-DG01ABD-LOAD	CCF OF EDG 01A/01B/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	36
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	35
PAGXKO8-PA03ABCD	8/8 CCF OF GROUP CONTROLLER 752-PA03A,03B,03C,03D	34
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOL. VALVES	34
VKHVKQ3-HV13A/13B/14A	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A	33
CVAVWD2-560/1	2/2 CCF OF AV 560, 561	32
CVAVWD2-505/6	2/2 CCF OF AV 505, 506	32
CVAVWD2-522/3	2/2 CCF OF AV 522, 523	32
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	32
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	32
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	32
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1D FAIL TO OPEN	30
SICVWQ4-V404/05/34/46	SI PUMP DISCHARGE C/V 404,405,434,446 CCF TO OPEN	30
DGDGKQ2-DG01AB	CCF OF EDG 01A/01B FAIL TO RUN	29

Table 19.1-143 (6 of 7)

Basic Event	Description	RAW
PELXKD2-LX03AB	2/2 CCF OF FAILURE OF LOOP CONTROLLER LX03A, LX03B	27
PELXKD2-LX06AB	2/2 CCF OF LOOP CONTROLLER LX06A, LX06B	27
PELXKD2-LX06A02B	2/2 CCF OF LOOP CONTROLLER LX06A, LX02B	27
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	26
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	26
PFHBWQ2-SW1DGAB	2/4 CCF OF SW01A&1B FEED BREAKER FROM DG A&B FAIL TO CLOSE	25
WOMPKQ3-PP04A/5A/4B	RUNNING CCF OF ECW PUMPS 4A/5A/4B	25
WOMPKQ3-PP01A/2A/1B	RUNNING CCF OF ECW PUMPS 1A/2A/1B	25
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	25
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	25
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	24
VGAHKQ3-AH04A/4B/5B	RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05B	24
VKVKWD2-AH01A/B	2/2 DEMAND CCF OF AH01A/B	23
DGDGWQ2-DG01AB-LOAD	CCF OF EDG 01A/01B FAIL TO LOAD AND RUN DURING 1ST 1HOUR	23
SICVWQ2-V133/43	SI LINE C/V 133,143 CCF TO OPEN	22
SICVWQ2-V123/33	SI LINE C/V 123,133 CCF TO OPEN	22

Table 19.1-143 (7 of 7)

Basic Event	Description	RAW
SICVWQ2-V227/37	2/4 CCF OF DVI LINE CHECK VALVES 227,237	22
SICVWQ2-V237/47	2/4 CCF OF DVI LINE CHECK VALVES 237,247	22
SICVWQ2-V541/42	2/4 CCF OF DVI LINE CHECK VALVES 541,542	22
SICVWQ2-V542/43	2/4 CCF OF DVI LINE CHECK VALVES 542,543	22
DGSQWQ2-LOADSQAB	CCF OF LOAD SEQUNCER A, B	21
PFHBWQ2-SW1OSATAB	2/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B FAIL TO OPEN	21

Table 19.1-144

LPSD Internal Events PRA Key CCF Events by FV (LRF)

Basic Event	Description	FV
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	0.5%

Table 19.1-145 (1 of 2)

LPSD Internal Events PRA Key Operator Actions by RAW (LRF)

Basic Event	Description	RAW
HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05	44
HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05	35
HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11	29
HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11	29
HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05	24
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	19
HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06	19
HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06	14
HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH a	9
HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation	8
HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05	7
HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B	7
HR-RS-LPP06	OPERATOR FAILS TO RESTORE SCS AT LO POS06	6
HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05	6
HR-RS-JLP04B	OPERATOR FAILS TO RESTORE SCS AT JL POS04B	6
HR-RS-S1P06	OPERATOR FAILS TO RESTORE SCS AT S1 POS06	6
HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01	5
HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11	5
HR-RS-S1P10	OPERATOR FAILS TO RESTORE SCS AT S1 POS10	5

Table 19.1-145 (2 of 2)

Basic Event	Description	RAW
HR-FB-SOP11-01	OPERATOR FAILS TO OPERATE F&B AT SO POS11 01	4
HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11	4
HR-RS-LPP10	OPERATOR FAILS TO RESTORE SCS AT LO POS10	4
HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05	4
HR-MI-JLP10	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS10	4
HR-RS-JLP10	OPERATOR FAILS TO RESTORE SCS AT JL POS10	4
HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05	4
HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01	4
HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01	3
HR-MI-JLP11	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS11	3
HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11	3
HR-RS-LPP04B	OPERATOR FAILS TO RESTORE SCS AT LO POS04B	3
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	3
HR-RS-S1P04B	OPERATOR FAILS TO RESTORE SCS AT S1 POS04B	3
HR-RS-KVP06	OPERATOR FAILS TO RESTORE SCS AT KV POS06	2
HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05	2
HR-MI-SLP11	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH a	2

Table 19.1-146 (1 of 2)

LPSD Internal Events PRA Key Operator Actions by FV (LRF)

Basic Event	Description	FV
HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation	49.8%
HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions	34.7%
HR-RS-SOP05	OPERATOR FAILS TO RESTORE SCS AT SO POS05	26.3%
HR-FB-SOP05-01-DE	HRA Dependance for RS & FB at SO POS05	26.3%
HR-FB-JLP05-01-DE	HRA Dependance for RS & FB at JL POS05	13.8%
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	13.8%
HR-RS-SOP11	OPERATOR FAILS TO RESTORE SCS AT SO POS11	9.6%
HR-FB-SOP11-01-DE	HRA Dependance for RS & FB at SO POS11	9.6%
HR-FB-SOP05-02-DE	HRA Dependance for MI & FB at SO POS05	8.2%
HR-MI-SOP05	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS05	8.2%
HR-FB-SLP05-01-DE	HRA Dependance for RS & FB at SL POS05	4.9%
HR-RS-SLP05	OPERATOR FAILS TO RESTORE SCS AT SL POS05	4.9%
HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05	4.3%
HR-FB-JLP05-02-DE	HRA Dependance for MI & FB at JL POS05	4.3%
HR-MI-SOP11	Operator Fails To Isolate and Makeup Over-Drainage (SO) PATH at POS11	3.5%
HR-FB-SOP11-02-DE	HRA Dependance for MI & FB at SO POS11	3.5%
HR-FB-JLP06-02-DE	HRA Dependance for MI & FB at JL POS06	3.3%
HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06	3.3%
HR-FB-SLP05-02-DE	HRA Dependance for MI & FB at SL POS05	1.5%

Table 19.1-146 (2 of 2)

Basic Event	Description	FV
HR-MI-SLP05	Operator Fails To Isolate and Makeup Failing to maintain water level (SL) PATH at POS05	1.5%
HR-RS-SLP11	OPERATOR FAILS TO RESTORE SCS AT SL POS11	1.3%
HR-FB-SLP11-01-DE	HRA Dependance for RS & FB at SL POS11	1.3%
HR-FB-JLP11-01-DE	HRA Dependance for RS & FB at JL POS11	1.1%
HR-RS-JLP11	OPERATOR FAILS TO RESTORE SCS AT JL POS11	1.1%
HR-RS-S1P05	OPERATOR FAILS TO RESTORE SCS AT S1 POS05	1.0%
HR-FB-S1P05-DE	HRA Dependance for RS & FB at S1 POS05	1.0%
HR-FB-JLP04B-02-DE	HRA Dependance for MI & FB at JL POS04B	0.8%
HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B	0.8%
HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06	0.6%
HR-FB-JLP06-01-DE	HRA Dependance for RS & FB at JL POS06	0.6%
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	0.6%
HR-FB-LPP05-DE	HRA Dependance for RS & FB at LP POS05	0.6%
HR-FB-SOP05-01	OPERATOR FAILS TO OPERATE F&B AT SO POS05 01	0.6%

Table 19.1-147

LPSD Internal Events Source Term Category Frequencies and Contributions to LRF (POS 4B-12A)

Source Term Category	Description	Frequency (/yr)	% Total of LRF
RC-2-LPSD	Large, Early LPSD releases	2.56E-8	38.5%
RC-3-LPSD	Large, Late LPSD releases	4.08E-8	61.5%
Total		6.64E-8	

Table 19.1-148 (1 of 2)

LPSD Fire LRF by POS

POS	LRF evaluation	CDF(/yr)*	CDF %	CPLR	LRF	% of total LRF
1	Containment Closed, at-power CPLR)	Screened in L1	-	-	-	-
2	Containment Closed, at-power CPLR)	Screened in L1	-	-	-	-
3A	Containment Closed, at-power CPLR)	6.53E-08	3.8%	8.40E-02	5.49E-09	4.7%
3B-JL	Containment bypass (ISLOCA)	6.83E-09	0.4%	1	6.83E-09	5.9%
3B-LX	Hatch open and no credit for closing w/o AC power	Fire SBO screened in L1	-	-	-	-
3B-other	Hatch close HEP/at-power CPLR (0.051+0.084)	1.75E-07	10.1%	1.35E-01	2.36E-08	20.2%
4A-JL	Containment bypass (ISLOCA)	4.17E-09	0.2%	1	4.17E-09	3.6%
4A-LX	Hatch open and no credit for closing w/o AC power	Fire SBO screened in L1	-	-	-	-
4A-other	Hatch close HEP/at-power CPLR (0.051+0.084)	1.82E-09	0.1%	1.35E-01	2.46E-10	0.2%
4B	RCS Draindown (manway open)	1.37E-07	7.9%	Detailed	7.29E-09	6.2%
5	Reduced Inventory Operation	7.65E-07	44.1%	Detailed	2.32E-08	19.9%
6	Fill for Refueling	7.37E-08	4.2%	Detailed	9.06E-09	7.8%
7	Refueling (Core-alteration)	-	-	-	-	-
8	Cavity drained	-	-	-	-	-
9	Refueling (Core-alteration)	-	-	-	-	-
10	RCS Draindown after Refueling	2.29E-07	13.2%	Detailed	1.70E-08	14.6%

Table 19.1-148 (2 of 2)

POS	LRF evaluation	CDF(/yr)*	CDF %	CPLR	LRF	% of total LRF
11	Reduced Inventory Operation	1.14E-08	0.7%	Detailed	3.39E-10	0.3%
12A	Refill RCS (manway open)	2.17E-07	12.5%	Detailed	5.19E-09	4.4%
12B	Refill RCS (manway closed)	-	-	-	-	-
13	RCS Heatup/SCS Isolate at 350F	9.95E-09	0.6%	8.40E-02	8.36E-10	0.7%
14	RCS Heatup with SGs	Screened in L1	-	-	-	-
15	Reactor Startup	Screened in L1	-	-	-	-
All	Main Cont Rm Fires	2.94E-08	1.7%	1.00E-01	2.94E-09	2.5%
All	MCA Fires not evaluated in detail in L2	1.06E-08	0.6%	1	1.06E-08	9.1%
		1.74E-06	100%	-	1.17E-07	100.0%

Table 19.1-149 (1 of 61)

LPSD Internal Fire PRA Top 100 Cutsets (LRF) – All POS

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	2.99E-09	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	4.4	4.4
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
2	1.90E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	2.8	7.1
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			

Table 19.1-149 (2 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
3	1.62E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	2.4	9.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (3 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
4	1.46E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	2.1	11.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
5	1.41E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	2.1	13.7
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			

Table 19.1-149 (4 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
6	1.11E-09	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	1.6	15.3
		HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01		
		SEQ-JL-P04B-03	JL POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
7	8.97E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.3	16.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (5 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
8	8.97E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.3	17.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
9	7.42E-10	BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration	1.1	19.0
		HR-FB-SAMG-NOT	Complement event of HEP for SAMG SI initiation		
		SEQ-SL-P11-05	SL POS 11 SEQUENCE 05 IDENTIFIER		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (6 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
10	7.02E-10	BE-RATE-P11	Conversion factor (SD-yr -> Calendar yr) for POS11 duration	1.0	20.0
		HR-FB-SAMG-NOT	Complement event of HEP for SAMG SI initiation		
		SEQ-SL-P11-05	SL POS 11 SEQUENCE 05 IDENTIFIER		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			
11	5.95E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.9	20.9
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F078-A19B	FIRE IN CORRIDOR		
12	4.93E-10	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.7	21.6
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
		%F078-A04D	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_28			

Table 19.1-149 (7 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
13	4.88E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.7	22.3
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		SEQ-JL-P10-05	JL POS 10 SEQUENCE 05 IDENTIFIER		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			
14	4.67E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.7	23.0
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		

Table 19.1-149 (8 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	4.45E-10	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.7	23.7
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_117			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
16	4.17E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.6	24.3
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		

Table 19.1-149 (9 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
17	4.00E-10	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.6	24.9
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_117			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
18	4.00E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.6	25.5
		HR-FB-JLP04B-02	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 02		
		HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B		
		SEQ-JL-P04B-05	JL POS 4B SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_78			

Table 19.1-149 (10 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	3.54E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	26.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
20	3.45E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	26.5
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			

Table 19.1-149 (11 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	3.33E-10	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.5	27.0
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
		%F078-A56B	FIRE IN CHANNEL-B DC & IP EQUIP. RM		
		COMBINATION_117			
22	2.86E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.4	27.4
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (12 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
23	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	27.8
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
24	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	28.2
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
25	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	28.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			

Table 19.1-149 (13 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
26	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	29.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
27	2.66E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.4	29.4
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B		
		HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B		
		SEQ-CC-P04B-03	CC POS 4B SEQUENCE 03 IDENTIFIER		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_23			
28	2.65E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.4	29.8
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F078-AEEB	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM		

Table 19.1-149 (14 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	2.58E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.4	30.1
		HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P10-03	JL POS 10 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (15 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	2.56E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	30.5
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (16 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
31	2.54E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	30.9
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (17 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
32	2.30E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	31.2
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (18 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	2.29E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	31.6
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (19 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	2.25E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.3	31.9
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P10-03	KV POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			
35	2.25E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.3	32.2
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P10-03	KV POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (20 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	2.25E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.3	32.5
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_112			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
37	2.21E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.3	32.9
		HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01		
		SEQ-JL-P04B-03	JL POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F078-A19B	FIRE IN CORRIDOR		

Table 19.1-149 (21 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
38	2.18E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	33.2
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
39	2.06E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.3	33.5
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F100-AEEB	FIRE IN 480V CLASS 1E MCC 01B ROOM		

Table 19.1-149 (22 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	2.03E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.3	33.8
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_112			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
41	1.97E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.3	34.1
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_112			

Table 19.1-149 (23 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	1.96E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	34.4
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (24 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
43	1.93E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.3	34.6
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		
44	1.93E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.3	34.9
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		

Table 19.1-149 (25 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
45	1.83E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	35.2
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (26 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	1.67E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	35.4
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (27 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	1.65E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	35.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
48	1.55E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.2	35.9
		HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01		
		SEQ-JL-P04B-03	JL POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		

Table 19.1-149 (28 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
49	1.53E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	36.1
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			
50	1.53E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	36.3
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (29 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	1.53E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	36.6
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			
52	1.53E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	36.8
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (30 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	1.50E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	37.0
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
54	1.44E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	37.2
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (31 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	1.44E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	37.4
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			
56	1.44E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	37.6
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (32 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	1.44E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	37.9
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P06-03	LP POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-149 (33 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	1.44E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	38.1
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (34 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
59	1.42E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	38.3
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (35 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	1.42E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	38.5
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (36 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	1.41E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	38.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (37 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
62	1.41E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	38.9
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (38 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	1.36E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	39.1
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
64	1.35E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.2	39.3
		HR-FB-JLP10-02	OPERATOR FAILS TO OPERATE F&B AT JL POS10 02		
		HR-MI-JLP10	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS10		
		SEQ-JL-P10-05	JL POS 10 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E2	Sump plugs for POSs 3A analysis (Level 2)		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_84			

Table 19.1-149 (39 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	1.31E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	39.5
		HR-FB-JLP06-02	OPERATOR FAILS TO OPERATE F&B AT JL POS06 02		
		HR-MI-JLP06	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS06		
		SEQ-JL-P06-05	JL POS 6 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_82			
66	1.30E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	39.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (40 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
67	1.25E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.2	39.8
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_112			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (41 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
68	1.25E-10	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.2	40.0
		HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B		
		HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P04B-03	KV POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_112			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (42 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
69	1.23E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	40.2
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (43 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
70	1.21E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	40.4
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (44 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
71	1.21E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	40.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
72	1.19E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	40.7
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F120-A15B	FIRE IN 480V CLASS 1E MCC 03B RM		

Table 19.1-149 (45 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
73	1.17E-10	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.2	40.9
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F157-A01D	FIRE IN I&C EQUIPMENT RM		
74	1.16E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	41.1
		HR-FB-JLP05-02	OPERATOR FAILS TO OPERATE F&B AT JL POS05 02		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_80			

Table 19.1-149 (46 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
75	1.12E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	41.2
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (47 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
76	1.09E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	41.4
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (48 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	1.03E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.2	41.5
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-AGAC	FIRE IN GENERAL ACCESS AREA		
78	1.03E-10	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.2	41.7
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-D-DGD	FAILS TO RUN OF EDG D		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-AGAC	FIRE IN GENERAL ACCESS AREA		

Table 19.1-149 (49 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	1.02E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	41.8
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (50 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
80	1.02E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	42.0
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (51 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	1.00E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	42.1
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (52 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	9.85E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.1	42.3
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
83	9.84E-11	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.1	42.4
		HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01		
		SEQ-JL-P04B-03	JL POS 4B SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F078-AEEB	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM		

Table 19.1-149 (53 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
84	9.73E-11	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.1	42.6
		HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A		
		HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-KV-P12A-03	KV POS 12A SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_117			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
85	9.61E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	42.7
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		

Table 19.1-149 (54 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
86	9.61E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	42.9
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		
87	9.61E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	43.0
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		

Table 19.1-149 (55 of 61)

Rank	Frequency (/yr)	Cutsets: Basic Event	Cutsets: Cutset Description	Contribution to CDF (%): Cutset	Contribution to CDF (%): Cumulative
88	9.61E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	43.1
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A19B	FIRE IN CORRIDOR		
89	9.51E-11	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.1	43.3
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F050-A04B	FIRE IN SC PUMP & MINI FLOW HX RM		
90	9.40E-11	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.1	43.4
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		

Table 19.1-149 (56 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
91	9.10E-11	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.13	43.54
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		HR-RS-JLP06	OPERATOR FAILS TO RESTORE SCS AT JL POS06		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ACVL	FIRE IN CVCS ACCESS AREA		
		COMBINATION_81			
92	8.96E-11	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.1	43.7
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAD	FIRE IN GENERAL ACCESS AREA-55' D		
		COMBINATION_28			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (57 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
93	8.59E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	43.8
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-AEEB	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM		
94	8.59E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	43.9
		DADGR-S-AACTG	AAC GTG FAILS TO RUN		
		DGDGR-A-DGA	FAILS TO RUN OF EDG A		
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-LP-P10-03	LP POS 10 SEQUENCE 03 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-AEEB	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM		

Table 19.1-149 (58 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	8.29E-11	BE-RATE-P10	Conversion factor (SD-yr -> Calendar yr) for POS10 duration	0.1	44.0
		HR-FB-JLP10-02	OPERATOR FAILS TO OPERATE F&B AT JL POS10 02		
		HR-MI-JLP10	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS10		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-JL-P10-05	JL POS 10 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_84			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
96	8.23E-11	BE-RATE-P06	Conversion factor (SD-yr -> Calendar yr) for POS6 duration	0.1	44.2
		HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01		
		SEQ-JL-P06-03	JL POS 6 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F157-ACPX	FIRE IN COMPUTER RM PACU RM		

Table 19.1-149 (59 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
97	8.20E-11	BE-RATE-P4B	Conversion factor (SD-yr -> Calendar yr) for POS4B duration	0.1	44.3
		HR-FB-JLP04B-02	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 02		
		HR-MI-JLP04B	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS04B		
		SEQ-JL-P04B-05	JL POS 4B SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ACVL	FIRE IN CVCS ACCESS AREA		
		COMBINATION_78			
98	8.15E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.1	44.4
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-149 (60 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	8.08E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.1	44.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-149 (61 of 61)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
100	8.07E-11	BE-RATE-P12A	Conversion factor (SD-yr -> Calendar yr) for POS12A duration	0.1	44.6
		HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A		
		HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P12A-03	CC POS 12A SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E2-NOT	Core debris does not plug screens (LPSD Level 2, POS 3A)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAD	FIRE IN GENERAL ACCESS AREA-55' D		
		COMBINATION_28			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (1 of 80)

LPSD Internal Fire PRA Top 100 Cutsets (LRF) – Reduced Inventory

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
1	1.90E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	7.8	7.8
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
2	1.62E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	6.7	14.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (2 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
3	1.46E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	6.0	20.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
4	1.41E-09	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	5.8	26.3
		H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			

Table 19.1-150 (3 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
5	8.97E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	3.7	30.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (4 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
6	8.97E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	3.7	33.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (5 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
7	3.54E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.5	35.1
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
8	3.45E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.4	36.5
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			

Table 19.1-150 (6 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
9	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.1	37.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
10	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.1	38.8
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
11	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.1	39.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			

Table 19.1-150 (7 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
12	2.76E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.1	41.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
13	2.56E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.1	42.1
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (8 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
14	2.54E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.0	43.2
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (9 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
15	2.30E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	1.0	44.1
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (10 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
16	2.29E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.9	45.0
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (11 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
17	2.18E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.9	45.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (12 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
18	1.96E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.8	46.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (13 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
19	1.83E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.8	47.5
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (14 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
20	1.65E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.7	48.2
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (15 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
21	1.44E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	48.8
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (16 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
22	1.42E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	49.4
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (17 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
23	1.42E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	49.9
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (18 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
24	1.41E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	50.5
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (19 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
25	1.41E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	51.1
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (20 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
26	1.36E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.6	51.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (21 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
27	1.30E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	52.2
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (22 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
28	1.23E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	52.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (23 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
29	1.21E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	53.2
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (24 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
30	1.21E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	53.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
31	1.16E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	54.2
		HR-FB-JLP05-02	OPERATOR FAILS TO OPERATE F&B AT JL POS05 02		
		HR-MI-JLP05	Operator Fails To Isolate and Makeup Unrecoverable LOCA (JL) PATH at POS05		
		SEQ-JL-P05-05	JL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		%F000-ADGD	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_80			

Table 19.1-150 (25 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
32	1.12E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	54.6
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (26 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
33	1.09E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.5	55.1
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (27 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
34	1.02E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	55.5
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (28 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
35	1.02E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	55.9
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (29 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
36	1.00E-10	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	56.3
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (30 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
37	9.85E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.4	56.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG ac7tions -complete dependency with other SAMG actions		

Table 19.1-150 (31 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
38	8.15E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	57.1
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (32 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
39	8.08E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	57.4
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-LCFH2BRUPE	Late contmt failure due to late H2 burn - EARLY CS success and WET cavity		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (33 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
40	8.01E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	57.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (34 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
41	8.01E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	58.1
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FD-D01A	FIRE IN CCW HEAT EXCHANGER "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (35 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
42	8.00E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	58.4
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AGAC	FIRE IN GENERAL ACCESS AREA		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (36 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
43	7.56E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	58.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (37 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
44	7.56E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	59.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A05C	FIRE IN CHANNEL-C DC & IP EQUIP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (38 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
45	7.34E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	59.3
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (39 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
46	7.28E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	59.6
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (40 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
47	7.20E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	59.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AGAC	FIRE IN GENERAL ACCESS AREA		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (41 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
48	7.04E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	60.2
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F157-A19C	FIRE IN I&C EQUIPMENT RM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
49	6.90E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	60.5
		CVCVC-S-189	CONTAINMENT ISOLATION CHECK V/V 189 FAIL TO CLOSE		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F000-ADGC	FIRE IN DIESEL GENERATOR ROOM		
		COMBINATION_113			

Table 19.1-150 (42 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
50	6.55E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	60.8
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (43 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
51	6.33E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	61.0
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F157-A19C	FIRE IN I&C EQUIPMENT RM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (44 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
52	6.31E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	61.3
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A10C	FIRE IN 480V CLASS 1E MCC 03C RM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (45 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
53	6.29E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	61.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F157-A25C	FIRE IN I&C EQUIPMENT RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (46 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
54	6.19E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	61.8
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (47 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
55	6.19E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	62.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AEEA	FIRE IN 480V CLASS 1E MCC 01A RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (48 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
56	6.07E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	62.3
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (49 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
57	6.07E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.3	62.5
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A03C	FIRE IN CLASS 1E LOADCENTER 01C RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (50 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
58	5.68E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	62.8
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A10C	FIRE IN 480V CLASS 1E MCC 03C RM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (51 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
59	5.66E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	63.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F157-A25C	FIRE IN I&C EQUIPMENT RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (52 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
60	5.59E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	63.2
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (53 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
61	5.55E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	63.5
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		
62	5.46E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	63.7
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE		
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			

Table 19.1-150 (54 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
63	5.15E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	63.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A04A	FIRE IN SC PUMP & MINI FLOW HX RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (55 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
64	5.15E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	64.1
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-A02C	FIRE IN CCW PUMP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (56 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
65	5.15E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	64.3
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A11C	FIRE IN ESSENTIAL CHILLER RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (57 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
66	5.04E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	64.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-A02A	FIRE IN CCW PUMP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (58 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
67	4.98E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	64.7
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A01C	FIRE IN CS PUMP & MINI FLOW HX RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (59 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
68	4.98E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	64.9
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A02C	FIRE IN SI PUMP RM		
		COMBINATION_24			
69	4.76E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	65.1
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (60 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
70	4.68E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	65.3
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			
71	4.68E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	65.5
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-150 (61 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
72	4.68E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	65.7
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			
73	4.68E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	65.9
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAD	FIRE IN GENERAL ACCESS AREA-120' D		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-150 (62 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
74	4.65E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	66.1
		GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE		
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		%F055-AGAC	FIRE IN GENERAL ACCESS AREA-55' C		
		COMBINATION_113			
75	4.63E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	66.3
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A04A	FIRE IN SC PUMP & MINI FLOW HX RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (63 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
76	4.63E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	66.5
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-A02C	FIRE IN CCW PUMP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (64 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
77	4.63E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	66.7
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A11C	FIRE IN ESSENTIAL CHILLER RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (65 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
78	4.54E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	66.9
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-A02A	FIRE IN CCW PUMP RM		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (66 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
79	4.53E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	67.0
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (67 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
80	4.53E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	67.2
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-AEPA	FIRE IN ELECTRICAL PENETRATION ROOM (A)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (68 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
81	4.48E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	67.4
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A01C	FIRE IN CS PUMP & MINI FLOW HX RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (69 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
82	4.48E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	67.6
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-LCFH2BRUP	Late contmt failure due to late H2 burn		
		LPSD-L2-LCF-INTDET	Containment intact after late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F050-A02C	FIRE IN SI PUMP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (70 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
83	4.44E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	67.8
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AGAC	FIRE IN GENERAL ACCESS AREA		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (71 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
84	4.44E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.0
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F100-AGAC	FIRE IN GENERAL ACCESS AREA		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (72 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
85	4.43E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.1
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			
86	4.43E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.3
		ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-150 (73 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
87	4.43E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.5
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			
88	4.43E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.7
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-SL-P05-05	SL POS 5 SEQUENCE 05 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F120-AGAC	FIRE IN GENERAL ACCESS AREA-120' C		
		BF_F120-AGAC_F120-AGAD			

Table 19.1-150 (74 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
89	4.36E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	68.9
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
90	4.36E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.0
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
91	4.36E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.2
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			

Table 19.1-150 (75 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
92	4.36E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.4
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		%F137-ANEA	FIRE IN ELECTRICAL EQUIPMENT ROOM		
		COMBINATION_171			
93	4.33E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.6
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
94	4.33E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.8
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			

Table 19.1-150 (76 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
95	4.33E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	69.9
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			
96	4.33E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	70.1
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		%FK-K01	FIRE IN ESW STRUCTURE "A" BUILDING		
		COMBINATION_24			

Table 19.1-150 (77 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
97	4.17E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	70.3
		HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05		
		HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05		
		LPSD-L2-LCF-RUPTDET	Containment ruptures due to late H2 burn		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-KV-P05-03	KV POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F055-AGAA	FIRE IN GENERAL ACCESS AREA-55' A		
		COMBINATION_113			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions -complete dependency with other SAMG actions		

Table 19.1-150 (78 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
98	4.04E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	70.5
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-NO	Debris in cavity covered by water but not cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (79 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
99	4.04E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	70.6
		HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05		
		HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05		
		LPSD-L2-DCOOL-YES	Debris in cavity covered by water and cooled		
		LPSD-L2-EVSE-MED-SUC	Success of branch for EVSE-Med water level		
		LPSD-L2-PAR	PARS successfully control hydrogen in containment		
		SEQ-S2-P05-03	S2 POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1	Sump plugs for POSs 3B to 6 analysis (Level 2)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F137-A11C	FIRE IN ELECTRICAL PENETRATION RM (C)		
		COMBINATION_171			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		

Table 19.1-150 (80 of 80)

Rank	Frequency (/yr)	Cutsets		Contribution to CDF (%)	
		Basic Event	Cutset Description	Cutset	Cumulative
100	4.01E-11	BE-RATE-P05	Conversion factor (SD-yr -> Calendar yr) for POS5 duration	0.2	70.8
		HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05		
		HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05		
		LPSD-L2-NOPAR	PARS fail to control hydrogen in containment		
		SEQ-CC-P05-03	CC POS 5 SEQUENCE 03 IDENTIFIER		
		SISPP-LPSD-L2-E1-NOT	Core debris does not plug screens (LPSD Level 2, POSs 3B-6)		
		XHOS-ERVC	Flag event for ERVC credit - no credit in base model		
		%F078-A04C	FIRE IN MISC. ELECTRICAL EQUIP RM		
		COMBINATION_24			
		HR-FB-SAMG-DE	HRA dependance for L1 FB & SAMG SI initiation		
		HR-SAMG-DE	SAMG actions - complete dependency with other SAMG actions		

Table 19.1-151 (1 of 7)

LPSD Internal Fire PRA LRF Contribution by Initiating Events – All POS

Initiator	Frequency	Contribution	Description
%F000-ADGC	1.20E-08	17.5%	FIRE IN DIESEL GENERATOR ROOM
%F000-ADGD	7.67E-09	11.2%	FIRE IN DIESEL GENERATOR ROOM
%F078-A19B	5.00E-09	7.3%	FIRE IN CORRIDOR
%F120-AGAD	4.02E-09	5.9%	FIRE IN GENERAL ACCESS AREA-120' D
%F078-A04C	3.29E-09	4.8%	FIRE IN MISC. ELECTRICAL EQUIP RM
%F120-AGAC	3.30E-09	4.8%	FIRE IN GENERAL ACCESS AREA-120' C
%F000-TB	2.71E-09	4.0%	FIRE IN TURBINE GENERATOR AREA
%F078-A05C	2.45E-09	3.6%	FIRE IN CHANNEL-C DC & IP EQUIP RM
%F078-AEEB	2.21E-09	3.2%	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM
%F067-T02	1.61E-09	2.3%	FIRE IN UNDERGROUND COMMON TUNNEL
%F137-ANEA	1.32E-09	1.9%	FIRE IN ELECTRICAL EQUIPMENT ROOM
%F078-AGAC	1.25E-09	1.8%	FIRE IN GENERAL ACCESS AREA
%FK-K01	1.23E-09	1.8%	FIRE IN ESW STRUCTURE "A" BUILDING
%F055-AGAC	1.13E-09	1.6%	FIRE IN GENERAL ACCESS AREA-55' C
%F120-A09D	9.68E-10	1.4%	FIRE IN ELECTRICAL PENETRATION ROOM (D)
%F078-A04D	7.52E-10	1.1%	FIRE IN MISC. ELECTRICAL EQUIP RM
%F100-AEEA	7.17E-10	1.0%	FIRE IN 480V CLASS 1E MCC 01A RM
%F120-A11B	6.59E-10	1.0%	FIRE IN GENERAL ACCESS AREA-120' B
%F137-A02D	6.99E-10	1.0%	FIRE IN ELECTRICAL EQUIP. RM

Table 19.1-151 (2 of 7)

Initiator	Frequency	Contribution	Description
%FD-D01A	6.99E-10	1.0%	FIRE IN CCW HEAT EXCHANGER "A" BUILDING
%F078-A03C	5.30E-10	0.8%	FIRE IN CLASS 1E LOADCENTER 01C RM
%F078-AGAD	5.67E-10	0.8%	FIRE IN GENERAL ACCESS AREA
%F100-AEEB	5.25E-10	0.8%	FIRE IN 480V CLASS 1E MCC 01B ROOM
%F100-AGAC	5.67E-10	0.8%	FIRE IN GENERAL ACCESS AREA
%F000-ACVL	4.60E-10	0.7%	FIRE IN CVCS ACCESS AREA
%F078-A56B	4.97E-10	0.7%	FIRE IN CHANNEL-B DC & IP EQUIP. RM
%F137-AEPA	4.28E-10	0.6%	FIRE IN ELECTRICAL PENETRATION ROOM (A)
%F157-A25C	4.09E-10	0.6%	FIRE IN I&C EQUIPMENT RM
%F078-A02D	3.22E-10	0.5%	FIRE IN CLASS 1E SWITCHGEAR 01D RM
%F137-A11C	3.58E-10	0.5%	FIRE IN ELECTRICAL PENETRATION RM (C)
%F157-A19C	3.53E-10	0.5%	FIRE IN I&C EQUIPMENT RM
%F050-A01C	2.41E-10	0.4%	FIRE IN CS PUMP & MINI FLOW HX RM
%F050-A02C	2.41E-10	0.4%	FIRE IN SI PUMP RM
%F050-A04A	2.65E-10	0.4%	FIRE IN SC PUMP & MINI FLOW HX RM
%F050-A04B	2.41E-10	0.4%	FIRE IN SC PUMP & MINI FLOW HX RM
%F055-A02A	3.08E-10	0.4%	FIRE IN CCW PUMP RM
%F055-A02C	2.65E-10	0.4%	FIRE IN CCW PUMP RM
%F055-AGAA	2.66E-10	0.4%	FIRE IN GENERAL ACCESS AREA-55' A
%F055-AGAD	2.91E-10	0.4%	FIRE IN GENERAL ACCESS AREA-55' D

Table 19.1-151 (3 of 7)

Initiator	Frequency	Contribution	Description
%F078-A11C	2.65E-10	0.4%	FIRE IN ESSENTIAL CHILLER RM
%F078-A19A	2.72E-10	0.4%	FIRE IN CORRIDOR
%F100-A08C	3.00E-10	0.4%	FIRE IN N1E DC & IP EQUIPMENT RM
%F120-A15B	3.03E-10	0.4%	FIRE IN 480V CLASS 1E MCC 03B RM
%F137-A09D	2.84E-10	0.4%	FIRE IN GENERAL ACCESS AREA
%F137-A10C	3.05E-10	0.4%	FIRE IN 480V CLASS 1E MCC 03C RM
%F157-A01D	2.98E-10	0.4%	FIRE IN I&C EQUIPMENT RM
%F157-ACPX	2.96E-10	0.4%	FIRE IN COMPUTER RM PACU RM
%F157-AMAX	2.42E-10	0.4%	FIRE IN MEETING ROOM
%F000-ACVU	2.28E-10	0.3%	FIRE IN CVCS SYSTEM AREA
%F078-A25A	1.99E-10	0.3%	FIRE IN CLASS 1E SWITCHGEAR 01A RM
%F100-A08D	2.17E-10	0.3%	FIRE IN N1E DC & IP EQUIPMENT RM
%F078-A05D	1.22E-10	0.2%	FIRE IN CHANNEL-D DC & IP EQUIP RM
%F078-A52D	1.22E-10	0.2%	FIRE IN 480V N1E MCC RM
%F100-A10A	1.62E-10	0.2%	FIRE IN GENERAL ACCESS AREA
%F100-A10B	1.34E-10	0.2%	FIRE IN GENERAL ACCESS AREA
%F100-A13A	1.42E-10	0.2%	FIRE IN MECHANICAL PENETRATION RM
%F100-A14A	1.33E-10	0.2%	FIRE IN PERSONNEL AIR LOCK ENTRANCE
%F120-A05C	1.15E-10	0.2%	FIRE IN ELECTRICAL EQUIP. RM
%F120-A09C	1.32E-10	0.2%	FIRE IN ELECTRICAL PENETRATION ROOM (C)

Table 19.1-151 (4 of 7)

Initiator	Frequency	Contribution	Description
%F120-AGAA	1.14E-10	0.2%	FIRE IN GENERAL ACCESS AREA-120' A
%F120-AMPB	1.15E-10	0.2%	FIRE IN MECHANICAL PENETRATION ROOM
%F137-A20A	1.31E-10	0.2%	FIRE IN GENERAL ACCESS AREA
%F157-ATOC	1.23E-10	0.2%	FIRE IN TSC EQUIP. REPAIR & MAINT ROOM
%FD-D01B	1.21E-10	0.2%	FIRE IN CCW HEAT EXCHANGER "B" BUILDING
%FK-K02	1.64E-10	0.2%	FIRE IN ESW STRUCTURE "B" BUILDING
%FK-K03	1.49E-10	0.2%	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA
%F000-AC	5.76E-11	0.1%	FIRE IN ACCESS AREA
%F000-ACV	7.09E-11	0.1%	FIRE IN CVCS ACCESS AREA
%F000-AFHL	7.05E-11	0.1%	FIRE IN FUEL HANDLING LOWER AREA
%F050-A01D	4.41E-11	0.1%	FIRE IN CS PUMP & MINI FLOW HX RM
%F050-A02D	4.41E-11	0.1%	FIRE IN SI PUMP RM
%F050-A03B	4.38E-11	0.1%	FIRE IN SI PUMP RM
%F055-A14C	9.54E-11	0.1%	FIRE IN PIPE CHASE & VALVE RM
%F055-A42A	5.23E-11	0.1%	FIRE IN CHARGING PUMP RM
%F055-AGAB	3.90E-11	0.1%	FIRE IN GENERAL ACCESS AREA-55' B
%F078-A02C	3.64E-11	0.1%	FIRE IN CLASS 1E SWITCHGEAR 01C RM
%F078-A03D	9.71E-11	0.1%	FIRE IN CLASS 1E LOADCENTER 01D RM
%F078-A12D	5.25E-11	0.1%	FIRE IN ESSENTIAL WATER CHILLER RM
%F100-A05D	5.68E-11	0.1%	FIRE IN ELECTRICAL EQUIPMENT RM

Table 19.1-151 (5 of 7)

Initiator	Frequency	Contribution	Description
%F100-A06D	5.01E-11	0.1%	FIRE IN GENERAL ACCESS AREA
%F100-A11A	4.54E-11	0.1%	FIRE IN CHANNEL-A BATTERY RM
%F100-A20A	8.85E-11	0.1%	FIRE IN GENERAL ACCESS AREA
%F100-A24A	7.35E-11	0.1%	FIRE IN SFP COOLING HX RM
%F100-T15	5.59E-11	0.1%	FIRE IN SWITCHGEAR RM
%F120-A01D	8.30E-11	0.1%	FIRE IN PIPING CABLE AREA
%F120-A05D	8.19E-11	0.1%	FIRE IN ELECTRICAL EQUIP. RM
%F120-A14A	8.07E-11	0.1%	FIRE IN SG BLOWDOWN REGEN HX RM
%F120-A24A	4.52E-11	0.1%	FIRE IN FUEL HANDLING AREA EMER. EXHAUST ACU RM
%F122-T01	7.21E-11	0.1%	FIRE IN SWITCHGEAR RM
%F137-A01C	4.24E-11	0.1%	FIRE IN CABLE SPREADING AREA
%F137-A05D	9.59E-11	0.1%	FIRE IN PCS RM
%F137-A10D	5.59E-11	0.1%	FIRE IN 480V CLASS 1E MCC 03D RM
%F137-A11D	7.21E-11	0.1%	FIRE IN ELECTRICAL PENETRATION RM (D)
%F137-A15B	6.42E-11	0.1%	FIRE IN 480V CLASS 1E MCC 04B RM
%F137-AEPB	6.26E-11	0.1%	FIRE IN ELECTRICAL PENETRATION ROOM (B)
%F157-A16C	9.30E-11	0.1%	FIRE IN GENERAL ACCESS AREA
%F157-A16D	3.48E-11	0.1%	FIRE IN GENERAL ACCESS AREA
%F157-A19D	8.53E-11	0.1%	FIRE IN I&C EQUIPMENT RM
%FY-UAT1	4.50E-11	0.1%	FIRE IN UNIT AUX. TRANSFORMER 1 AREA

Table 19.1-151 (6 of 7)

Initiator	Frequency	Contribution	Description
%FY-UAT2	4.50E-11	0.1%	FIRE IN UNIT AUX. TRANSFORMER 2 AREA
%F000-AFHU	5.42E-12	0.0%	FIRE IN FUEL HANDLING UPPER AREA
%F055-A02D	2.08E-12	0.0%	FIRE IN CCW PUMP RM
%F055-A21A	5.48E-12	0.0%	FIRE IN PIPE CHASE & VALVE RM
%F073-T01	2.21E-12	0.0%	FIRE IN STAIR
%F078-A01C	1.05E-12	0.0%	FIRE IN PNS SWGR RM
%F078-A01D	1.13E-11	0.0%	FIRE IN PNS SWGR RM
%F100-A04C	2.99E-11	0.0%	FIRE IN CABLE ACCESS AREA
%F100-A04D	5.52E-12	0.0%	FIRE IN CABLE ACCESS AREA
%F100-A05C	6.88E-12	0.0%	FIRE IN ELECTRICAL EQUIPMENT RM
%F100-A13B	1.12E-11	0.0%	FIRE IN MECHANICAL PENETRATION RM
%F100-A23A	1.81E-11	0.0%	FIRE IN AUX. BLDG. CONTROLLED AREA I SUPPLY AHU ROOM
%F100-A37B	2.87E-11	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A38A	1.47E-11	0.0%	FIRE IN FUEL HANDLING AREA NORMAL EXHAUST ACU RM
%F100-T17	5.61E-13	0.0%	FIRE IN BATTERY RM
%F120-A01C	5.72E-12	0.0%	FIRE IN PIPING CABLE AREA
%F120-A08C	2.17E-12	0.0%	FIRE IN 480V N1E MCC RM
%F120-A08D	1.52E-12	0.0%	FIRE IN 480V N1E MCC RM
%F120-A16A	2.63E-11	0.0%	FIRE IN MECHANICAL PENETRATION RM
%F120-A31B	3.18E-11	0.0%	FIRE IN GENERAL ACCESS AREA-120' B

Table 19.1-151 (7 of 7)

Initiator	Frequency	Contribution	Description
%F137-A01D	3.11E-11	0.0%	FIRE IN CABLE SPREADING AREA
%F137-A15A	2.63E-12	0.0%	FIRE IN 480V CLASS 1E MCC 04A RM
%F137-A24B	7.02E-13	0.0%	FIRE IN 480V N1E MCC RM
%F137-A30D	2.64E-11	0.0%	FIRE IN MAIN STEAM ENCLOSURE
%F137-A31C	2.41E-11	0.0%	FIRE IN MAIN STEAM VALVE RM
%F137-A31D	1.68E-11	0.0%	FIRE IN MAIN STEAM VALVE RM
%F137-AGAB	2.49E-13	0.0%	FIRE IN GENERAL ACCESS AREA
%F137-ANEC	3.40E-11	0.0%	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM
%F157-A17C	3.13E-12	0.0%	FIRE IN CORRIDOR
%F157-A21D	5.03E-12	0.0%	FIRE IN INSTRUMENT MAINTENANCE SHOP
%F157-A23D	5.03E-12	0.0%	FIRE IN AEB RM
%F172-A13C	2.57E-12	0.0%	FIRE IN 480V N1E MCC RM
%FK-K04	2.71E-11	0.0%	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1B AREA
%FY-SAT1	2.14E-12	0.0%	FIRE IN STAND-BY AUX. TRANSFORMER 1 AREA

Table 19.1-152 (1 of 7)

LPSD Internal Fire PRA LRF Contribution by Initiating Events – Reduced Inventory POS

Initiator	Frequency	Contribution	Description
%F000-ADGC	7.36E-09	30.3%	FIRE IN DIESEL GENERATOR ROOM
%F078-A04C	2.87E-09	11.8%	FIRE IN MISC. ELECTRICAL EQUIP RM
%F078-A05C	2.13E-09	8.8%	FIRE IN CHANNEL-C DC & IP EQUIP RM
%F137-ANEA	1.15E-09	4.7%	FIRE IN ELECTRICAL EQUIPMENT ROOM
%FK-K01	1.08E-09	4.4%	FIRE IN ESW STRUCTURE "A" BUILDING
%F055-AGAC	9.82E-10	4.0%	FIRE IN GENERAL ACCESS AREA-55' C
%FD-D01A	6.11E-10	2.5%	FIRE IN CCW HEAT EXCHANGER "A" BUILDING
%F100-AEEA	5.06E-10	2.1%	FIRE IN 480V CLASS 1E MCC 01A RM
%F078-A03C	4.64E-10	1.9%	FIRE IN CLASS 1E LOADCENTER 01C RM
%F120-AGAC	4.49E-10	1.8%	FIRE IN GENERAL ACCESS AREA-120' C
%F100-AGAC	3.63E-10	1.5%	FIRE IN GENERAL ACCESS AREA
%F120-AGAD	3.58E-10	1.5%	FIRE IN GENERAL ACCESS AREA-120' D
%F137-AEPA	3.76E-10	1.5%	FIRE IN ELECTRICAL PENETRATION ROOM (A)
%F000-TB	3.34E-10	1.4%	FIRE IN TURBINE GENERATOR AREA
%F137-A11C	3.14E-10	1.3%	FIRE IN ELECTRICAL PENETRATION RM (C)
%F157-A19C	3.11E-10	1.3%	FIRE IN I&C EQUIPMENT RM
%F157-A25C	2.89E-10	1.2%	FIRE IN I&C EQUIPMENT RM
%F000-ADGD	2.66E-10	1.1%	FIRE IN DIESEL GENERATOR ROOM
%F137-A10C	2.67E-10	1.1%	FIRE IN 480V CLASS 1E MCC 03C RM

Table 19.1-152 (2 of 7)

Initiator	Frequency	Contribution	Description
%F050-A04A	2.32E-10	1.0%	FIRE IN SC PUMP & MINI FLOW HX RM
%F055-A02C	2.32E-10	1.0%	FIRE IN CCW PUMP RM
%F078-A11C	2.32E-10	1.0%	FIRE IN ESSENTIAL CHILLER RM
%F050-A01C	2.11E-10	0.9%	FIRE IN CS PUMP & MINI FLOW HX RM
%F050-A02C	2.11E-10	0.9%	FIRE IN SI PUMP RM
%F055-A02A	2.28E-10	0.9%	FIRE IN CCW PUMP RM
%F055-AGAA	1.89E-10	0.8%	FIRE IN GENERAL ACCESS AREA-55' A
%F067-T02	1.95E-10	0.8%	FIRE IN UNDERGROUND COMMON TUNNEL
%F157-AMAX	1.72E-10	0.7%	FIRE IN MEETING ROOM
%F078-A19A	1.10E-10	0.5%	FIRE IN CORRIDOR
%F078-AGAC	1.12E-10	0.5%	FIRE IN GENERAL ACCESS AREA
%F100-A10A	1.15E-10	0.5%	FIRE IN GENERAL ACCESS AREA
%F100-A13A	1.17E-10	0.5%	FIRE IN MECHANICAL PENETRATION RM
%F100-A14A	1.17E-10	0.5%	FIRE IN PERSONNEL AIR LOCK ENTRANCE
%F137-A20A	1.15E-10	0.5%	FIRE IN GENERAL ACCESS AREA
%FK-K03	1.30E-10	0.5%	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1A AREA
%F157-ATOC	8.72E-11	0.4%	FIRE IN TSC EQUIP. REPAIR & MAINT ROOM
%F000-ACVU	7.80E-11	0.3%	FIRE IN CVCS SYSTEM AREA
%F055-A14C	8.36E-11	0.3%	FIRE IN PIPE CHASE & VALVE RM
%F078-A25A	8.21E-11	0.3%	FIRE IN CLASS 1E SWITCHGEAR 01A RM

Table 19.1-152 (3 of 7)

Initiator	Frequency	Contribution	Description
%F157-A16C	8.15E-11	0.3%	FIRE IN GENERAL ACCESS AREA
%F000-ACVL	3.83E-11	0.2%	FIRE IN CVCS ACCESS AREA
%F078-A19B	5.05E-11	0.2%	FIRE IN CORRIDOR
%F120-A09C	5.67E-11	0.2%	FIRE IN ELECTRICAL PENETRATION ROOM (C)
%F120-A14A	5.74E-11	0.2%	FIRE IN SG BLOWDOWN REGEN HX RM
%F120-AGAA	3.90E-11	0.2%	FIRE IN GENERAL ACCESS AREA-120' A
%F000-AC	1.47E-11	0.1%	FIRE IN ACCESS AREA
%F000-ACV	2.54E-11	0.1%	FIRE IN CVCS ACCESS AREA
%F078-A02C	1.84E-11	0.1%	FIRE IN CLASS 1E SWITCHGEAR 01C RM
%F078-A04D	1.99E-11	0.1%	FIRE IN MISC. ELECTRICAL EQUIP RM
%F078-A56B	1.22E-11	0.1%	FIRE IN CHANNEL-B DC & IP EQUIP. RM
%F078-AEEB	2.31E-11	0.1%	FIRE IN CLASS 1E SWITCHGEAR 01B ROOM
%F100-A04C	2.63E-11	0.1%	FIRE IN CABLE ACCESS AREA
%F100-A08C	2.43E-11	0.1%	FIRE IN N1E DC & IP EQUIPMENT RM
%F100-AEEB	1.74E-11	0.1%	FIRE IN 480V CLASS 1E MCC 01B ROOM
%F137-A01C	3.03E-11	0.1%	FIRE IN CABLE SPREADING AREA
%F137-A31C	2.41E-11	0.1%	FIRE IN MAIN STEAM VALVE RM
%F137-ANEC	2.90E-11	0.1%	FIRE IN ELECTRICAL EQUIPMENT ROOM/CEDM M/G SET RM
%F000-AFHL	1.25E-12	0.0%	FIRE IN FUEL HANDLING LOWER AREA
%F050-A01D	1.00E-12	0.0%	FIRE IN CS PUMP & MINI FLOW HX RM

Table 19.1-152 (4 of 7)

Initiator	Frequency	Contribution	Description
%F050-A02D	1.00E-12	0.0%	FIRE IN SI PUMP RM
%F050-A03B	9.93E-13	0.0%	FIRE IN SI PUMP RM
%F050-A04B	7.74E-12	0.0%	FIRE IN SC PUMP & MINI FLOW HX RM
%F055-A02D	1.09E-12	0.0%	FIRE IN CCW PUMP RM
%F055-A21A	4.83E-13	0.0%	FIRE IN PIPE CHASE & VALVE RM
%F055-A42A	4.69E-12	0.0%	FIRE IN CHARGING PUMP RM
%F055-AGAB	8.80E-13	0.0%	FIRE IN GENERAL ACCESS AREA-55' B
%F055-AGAD	7.05E-12	0.0%	FIRE IN GENERAL ACCESS AREA-55' D
%F078-A01C	7.98E-13	0.0%	FIRE IN PNS SWGR RM
%F078-A02D	5.89E-13	0.0%	FIRE IN CLASS 1E SWITCHGEAR 01D RM
%F078-A03D	2.33E-12	0.0%	FIRE IN CLASS 1E LOADCENTER 01D RM
%F078-A05D	2.93E-12	0.0%	FIRE IN CHANNEL-D DC & IP EQUIP RM
%F078-A12D	1.19E-12	0.0%	FIRE IN ESSENTIAL WATER CHILLER RM
%F078-A52D	3.05E-12	0.0%	FIRE IN 480V N1E MCC RM
%F078-AGAD	1.18E-12	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A04D	7.72E-14	0.0%	FIRE IN CABLE ACCESS AREA
%F100-A05C	4.67E-12	0.0%	FIRE IN ELECTRICAL EQUIPMENT RM
%F100-A05D	4.37E-12	0.0%	FIRE IN ELECTRICAL EQUIPMENT RM
%F100-A06D	3.87E-12	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A08D	5.27E-12	0.0%	FIRE IN N1E DC & IP EQUIPMENT RM

Table 19.1-152 (5 of 7)

Initiator	Frequency	Contribution	Description
%F100-A10B	3.66E-12	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A11A	3.71E-12	0.0%	FIRE IN CHANNEL-A BATTERY RM
%F100-A13B	6.15E-13	0.0%	FIRE IN MECHANICAL PENETRATION RM
%F100-A20A	7.23E-12	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A23A	1.42E-12	0.0%	FIRE IN AUX. BLDG. CONTROLLED AREA I SUPPLY AHU ROOM
%F100-A24A	6.00E-12	0.0%	FIRE IN SFP COOLING HX RM
%F100-A37B	1.25E-12	0.0%	FIRE IN GENERAL ACCESS AREA
%F100-A38A	1.16E-12	0.0%	FIRE IN FUEL HANDLING AREA NORMAL EXHAUST ACU RM
%F100-T15	6.01E-12	0.0%	FIRE IN SWITCHGEAR RM
%F120-A01C	3.87E-12	0.0%	FIRE IN PIPING CABLE AREA
%F120-A01D	1.15E-13	0.0%	FIRE IN PIPING CABLE AREA
%F120-A05C	7.55E-12	0.0%	FIRE IN ELECTRICAL EQUIP. RM
%F120-A05D	7.76E-12	0.0%	FIRE IN ELECTRICAL EQUIP. RM
%F120-A08C	9.11E-13	0.0%	FIRE IN 480V N1E MCC RM
%F120-A09D	2.06E-12	0.0%	FIRE IN ELECTRICAL PENETRATION ROOM (D)
%F120-A11B	5.86E-12	0.0%	FIRE IN GENERAL ACCESS AREA-120' B
%F120-A15B	9.06E-12	0.0%	FIRE IN 480V CLASS 1E MCC 03B RM
%F120-A16A	1.65E-12	0.0%	FIRE IN MECHANICAL PENETRATION RM
%F120-A24A	3.70E-12	0.0%	FIRE IN FUEL HANDLING AREA EMER. EXHAUST ACU RM
%F120-A31B	1.86E-12	0.0%	FIRE IN GENERAL ACCESS AREA-120' B

Table 19.1-152 (6 of 7)

Initiator	Frequency	Contribution	Description
%F120-AMPB	3.08E-12	0.0%	FIRE IN MECHANICAL PENETRATION ROOM
%F122-T01	7.98E-12	0.0%	FIRE IN SWITCHGEAR RM
%F137-A01D	9.09E-13	0.0%	FIRE IN CABLE SPREADING AREA
%F137-A02D	1.33E-12	0.0%	FIRE IN ELECTRICAL EQUIP. RM
%F137-A05D	3.57E-12	0.0%	FIRE IN PCS RM
%F137-A09D	5.04E-13	0.0%	FIRE IN GENERAL ACCESS AREA
%F137-A10D	1.27E-12	0.0%	FIRE IN 480V CLASS 1E MCC 03D RM
%F137-A11D	1.68E-12	0.0%	FIRE IN ELECTRICAL PENETRATION RM (D)
%F137-A15A	2.63E-12	0.0%	FIRE IN 480V CLASS 1E MCC 04A RM
%F137-A15B	1.47E-12	0.0%	FIRE IN 480V CLASS 1E MCC 04B RM
%F137-A30D	7.49E-13	0.0%	FIRE IN MAIN STEAM ENCLOSURE
%F137-AEPB	1.43E-12	0.0%	FIRE IN ELECTRICAL PENETRATION ROOM (B)
%F157-A01D	9.69E-12	0.0%	FIRE IN I&C EQUIPMENT RM
%F157-A16D	7.90E-13	0.0%	FIRE IN GENERAL ACCESS AREA
%F157-A17C	3.43E-13	0.0%	FIRE IN CORRIDOR
%F157-A19D	1.44E-12	0.0%	FIRE IN I&C EQUIPMENT RM
%F157-A21D	7.63E-14	0.0%	FIRE IN INSTRUMENT MAINTENANCE SHOP
%F157-A23D	7.63E-14	0.0%	FIRE IN AEB RM
%F157-ACPX	6.65E-12	0.0%	FIRE IN COMPUTER RM PACU RM
%F172-A13C	2.57E-12	0.0%	FIRE IN 480V N1E MCC RM

Table 19.1-152 (7 of 7)

Initiator	Frequency	Contribution	Description
%FD-D01B	2.91E-12	0.0%	FIRE IN CCW HEAT EXCHANGER "B" BUILDING
%FK-K02	3.97E-12	0.0%	FIRE IN ESW STRUCTURE "B" BUILDING
%FK-K04	6.17E-13	0.0%	FIRE IN ESW ULTIMATE HEAT SINK COOLING TOWER 1B AREA
%FY-SAT1	1.75E-12	0.0%	FIRE IN STAND-BY AUX. TRANSFORMER 1 AREA

Table 19.1-153 (1 of 7)

LPSD Internal Fire PRA Key Basic Events by RAW (LRF) –All POS

Basic Event	Description	RAW
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	434
UNCLEARD-SPUR-IND	UNCLEARED SPURIOUS INDICATION PROBABILITY > 9 MINUTES	99
CCMVXO8-143-150	8/8 CCF (DEMAND) OF MOV 143,144,145,146,147,148,149,150 IN NON-SAFETY LOAD LINE	35
PELXY-A-LX06A-P	FAILURE OF PRIMARY LOOP CONTROLLER LX06A	31
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	22
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	22
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	22
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	22
CI-HATCH	HATCH FAILS TO ISOLATE	21
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	21
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	19
PFBSY1A-SW01A	BUS FAULT ON 4.16kV SWGR SW01A	18
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE	14
PEDOY-B-LX02B04	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 04	13
CVCVC-S-189	CONTAINMENT ISOLATION CHECK V/V 189 FAIL TO CLOSE	12
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	11
PGBSY1A-LC01A	BUS FAULT ON 480V LC LC01A	8
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	8

Table 19.1-153 (2 of 7)

Basic Event	Description	RAW
PGXMY1A-TR01A	480V LC TRANSFORMER LC-TR01A FAULT	8
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	8
PALXY-D-PA06D-P	PRIMARY LOOP CONTROLLER 752-PA06D FAILS TO RUN	7
PEDOY-D-LX03D01	FAILURE OF DIGITAL OUTPUT MODULE LX03D BRANCH 01	7
PADOY-D-PA06D01	FAILURE OF DIGITAL OUTPUT MODULE PA06D BRANCH 01	7
PADOY-D-PA06D03	FAILURE OF DIGITAL OUTPUT MODULE 752-PA06D BRANCH 03	7
WOTKB-B-TK02B	ECW AIR SEPARATOR TK02B FAILS CATASTROPHICALLY	6
WOTKB-B-TK01B	ECW COMPRESSION TANK TK01B FAILS CATASTROPHICALLY	6
CCTKB-B-TK01B	CCW SURGE TANK TK01B FAILS CATASTROPHICALLY	6
WOTKB-B-TK04B	ECW COMPRESSION TANK TK04B FAILS CATASTROPHICALLY	6
WOTKB-B-TK05B	ECW AIR SEPARATOR TK05B FAILS CATASTROPHICALLY	6
VGFLP1A-FT01B	ESW BUILDING SUPPLY FAN FILTER FT01B PLUGGED	6
DEAVC-S-006	CTMT. ISOL. AOV DE-006 FAIL TO CLOSE	6
CACVC-S-1023	CONTAINMENT ISOLATION CHECK V/V 1023 FAIL TO CLOSE	6
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	5
PEDOY-A-LX06A04	FAILURE OF DIGITAL OUTPUT MODULE LX06A BRANCH 04	5
IPINY-B-IN01B	120V AC POWER SUPPLY INVERTER IN01B FAILS WHILE OPERATING	5
PALXY-C-PA06C-P	PRIMARY LOOP CONTROLLER 752-PA06C FAILS TO RUN	5
DADGR-S-AACTG	AAC GTG FAILS TO RUN	5
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	4

Table 19.1-153 (3 of 7)

Basic Event	Description	RAW
PADOY-C-PA06C04	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 04	4
PADOY-D-PA06C02	FAILURE OF DIGITAL OUTPUT MODULE PA06C BRANCH 02	4
PEDOY-C-LX03C01	FAILURE OF DIGITAL OUTPUT MODULE LX03C BRANCH 01	4
VUHVS-S-HV81	FAILS TO START OF HIGH VOLUME CUBICLE COOLER HV81	4
VUHVS-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO START	4
DADGS-S-AACTG	AAC GTG FAILS TO START	4
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	4
IPBSY-B-MC01B	120V AC DIST. PANEL BUS 1-842-E-IN01B LOCAL FAULTS	4
VUHVR-S-HV81	FAILS TO RUN OF HIGH VOLUME CUBICLE COOLER HV81	3
VUHVR-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO RUN	3
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	3
WOTKB-A-TK01A	ECW COMPRESSION TANK TK01A FAILS CATASTROPHICALLY	3
CCTKB-A-TK01A	CCW SURGE TANK TK01A FAILS CATASTROPHICALLY	3
WOTKB-A-TK05A	ECW AIR SEPARATOR TK05A FAILS CATASTROPHICALLY	3
WOTKB-A-TK04A	ECW COMPRESSION TANK TK04A FAILS CATASTROPHICALLY	3
WOTKB-A-TK02A	ECW AIR SEPARATOR TK02A FAILS CATASTROPHICALLY	3
DAVVT-A-V1002	AAC DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1002 FAILS TO REMAIN OPEN	3
DAVVT-A-V1009	AAC DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1009 FAILS TO REMAIN OPEN	3
DAVVT-A-V1010	AAC DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1010 FAILS TO REMAIN OPEN	3
DAVVT-A-V1015	AAC DIESEL FUEL OIL COMMON LINE VALVE V1015 FAILS TO REMAIN OPEN	3

Table 19.1-153 (4 of 7)

Basic Event	Description	RAW
DAVVT-A-V4015	AAC DIESEL FUEL OIL COMMON LINE VALVE V4015 FAILS TO REMAIN OPEN	3
DAVVT-B-V1022	AAC DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1022 FAILS TO REMAIN OPEN	3
DAVVT-B-V1020	AAC DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1020 FAILS TO REMAIN OPEN	3
CCMVXO4-144/6/8/50	4/4 CCF(DEMAND) OF MOV 144,146,148,150 IN NON-SAFETY LOAD LINE	3
VGFLP1A-FT01A	ESW BUILDING SUPPLY FAN FILTER FT01A PLUGGED	3
DCBTY-B-BT01B	BAT. BT01B (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	3
ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY	3
DGDGR-A-DGA	FAILS TO RUN OF EDG A	3
PHBSY1A-MC03A	BUS FAULT ON 480V MCC MC03A	3
NBBSY-S-SW03N	BUS FAULTS ON NON-1E 4.16kV SWGR 3-SW03N	3
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	3
DGDGL-A-DGA	DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	3
DGDGS-A-DGA	FAILS TO START OF EDG A	3
WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND	3
WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND	3
VDHVS-A-HV12A	FAILS TO START EDG ROOM CUBICLE COOLER HV12A	3
VDHVS-A-HV13A	FAILS TO START EDG ROOM CUBICLE COOLER HV13A	3
DGSQA-A-LOADSQ	LOAD SEQUNCER A FAILS TO OPERATE	3
IPBSY-A-MC01A	120V AC DIST. PANEL BUS 842-IN01A LOCAL FAULTS	3
CSXPL-A-ECSBSPUMP	ECSBS PUMPING DEVICE FAILS TO RUN	3

Table 19.1-153 (5 of 7)

Basic Event	Description	RAW
VKHVS1A-HV13A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV13A	3
CSXPSA-ECSBSPUMP	ECSBS PUMPING DEVICE FAILS TO START	3
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	3
CCMVO-A-191	CCW MOV 191 FOR EDG01A INLET FAILS TO OPEN	2
CCMPS1A-PP01A	CCW PUMP PP01A FAILS TO START	2
SXMPS1A-PP01A	ESW PUMP PP01A FAILS TO START	2
WOMPS1A-PP01A	FAILS TO START OF ECW PUMP 01A	2
WOMPS4A-PP04A	FAILS TO START OF ECW PUMP 04A	2
DCBTY-S-BT04N	BATTERY 0-841-BT04N FAILS TO PROVIDE ADEQUATE OUTPUT	2
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	2
PELXY-A-LX03A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX03A	2
WOCHR3A-CH03A	ECW CHILLER CH03A FAILS TO RUN FOR 24 HOURS	2
WOCHR1A-CH01A	ECW CHILLER CH01A FAILS TO RUN FOR 24 HOURS	2
PHBSY1B-MC03B	BUS FAULT ON 480V MCC MC03B	2
VGAHS1A-AH04A	ESW PUMP ROOM II. AHU HV01A SUPPLY FAN AH04A FAILS TO START	2
PELXY-B-LX06B-P	PRIMARY LOOP CONTROLLER LX06B FAILS TO RUN	2
CSXPRA-ECSBSPUMP	ECSBS PUMPING DEVICE FAILS TO RUN	2
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	2
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	2
CSVVO-A-V1013ECSBS	ECSBS VV V1013 IN CS TRAIN A FAILS TO OPEN	2

Table 19.1-153 (6 of 7)

Basic Event	Description	RAW
PAGXY-A-PM3-PA03A-P	FAILURE OF PRIMARY GROUP CONTROLLER OF 752-PA-PA03A	2
DGDGR-B-DGB	FAILS TO RUN OF EDG B	2
VGAHR1A-AH04A	ESW PUMP ROOM II. AHU HV01A SUPPLY FAN AH04A FAILS TO RUN	2
VDHVR-A-HV12A	FAILS TO RUN EDG ROOM CUBICLE COOLER HV12A	2
VGAHR1A-AH01A	ESW PUMP ROOM I. FAN AH01A FAILS TO RUN	2
VDHVR-A-HV13A	FAILS TO RUN EDG ROOM CUBICLE COOLER HV13A	2
VKHVR1A-HV13A	FAILS TO RUN CCW PUMP ROOM CUBICLE COOLER HV13A	2
IPINY-C-IN01C	120V AC POWER SUPPLY INVERTER IN01C FAILS WHILE OPERATING	2
PELXY-A-LX04A-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX04A	2
PELXY-A-LX05A-P	PRIMARY LOOP CONTROLLER LX05A FAILS TO RUN	2
DOVVT-A-V1009A	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1009A FAILS TO REMAIN OPEN	2
DOVVT-A-V4011A	DIESEL FUEL OIL TRANSFER PUMP DISCH. VALVE V4011A FAILS TO REMAIN OPEN	2
DOVVT-A-V1015A	DIESEL FUEL OIL TRANSFER PUMP DISCH. VALVE V1015A FAILS TO REMAIN OPEN	2
DOVVT-A-V1010A	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1010A FAILS TO REMAIN OPEN	2
DOVVT-A-V1002A	DIESEL FUEL OIL TRANSFER PUMP SUCTION VALVE V1002A FAILS TO REMAIN OPEN	2
CCVVT-A-V1291	EDG01A OUTLET MANUAL VALVE V1291 TRANSFER CLOSED	2
CVAVC-S-523	CTMT. ISOL. AOV CV-523 FAIL TO CLOSE	2
SXMPR1A-PP01A	ESW PUMP PP01A FAILS TO RUN	2
CCMPR1A-PP01A	CCW PUMP PP01A FAILS TO RUN	2

Table 19.1-153 (7 of 7)

Basic Event	Description	RAW
CVAVC-S-505	CTMT. ISOL. AOV CV-505 FAIL TO CLOSE	2
WOMPR4A-PP04A	FAILS TO RUN OF ECW PUMP 04A	2
CVAVC-S-561	CTMT. ISOL. AOV CV-561 FAIL TO CLOSE	2
WOMPR1A-PP01A	FAILS TO RUN OF ECW PUMP 01A	2
DEMVC-S-005	CTMT. ISOL. MOV 005 FAIL TO CLOSE	2
PEDOY-B-LX03B02	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 02	2
PEDOY-B-LX03B03	FAILURE OF DIGITAL OUTPUT MODULE LX03B BRANCH 03	2
PEDOY-B-LX06B01	FAILURE OF DIGITAL OUTPUT MODULE LX06B BRANCH 01	2

Table 19.1-154 (1 of 3)

LPSD Internal Fire PRA Key Basic Events by RAW (LRF) –Reduced Inventory

Basic Event	Description	RAW
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	38
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	38
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	38
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	38
CIILRTLINES	LEAK RATE TEST LINES FAIL TO ISOLATE (VQ-2024, 2014, 2016)	38
CI-HATCH	HATCH FAILS TO ISOLATE	38
DCBSY-B-MC01B	BUS FAULTS ON 1E 125VDC BUS MC01B	8
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	7
IPINY-A-IN01A	120V AC POWER SUPPLY INVERTER IN01A FAILS WHILE OPERATING	7
IPBSY-A-MC01A	120V AC DIST. PANEL BUS 842-IN01A LOCAL FAULTS	7
DCBSY-A-MC01A	BUS FAULTS ON 1E 125VDC BUS MC01A	6
DCBTY-A-BT01A	BAT. BT01A (125VDC) FAILS TO PROVIDE ADEQUATE OUTPUT	6
PELXY-B-LX01B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX01B	5
PELXY-B-LX02B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX02B	4

Table 19.1-154 (2 of 3)

Basic Event	Description	RAW
PELXY-B-LX09B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-PE-LX09B	3
PELXY-B-LX10B-P	PRIMARY LOOP CONTROLLER LX10B FAILS TO RUN	3
PELXY-A-LX10A-P	PRIMARY LOOP CONTROLLER LX10A FAILS TO RUN	3
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	3
PEDOY-A-LX10A02	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 02	3
PEDOY-B-LX10B04	FAILURE OF DIGITAL OUTPUT MODULE LX10B BRANCH 04	3
PEDOY-B-LX09B03	FAILURE OF DIGITAL OUTPUT MODULE LX09B BRANCH 03	3
PEDOY-A-LX10A03	FAILURE OF DIGITAL OUTPUT MODULE LX10A BRANCH 03	3
PELXY-B-LX03B-P	FAILURE OF PRIMARY LOOP CONTROLLERS 745-PE-LX03C	3
SIMPS1B-SCPP01B	SC PUMP 2 PP01B FAILS TO START	3
CCMVO-B-352	SC HX HE01B INLET MOV 352 FAILS TO OPEN	3
SIMPR1B-SCPP01B	SC PUMP 2 PP01B FAILS TO RUN	2
PFBSY1B-SW01B	BUS FAULT ON 4.16kV SWGR SW01B	2
PGBSY1B-LC01B	BUS FAULT ON 480V LC LC01B	2
PELXY-B-LX04B-P	FAILURE OF PRIMARY LOOP CONTROLLER OF 745-LX04B	2

Table 19.1-154 (3 of 3)

Basic Event	Description	RAW
VKHVR2B-HV16B	FAILS TO RUN SC PUMP 02B ROOM CUBICLE COOLER HV16B	2
SIVVT2B-V579	VV V579 IN SC PUMP 2 DISCH. PATH FAILS TO REMAIN OPEN	2
CCVVT-B-V1512	SC HX HE01B OUTLET MANUAL VALVE V1512 TRANSFER CLOSED	2
SIVVT2B-V107	SCS PUMP 2 SUCTION MANUAL VALVE V107 TRANSFER CLOSED	2
PEDOY-B-LX04B03	FAILURE OF DIGITAL OUTPUT MODULE LX04B BRANCH 03	2
PEDOY-B-LX02B03	FAILURE OF DIGITAL OUTPUT MODULE LX02B BRANCH 03	2
PEDOY-B-LX01B02	FAILURE OF DIGITAL OUTPUT MODULE LX01B BRANCH 02	2
VKHVS2A-HV16A	FAILS TO START SC PUMP 02A ROOM CUBICLE COOLER HV16A	2
PHBSY1B-MC01B	BUS FAULT ON 480V MCC MC01B	2
PGXMY1B-TR01B	480V LC TRANSFORMER LC-TR01B FAULT	2
SICVO2B-V569	CV V569 IN SC PUMP 2 DISCH. PATH FAILS TO OPEN	2
SICVO2B-V123	SI PUMP DVI2B INJECTION LINE CV 123 FAILS TO OPEN	2
SICVO2B-V227	SI LINE 2 CHECK VALVE SI-227 FAILS TO OPEN	2
SICVO2B-V168	CV 168 IN SCS TRAIN B HX DISCH. PATH FAILS TO OPEN	2
SICVO2B-V541	SI DVI INJECTION LINE 2B CHECK VALVE V541 FAILS TO OPEN	2

Table 19.1-155 (1 of 2)

LPSD Internal Fire PRA Key Basic Events by FV (LRF) – All POS

Basic Event	Description	FV
ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY	22.3%
DADGR-S-AACTG	AAC GTG FAILS TO RUN	9.4%
H-CI-OPEN	OPERATOR FAILS TO RECOVERY FOR CIS ISOLATION	6.9%
DGDGR-A-DGA	FAILS TO RUN OF EDG A	5.0%
DGDGR-B-DGB	FAILS TO RUN OF EDG B	2.9%
NBHBC-S-SW03N-A2	FAIL TO CLOSE OF SWGR SW03N-A2 FEED BREAKER FROM AAC GTG	2.3%
DGDGR-D-DGD	FAILS TO RUN OF EDG D	2.2%
WOCHS3A-CH03A	ECW CHILLER CH03A FAILS TO START ON DEMAND	2.2%
WOCHS1A-CH01A	ECW CHILLER CH01A FAILS TO START ON DEMAND	2.2%
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	2.0%
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	2.0%
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	2.0%
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	2.0%
GWSVO-S-002	CTMT. ISOL. SOV GW-002 FAIL TO OPERATE	1.5%

Table 19.1-155 (2 of 2)

Basic Event	Description	FV
VUHVS-S-HV83	HIGH VOLUME CUBICLE COOLER HV83 FAILS TO START	1.3%
VUHVS-S-HV81	FAILS TO START OF HIGH VOLUME CUBICLE COOLER HV81	1.3%
PFHBC1A-SW01A-E2	FAILS TO CLOSE OF FEEDER BRK SW01A-E2 TO EDG A	1.2%
PFHBO1A-SW01A-H2	FAILS TO OPEN OF PCB SW01A-H2 OF 4.16kV SWGR SW01A FROM UAT	1.0%
DADGS-S-AACTG	AAC GTG FAILS TO START	0.9%
DGDGR-C-DGC	FAILS TO RUN OF EDG C	0.7%
DGDGL-A-DGA	DG A FAILS TO LOAD AND RUN DURING 1ST 1HR OF OPERATION	0.6%
PFHBC1B-SW01B-D2	FAILS TO CLOSE OF FEEDER BRK SW01B-D2 TO DG B	0.6%
WOCHS3B-CH03B	ECW CHILLER CH03B FAILS TO START ON DEMAND	0.6%
WOCHS1B-CH01B	ECW CHILLER CH01B FAILS TO START ON DEMAND	0.6%
VDHVS-A-HV12A	FAILS TO START EDG ROOM CUBICLE COOLER HV12A	0.6%
VDHVS-A-HV13A	FAILS TO START EDG ROOM CUBICLE COOLER HV13A	0.6%
WOCHS2B-CH02B	ECW CHILLER 2B FAILS TO START	0.6%
VKHVS1A-HV13A	FAILS TO START CCW PUMP ROOM CUBICLE COOLER HV13A	0.6%
WOCHS4B-CH04B	ECW CHILLER CH04B FAILS TO START ON DEMAND	0.5%
SISPP-S-IRWST	FAILURE OF IRWST SUMP DUE TO PLUGGING	0.5%
PFHBO2B-SW01D-G2	4.16kVCLASS 1E 4.16kV SWITCHGEAR PCB SW01D-G2 (UAT) FAILS TO OPEN	0.5%

Table 19.1-156

LPSD Internal Fire PRA Key Basic Events by FV (LRF) – Reduced Inventory

Basic Event	Description	FV
PSAVC-S-031	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	3.6%
PSAVC-S-034	CTMT. ISOL. AOV PS-034 FAIL TO CLOSE	3.6%
PSAVC-S-032	CTMT. ISOL. AOV PS-031 FAIL TO CLOSE	3.6%
PSAVC-S-033	CTMT. ISOL. AOV PS-033 FAIL TO CLOSE	3.6%
VKHVS2B-HV16B	FAILS TO START SC PUMP 02B ROOM CUBICLE COOLER HV16B	0.7%
RAC-LXP05-AC-WE	RECOVER OFFSITE POWER WITHIN 1.8HR AT SBO POS5 WE	0.6%
ECOPH-S-ALIGN	OPERATOR FAILS TO ALIGN ECSBS FOR CONTAINMENT SPRAY	0.6%

Table 19.1-157 (1 of 7)

LPSD Internal Fire PRA Key CCF Events by RAW (LRF)

Basic Event	Description	RAW
SICVWQ4-V113/23/33/43	SI LINE C/V 113,123,133,143 CCF TO OPEN	278
SICVWQ4-V217/27/37/47	SI LINE C/V 247,227,237,217 CCF TO OPEN	278
SICVWQ4-V540/41/42/43	SI LINE C/V 543,541,542,540 CCF TO OPEN	278
SIMVWQ4-616/26/36/46	CCF OF 4/4 DVI LINEMOV 616,626,636,646	113
SIMPWQ4-PP02ABCD	4/4 CCF OF START FOR SI PUMP PP02A/B/C/D	101
SIMPKQ4-PP02ABCD	4/4 CCF OF RUN FOR SI PUMP PP02A/B/C/D	97
SIMVWQ3-616/36/46	CCF OF 3/4 DVI LINE MOV 646,636,616	89
SIMPWQ3-PP02A/C/D	3/4 CCF OF START FOR SI PUMP PP02A/C/D	84
SIMPKQ3-PP02A/C/D	3/4 CCF OF RUN FOR SI PUMP PP02A/C/D	83
SIMVWQ2-636/46	CCF OF 2/4 DVI LINEMOV 636,646	79
SIMVWQ3-626/36/46	CCF OF 3/4 DVI LINE MOV 626,636,646	78
SICVWQ4-V404/05/34/46	SI PUMP DISCHARGE C/V 404,405,434,446 CCF TO OPEN	78
DGDGKQ4-DG01ABCD	CCF OF EDGS FAIL TO RUN	77
SIMPWQ2-PP02A/C	2/4 CCF OF START FOR SI PUMP PP02A/C	75
SICVWQ2-V540/41	2/4 CCF OF DVI LINE CHECK VALVES 540,541	74
SICVWQ2-V217/27	2/4 CCF OF DVI LINE CHECK VALVES 217,227	74
SICVWQ2-V113/23	SI LINE C/V 113,123 CCF TO OPEN	74
SIMPKQ2-PP02A/C	2/4 CCF OF RUN FOR SI PUMP PP02A/C	74

Table 19.1-157 (2 of 7)

Basic Event	Description	RAW
PFHBWQ4-SW1DG	CCF OF SW01A&1B&1C&1D FEED BREAKER FROM DG A&B FAIL TO CLOSE	74
VDHVWQ4-HV12ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	73
VDHVWQ4-HV13ABCD	4/4 CCF OF START FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	73
SIMPWQ3-PP02A/B/C	3/4 CCF OF START FOR SI PUMP PP02A/B/C	73
SICVWQ3-V217/37/47	3/4 CCF OF DVI LINE CHECK VALVES 217,237,247	73
SICVWQ3-V113/33/43	SI LINE C/V 113,133,143 CCF TO OPEN	73
SICVWQ3-V540/42/43	3/4 CCF OF DVI LINE CHECK VALVES 540,542,543	73
WOCHWQ4-CH01A/2A/1B/2B	CCF OF ECW CHILLERS FAIL TO START	73
WOCHWQ4-CH03A/4A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B/4B	73
SIMPKQ3-PP02A/B/C	3/4 CCF OF RUN FOR SI PUMP PP02A/B/C	73
WOCHKQ4-CH01A/1B/2A/2B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B/2B	70
WOCHKQ4-CH03A/3B/4A/4B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B/4B	70
DOMPWO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO START	70
DGSQWQ4-LOADSQABCD	CCF OF LOAD SEQUNCER A, B, C, D	69
SICVWQ2-V542/43	2/4 CCF OF DVI LINE CHECK VALVES 542,543	68
SICVWQ2-V133/43	SI LINE C/V 133,143 CCF TO OPEN	68
SICVWQ2-V237/47	2/4 CCF OF DVI LINE CHECK VALVES 237,247	68
DGDGWQ4-DG01ABCD	CCF OF EDGS FAIL TO START	68

Table 19.1-157 (3 of 7)

Basic Event	Description	RAW
VGAHKQ4-AH04A/4B/5A/5B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A, 05B	68
VGAHKQ4-AH01A/1B/2A/2B	4/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A/B, 02A/B	68
SICVWQ3-V123/33/43	SI LINE C/V 123,133,143 CCF TO OPEN	66
SICVWQ3-V541/42/43	3/4 CCF OF DVI LINE CHECK VALVES 541,542,543	66
SICVWQ3-V227/37/47	3/4 CCF OF DVI LINE CHECK VALVES 227,237,247	66
DGDGWQ4-DG01ABCD-LOAD	CCF OF EDGS FAIL TO LOAD AND RUN DURING 1ST 1HOUR	66
SICVWQ3-V113/23/33	SI LINE C/V 113,123,133 CCF TO OPEN	65
SICVWQ3-V217/27/37	3/4 CCF OF DVI LINE CHECK VALVES 217,227,237	65
SICVWQ3-V540/41/42	3/4 CCF OF DVI LINE CHECK VALVES 540,541,542	65
WOMPWQ4-PP01A/2A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/2A/1B/2B	65
CCMPWQ4-PP01A/2A/1B/2B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (DEMAND)	65
WOMPWQ4-PP04A/5A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/5A/4B/5B	65
CCMVWQ4-191/2/181/2	4/4 CCF OF CCW MOV 191, 192, 181, 182 FOR EDG01A/B/C/D INLET	63
SICVWQ3-V113/23/43	SI LINE C/V 113,123,143 CCF TO OPEN	63
SICVWQ3-V540/41/43	3/4 CCF OF DVI LINE CHECK VALVES 540,541,543	63
SICVWQ3-V217/27/47	3/4 CCF OF DVI LINE CHECK VALVES 217,227,247	63
DOMPKO8-PP012ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP 012ABCD FAIL TO RUN	63
SICVWQ3-V404/34/46	SI PUMP DISCHARGE C/V 404,434,446 CCF TO OPEN	62
VDHVWO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO START	61

Table 19.1-157 (4 of 7)

Basic Event	Description	RAW
SICVWQ2-V404/34	2/4 CCF OF SI PUMP DISCH. LINE CVs 404,434	60
SXMPWQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO START	60
VKHVKQ4-HV13A/13B/14A/14B	4/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A, 14B	58
VDHVKQ4-HV12ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV12A, 12B, 12C, 12D	57
VDHVKQ4-HV13ABCD	4/4 CCF OF RUN FOR EDG ROOM CUBICLE COOLER HV13A, 13B, 13C, 13D	57
SXFLKE6-FT01AB/2AB/3AB	6/6 CCF OF ESW DEBRIS FILTER 1A/1B, 2A/B, 3A/3B IN TRAIN A/B	57
PALXKQ4-PA06CD	4/4 CCF OF LOOP CONTROLLER PA06C, PA06D	55
SICVWQ3-V404/05/34	SI PUMP DISCHARGE C/V 404,405,434 CCF TO OPEN	55
VGFLKD2-FT01A/01B	2/2 CCF OF ESW PUMP ROOM FILTER FT01A, 01B	54
SXMPKQ4-PP01A/B/2A/B	4/4 CCF OF ESW PUMPS PP01A/2A, PP01B/2B TO RUN	54
VDHVKO8-HV12/13ABCD	CCF OF ALL EDG ROOM CUBICLE COOLERS FAIL TO RUN	52
PELXKO8-LX04AB03AB	8/8 CCF OF LOOP CONTROLLER LX03AB, LX04AB FOR CCW NON-SAFETY LINE ISOL. VALVES	50
PAGXKO8-PA03ABCD	8/8 CCF OF GROUP CONTROLLER 752-PA03A,03B,03C,03D	50
PELXKO8-LX03ABCD	8/8 CCF OF LOOP CONTROLLER LX03A/B/C/D	50
PELXKO8-LX05AB3CD	8/8 CCF OF LOOP CONTROLLER LX05A LX05B, LX03C, LX03D	47
PELXKO8-LX06A04B03C03D	8/8 CCF OF LOOP CONTROLLER LX06A 12, LX04B 12, LX03C 12, LX03D 12	47
CCMPKQ4-PP01A/B/2A/B	4/4 CCF OF CCW PUMPS PP01A/1B/2A/2B (RUNNING)	46
WOMPKQ4-PP01A/2A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/2A/1B/2B	46
WOMPKQ4-PP04A/5A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/5A/4B/5B	46

Table 19.1-157 (5 of 7)

Basic Event	Description	RAW
PFHBWQ4-SW2OUAT	CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	44
DGDGKQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO RUN	41
PFHBWQ4-SW1OSAT	CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C,1D FAIL TO OPEN	39
DGDGKQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO RUN	38
PFHBWQ3-SW2OUATABD	3/4 CCF OF PCB BETWEEN UAT & 4.16kV SW01A,1B, 1D FAIL TO OPEN	38
WOCHWQ3-CH03A/4A/3B	DEMAND CCF OF ECW CHILLERS 3A/4A/3B	37
WOCHWQ3-CH01A/2A/1B	DEMAND CCF OF ECW CHILLERS 1A/2A/1B	37
PFHBWQ3-SW1DGABD	3/4 CCF OF SW01A&1B&1D FEED BREAKER FROM DG B FAIL TO CLOSE	37
IPINKQ4-IN01ABCD	CCF OF 120V AC POWER SUPPLY INVERTER IN01A/B/C/D	37
PFHBWQ3-SW1DGABC	3/4 CCF OF SW01A&1B&1C FEED BREAKER FROM DG A&B FAIL TO CLOSE	36
WOCHWQ3-CH01A/1B/2B	DEMAND CCF OF ECW CHILLERS 1A/1B/2B	35
WOCHWQ3-CH03A/3B/4B	DEMAND CCF OF ECW CHILLERS 3A/3B/4B	35
DOCVWO8-V1005/7ABCD	8/8 CCF OF DIESEL FUEL OIL TRANSFER PUMP CV V1005/1007 A/B/C/D FAIL TO OPEN	35
SXAHKQ4-AH01A/02A/01B/02B	4/4 RUNNING CCF OF ESW COOLING TOWER FANS AH01A, 02A, 01B, 02B	35
PFHBWQ3-SW1OSATABC	3/4 CCF OF PCB BETWEEN SAT & 4.16kV SW01A,1B,1C FAIL TO OPEN	35
DGSQWQ3-LOADSQABD	CCF OF LOAD SEQUNCER A, B, D	33
DGSQWQ3-LOADSQABC	CCF OF LOAD SEQUNCER A, B, C	33
DGDGWQ3-DG01ABC	CCF OF EDG 01A/01B/01C FAIL TO START	33
DGDGWQ3-DG01ABD	CCF OF EDG 01A/01B/01D FAIL TO START	32

Table 19.1-157 (6 of 7)

Basic Event	Description	RAW
CCMPWQ3-PP01A/2A/1B	3/4 CCF OF CCW PUMPS PP01A/2A/1B (DEMAND)	32
WOMPWQ3-PP01A/2A/1B	DEMAND CCF OF ECW PUMPS 1A/2A/1B	32
WOMPWQ3-PP04A/5A/4B	DEMAND CCF OF ECW PUMPS 4A/5A/4B	32
WOCHKQ3-CH01A/2A/1B	RUNNING CCF OF ECW CHILLERS 1A/2A/1B	32
WOCHKQ3-CH03A/4A/3B	RUNNING CCF OF ECW CHILLERS 3A/4A/3B	32
WOCHKQ3-CH01A/1B/2B	RUNNING CCF OF ECW CHILLERS 1A/1B/2B	31
WOCHKQ3-CH03A/3B/4B	RUNNING CCF OF ECW CHILLERS 3A/3B/4B	31
DGDGWQ3-DG01ABC-LOAD	CCF OF EDG 01A/01B/01C FAIL TO LOAD AND RUN DURING 1ST 1HOUR	31
SXMPWQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (START)	31
CCMVWQ3-191/2/181	3/4 CCF OF CCW MOV 191, 192, 181 FOR EDG01A/B/C INLET	31
DGDGWQ3-DG01ABD-LOAD	CCF OF EDG 01A/01B/01D FAIL TO LOAD AND RUN DURING 1ST 1HOUR	31
VGAHKQ3-AH04A/4B/5A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05A	30
VGAHKQ3-AH01A/1B/2A	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02A	30
VKHVKQ3-HV13A/13B/14A	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14A	30
CCMPKQ3-PP01A/B/2A	3/4 CCF OF CCW PUMPS PP01A/1B/2A (RUNNING)	30
WOMPKQ3-PP04A/5A/4B	RUNNING CCF OF ECW PUMPS 4A/5A/4B	30
WOMPKQ3-PP01A/2A/1B	RUNNING CCF OF ECW PUMPS 1A/2A/1B	30
SXMPKQ3-PP01A/B/2A	3/4 CCF OF ESW PUMPS PP01A, PP02A, PP01B (RUNNING)	30
CCMVWQ3-191/2/182	3/4 CCF OF CCW MOV 191, 192, 182 FOR EDG01A/B/D INLET	29

Table 19.1-157 (7 of 7)

Basic Event	Description	RAW
VGAHKQ3-AH01A/1B/2B	3/4 RUNNING CCF OF ESW PUMP ROOM FAN AH01A, 01B, 02B	29
VGAHKQ3-AH04A/4B/5B	RUNNING CCF OF ESW PUMP ROOM FAN AH04A, 04B, 05B	29
WOMPWQ3-PP01A/1B/2B	DEMAND CCF OF ECW PUMPS 1A/1B/2B	28
CCMPWQ3-PP01A/1B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (DEMAND)	28
WOMPWQ3-PP04A/4B/5B	DEMAND CCF OF ECW PUMPS 4A/4B/5B	28
SXMPWQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (START)	26
IPINKQ3-IN01BCD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01B/C/D	26
IPINKQ3-IN01ACD	3/4 CCF OF 120V AC POWER SUPPLY INVERTER IN01A/C/D	23
VKHVKQ3-HV13A/13B/14B	3/4 CCF OF RUN FOR CCW PUMP ROOM CUBICLE COOLER HV13A, 13B, 14B	23
SXMPKQ3-PP01A/B/2B	3/4 CCF OF ESW PUMPS PP01A, PP01B, PP02B (RUNNING)	22
CCMPKQ3-PP01A/B/2B	3/4 CCF OF CCW PUMPS PP01A/1B/2B (RUNNING)	22
WOMPKQ3-PP01A/1B/2B	RUNNING CCF OF ECW PUMPS 1A/1B/2B	22
WOMPKQ3-PP04A/4B/5B	RUNNING CCF OF ECW PUMPS 4A/4B/5B	22
SIMVWQ2-616/26	CCF OF 2/4 DVI LINEMOV 626,616	22
SIMVWQ3-616/26/36	CCF OF 3/4 DVI LINE MOV 636,626,616	21
CVAVWD2-522/3	2/2 CCF OF AV 522, 523	21
CVAVWD2-560/1	2/2 CCF OF AV 560, 561	21
CVAVWD2-505/6	2/2 CCF OF AV 505, 506	21
SIMVWQ3-616/26/46	SAFETY INJECTION LINE MOV 616,626, 646 CCF TO OPEN	20

Table 19.1-158

LPSD Internal Fire PRA Key CCF Events by FV (LRF)

Basic Event	Description	FV
FPXPKD2-PP01/02	2/2 CCF (RUN) FOR FIRE PUMP PP01 & PP02	0.6%

Table 19.1-159 (1 of 2)

LPSD Internal Fire PRA Key Operator Actions by RAW (LRF)

Basic Event	Description	RAW
HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05	270
HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05	95
HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01	59
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	49
HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A	46
HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B	32
HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A	27
HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01	23
HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01	21
HR-FB-JLP05-01	OPERATOR FAILS TO OPERATE F&B AT JL POS05 01	20
HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05	15
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	12
HR-FB-SLP11-01	OPERATOR FAILS TO OPERATE F&B AT SL POS11 01	9
HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B	8

Table 19.1-159 (2 of 2)

Basic Event	Description	RAW
HR-FB-JLP06-02	OPERATOR FAILS TO OPERATE F&B AT JL POS06 02	8
HR-FB-SAMG-DE	HRA DEPENDANCE FOR L1 FB & SAMG SI INITIATION	6
HR-MI-JLP04B	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS04B	6
HR-RS-JLP05	OPERATOR FAILS TO RESTORE SCS AT JL POS05	6
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	5
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	5
HR-MI-JLP06	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS06	5
HR-FB-JLP11-01	OPERATOR FAILS TO OPERATE F&B AT JL POS11 01	5
HR-FB-LPP12A	OPERATOR FAILS TO OPERATE F&B AT LP POS12A	3
HR-MI-JLP05	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS05	2
HR-FB-JLP12A-01	OPERATOR FAILS TO OPERATE F&B AT JL POS12A 01	2

Table 19.1-160 (1 of 2)

LPSD Internal Events PRA Key Operator Actions by FV (LRF)

Basic Event	Description	FV
HR-FB-SAMG-DE	HRA DEPENDANCE FOR L1 FB & SAMG SI INITIATION	33.0%
HR-SAMG-DE	SAMG ACTIONS -COMPLETE DEPENDENCY WITH OTHER SAMG ACTIONS	23.5%
HR-RS-KVP05	OPERATOR FAILS TO RESTORE SCS AT KV POS05	19.3%
HR-FB-KVP05	OPERATOR FAILS TO OPERATE F&B AT KV POS05	19.2%
HR-FB-JLP06-01	OPERATOR FAILS TO OPERATE F&B AT JL POS06 01	9.3%
HR-RS-CCP05	OPERATOR FAILS TO RESTORE SCS AT CC POS05	8.3%
HR-FB-CCP05	OPERATOR FAILS TO OPERATE F&B AT CC POS05	8.3%
HR-RS-S2P05	OPERATOR FAILS TO RESTORE SCS AT S2 POS05	4.2%
HR-FB-S2P05	OPERATOR FAILS TO OPERATE F&B AT S2 POS05	4.2%
HR-RS-KVP12A	OPERATOR FAILS TO RESTORE SCS AT KV POS12A	4.0%
HR-FB-KVP12A	OPERATOR FAILS TO OPERATE F&B AT KV POS12A	4.0%
HR-FB-JLP04B-01	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 01	3.5%
HR-FB-JLP10-01	OPERATOR FAILS TO OPERATE F&B AT JL POS10 01	3.2%
HR-RS-KVP04B	OPERATOR FAILS TO RESTORE SCS AT KV POS04B	2.7%
HR-FB-KVP04B	OPERATOR FAILS TO OPERATE F&B AT KV POS04B	2.7%
HR-RS-CCP12A	OPERATOR FAILS TO RESTORE SCS AT CC POS12A	2.3%

Table 19.1-160 (2 of 2)

Basic Event	Description	FV
HR-FB-CCP12A	OPERATOR FAILS TO OPERATE F&B AT CC POS12A	2.3%
HR-FB-SAMG-NOT	COMPLEMENT EVENT OF HEP FOR SAMG SI INITIATION	2.1%
HR-MI-JLP04B	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS04B	1.6%
HR-FB-JLP04B-02	OPERATOR FAILS TO OPERATE F&B AT JL POS04B 02	1.6%
HR-FB-JLP10-02	OPERATOR FAILS TO OPERATE F&B AT JL POS10 02	1.3%
HR-MI-JLP10	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS10	1.3%
HR-RS-CCP04B	OPERATOR FAILS TO RESTORE SCS AT CC POS04B	1.2%
HR-FB-CCP04B	OPERATOR FAILS TO OPERATE F&B AT CC POS04B	1.2%
HR-RS-LPP05	OPERATOR FAILS TO RESTORE SCS AT LO POS05	1.0%
HR-FB-LPP05	OPERATOR FAILS TO OPERATE F&B AT LP POS05	1.0%
HR-RS-S2P12A	OPERATOR FAILS TO RESTORE SCS AT S2 POS12A	1.0%
HR-FB-S2P12A	OPERATOR FAILS TO OPERATE F&B AT S2 POS12A	1.0%
HR-FB-S2P04B	OPERATOR FAILS TO OPERATE F&B AT S2 POS04B	0.6%
HR-RS-S2P04B	OPERATOR FAILS TO RESTORE SCS AT S2 POS04B	0.6%
HR-MI-JLP06	OPERATOR FAILS TO ISOLATE AND MAKEUP UNRECOVERABLE LOCA (JL) PATH AT POS06	0.5%
HR-FB-JLP06-02	OPERATOR FAILS TO OPERATE F&B AT JL POS06 02	0.5%

Table 19.1-161

LPSD FPRA Source Term Category Frequencies and Contributions to LRF (POS 4B-12A)

Source Term Category	Description	Frequency (/yr)	% Total of LRF
RC-2-LPSD	Large, Early LPSD releases	2.69E-8	43.3
RC-3-LPSD	Large, Late LPSD releases	3.52E-8	56.7
Total		6.21E-8	100.0

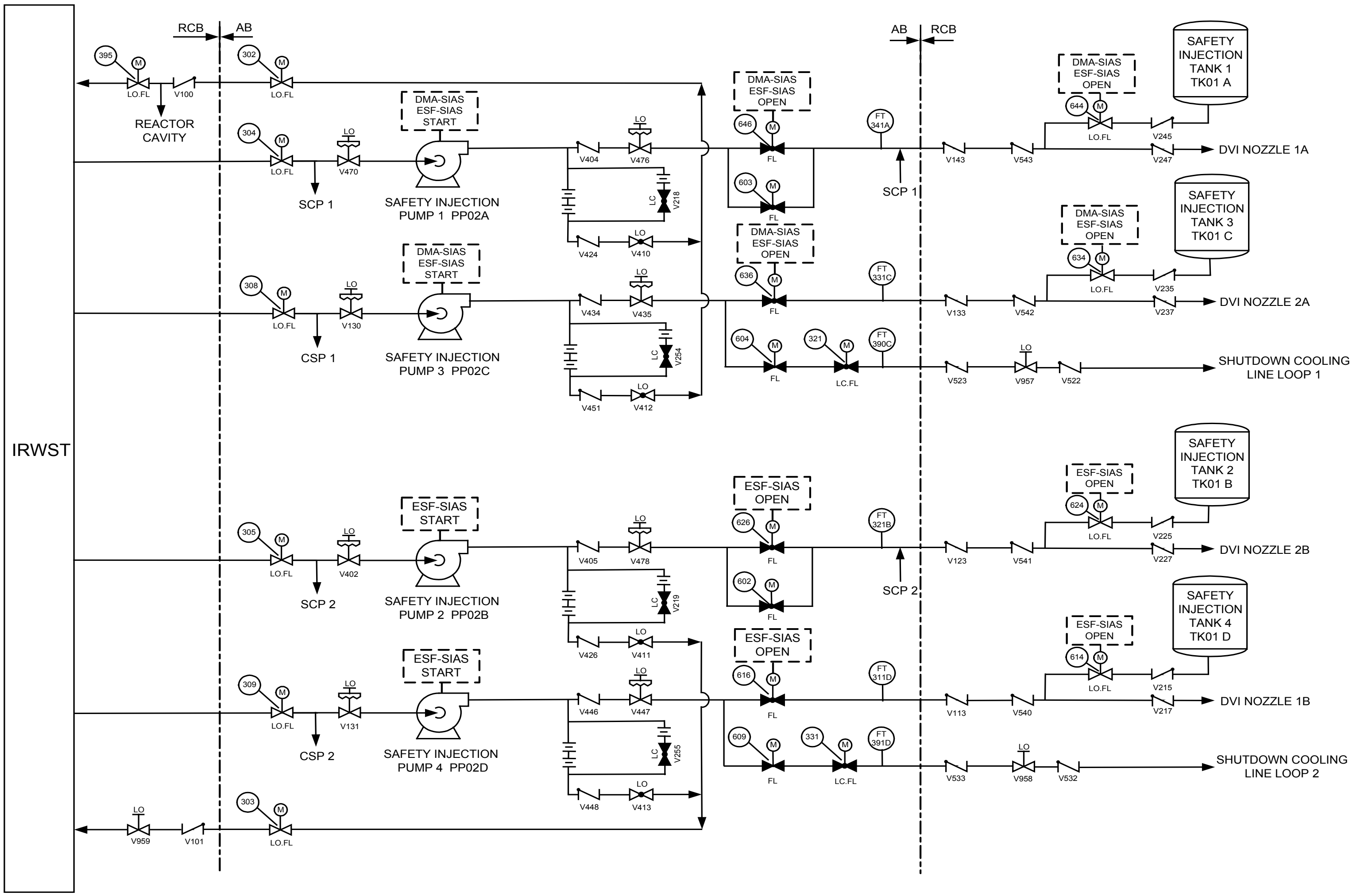

Figure 19.1-1 Simplified Diagram - Safety Injection System

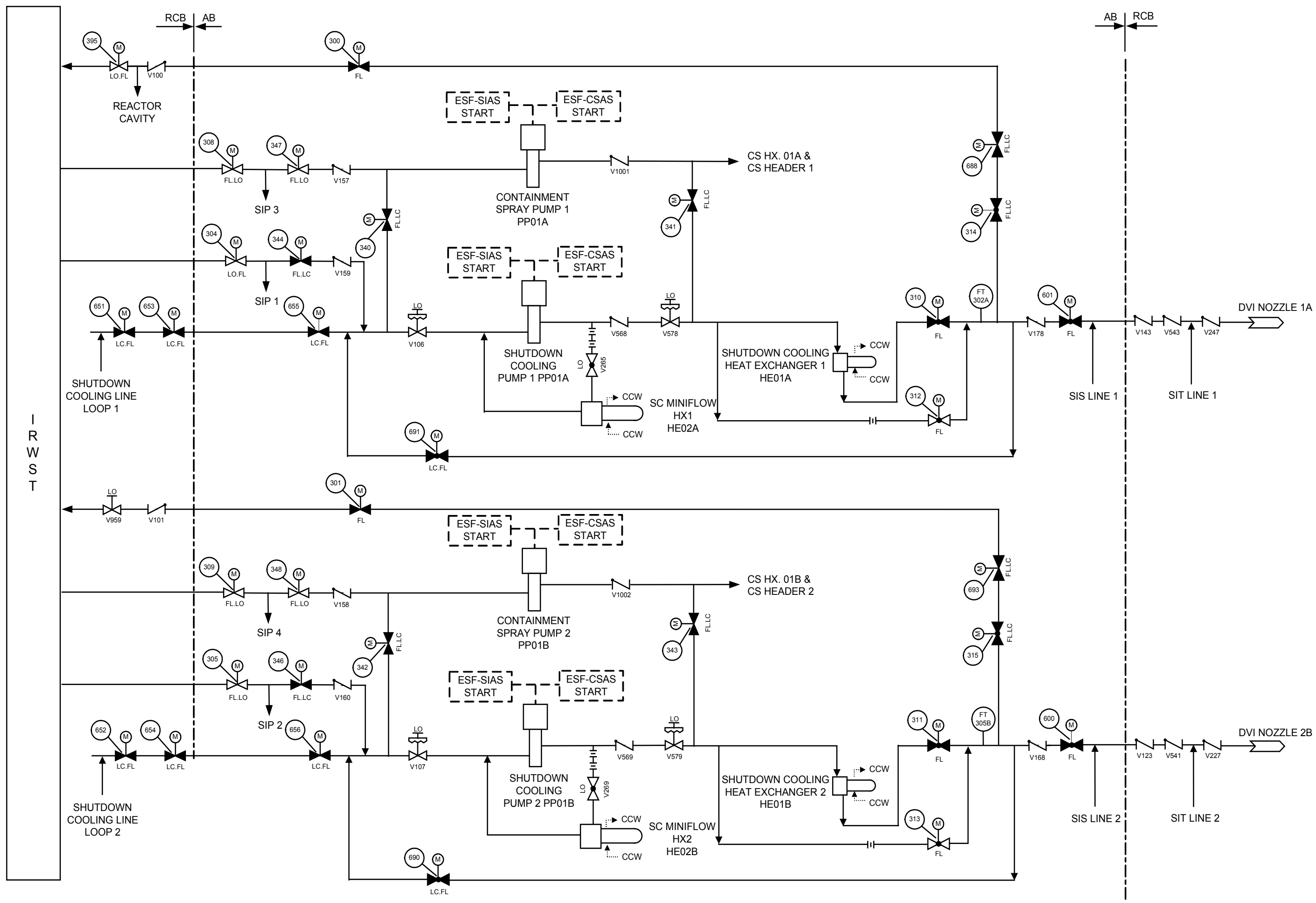

Figure 19.1-2 Simplified Diagram - Shutdown Cooling System

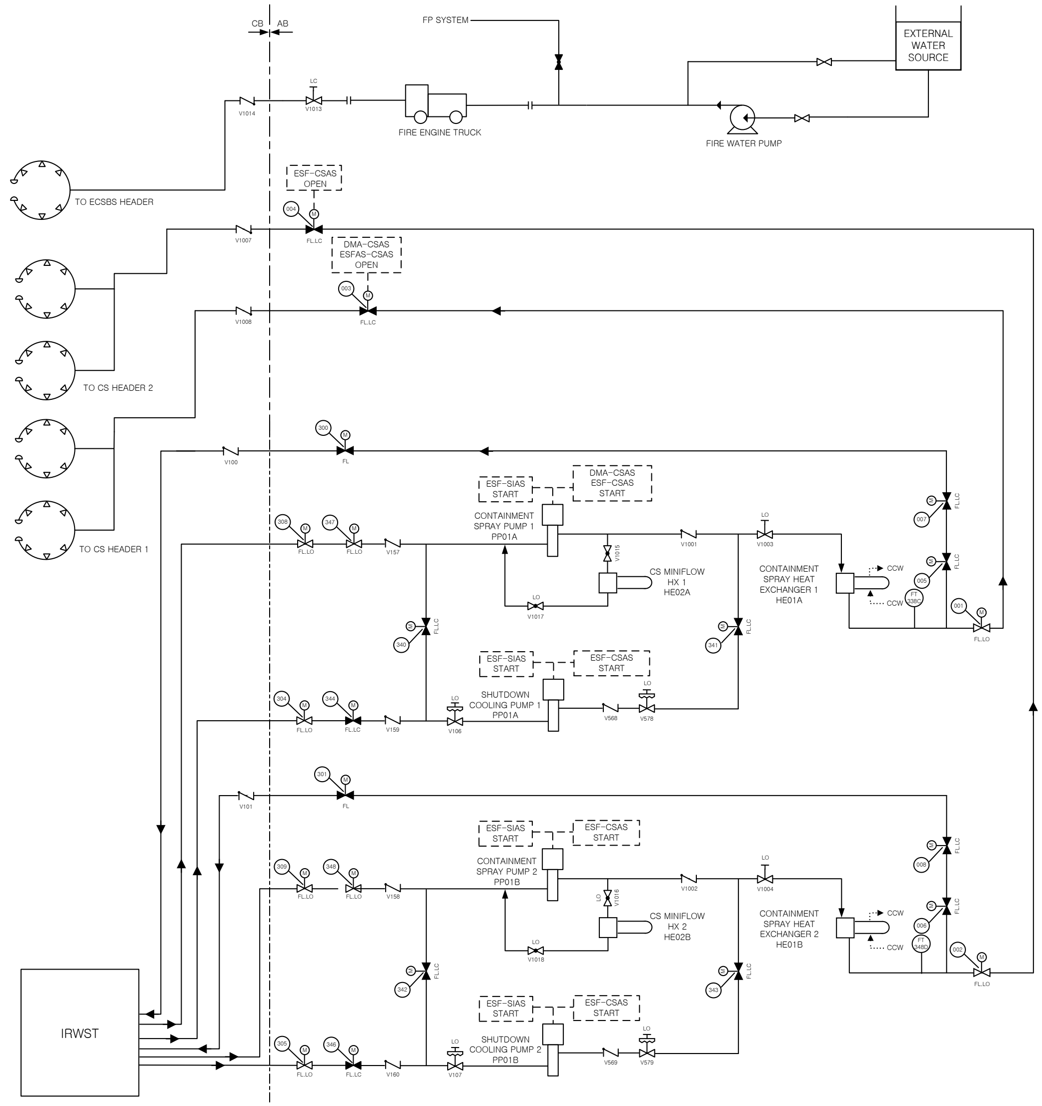

Figure 19.1-3 Simplified Diagram - Containment Spray System

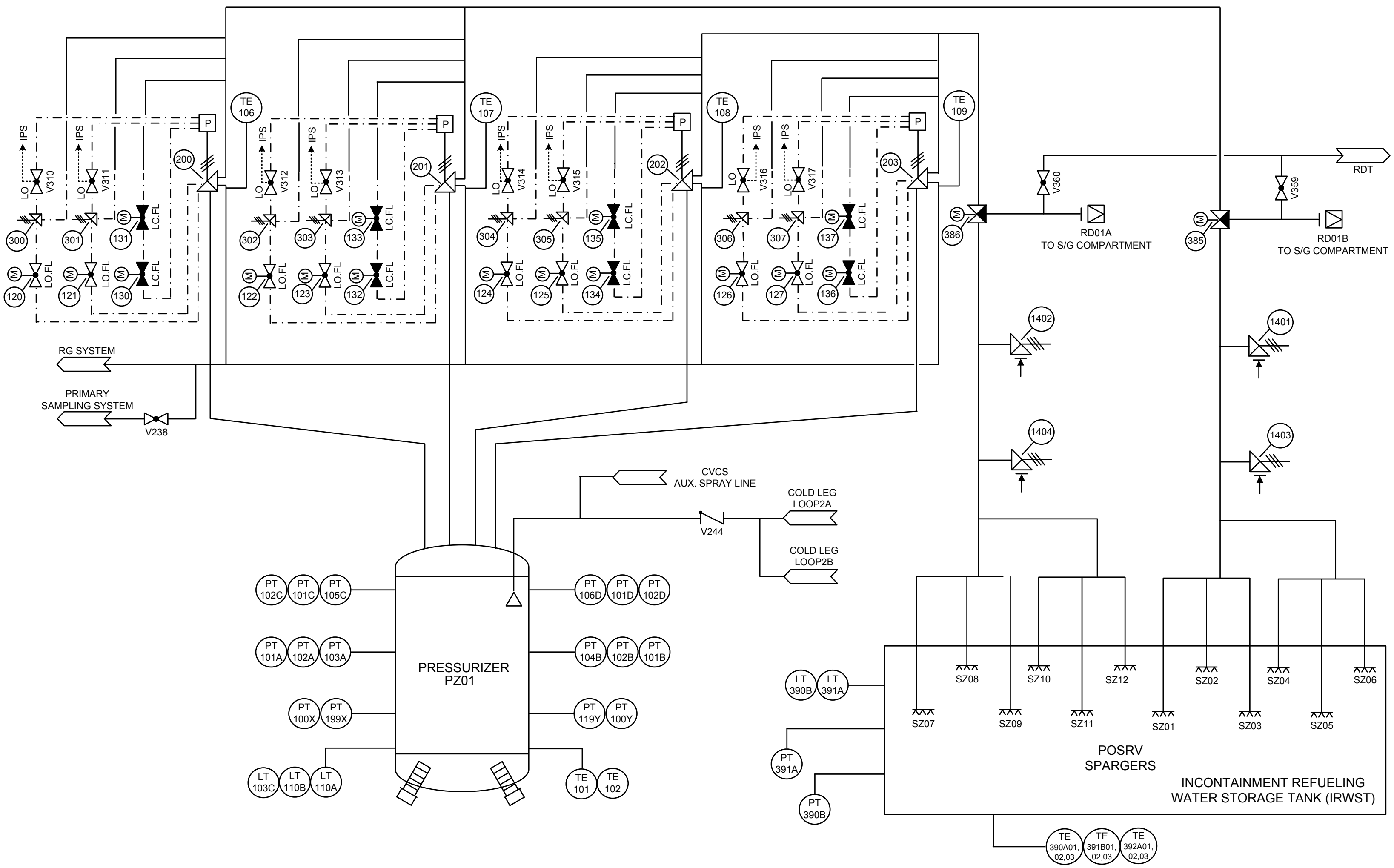

Figure 19.1-4 Simplified Diagram - POSRVs and Discharge Path to IRWST

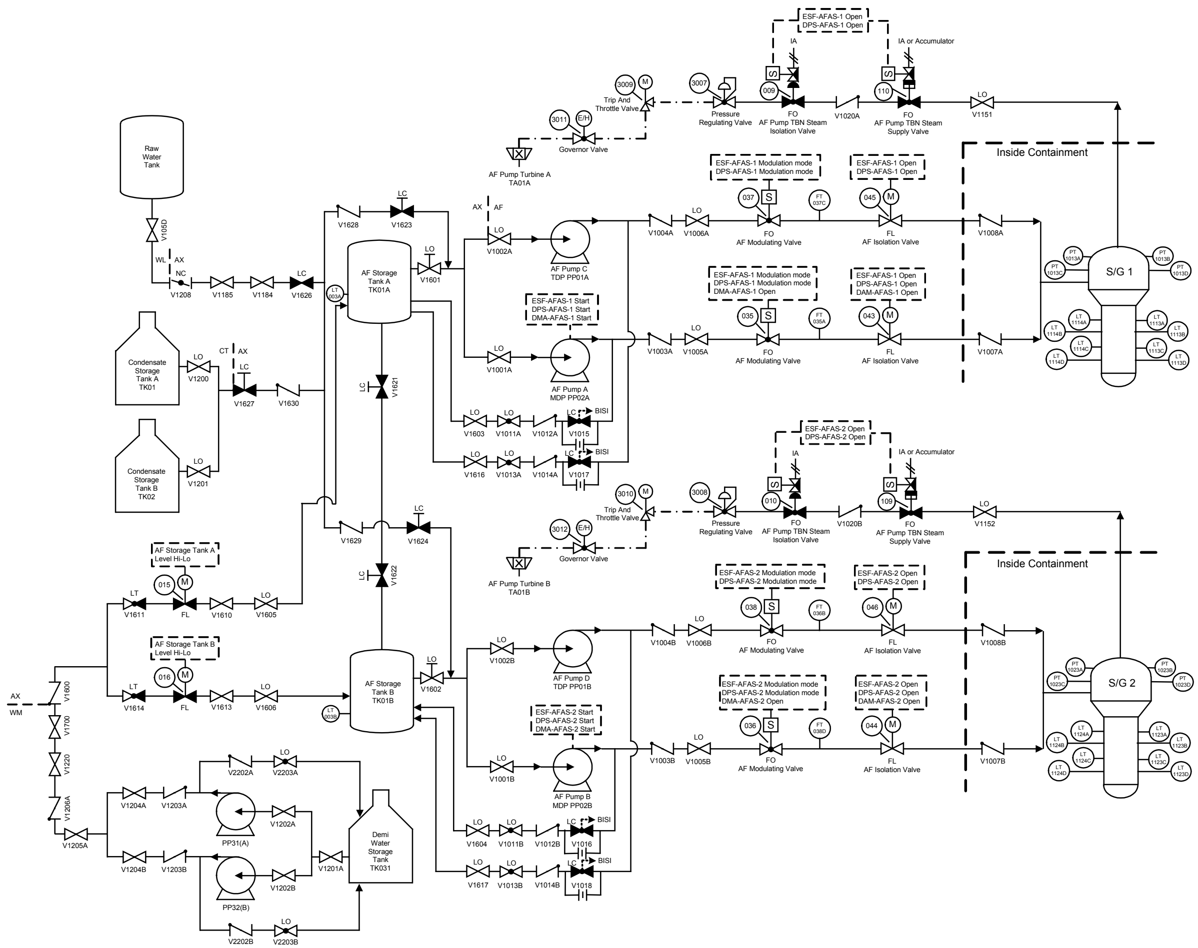

Figure 19.1-5 Simplified Diagram - Auxiliary Feedwater System

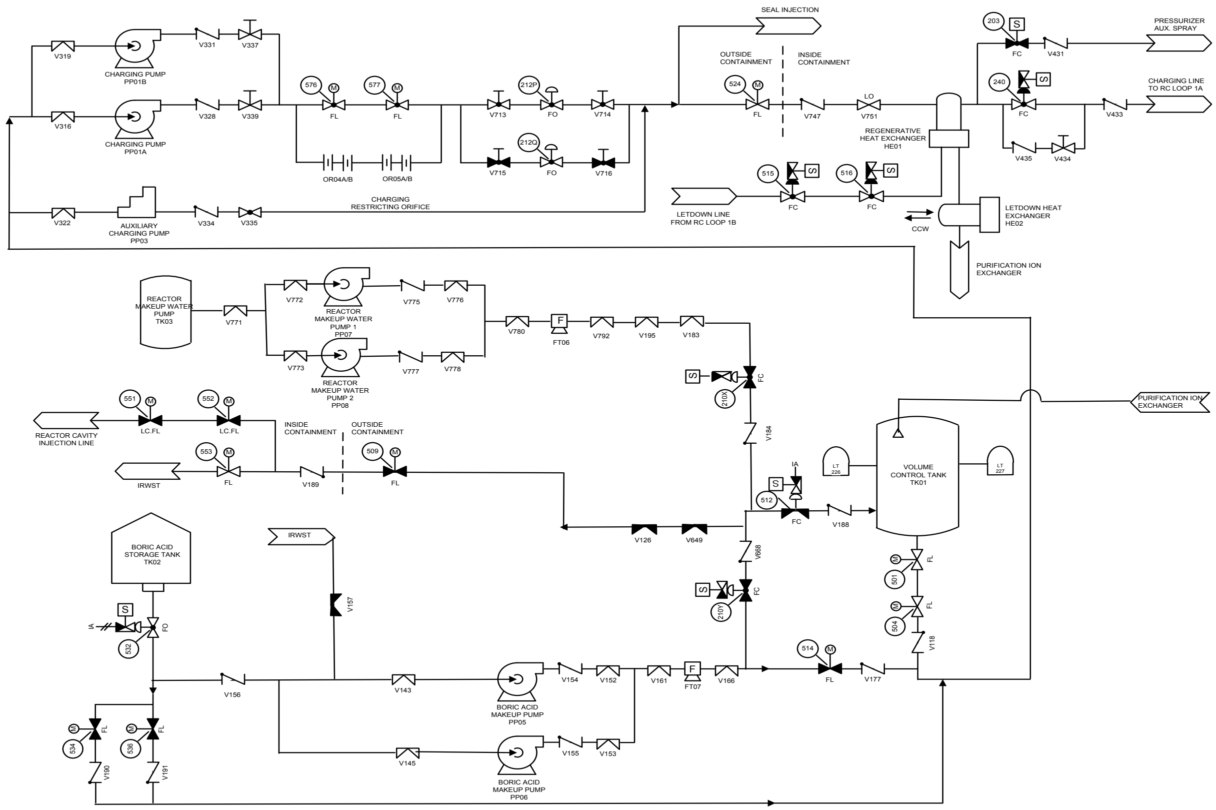

Figure 19.1-6 Simplified Diagram - Chemical and Volume Control System

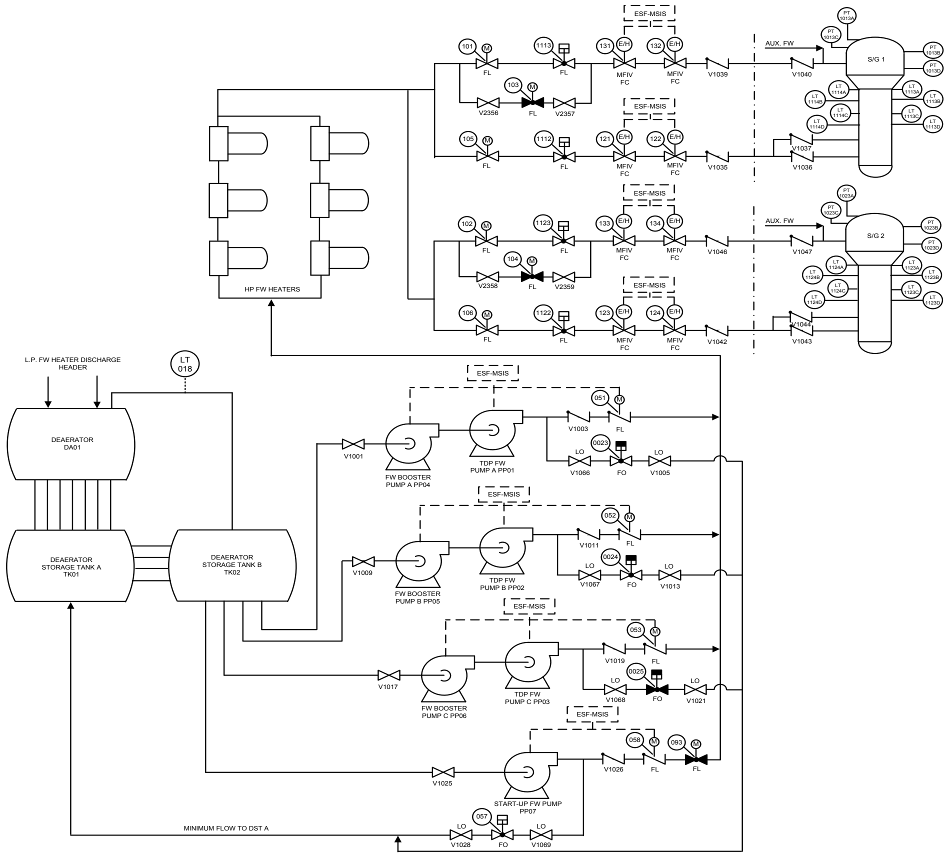

Figure 19.1-7   Simplified Diagram - Feedwater System

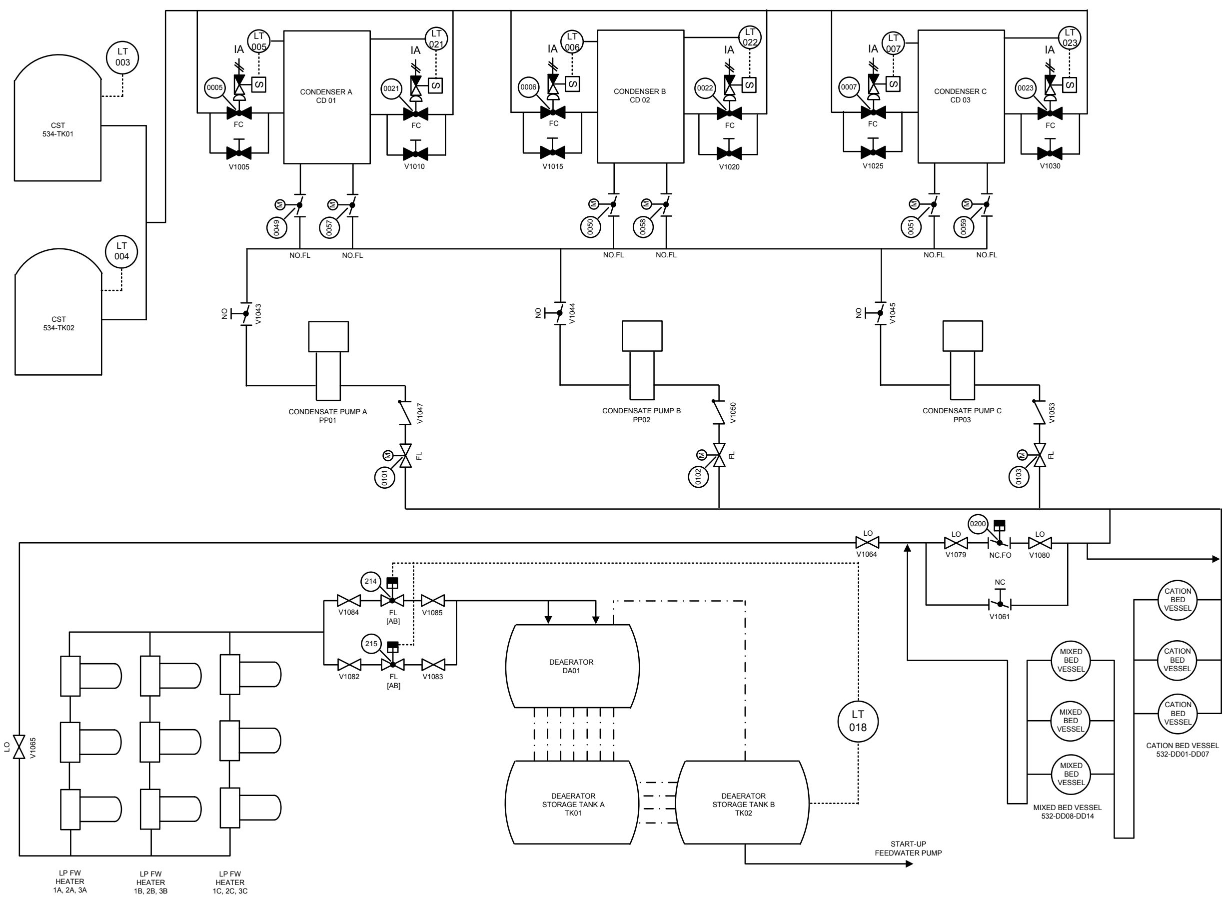

Figure 19.1-8 Simplified Diagram - Condensate System and Condensate Storage and Transfer System

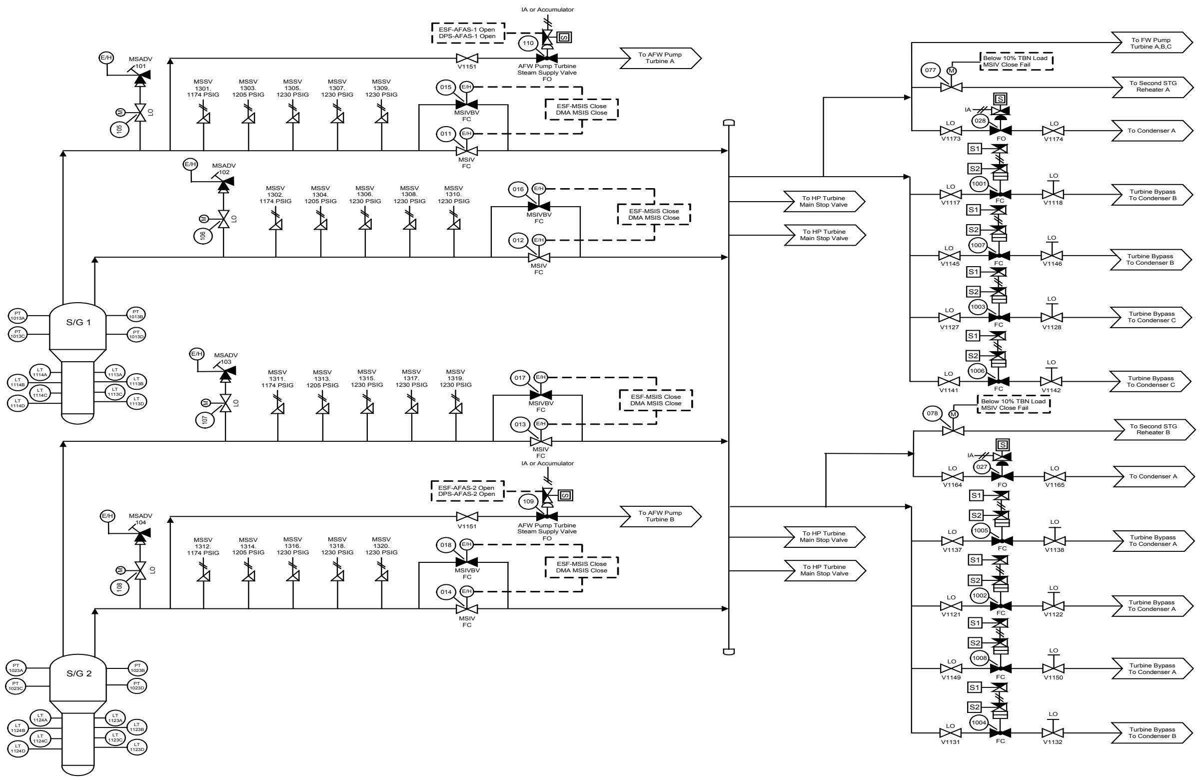

Figure 19.1-9 Simplified Diagram - Main Steam System

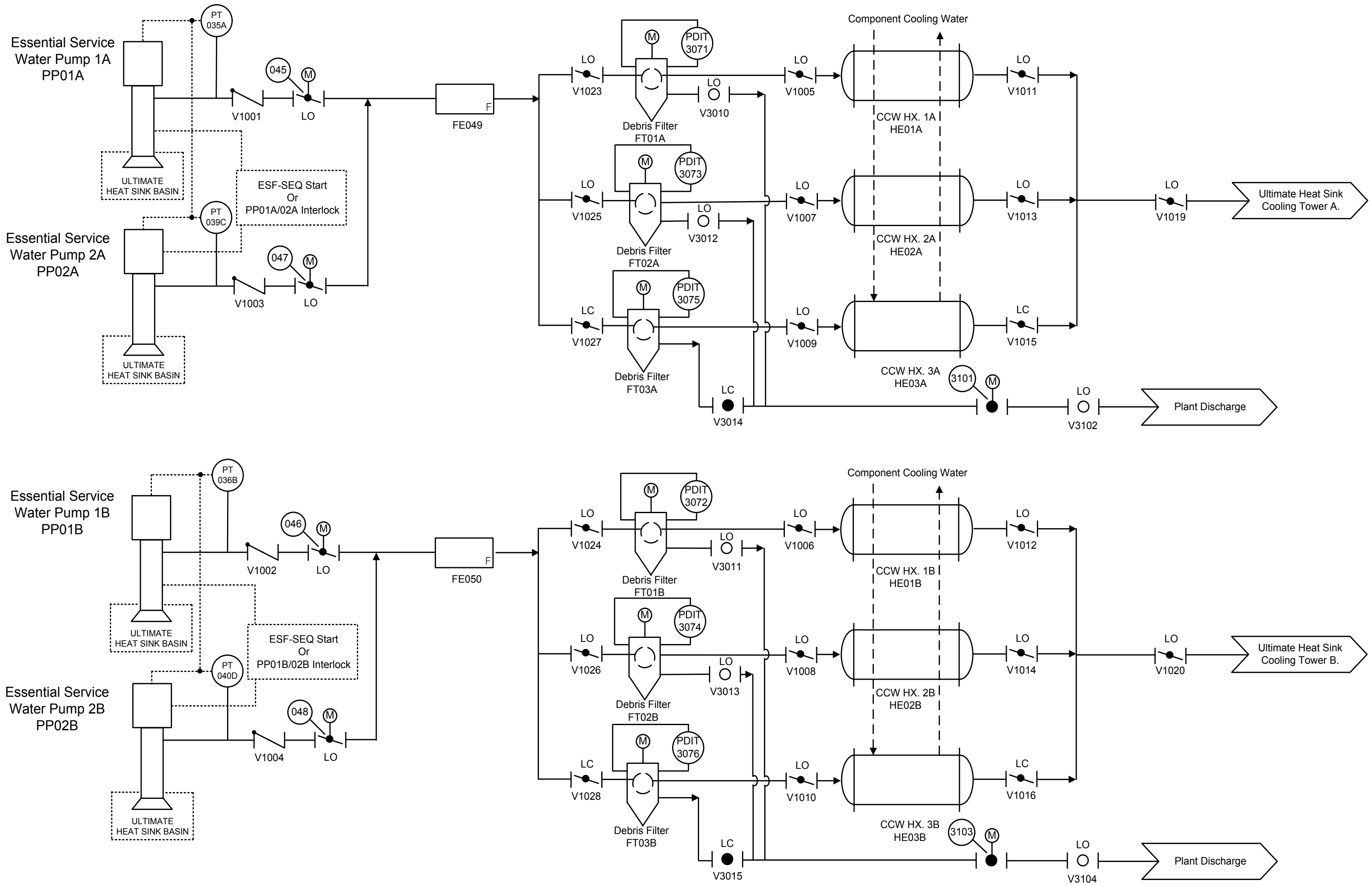

Figure 19.1-10 Simplified Diagram - Essential Service Water System

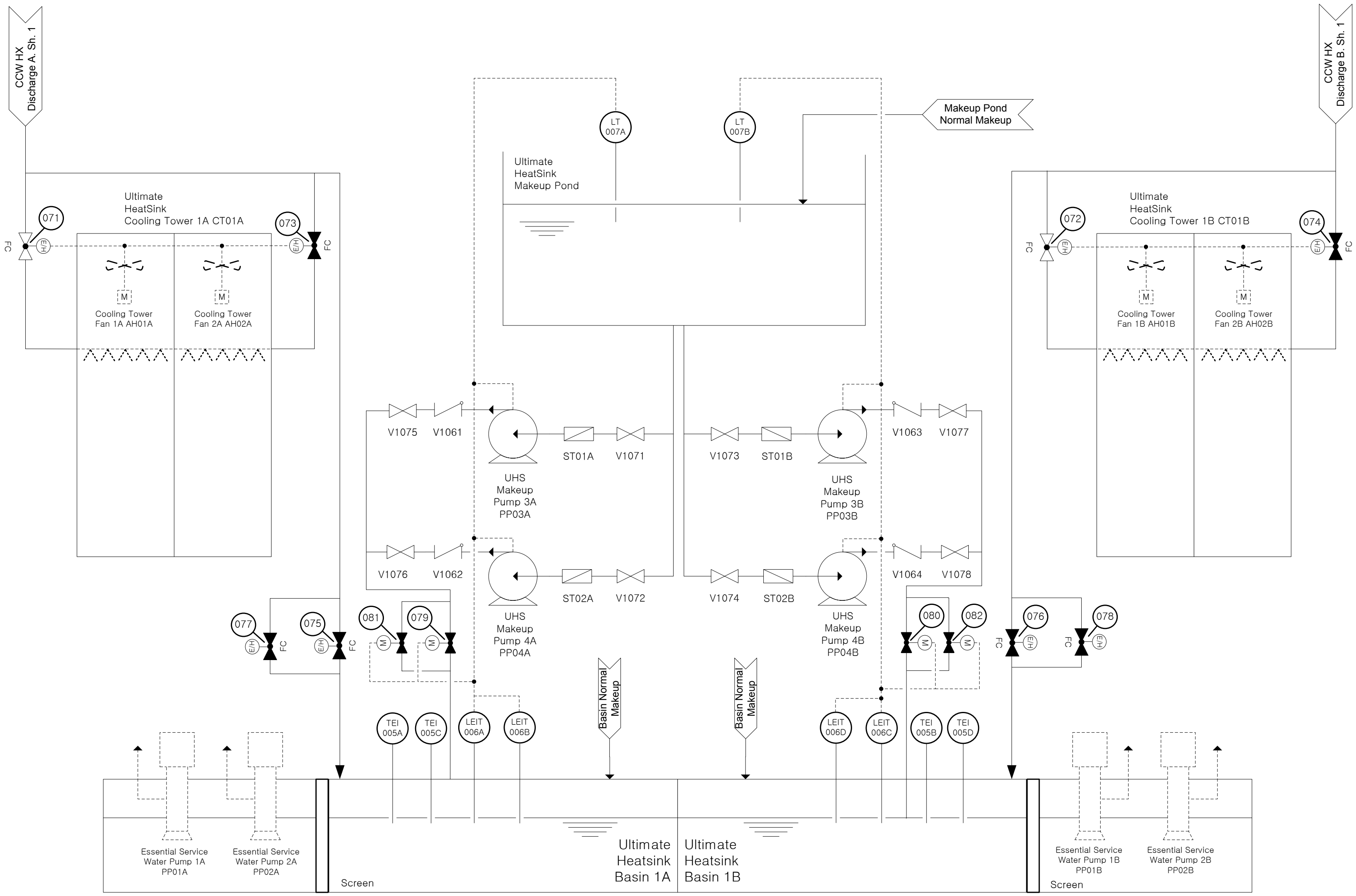

Figure 19.1-11 Simplified Diagram - Ultimate Heat Sink

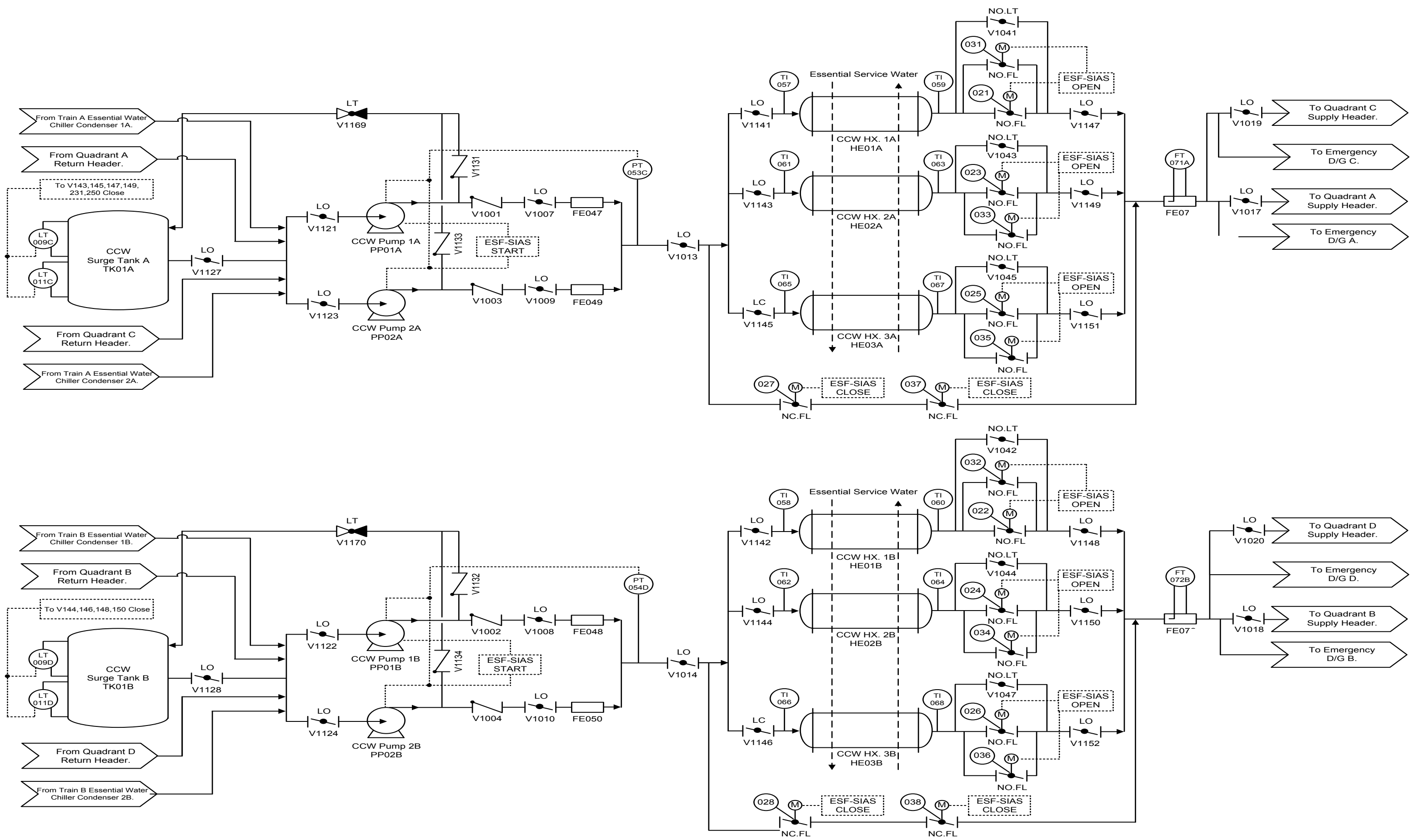

Figure 19.1-12 Simplified Diagram - Component Cooling Water System

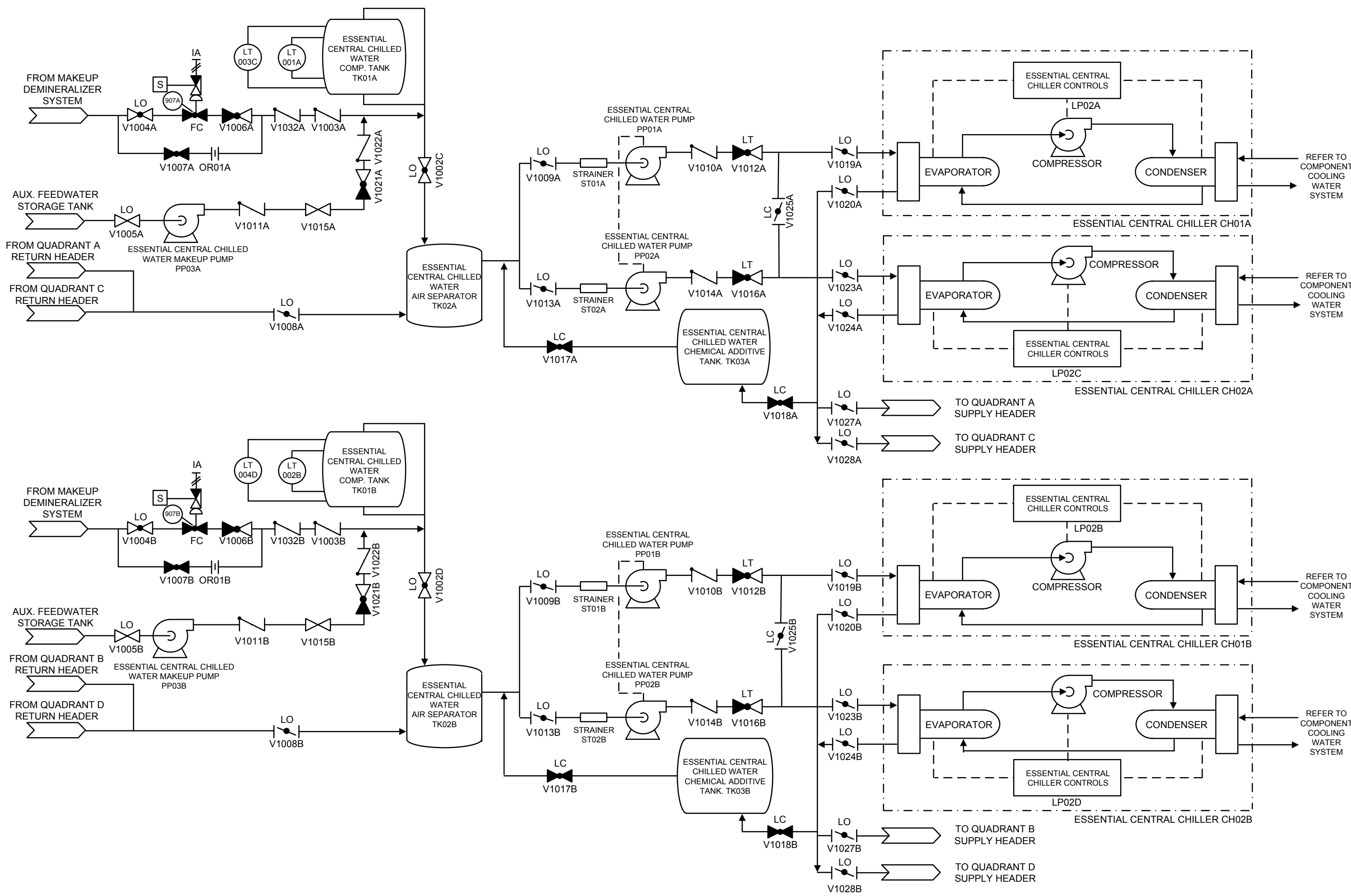

Figure 19.1-13 Simplified Diagram - Essential Chilled Water System

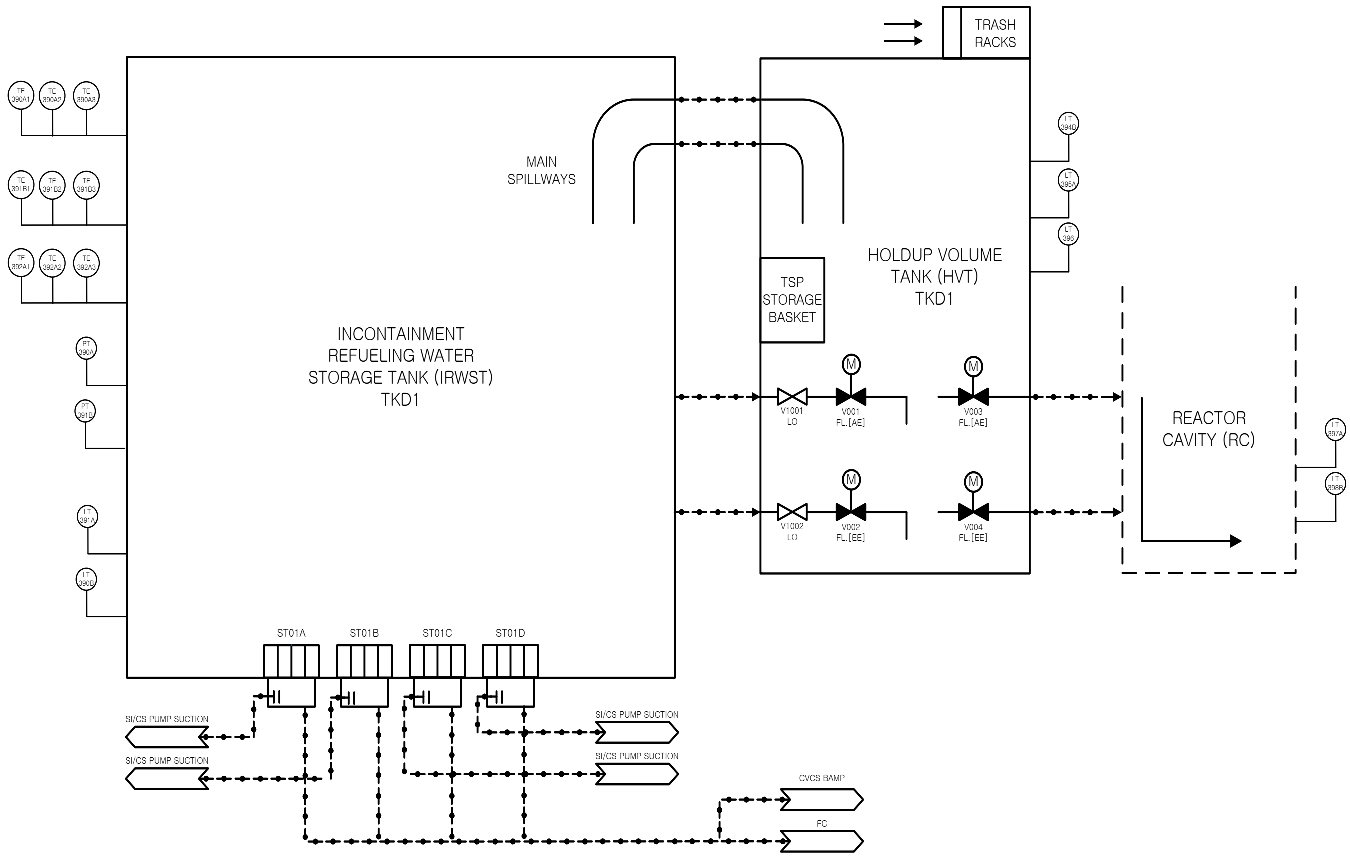

Figure 19.1-14 Simplified Diagram - IRWST, HVT and CFS

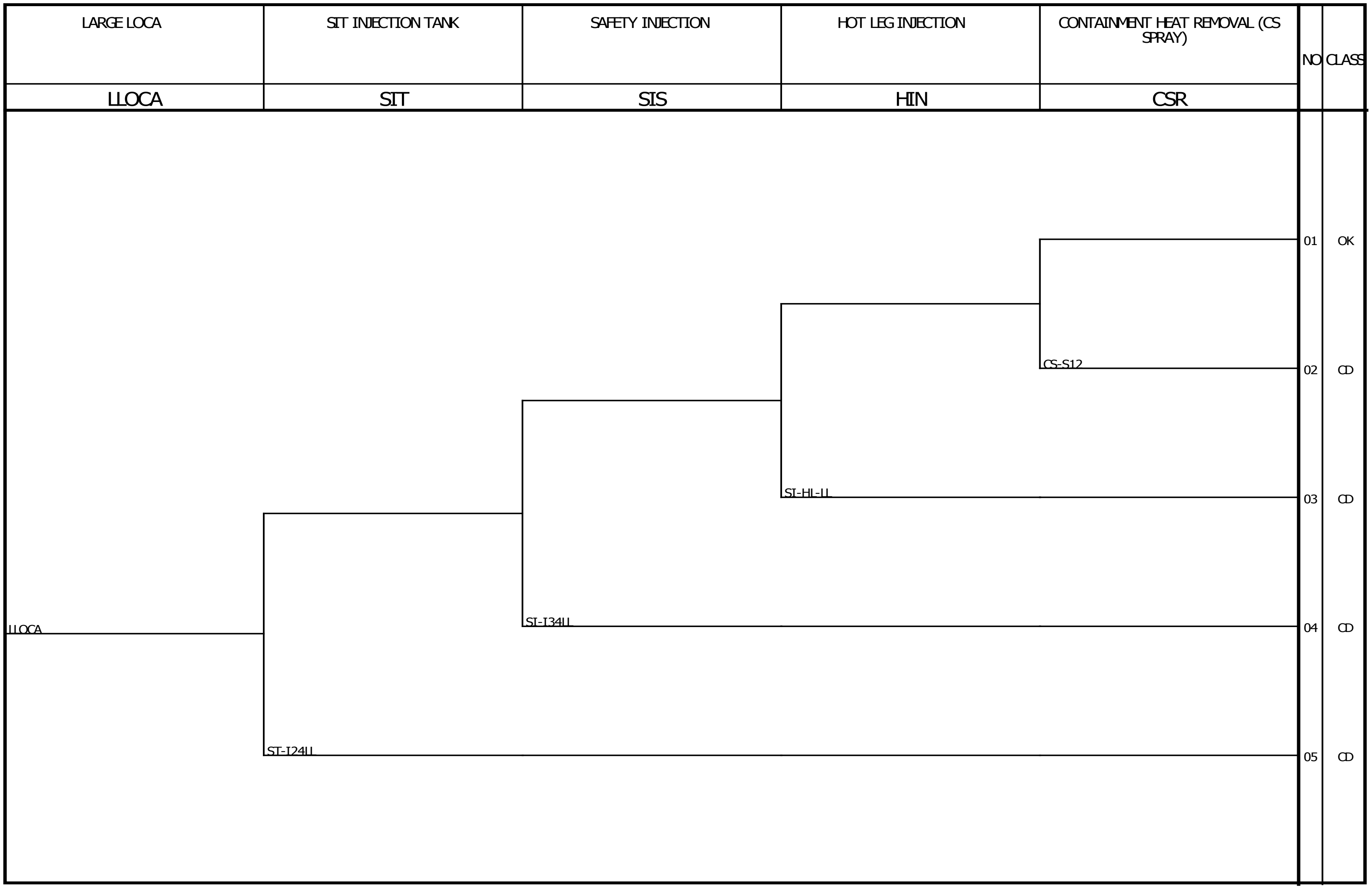

Figure 19.1-15 Level 1 Event Tree - Large LOCA (LLOCA)

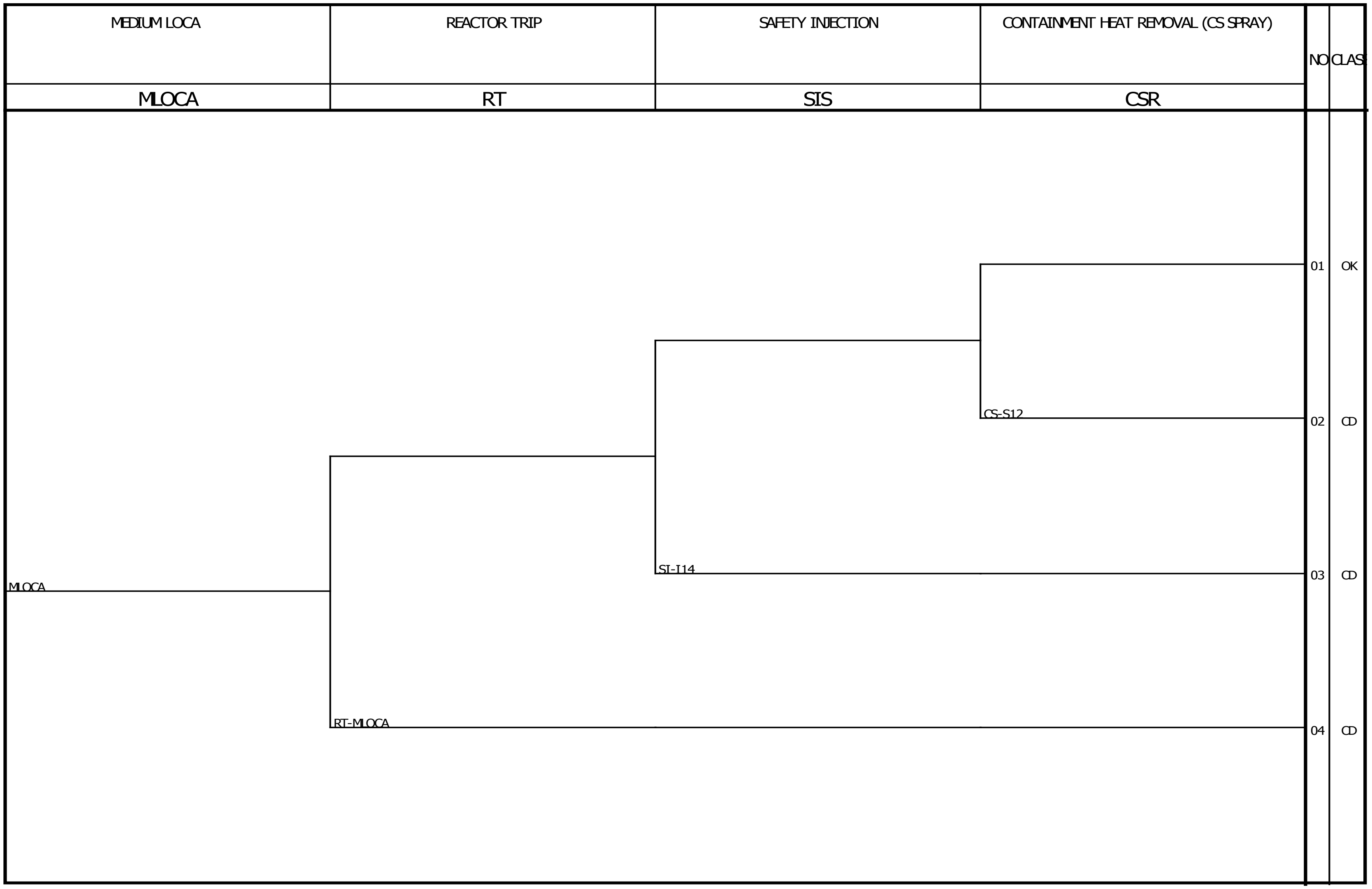

Figure 19.1-16 Level 1 Event Tree - Medium LOCA (MLOCA)

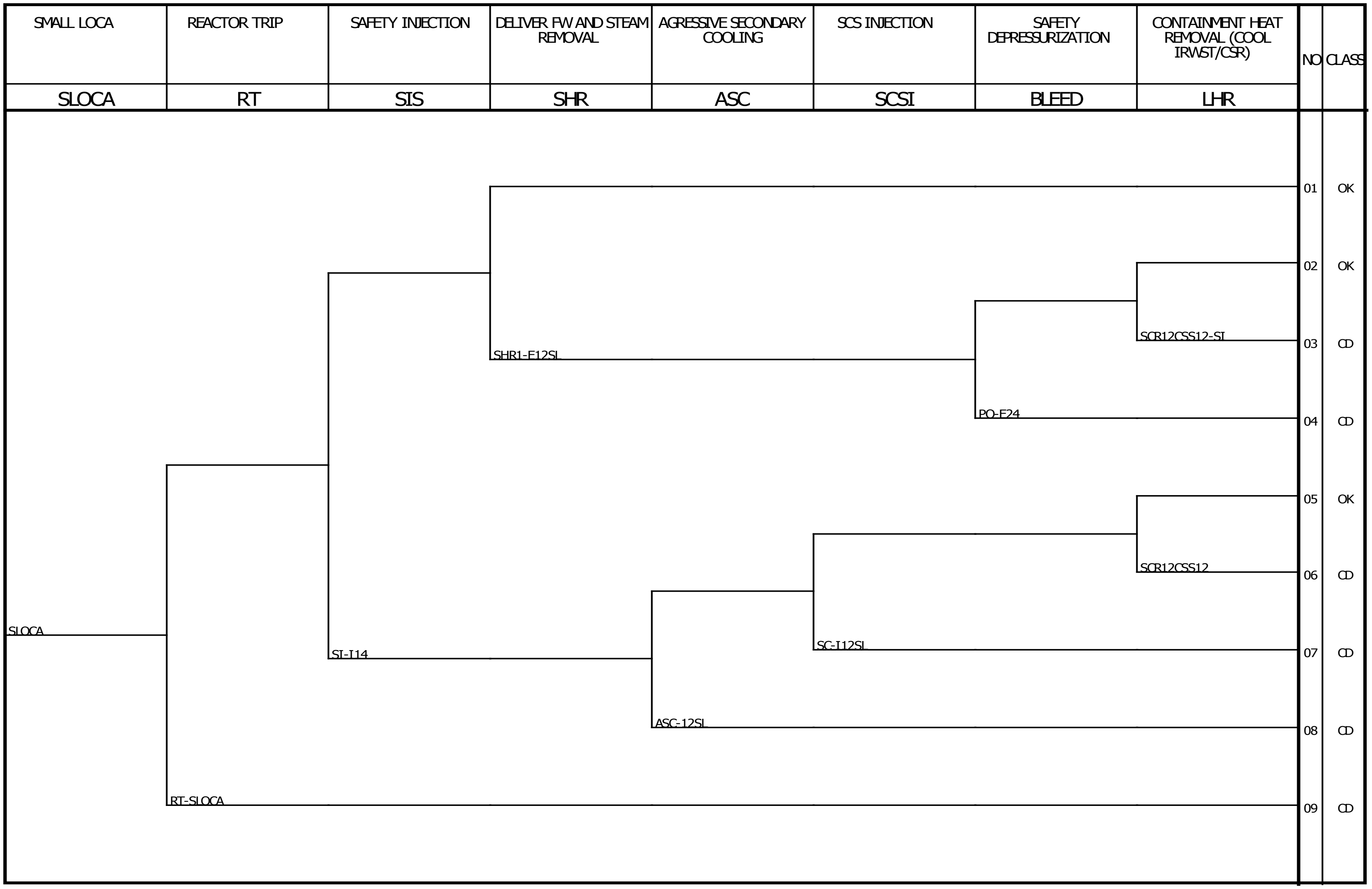

Figure 19.1-17   Level 1 Event Tree - Small LOCA (SLOCA)

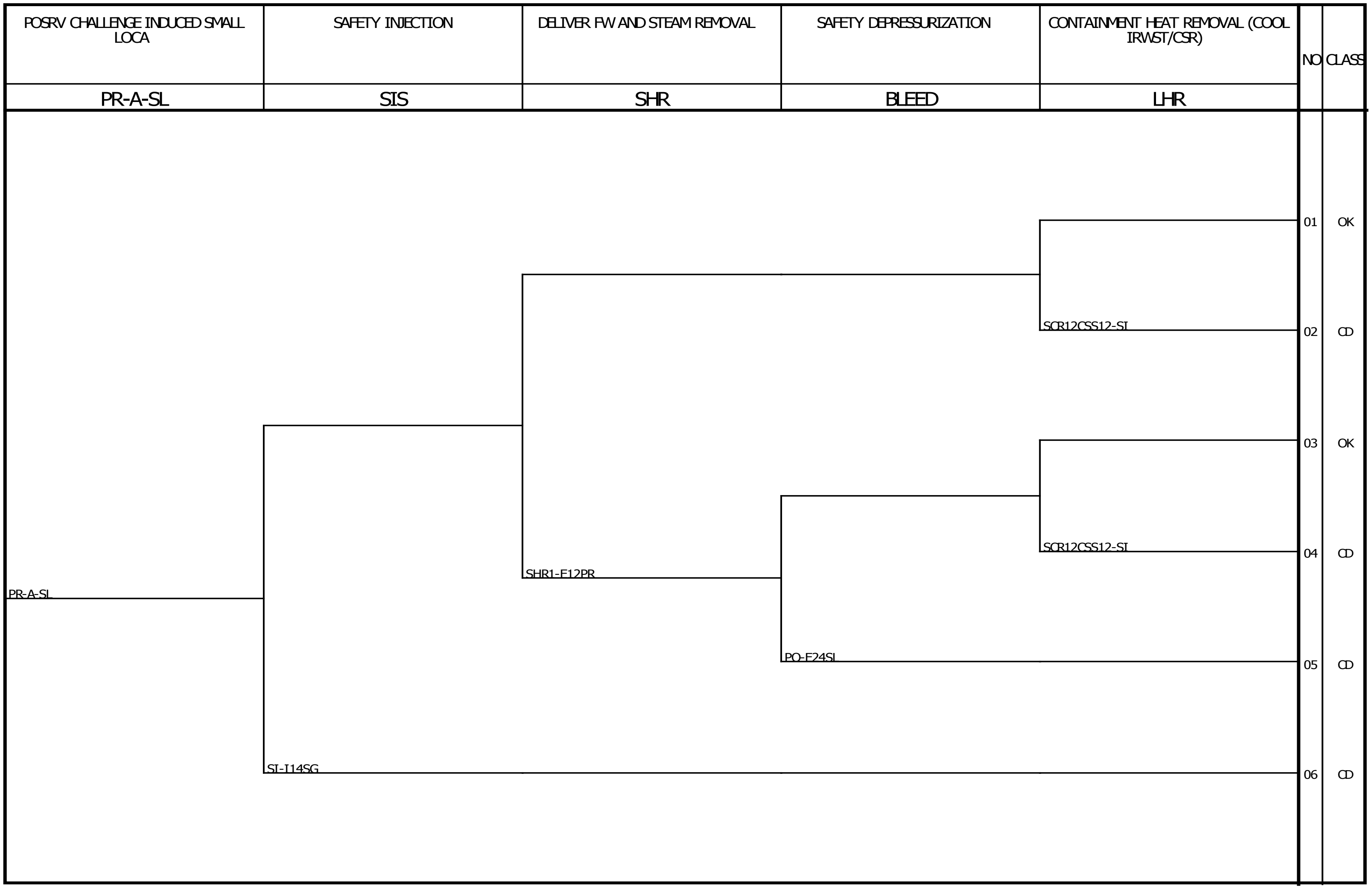

Figure 19.1-18 Level 1 Event Tree - Stuck Open POSRVs (PR-SL)

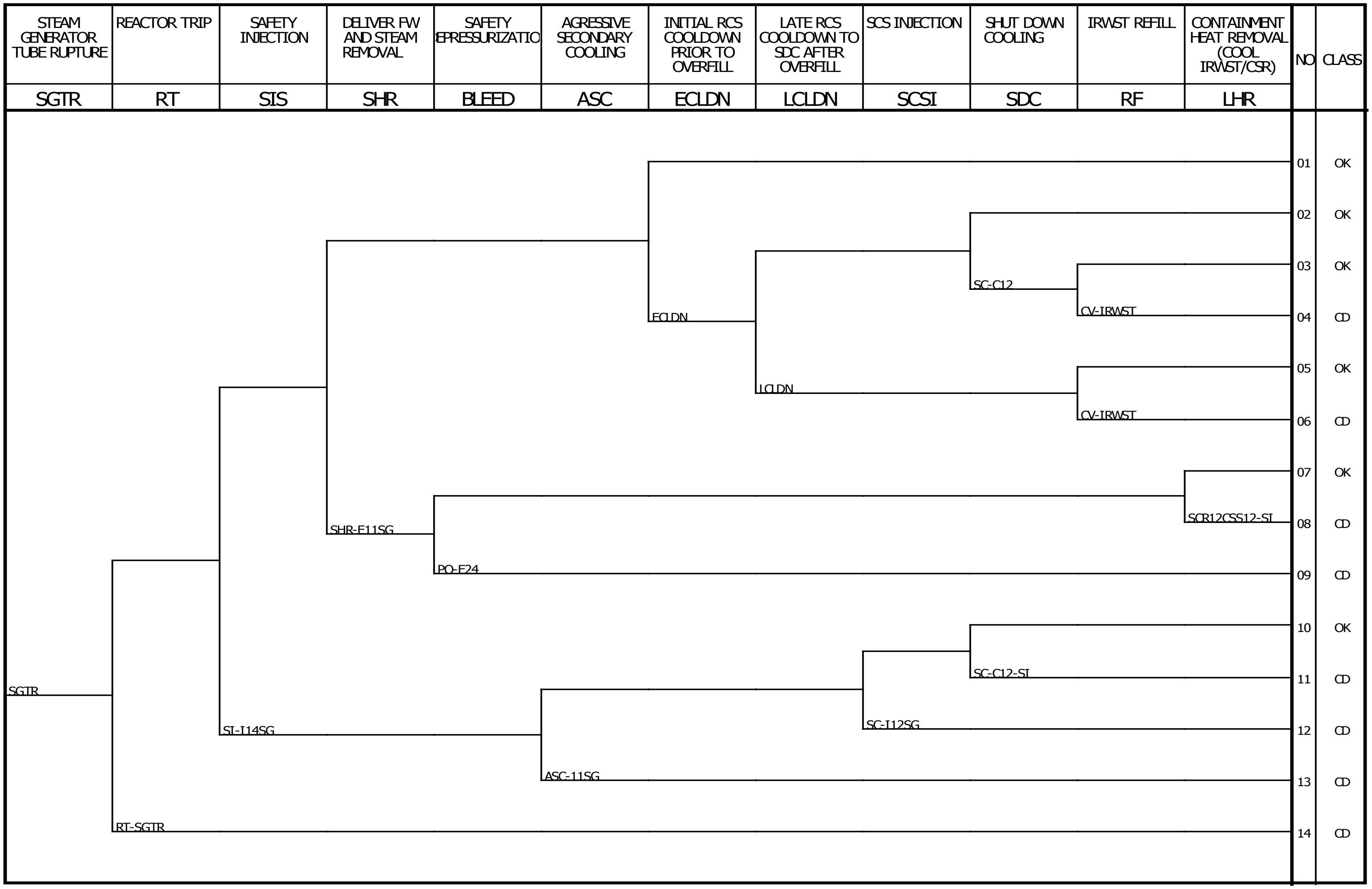

Figure 19.1-19 Level 1 Event Tree - Steam Generator Tube Rupture (SGTR)

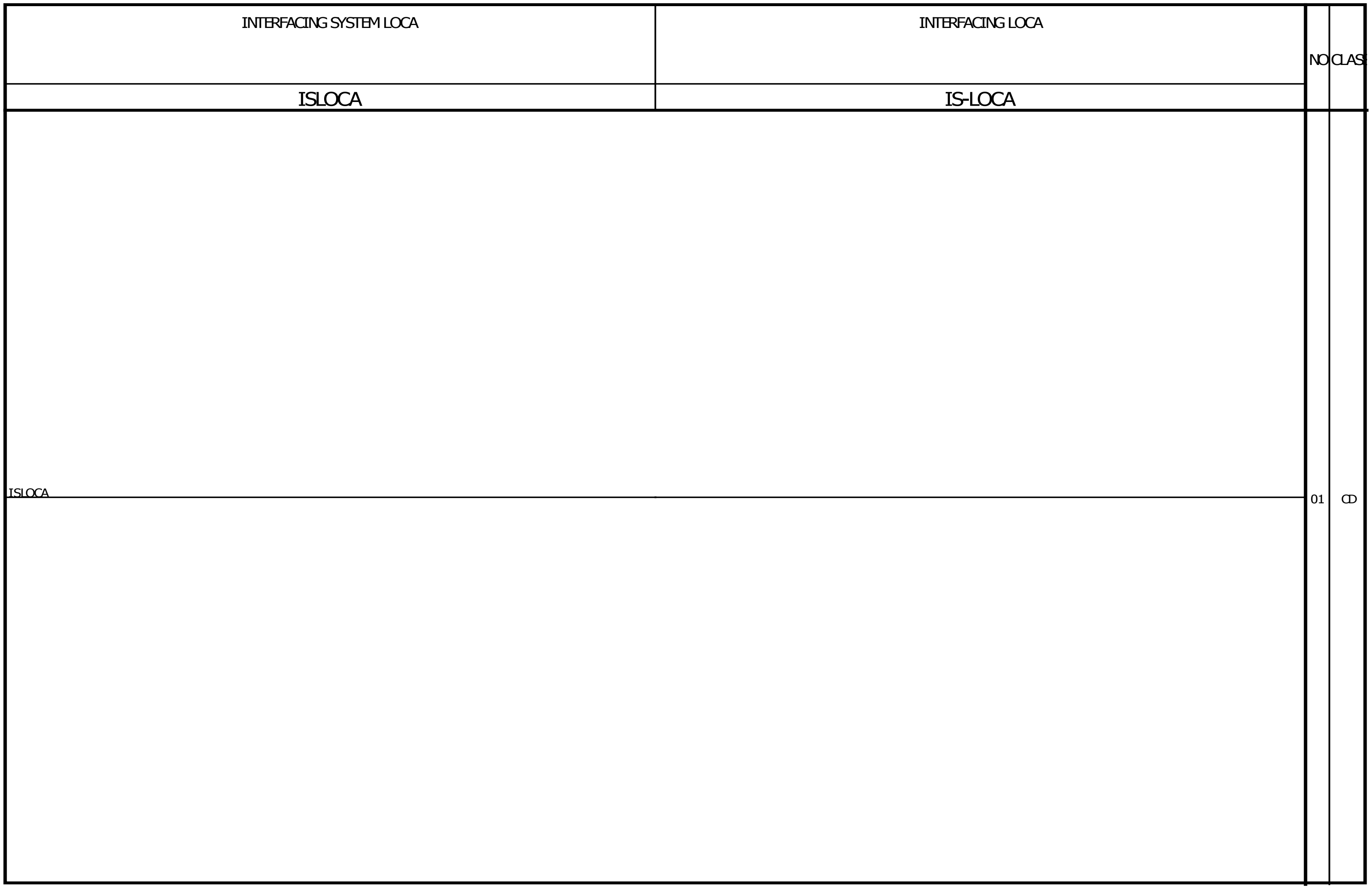

Figure 19.1-20 Level 1 Event Tree - Interfacing System LOCA (ISLOCA)

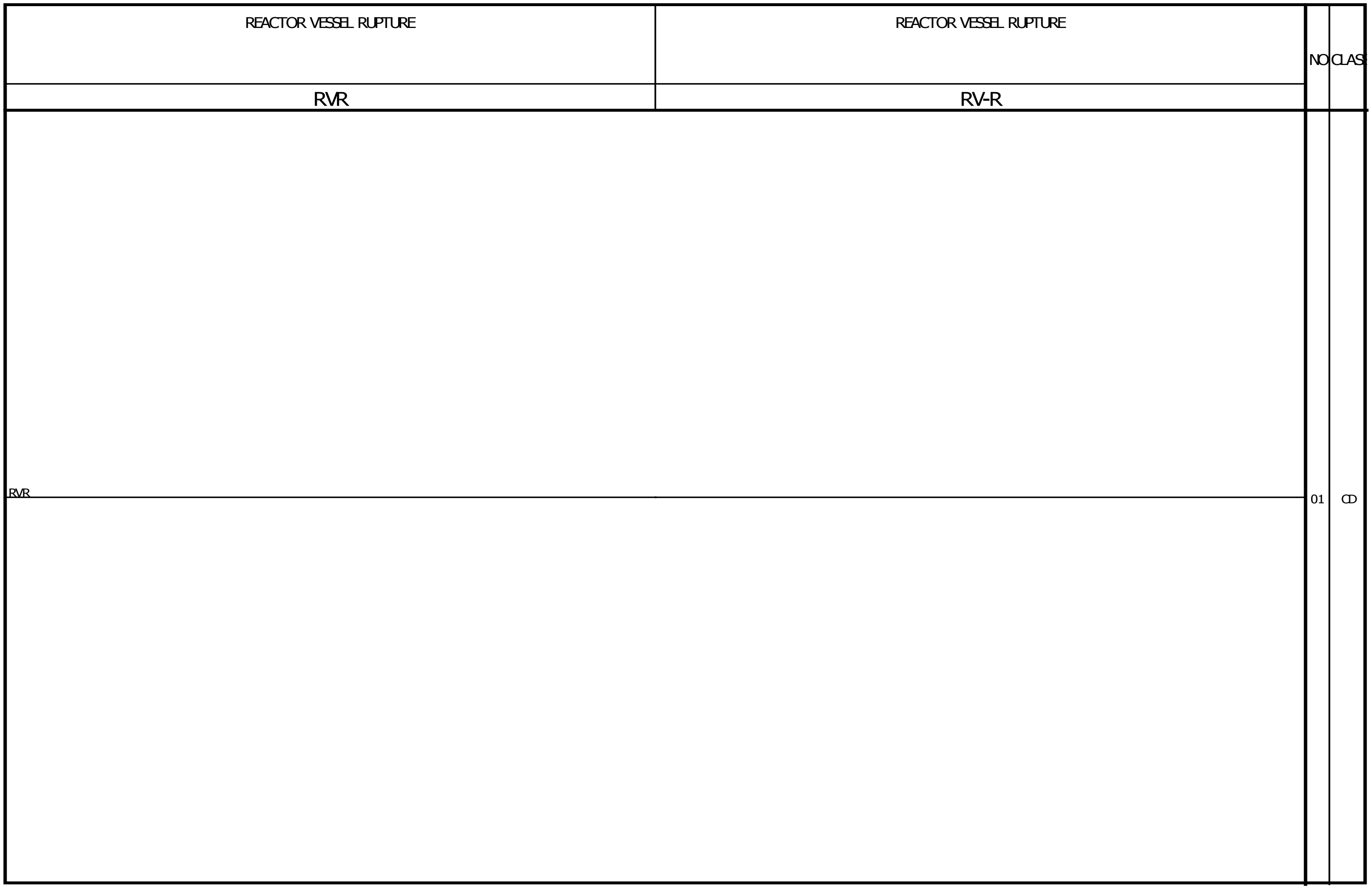

Figure 19.1-21 Level 1 Event Tree - Reactor Vessel Rupture (RVR)

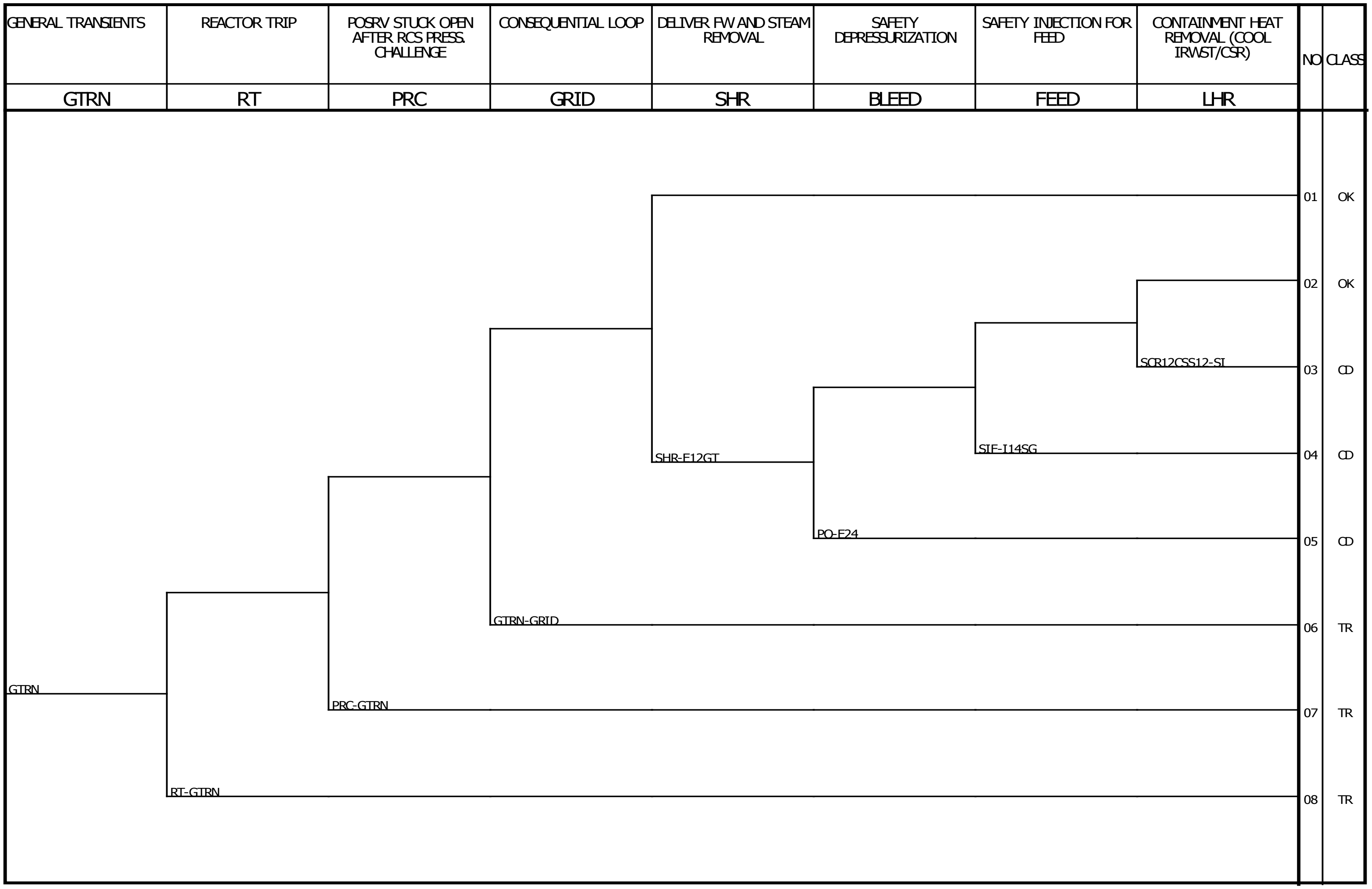

Figure 19.1-22 Level 1 Event Tree - General Transient (GTRN)

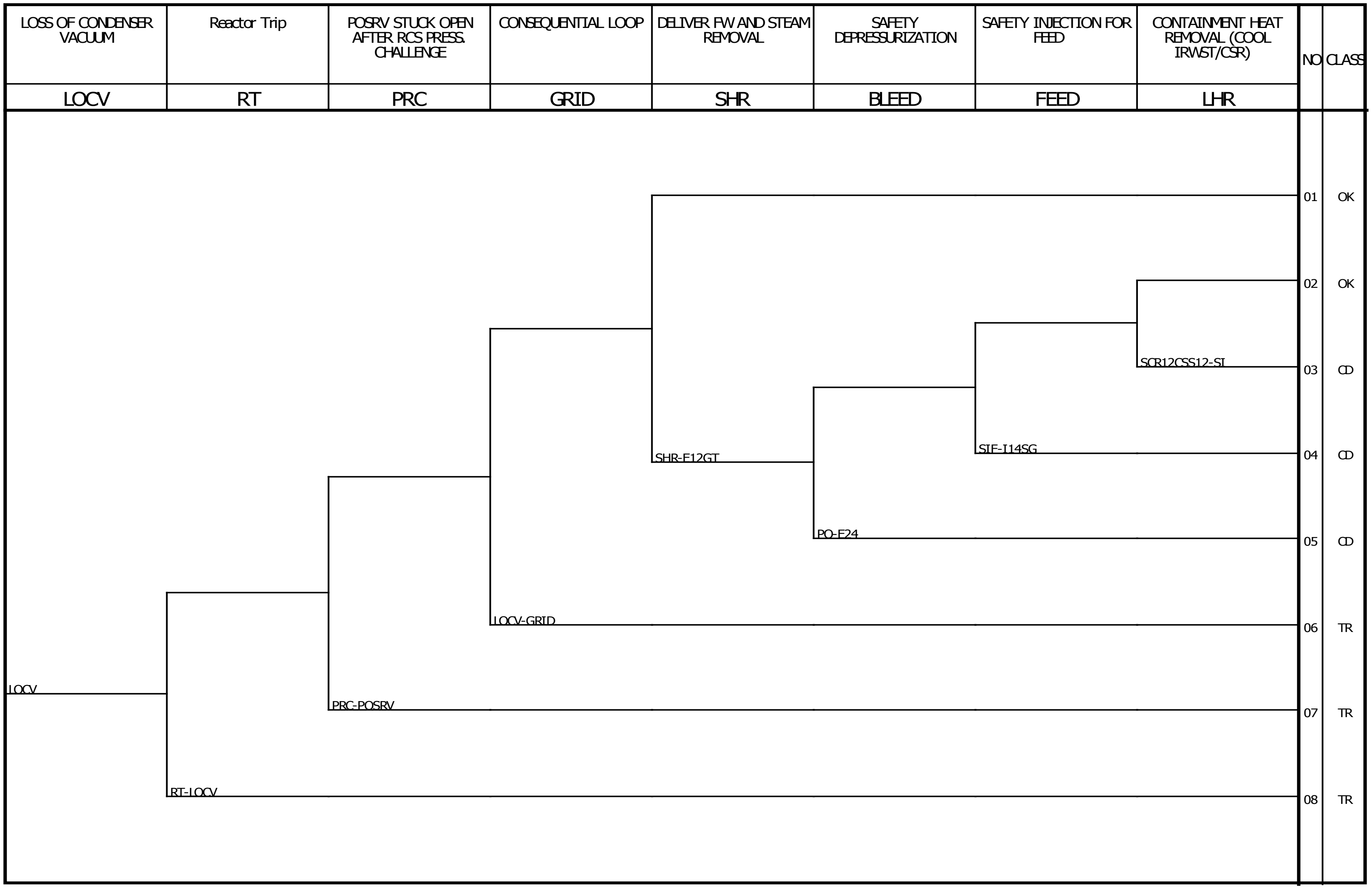

Figure 19.1-23 Level 1 Event Tree - Loss of Condenser Vacuum (LOCV)

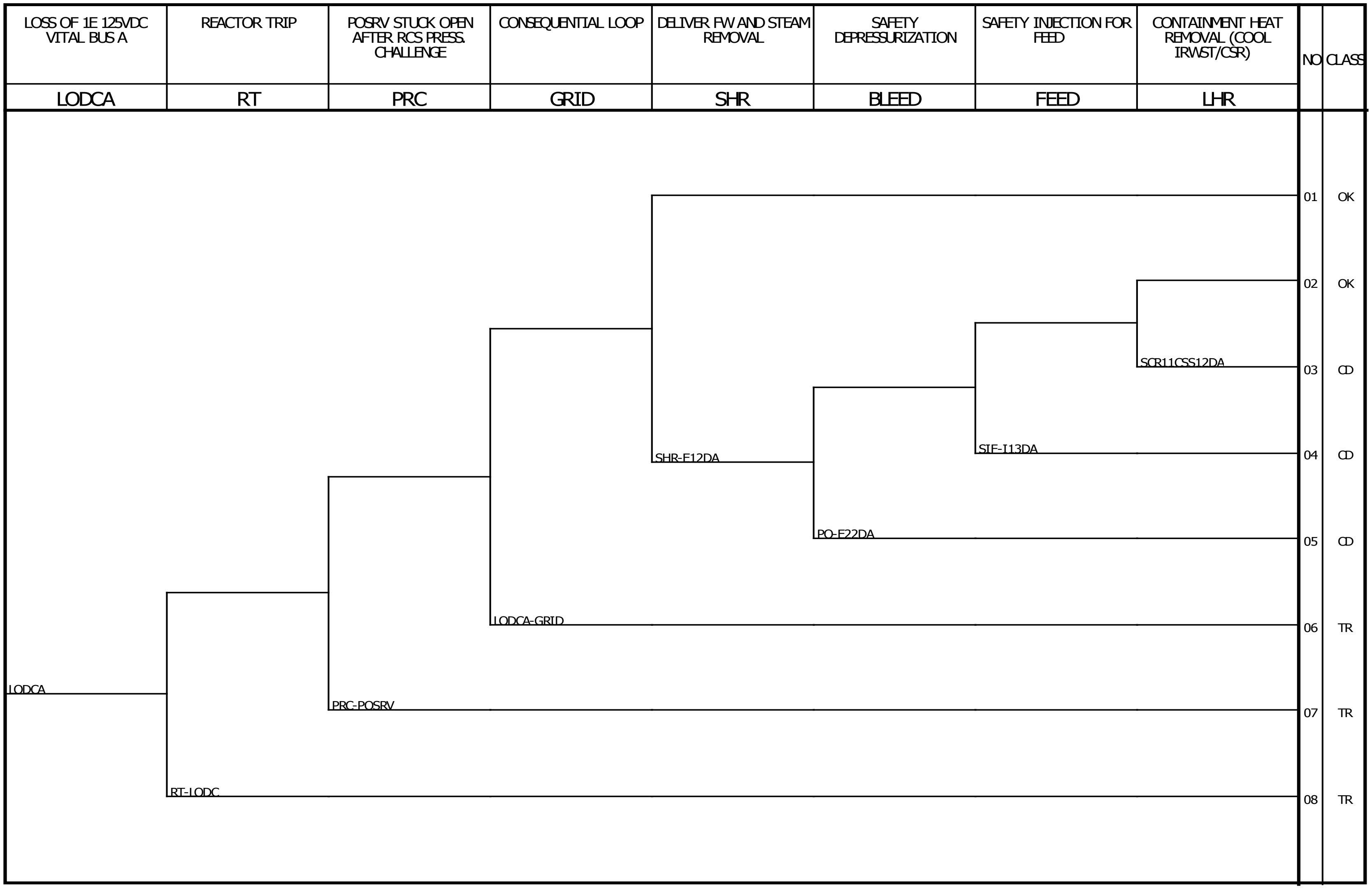

Figure 19.1-24 Level 1 Event Tree - Loss of 125 Vdc - Bus A (LODCA)

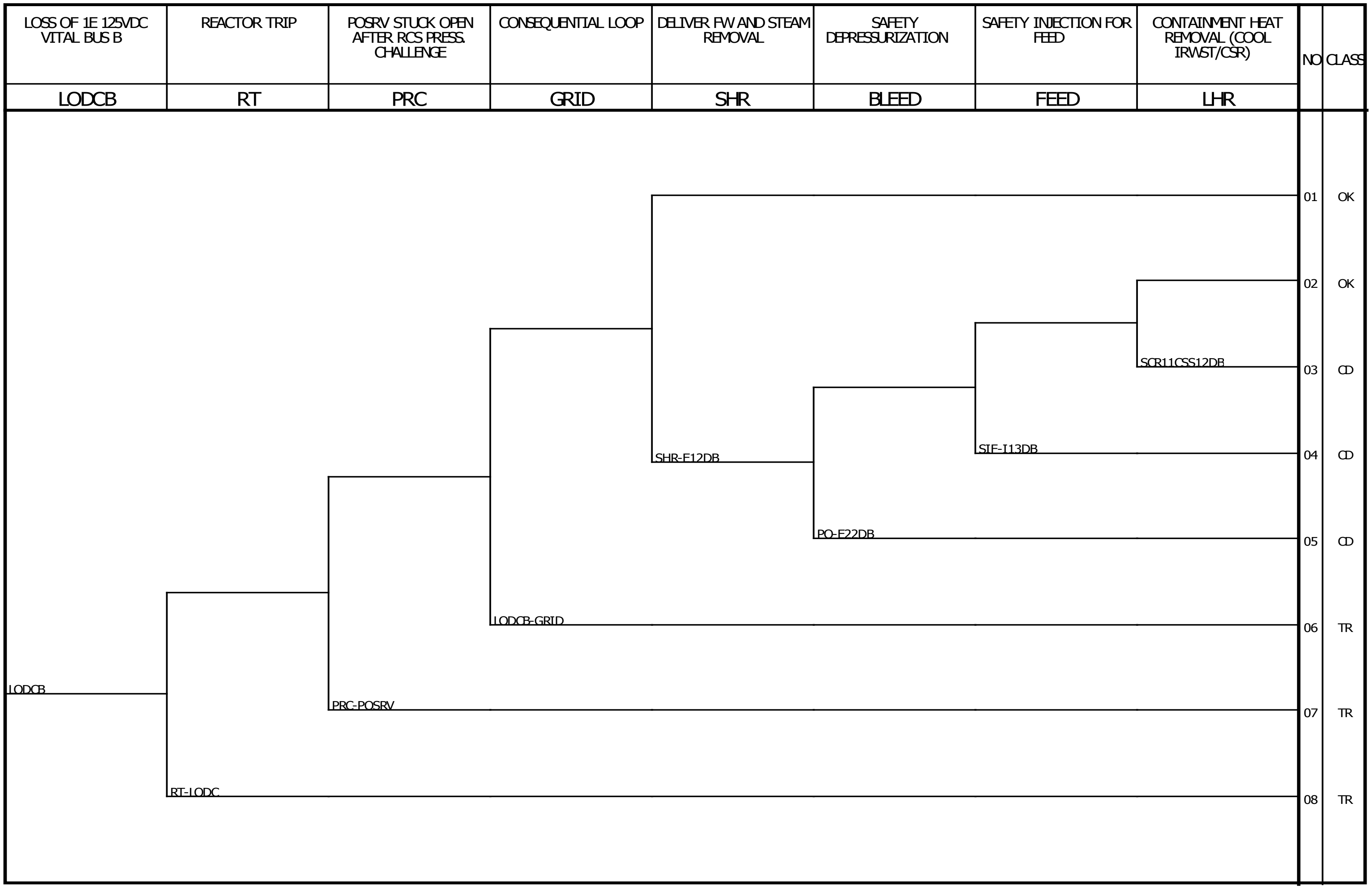

Figure 19.1-25 Level 1 Event Tree - Loss of 125 Vdc - Bus B (LODCB)

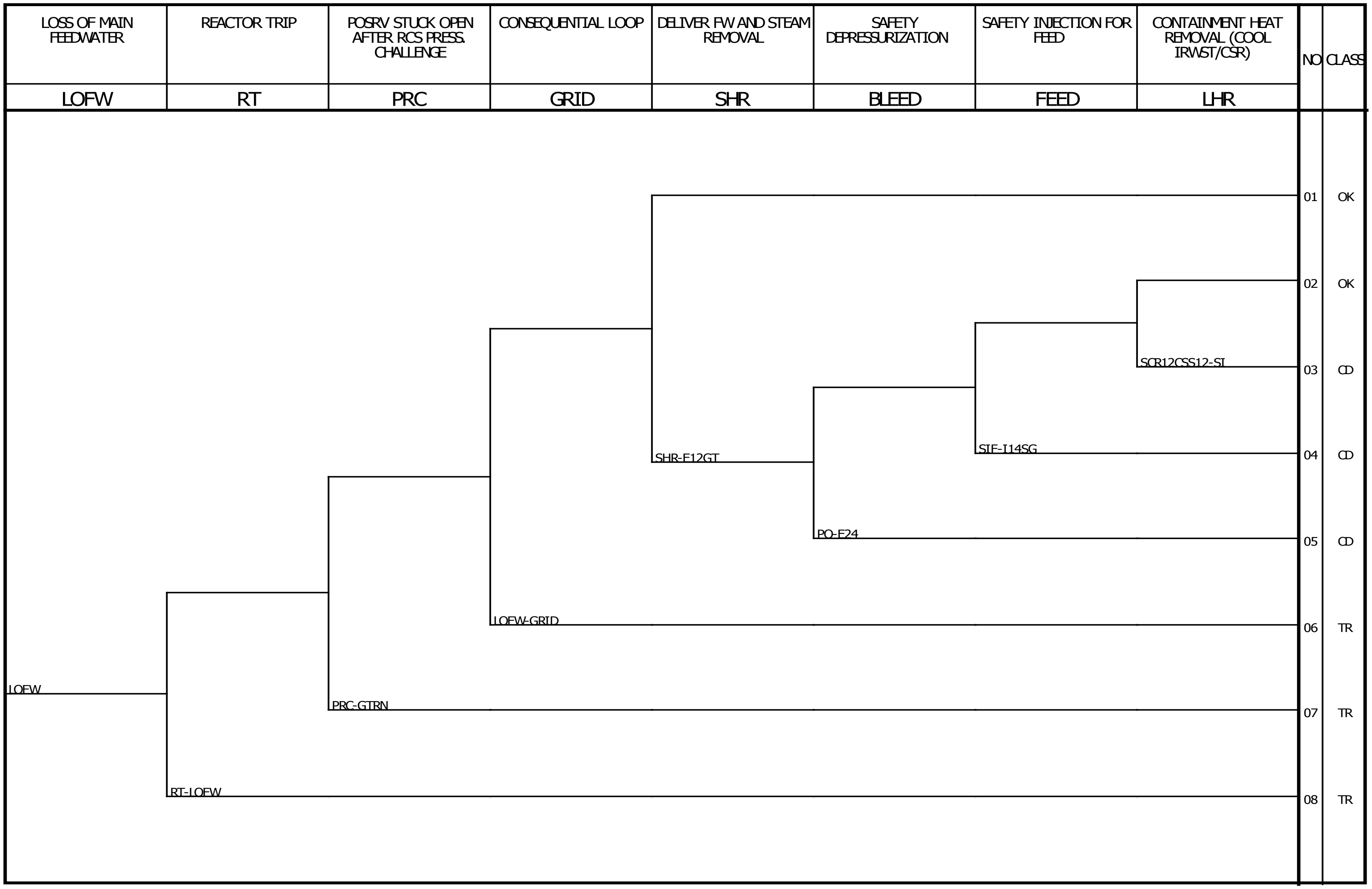

Figure 19.1-26 Level 1 Event Tree - Loss of Feedwater (LOFW)

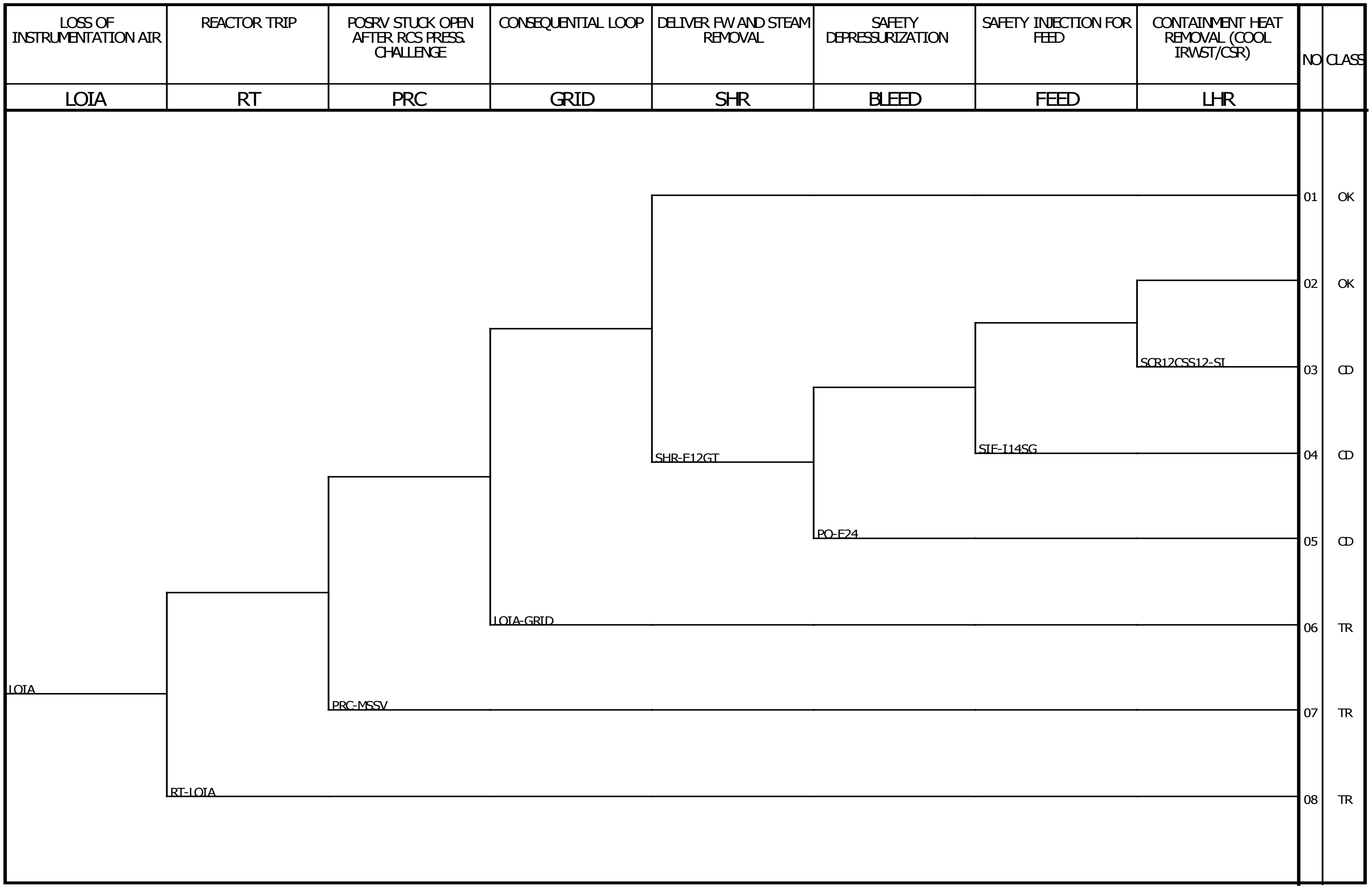

Figure 19.1-27 Level 1 Event Tree - Loss of Instrument Air (LOIA)

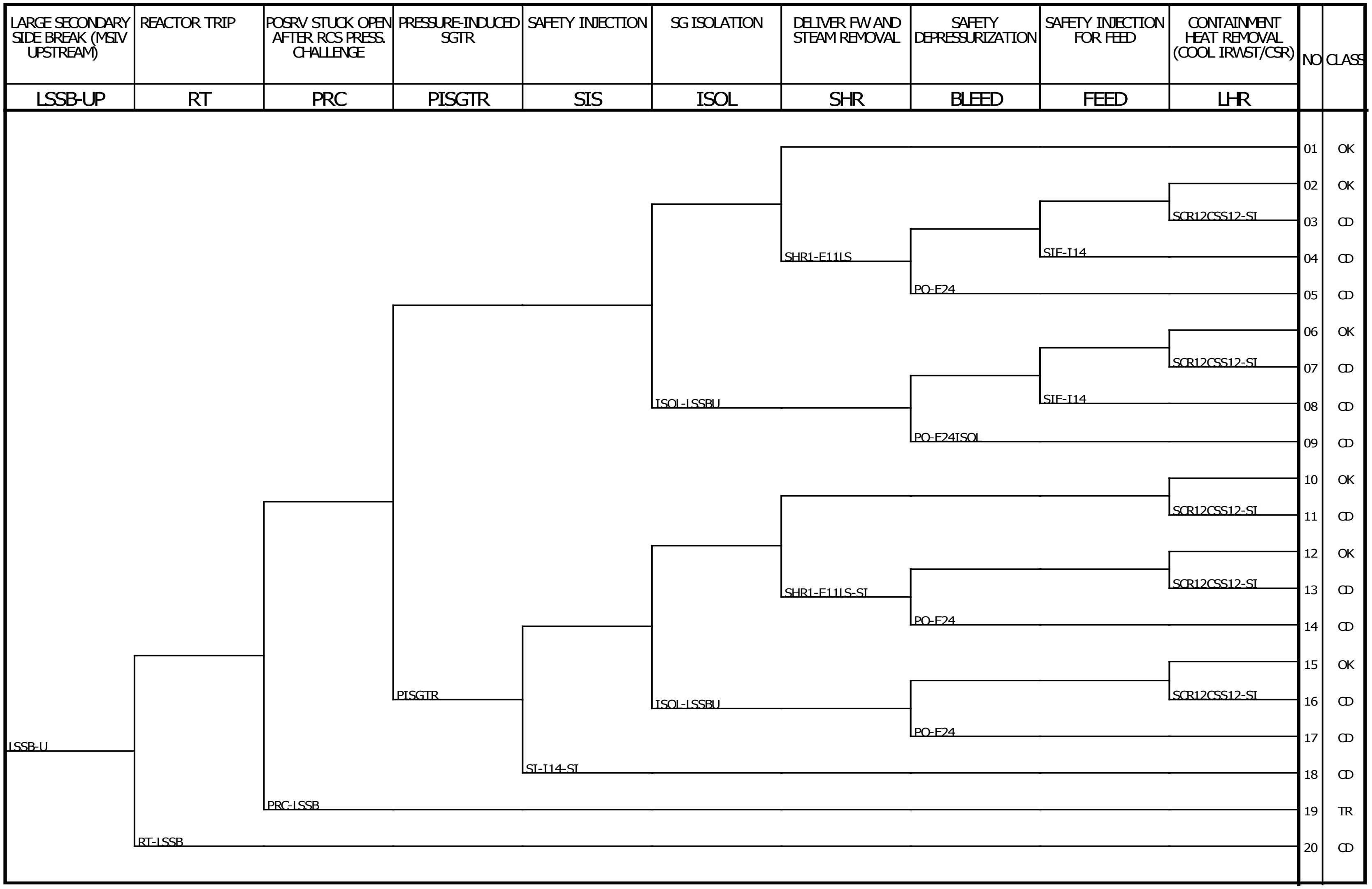

Figure 19.1-28 Level 1 Event Tree - Large Secondary Steam Line Break Upstream of MSIV (LSSB-U)

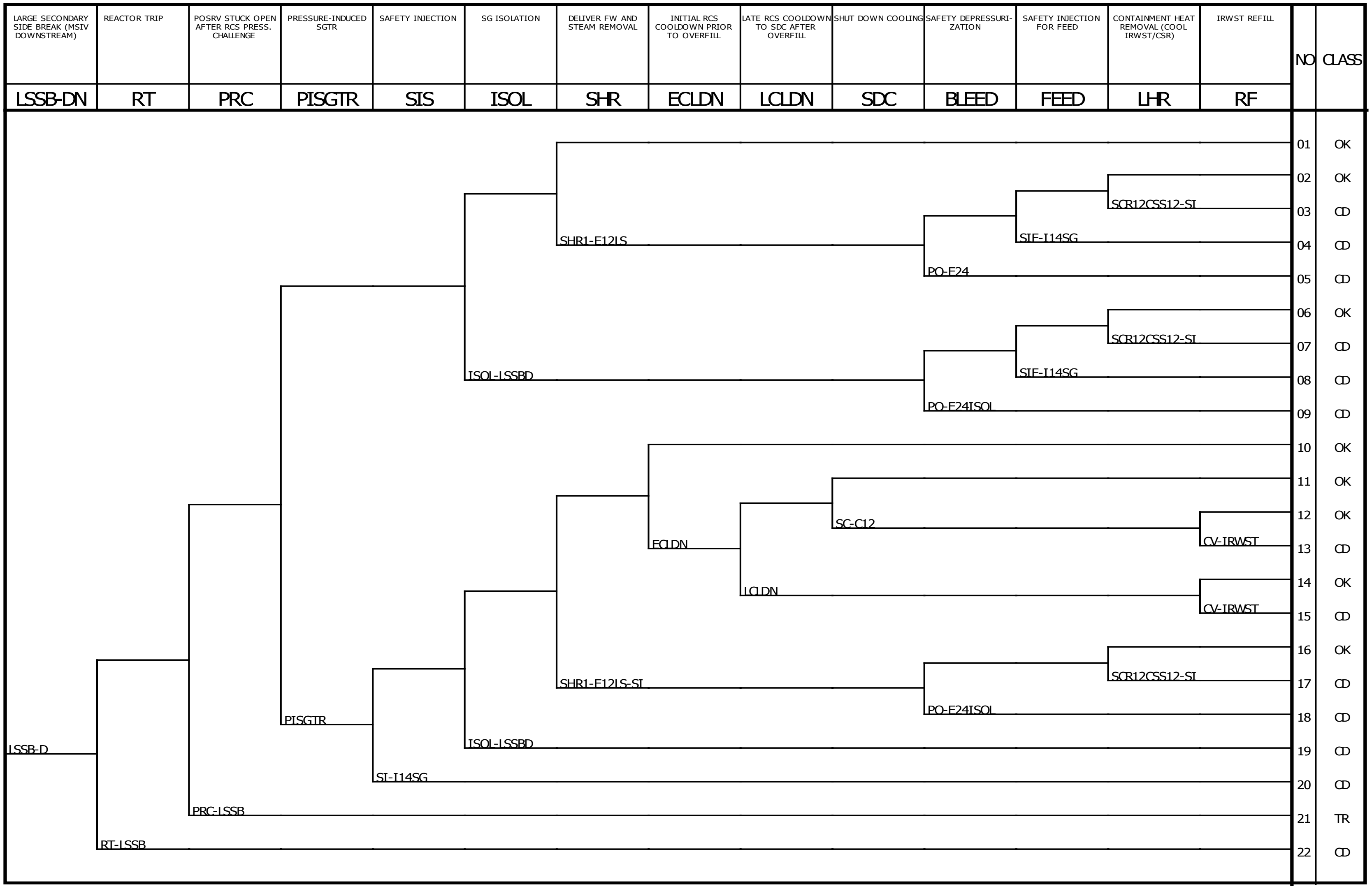

Figure 19.1-29 Level 1 Event Tree - Large Secondary Steam Line Break Downstream of MSIV (LSSB-D)

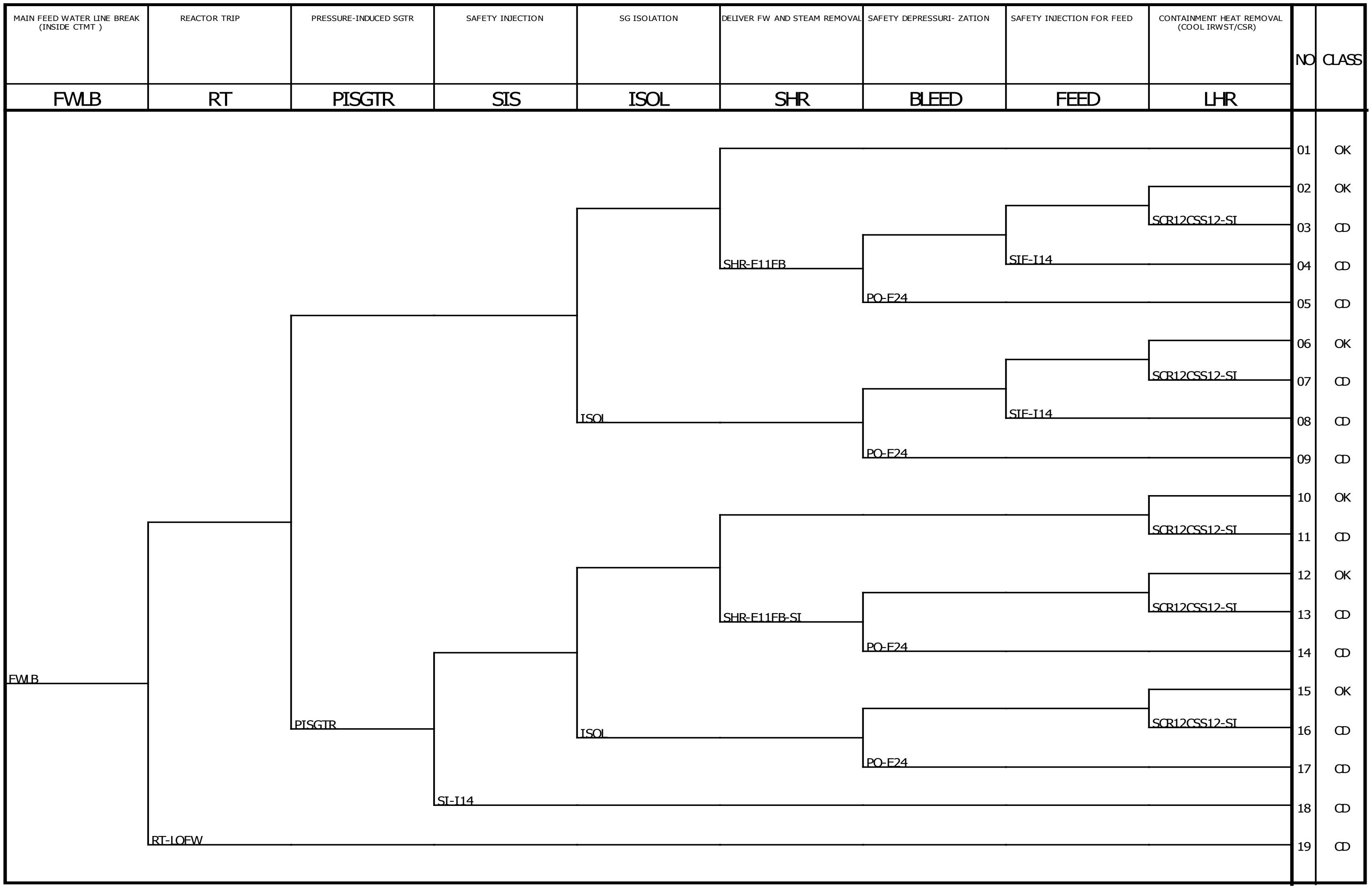

Figure 19.1-30 Level 1 Event Tree - Feedwater Line Break (FWLB)

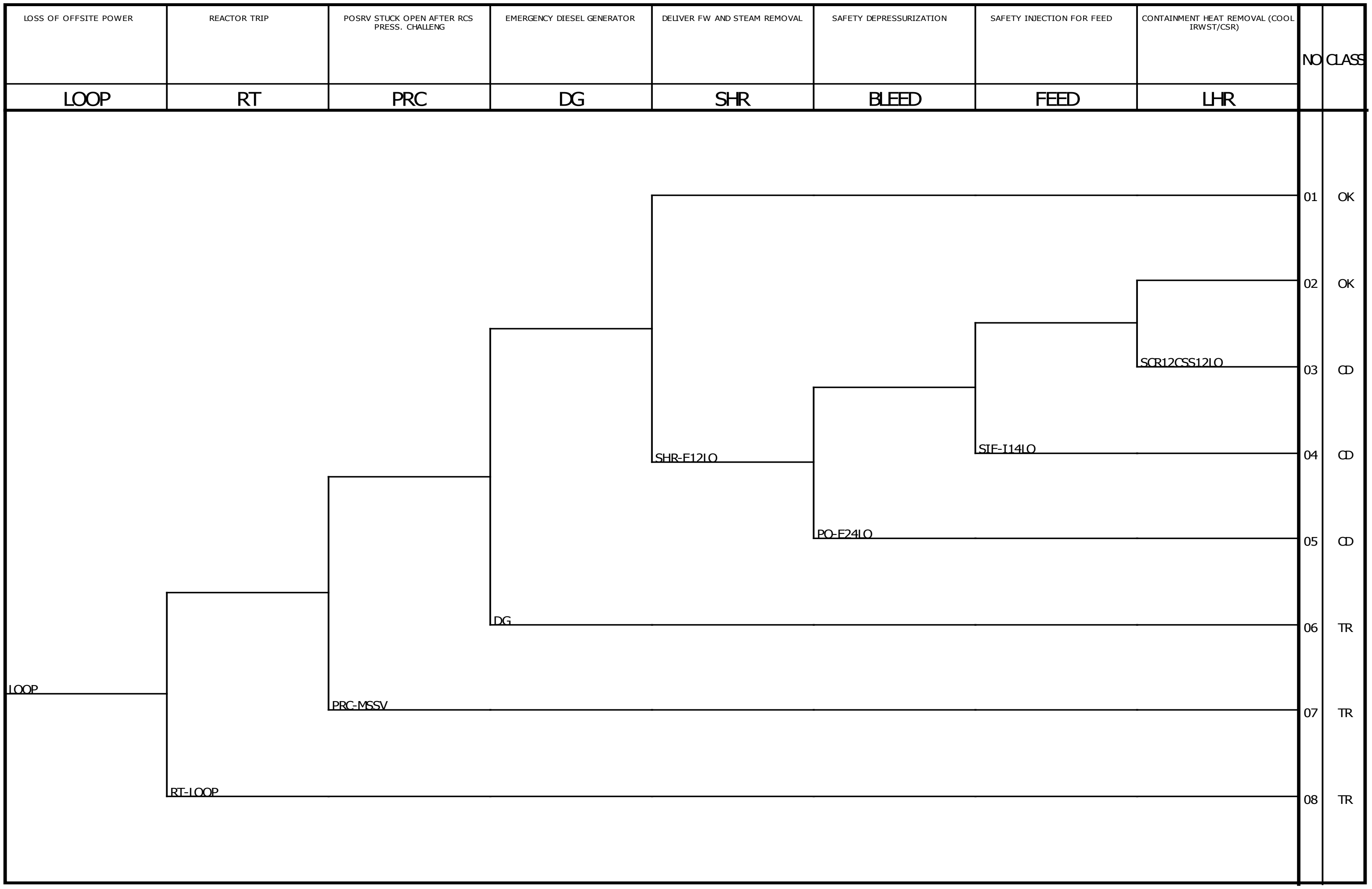

Figure 19.1-31 Level 1 Event Tree - Loss of Offsite Power (LOOP)

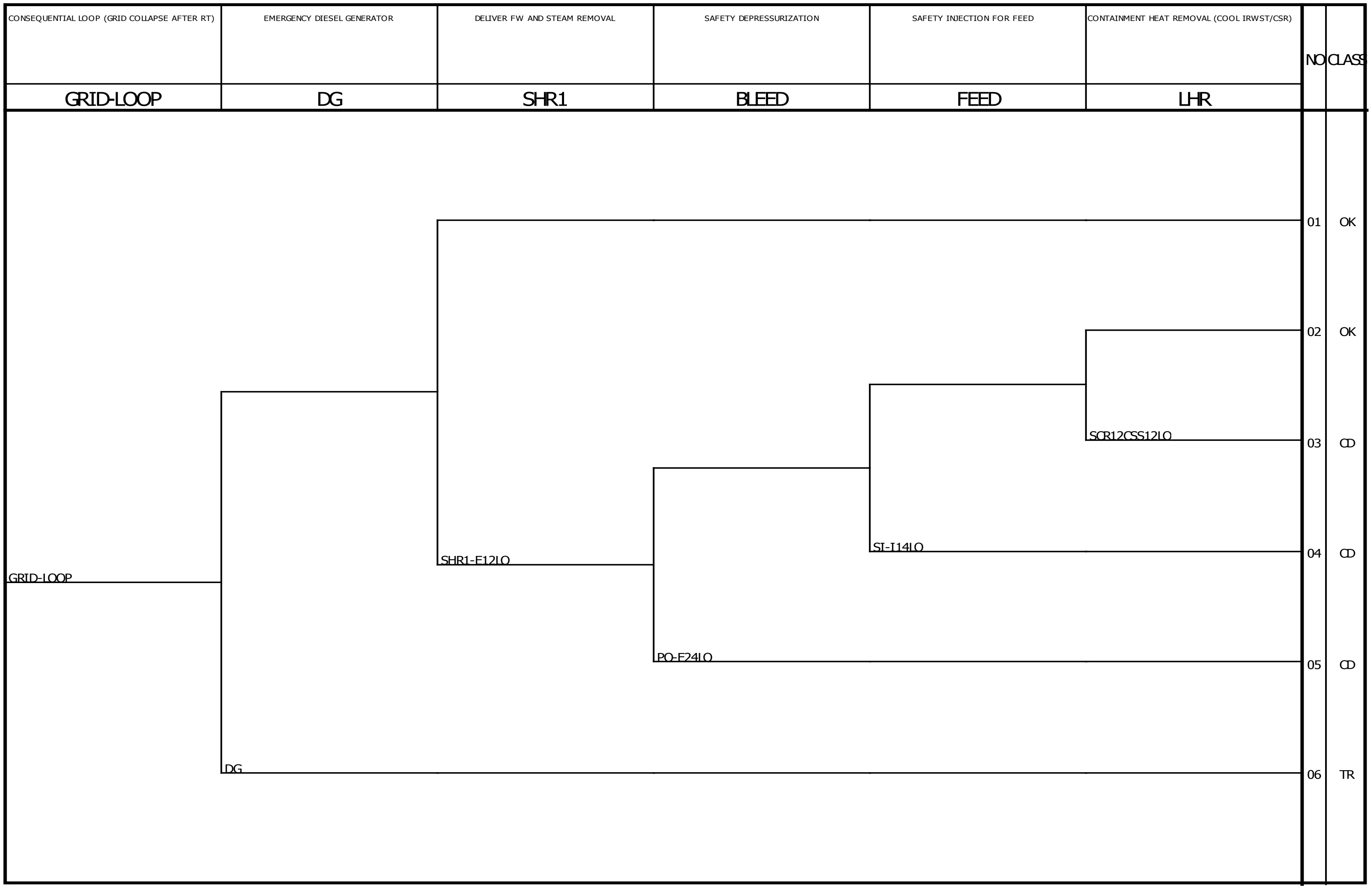

Figure 19.1-32   Level 1 Event Tree - Consequential LOOP (GRID-LOOP)

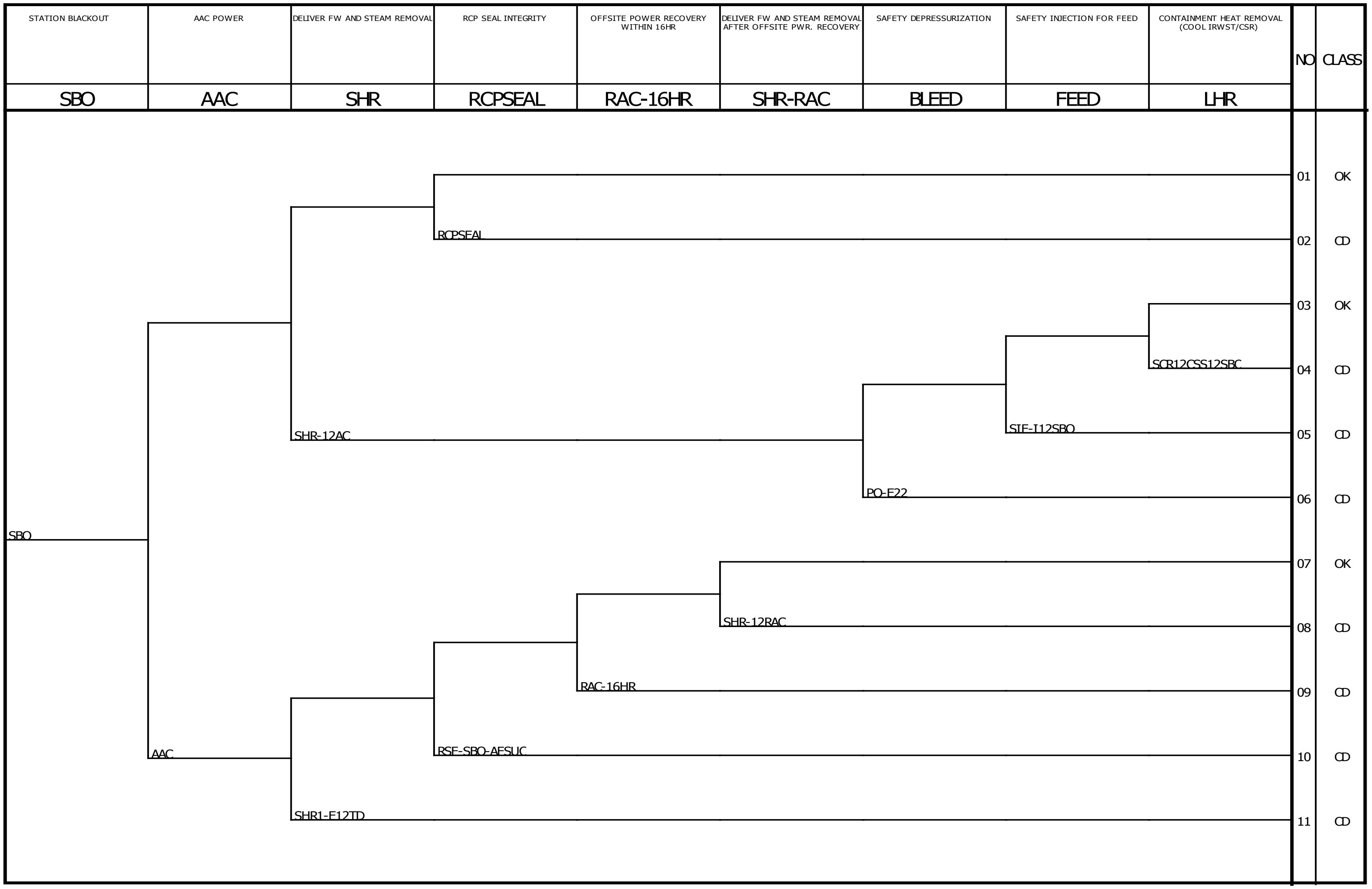

Figure 19.1-33 Level 1 Event Tree - Station Blackout (SBO)

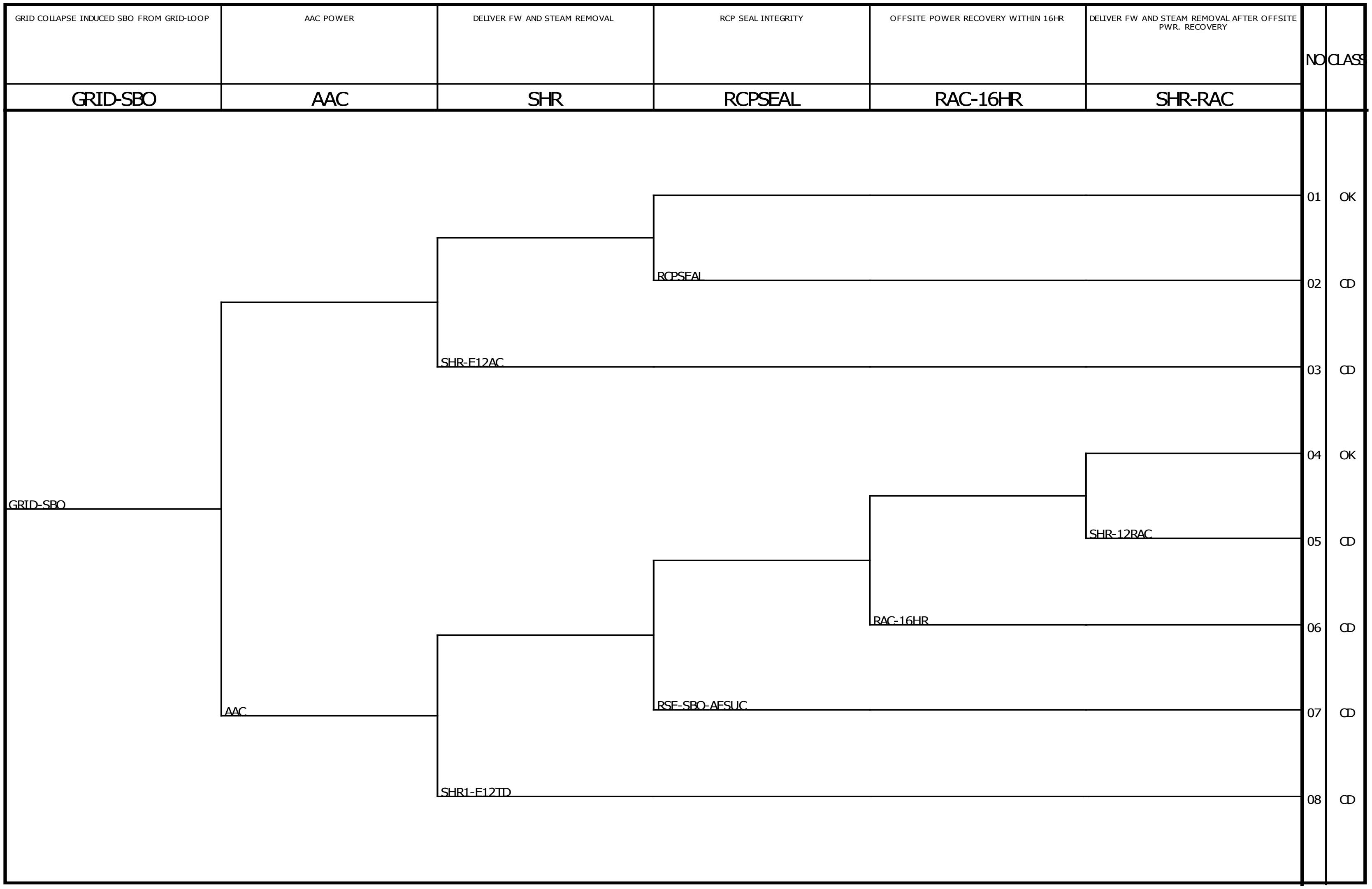

Figure 19.1-34   Level 1 Event Tree - Consequential SBO (GRID-SBO)

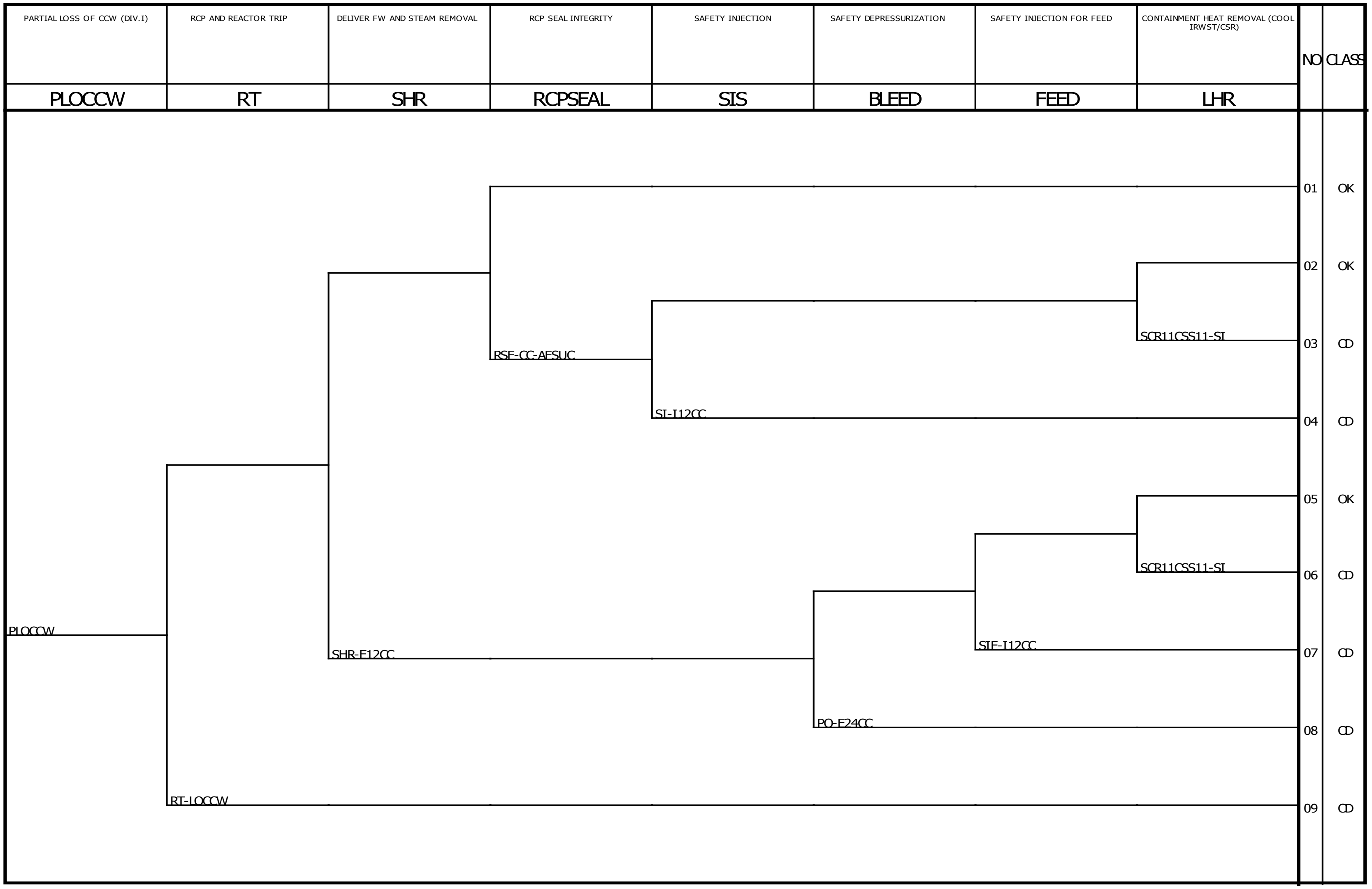

Figure 19.1-35 Level 1 Event Tree - Partial Loss of CCW (PLOCCW)

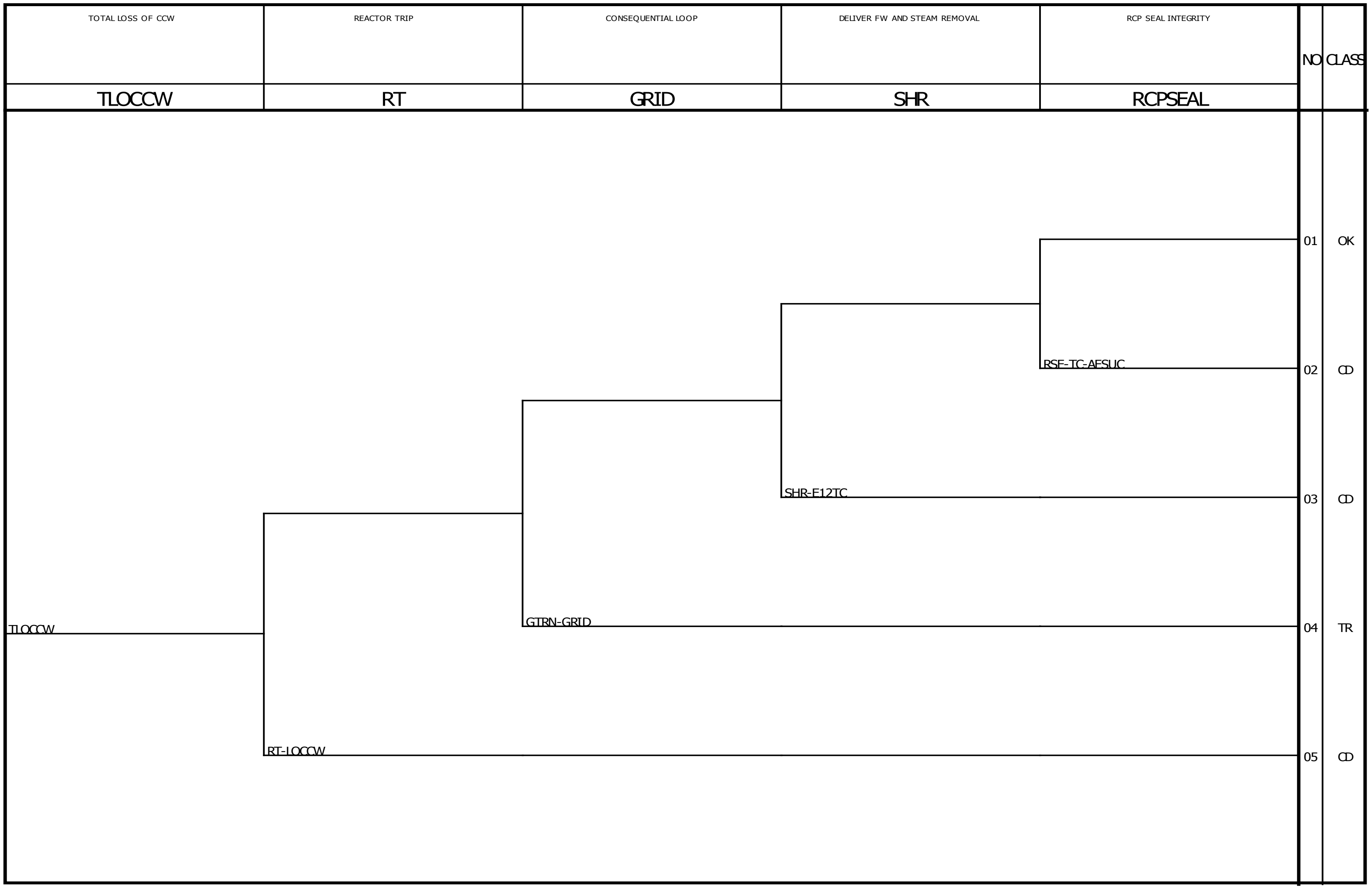

Figure 19.1-36 Level 1 Event Tree - Total Loss of CCW (TLOCCW)

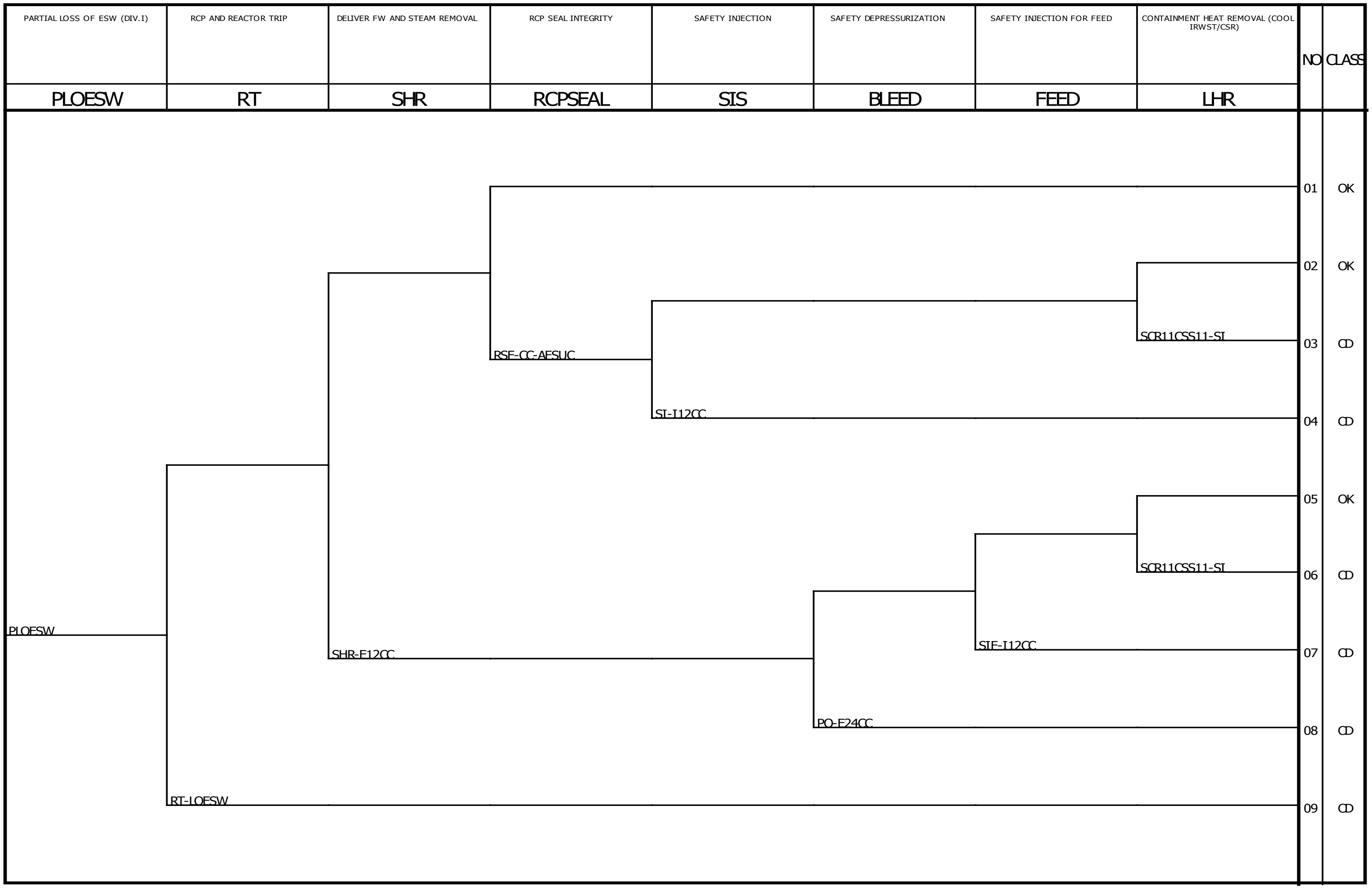

Figure 19.1-37 Level 1 Event Tree - Partial Loss of ESW (PLOESW)

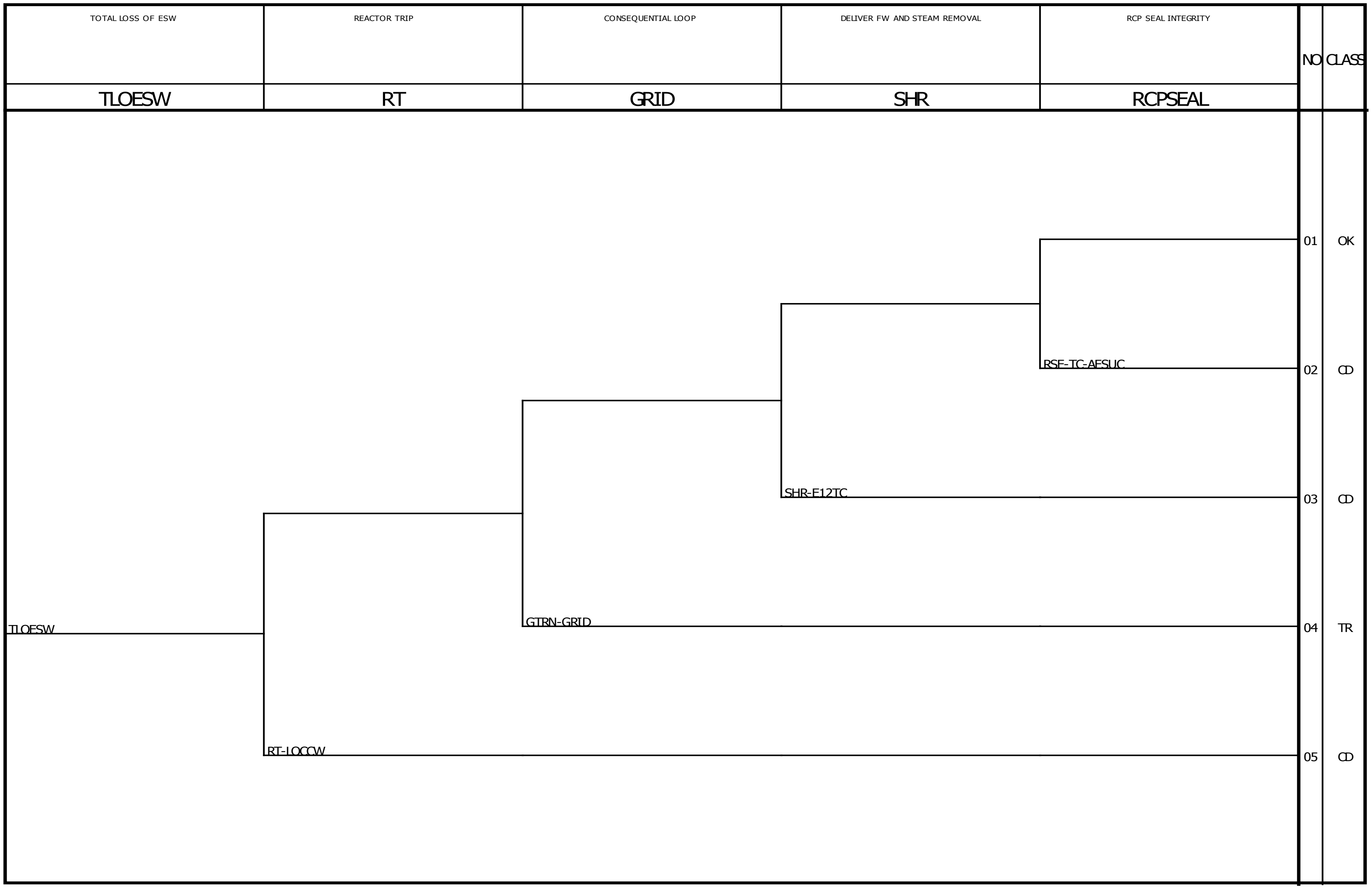

Figure 19.1-38   Level 1 Event Tree - Total Loss of ESW (TLOESW)

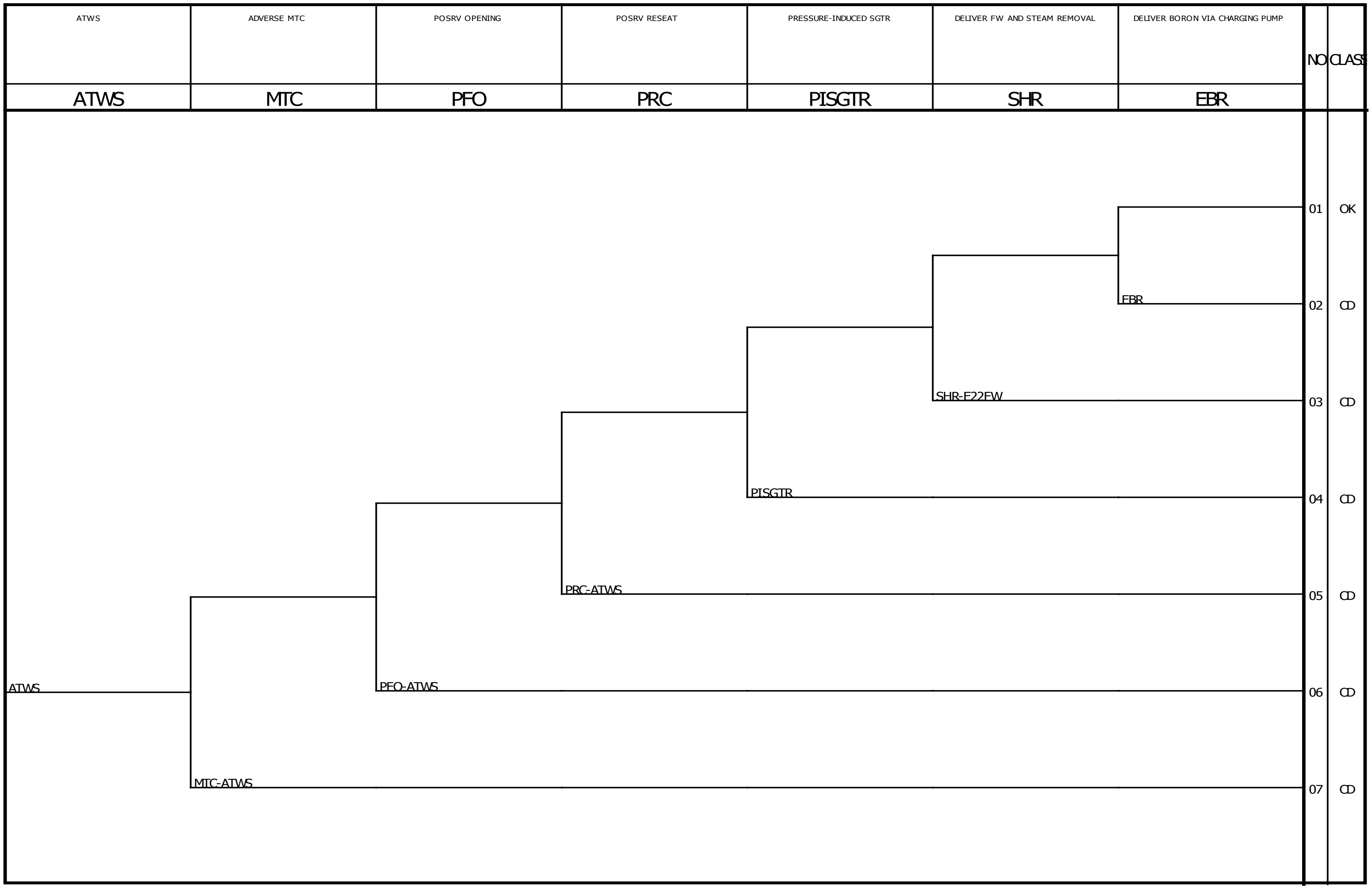

Figure 19.1-39 Level 1 Event Tree - Anticipated Transient Without Scram (ATWS)

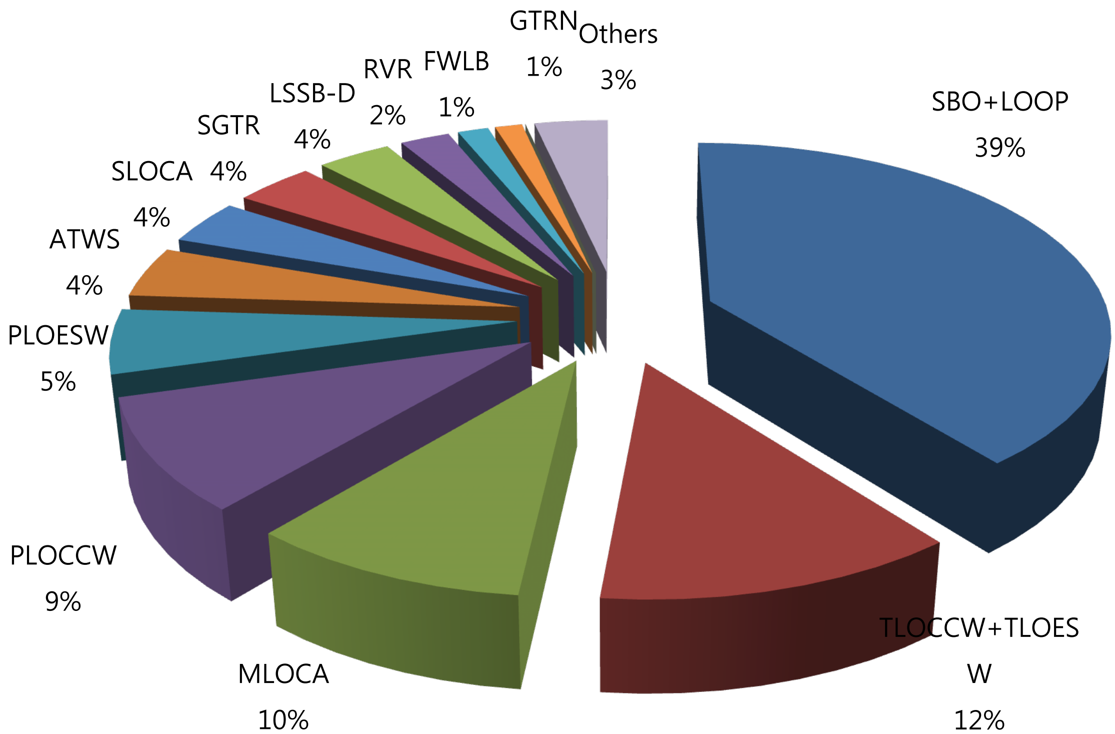

Figure 19.1-40 Initiating Events Contributions to CDF - Level 1 Internal Events

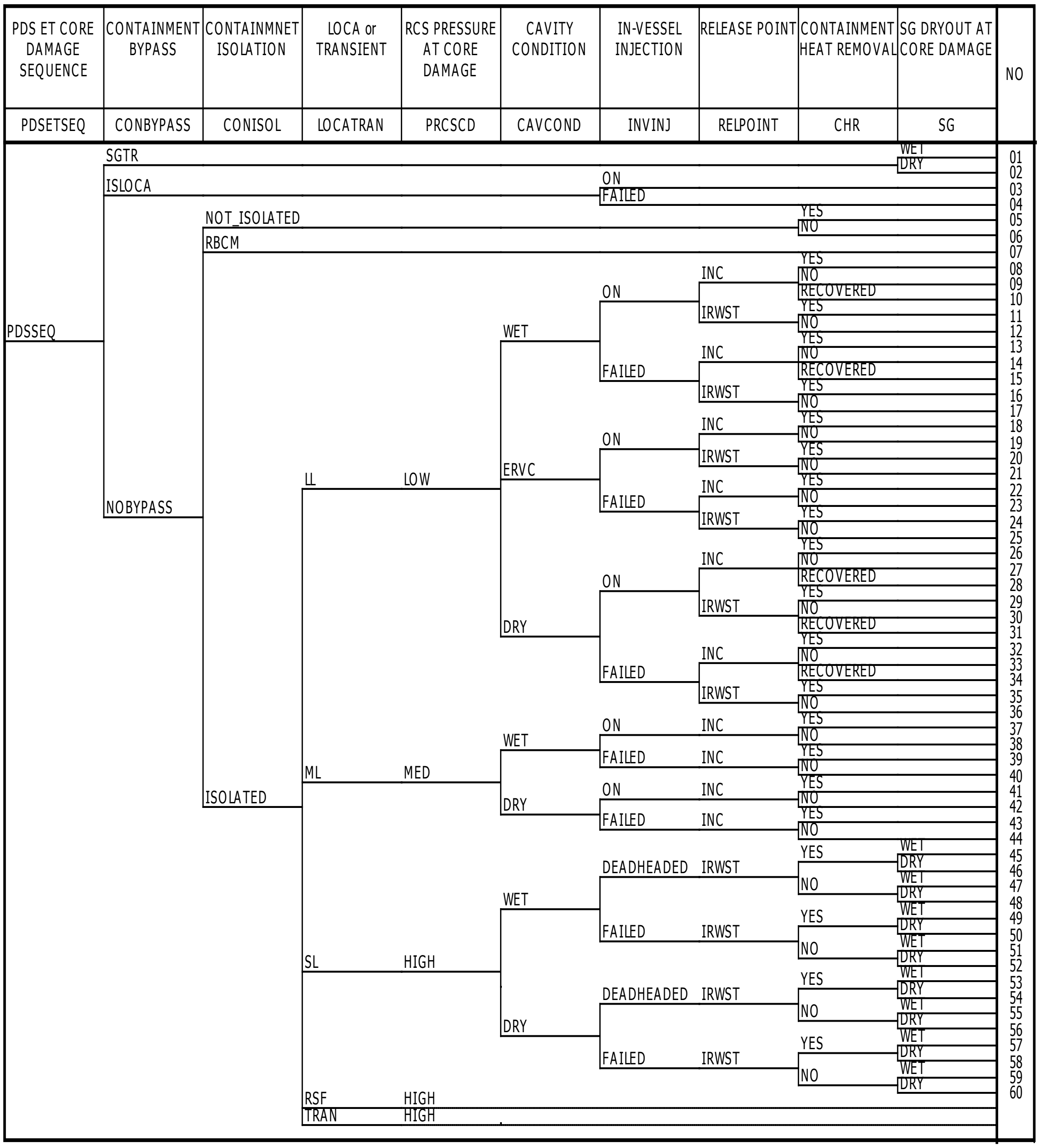

Figure 19.1-41 Plant Damage State Grouping Logic Diagram (1 of 2)

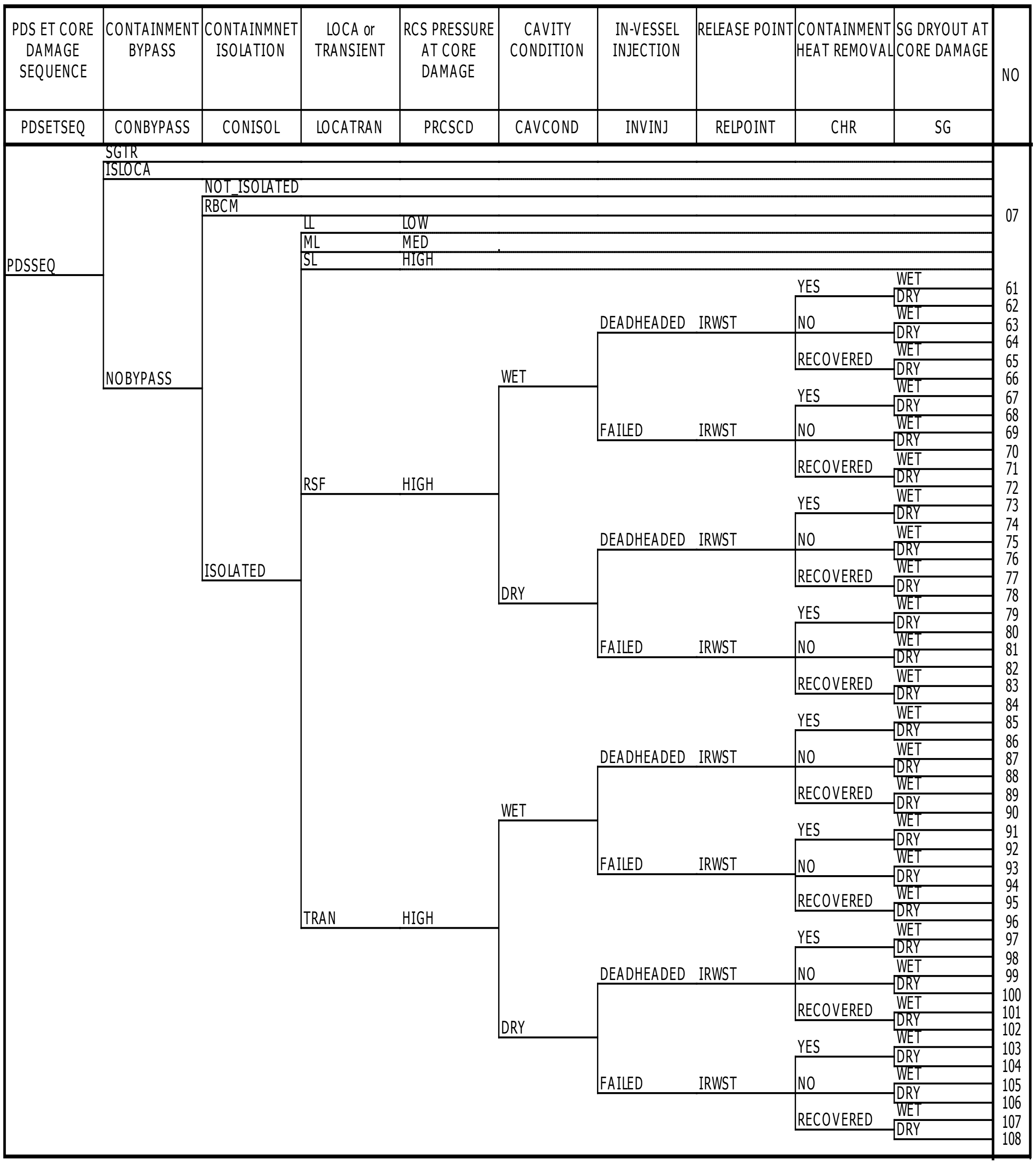

Figure 19.1-41 Plant Damage State Grouping Logic Diagram (2 of 2)

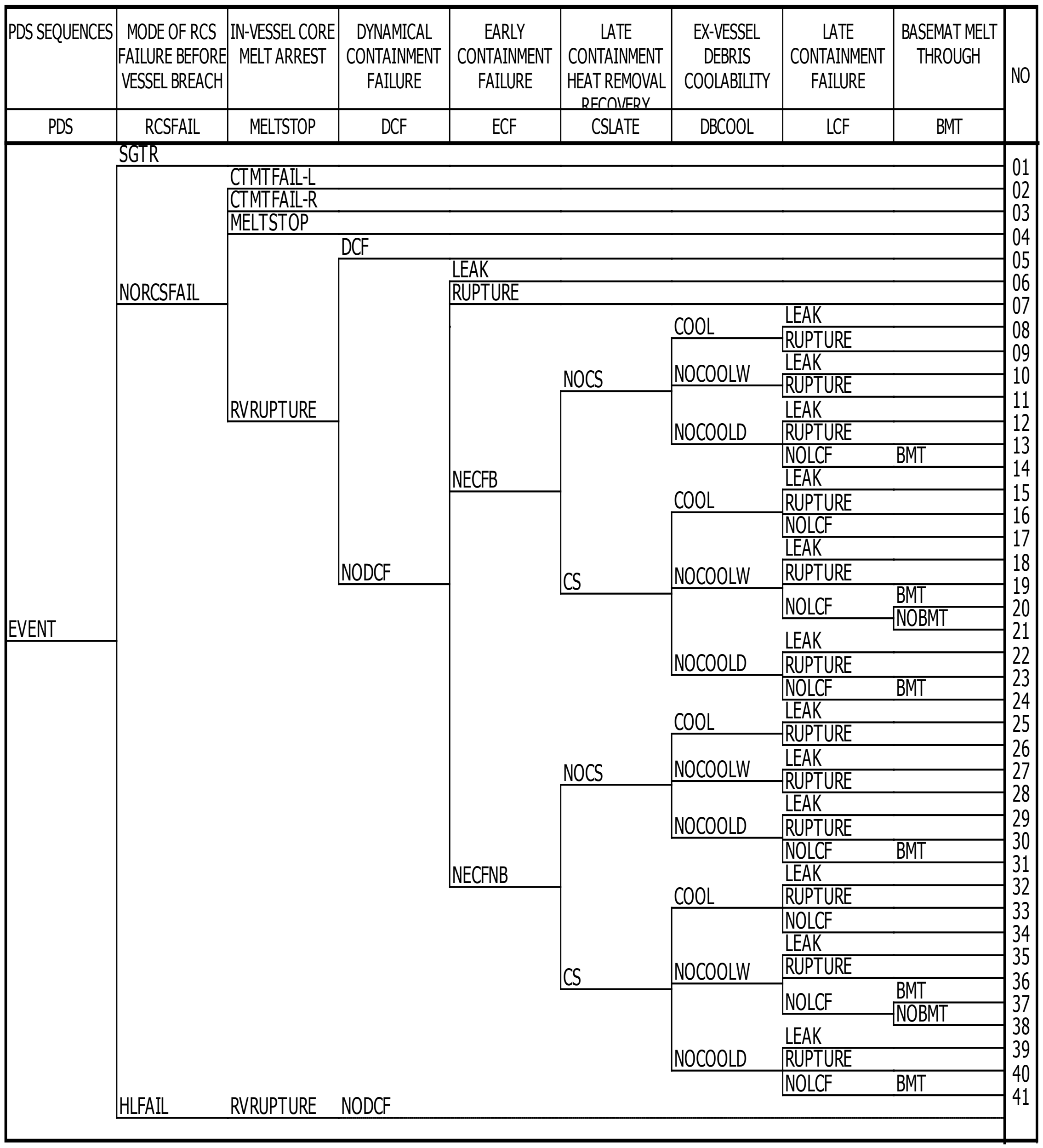

Figure 19.1-42 General Containment Event Tree (1 of 2)

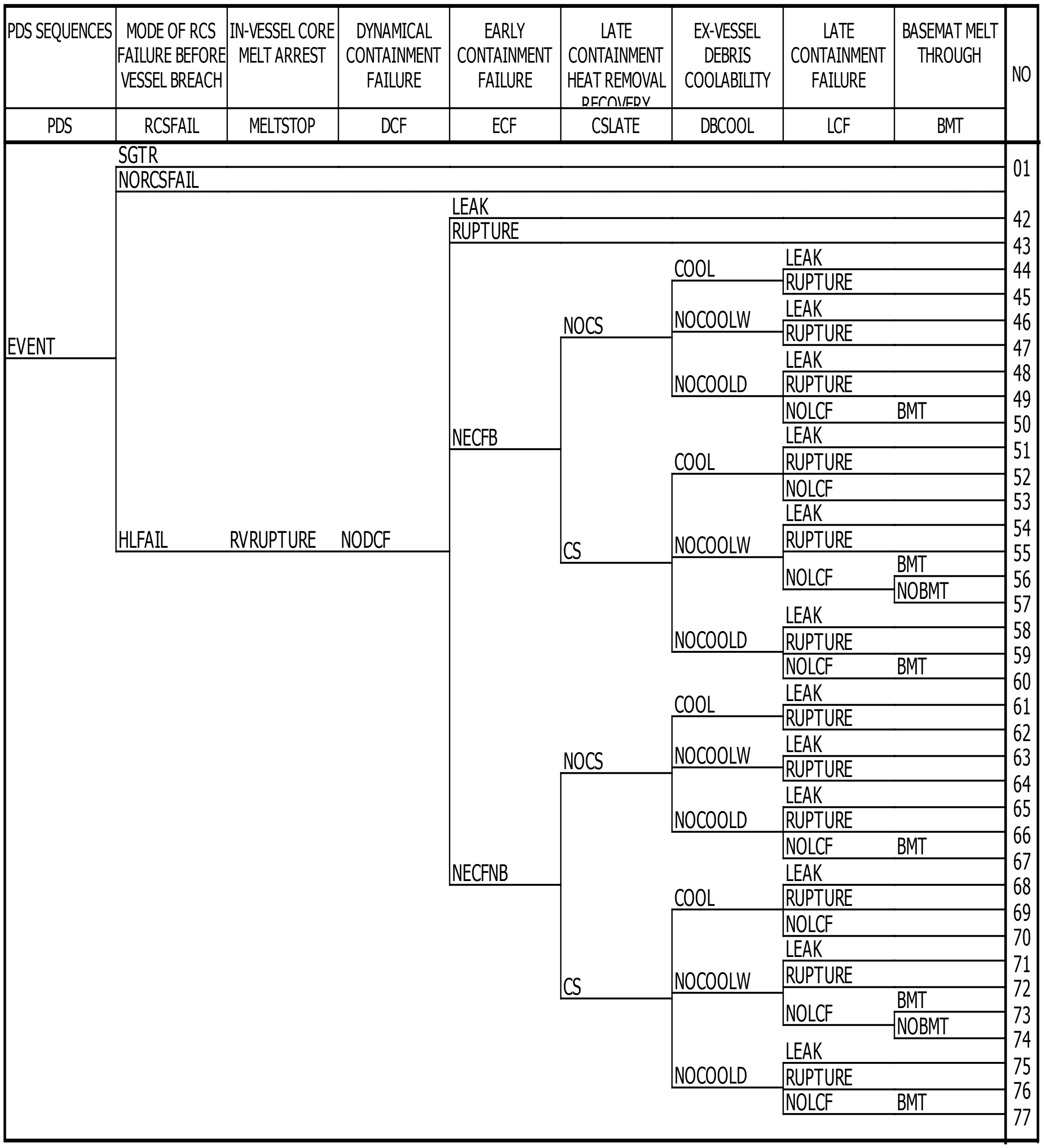

Figure 19.1-42   General Containment Event Tree (2 of 2)

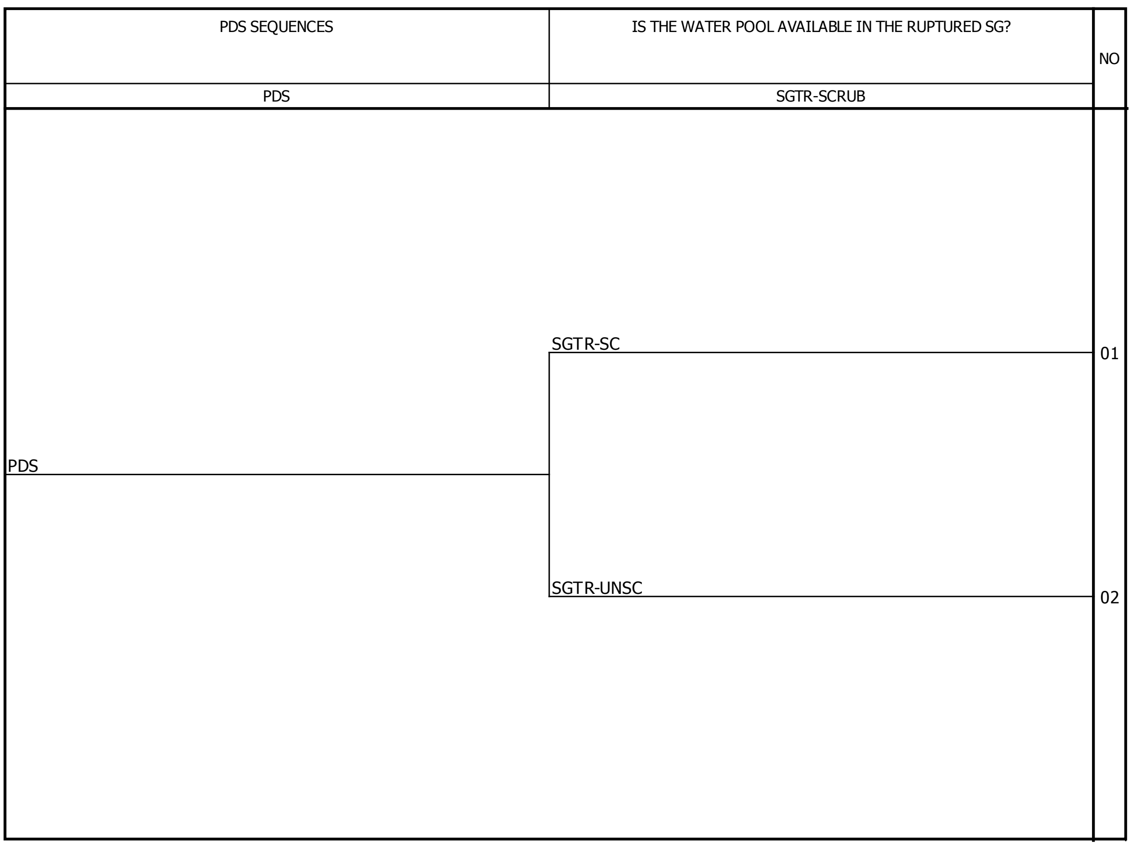

Figure 19.1-43 SGTR Containment Event Tree

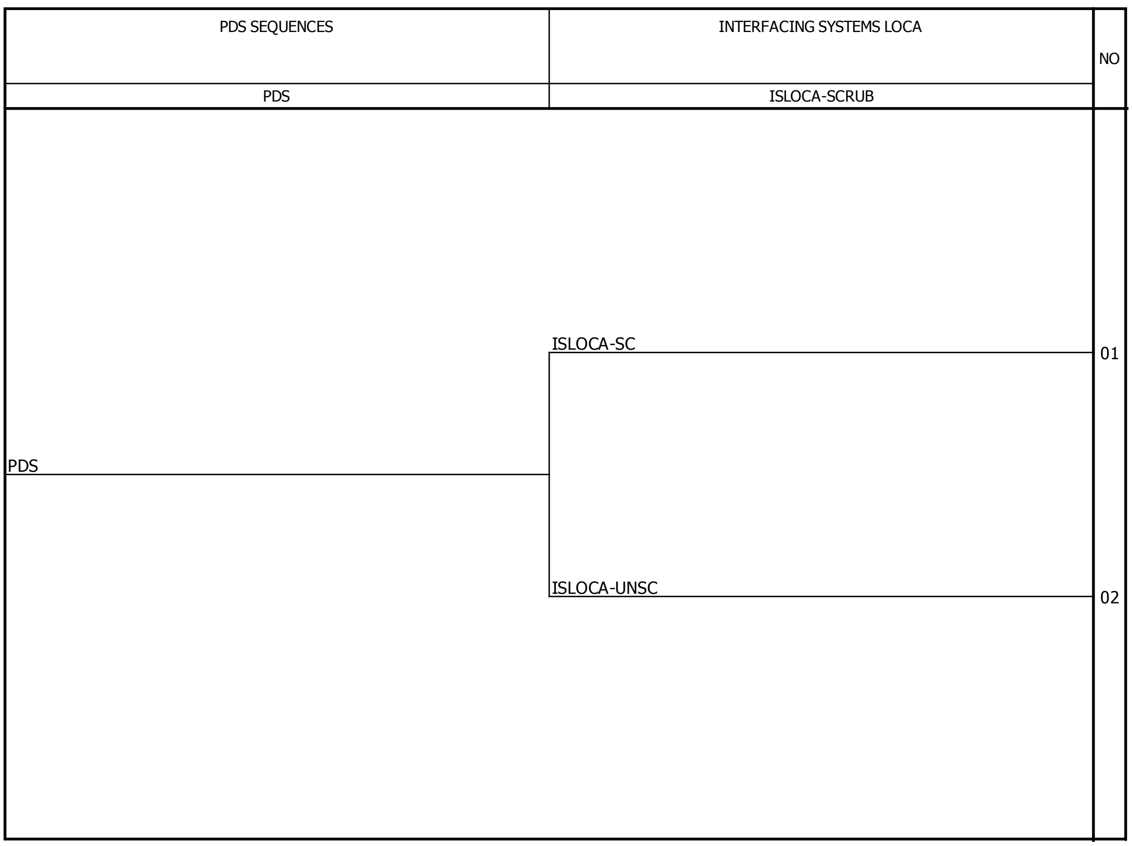

Figure 19.1-44 ISLOCA Containment Event Tree

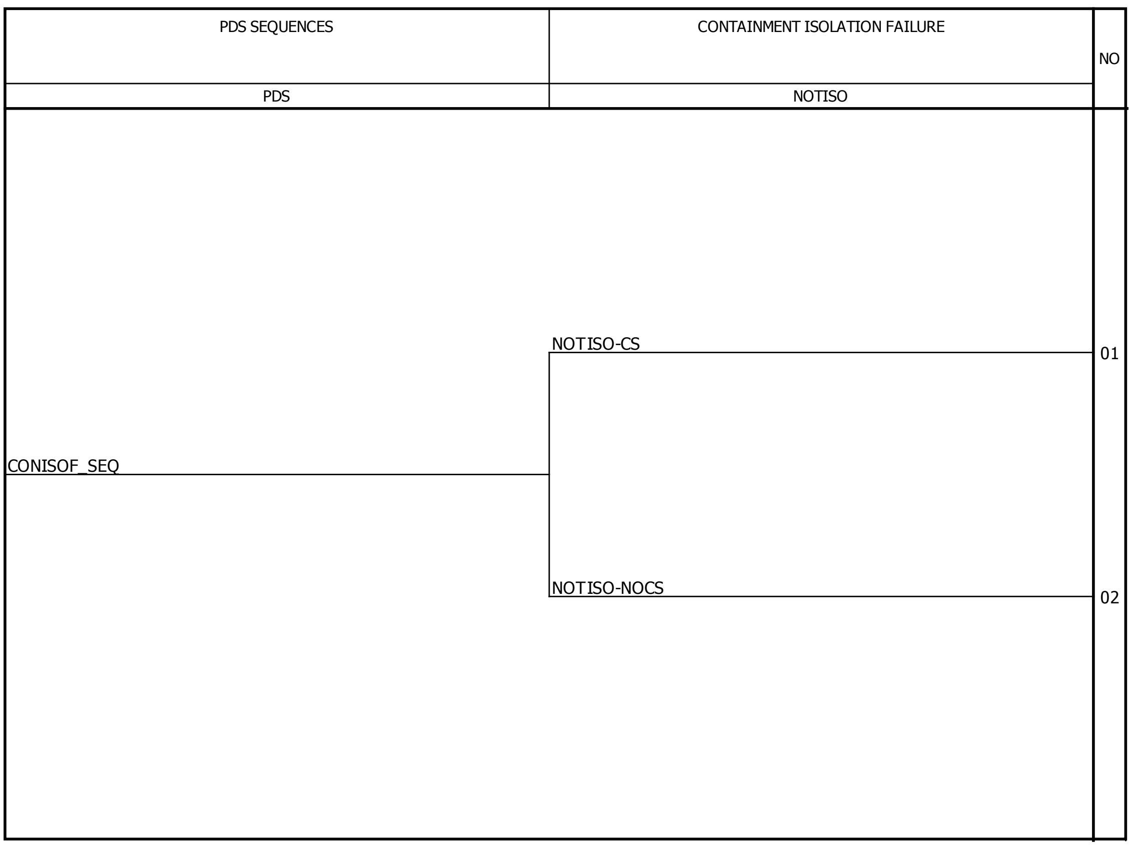

Figure 19.1-45 Containment Isolation Failure Containment Event Tree

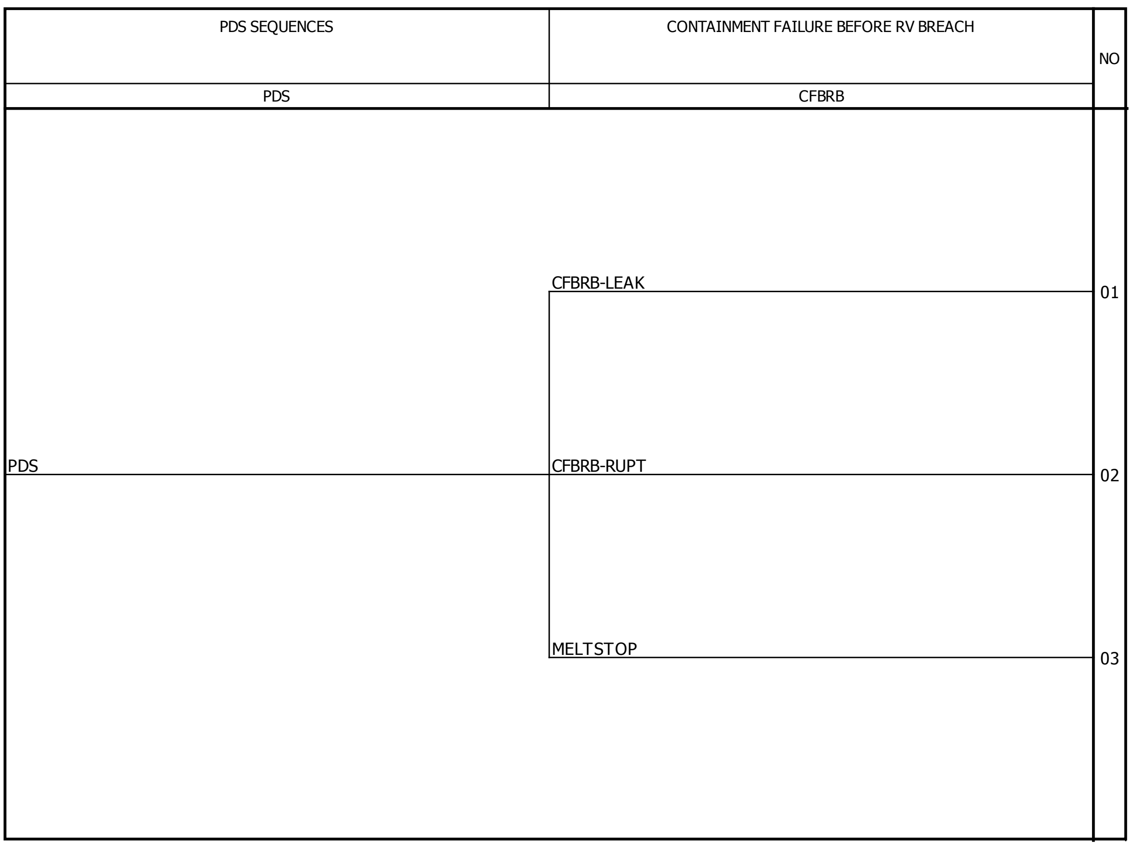

Figure 19.1-46   Containment Failure Before Vessel Breach Containment Event Tree

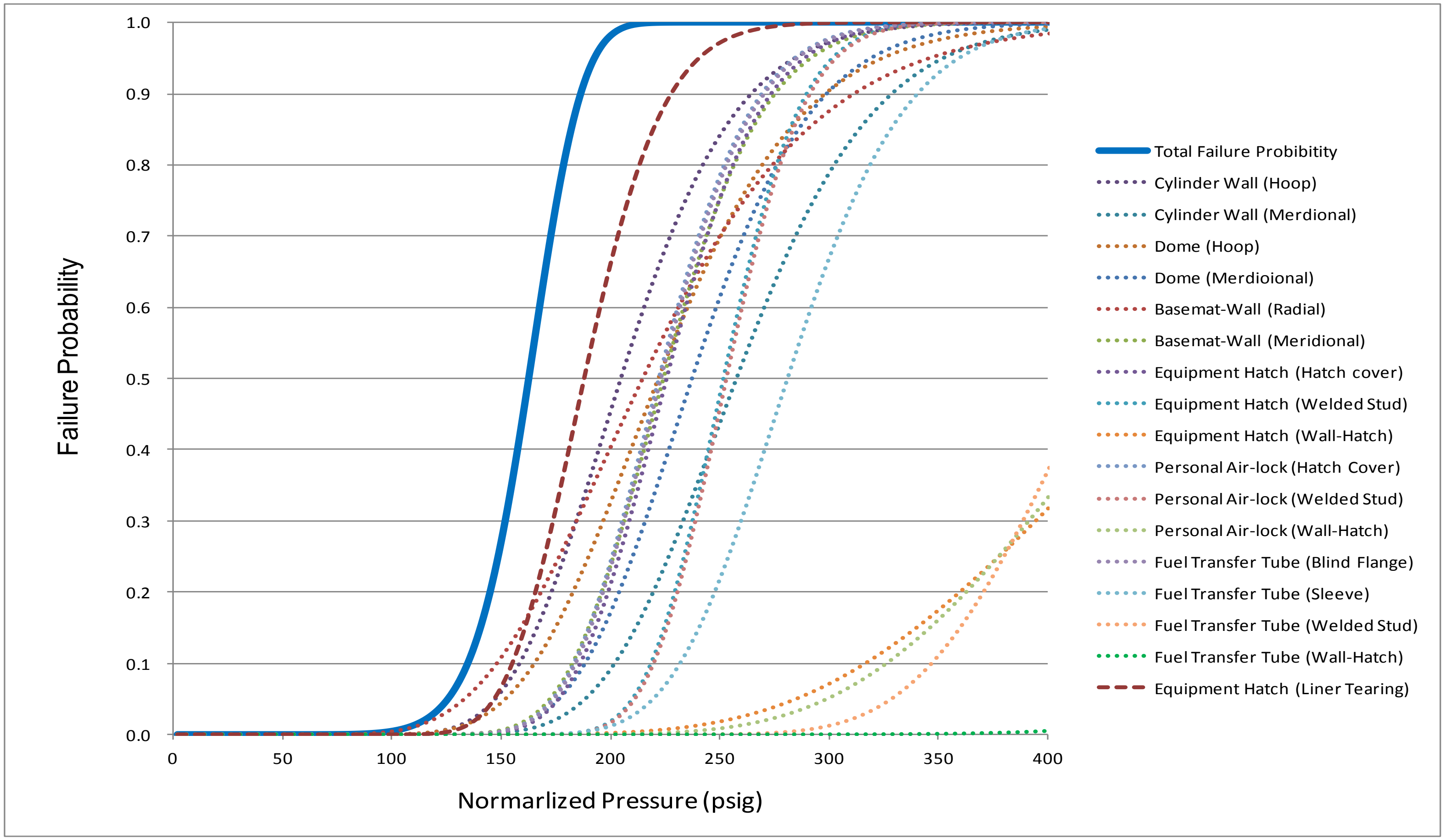

Figure 19.1-47 Total Containment Fragility Curve

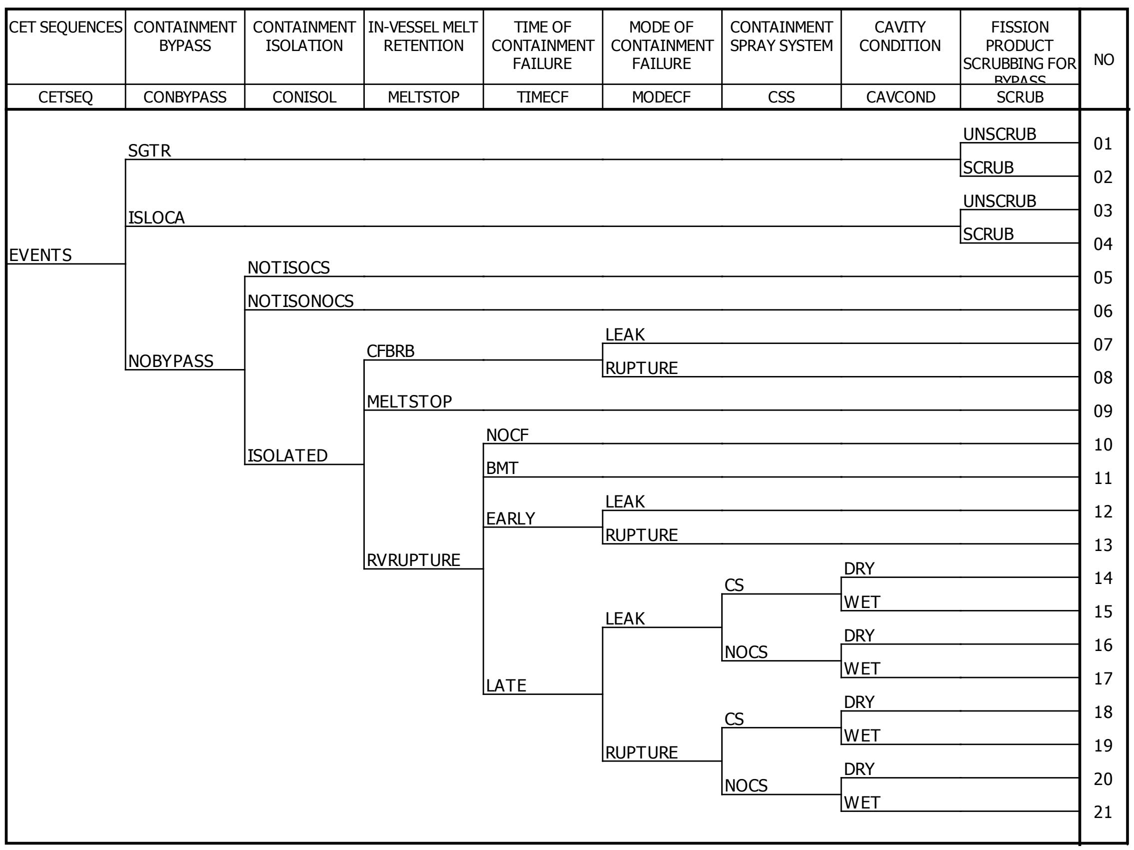

Figure 19.1-48 Source Term Binning Diagram

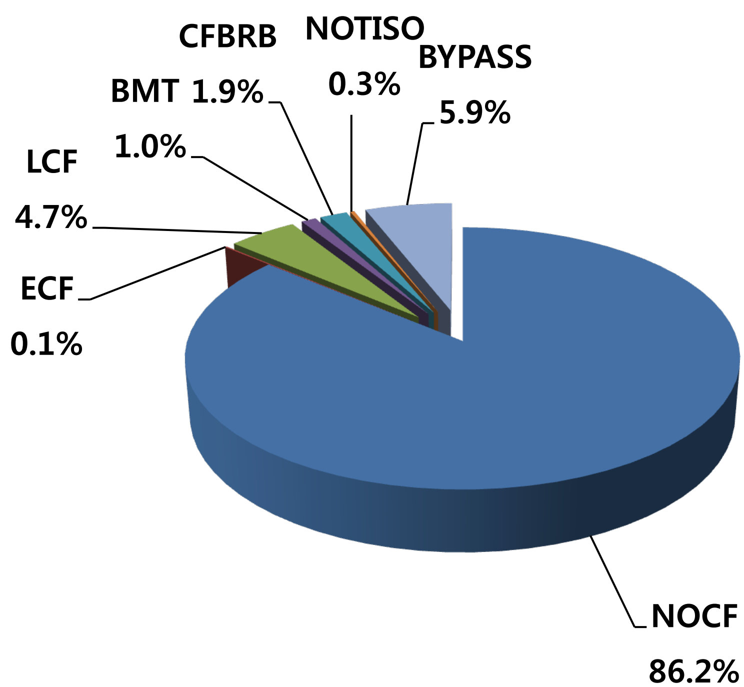

Figure 19.1-49   CET Quantification Results for Internal Events

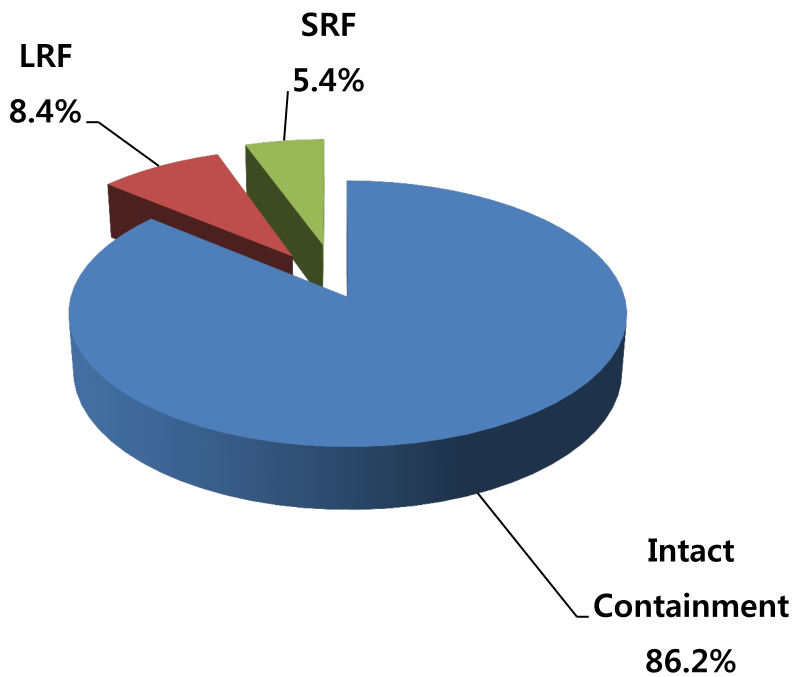

Figure 19.1-50 Level 2 PRA Results in Terms of Containment End State for Internal Events

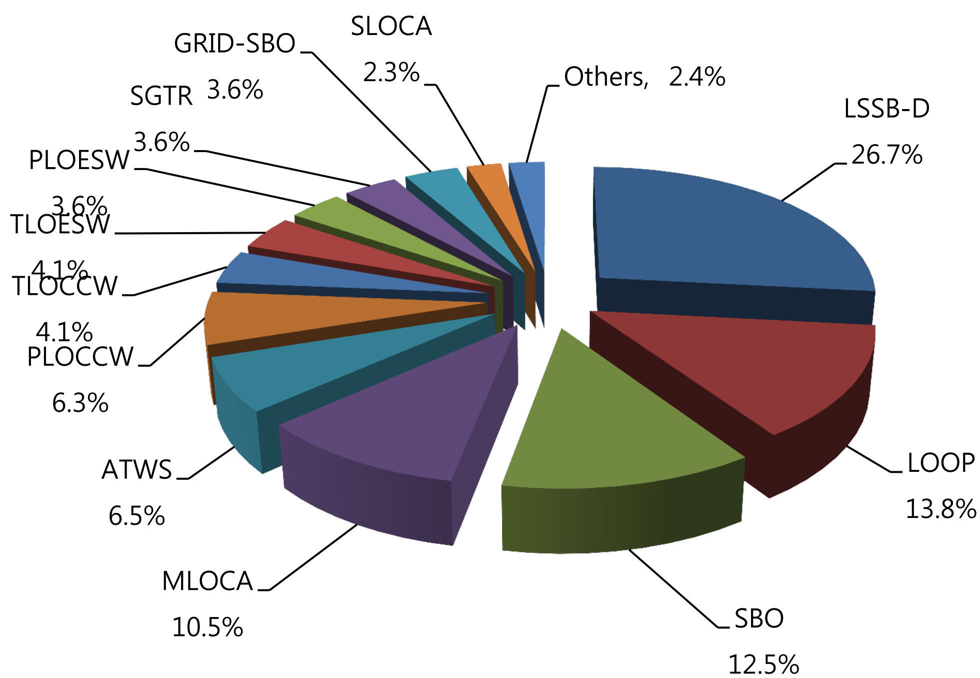

Figure 19.1-51 Internal Initiating Events Contributions to LRF

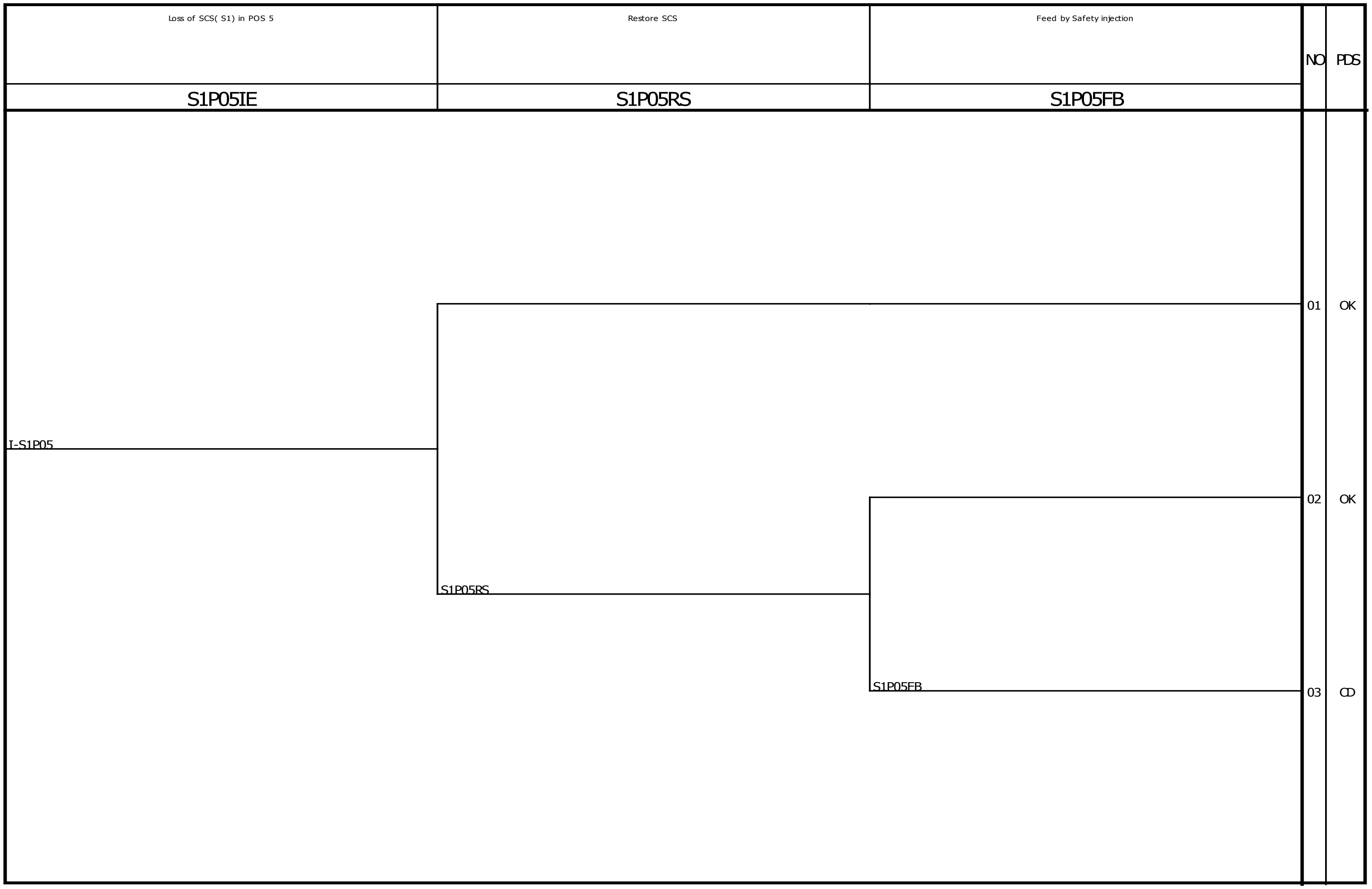

Figure 19.1-52   Recoverable Loss of Shutdown Cooling (S1) Event Tree in POS 5

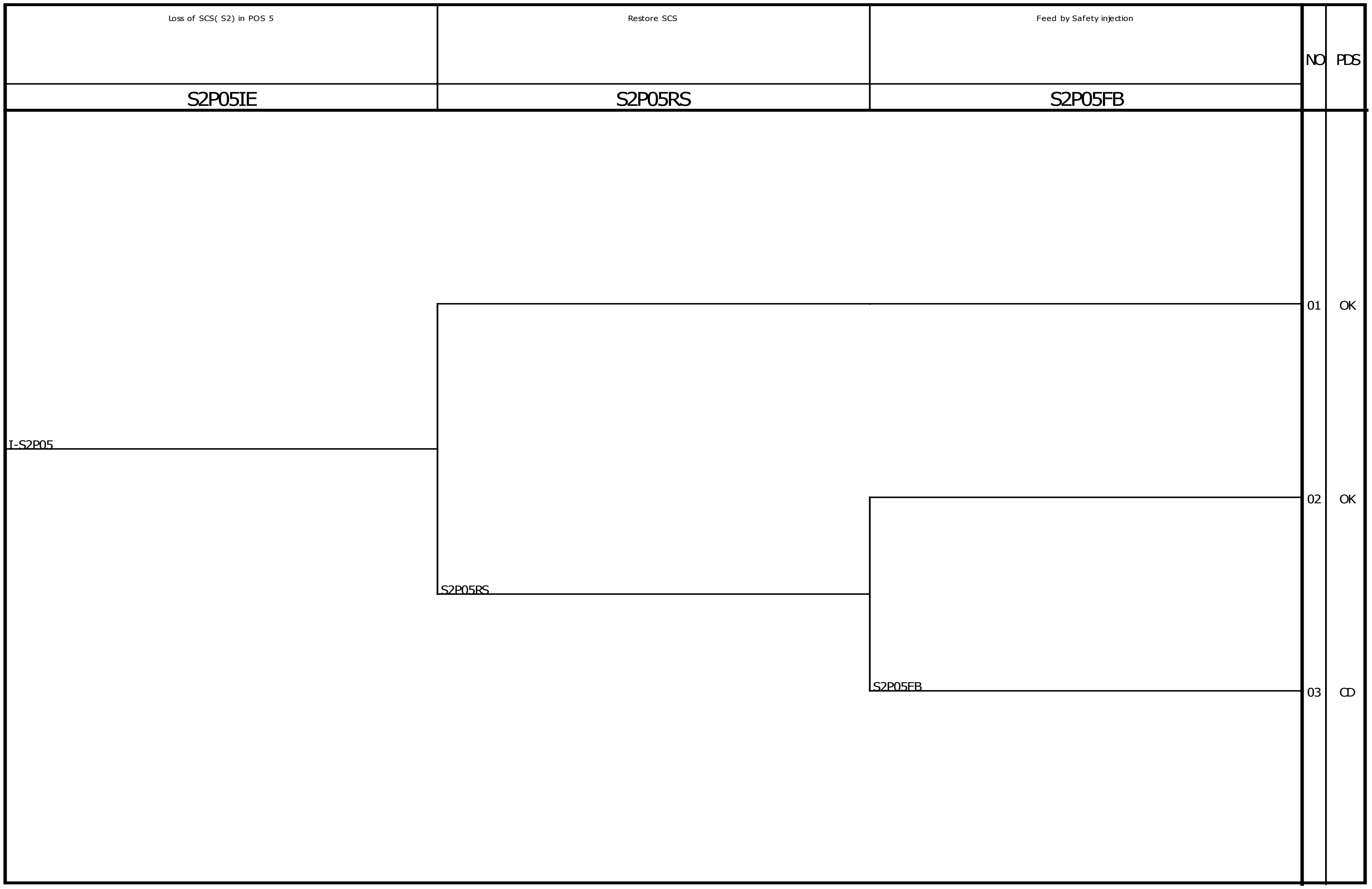

Figure 19.1-53 Unrecoverable Loss of Shutdown Cooling (S2) Event Tree in POS 5

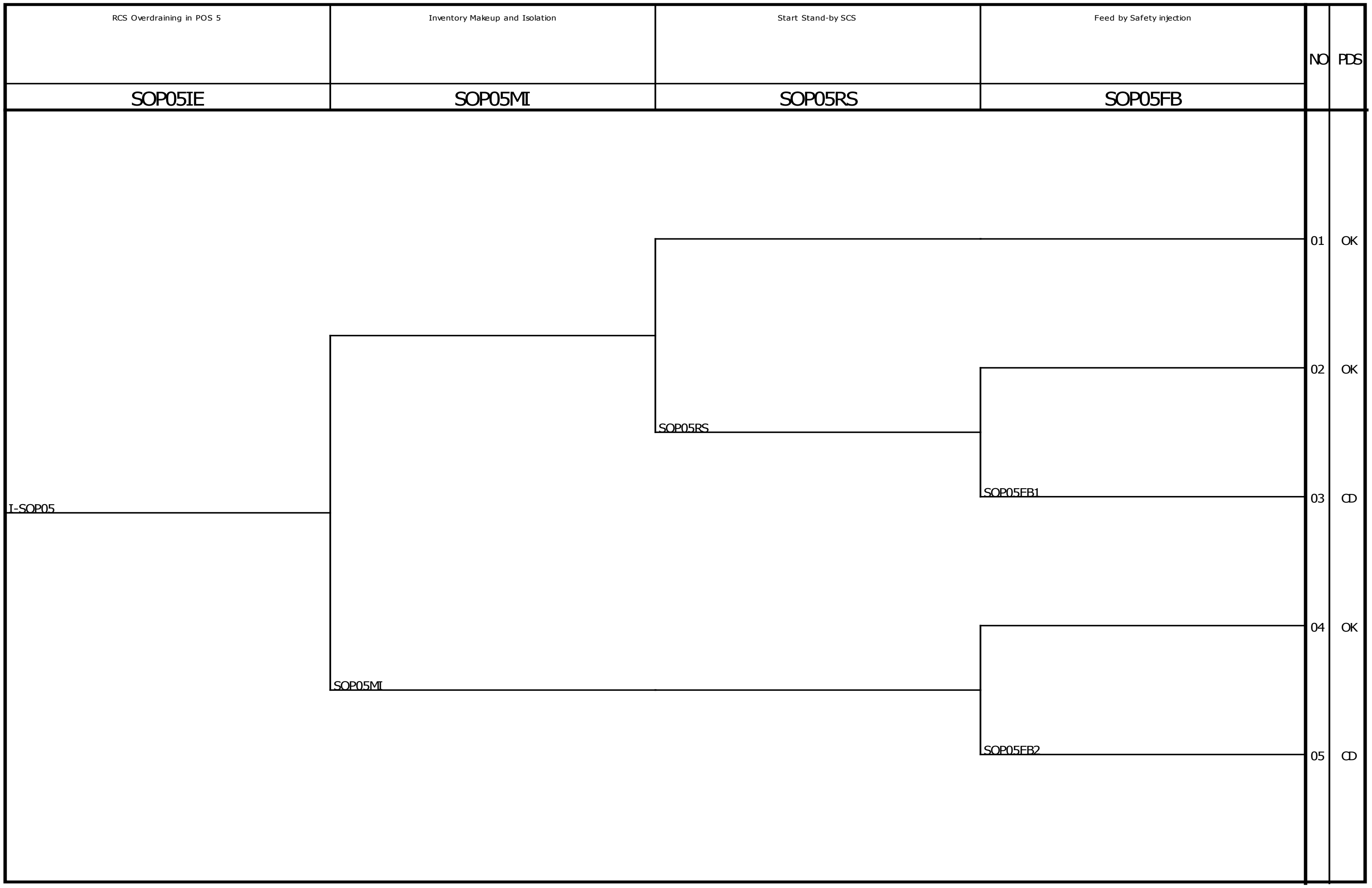

Figure 19.1-54 Over-drainage during Reduced Inventory Operation (SO) Event Tree in POS 5

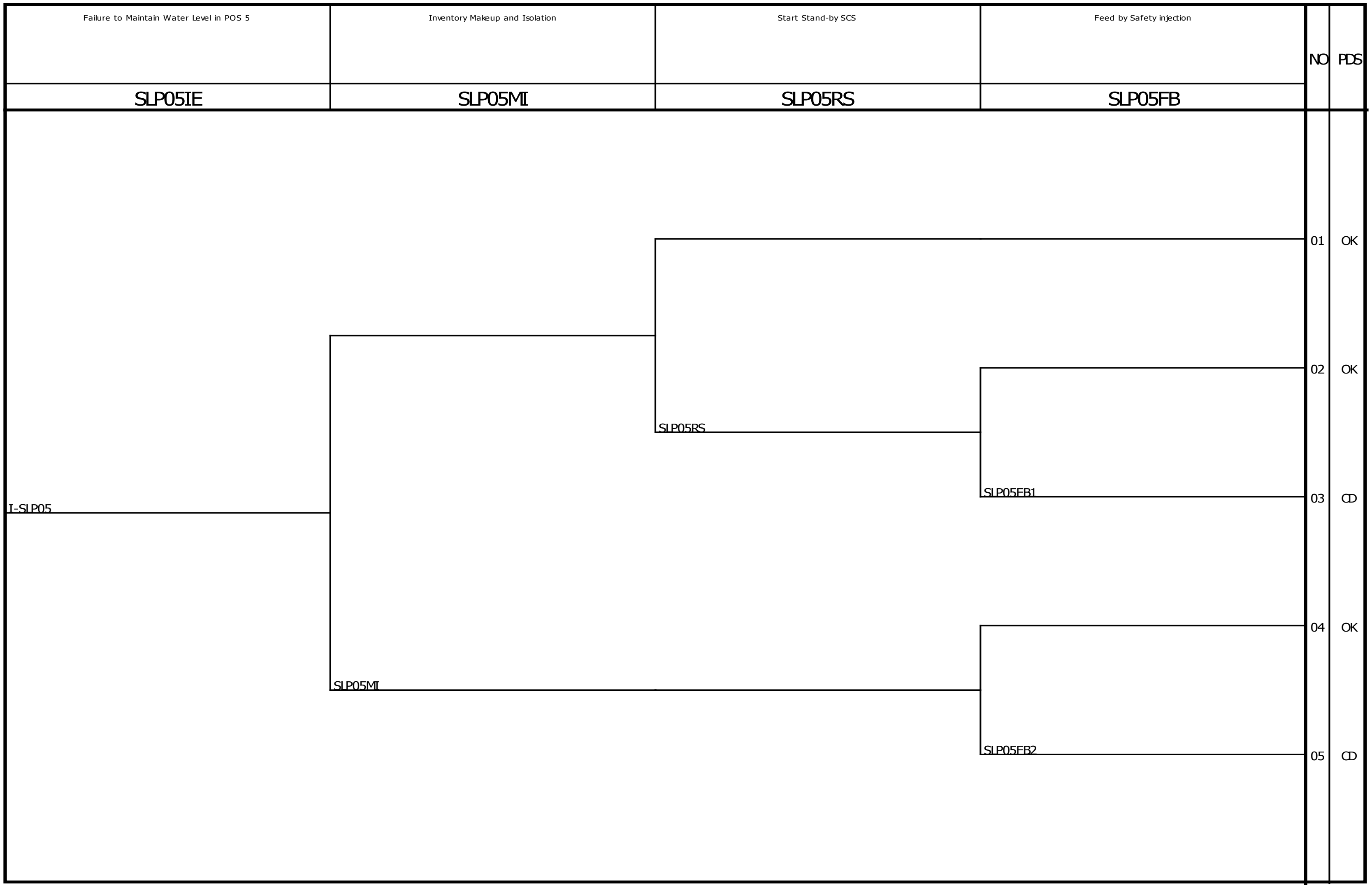

Figure 19.1-55   Failure to Maintain Water Level During Reduced Inventory Operation (SL) in POS 5

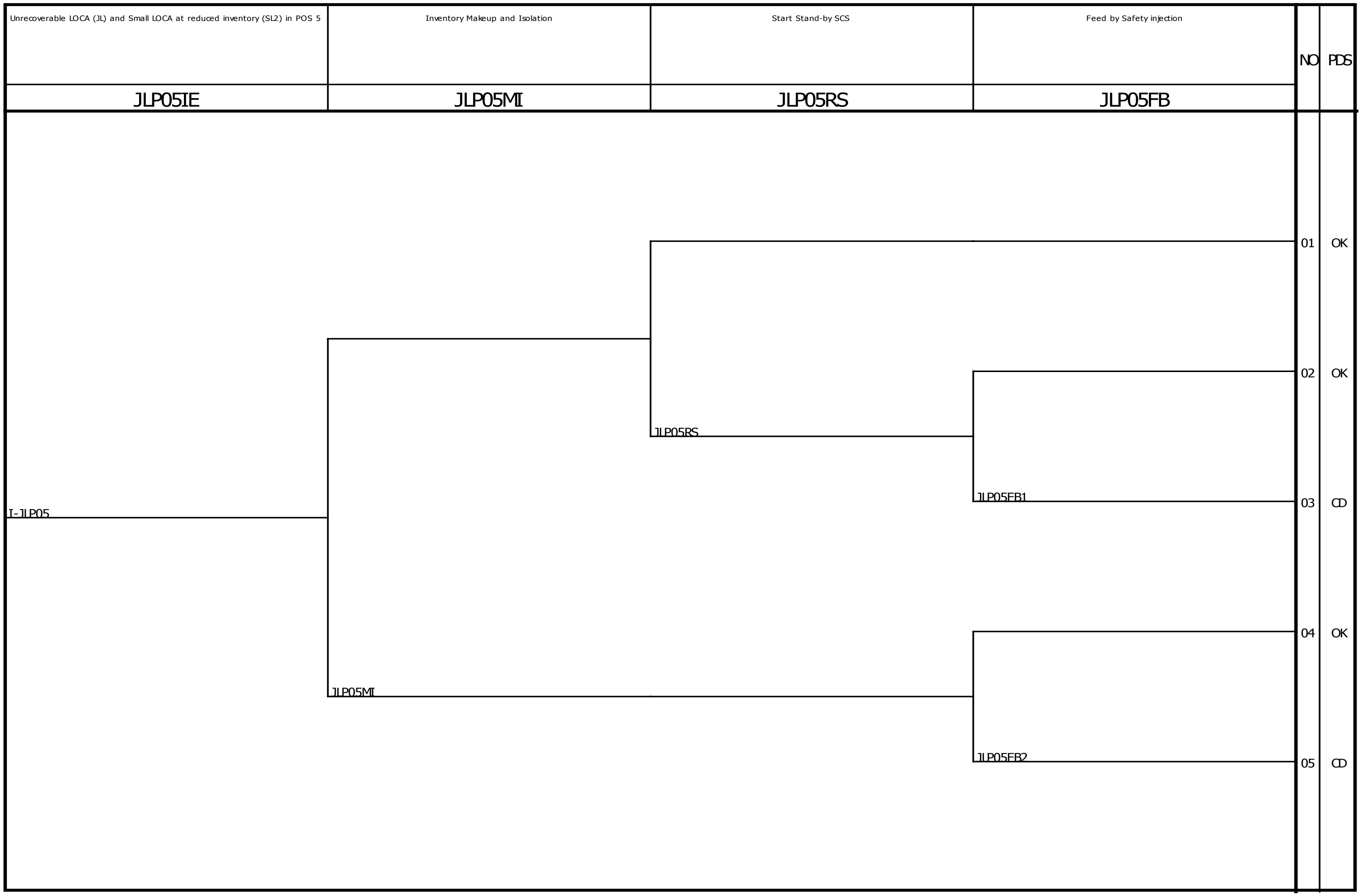

Figure 19.1-56 Unrecoverable LOCA (JL - purification line rupture) in POS 5

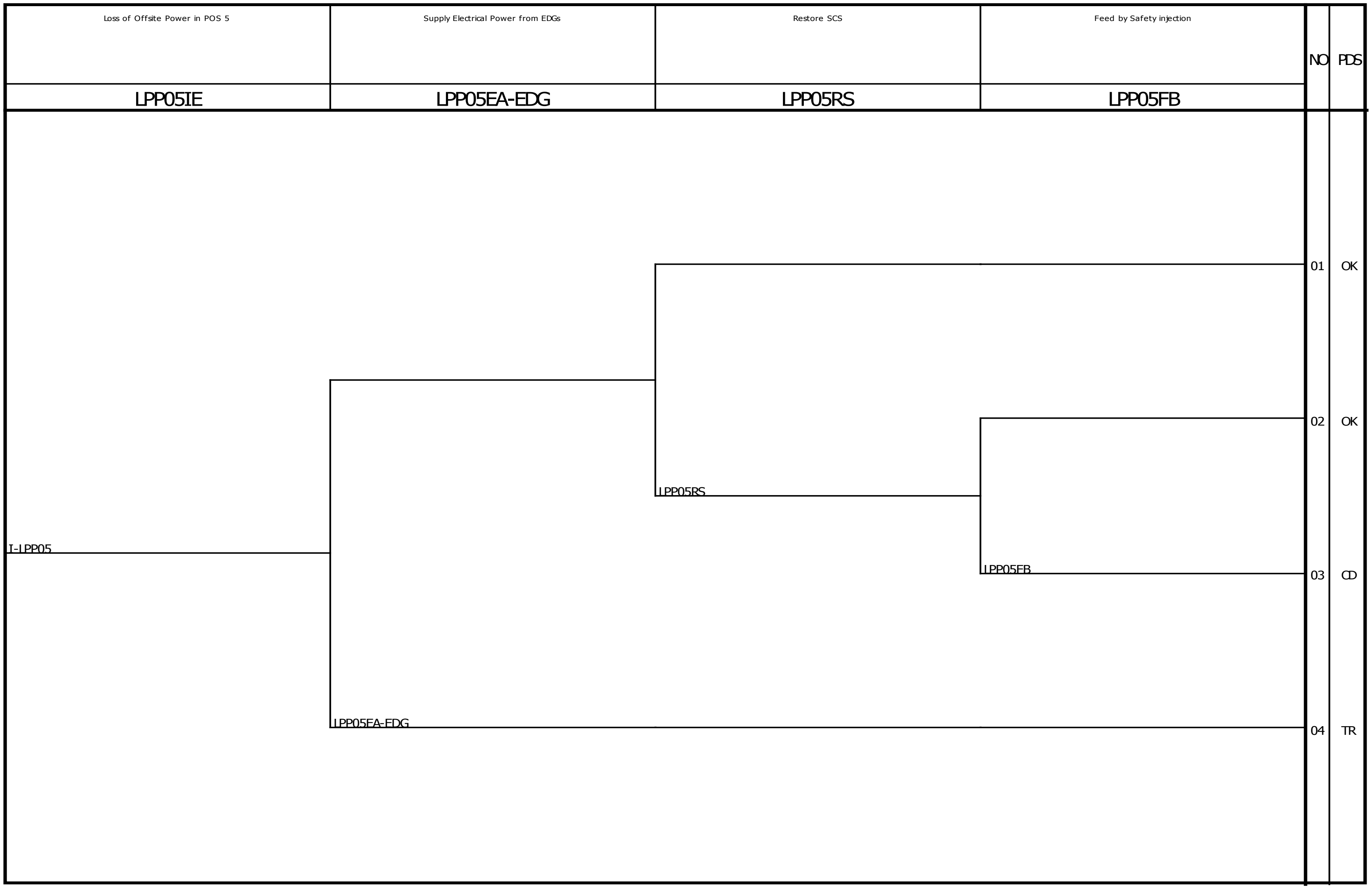

Figure 19.1-57 Loss of Offsite Power (LP) in POS 5

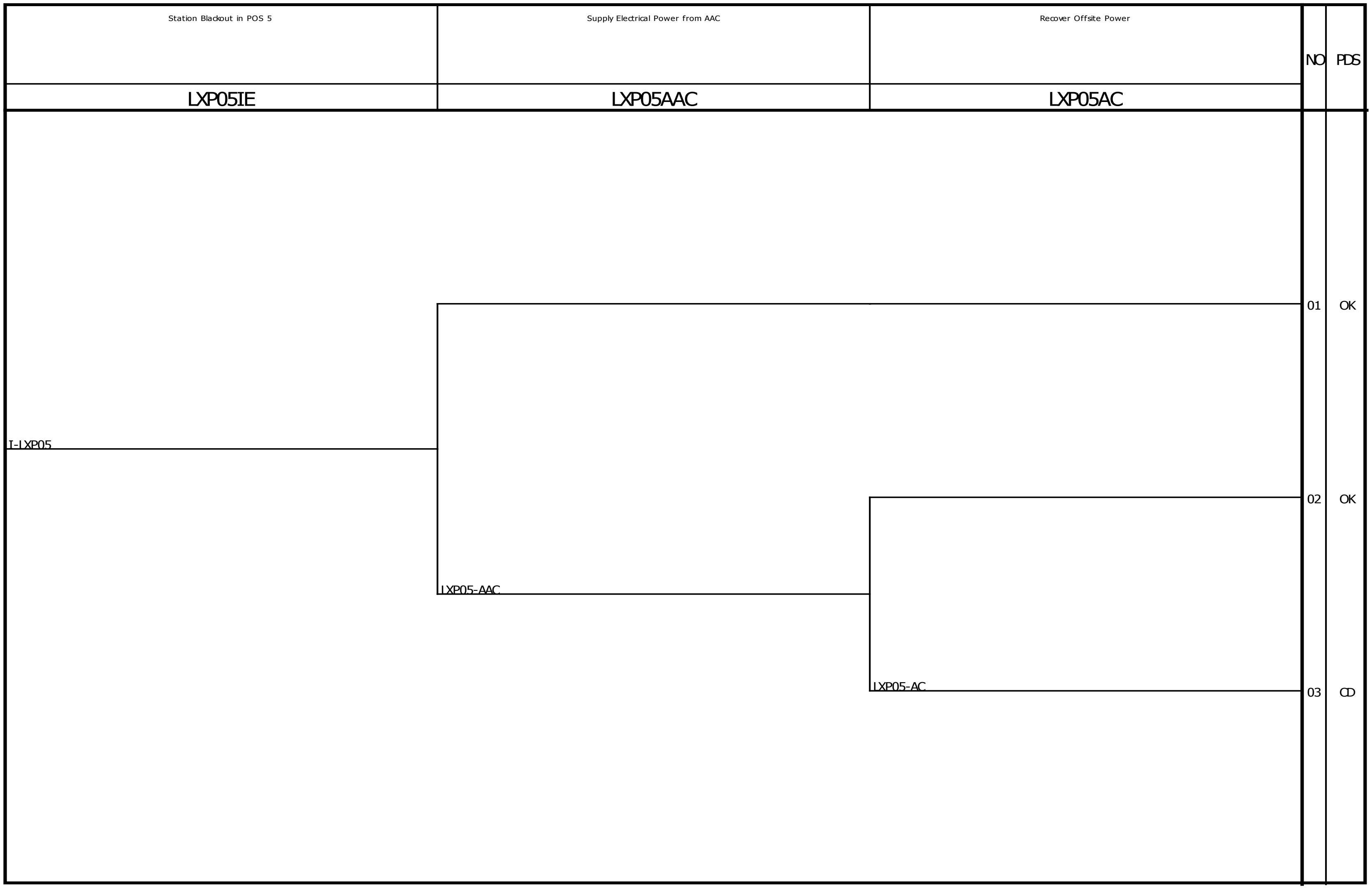

Figure 19.1-58   Station Blackout (LX) in POS 5

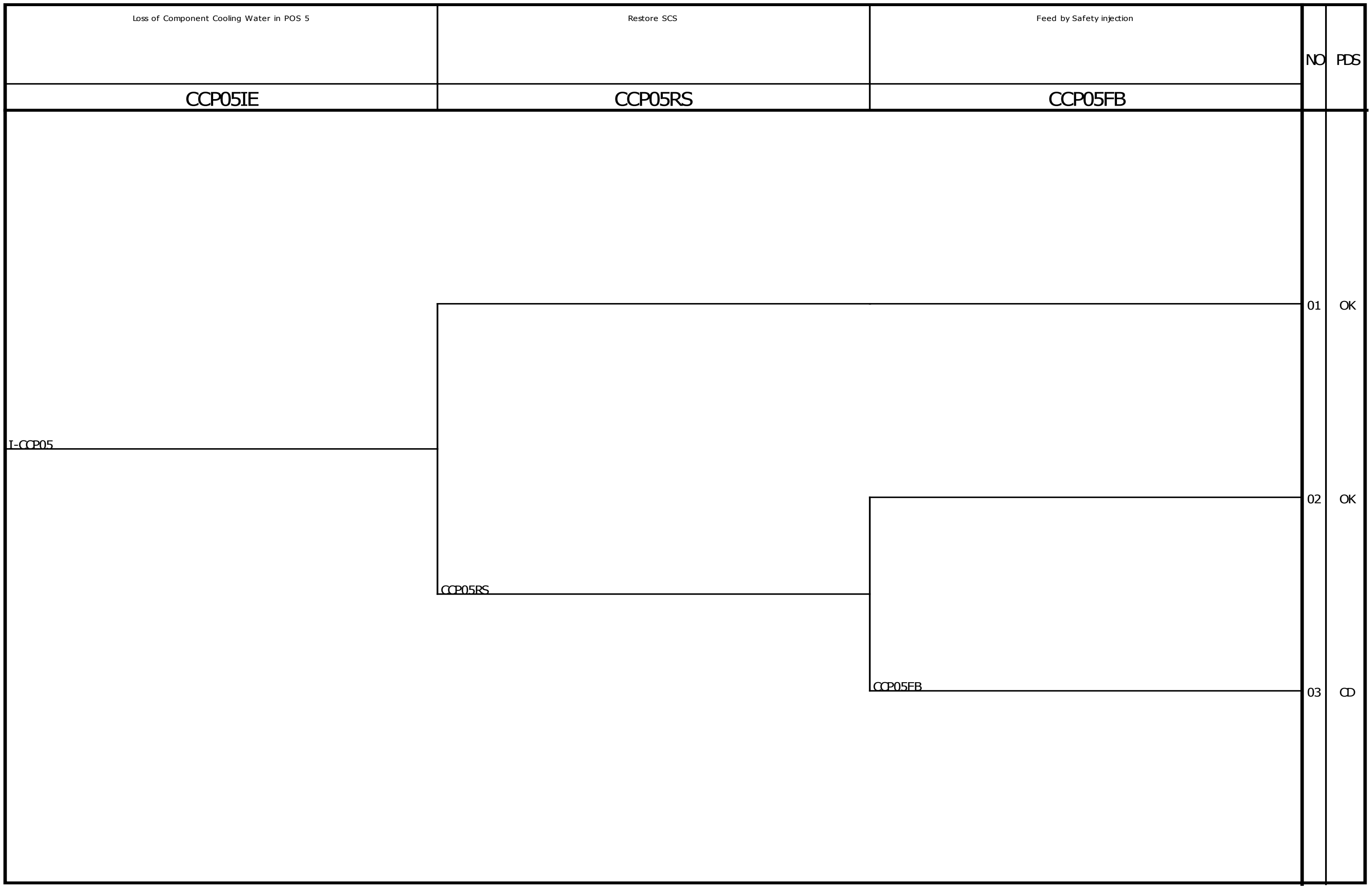

Figure 19.1-59 Partial Loss of Component Cooling (CC) in POS 5

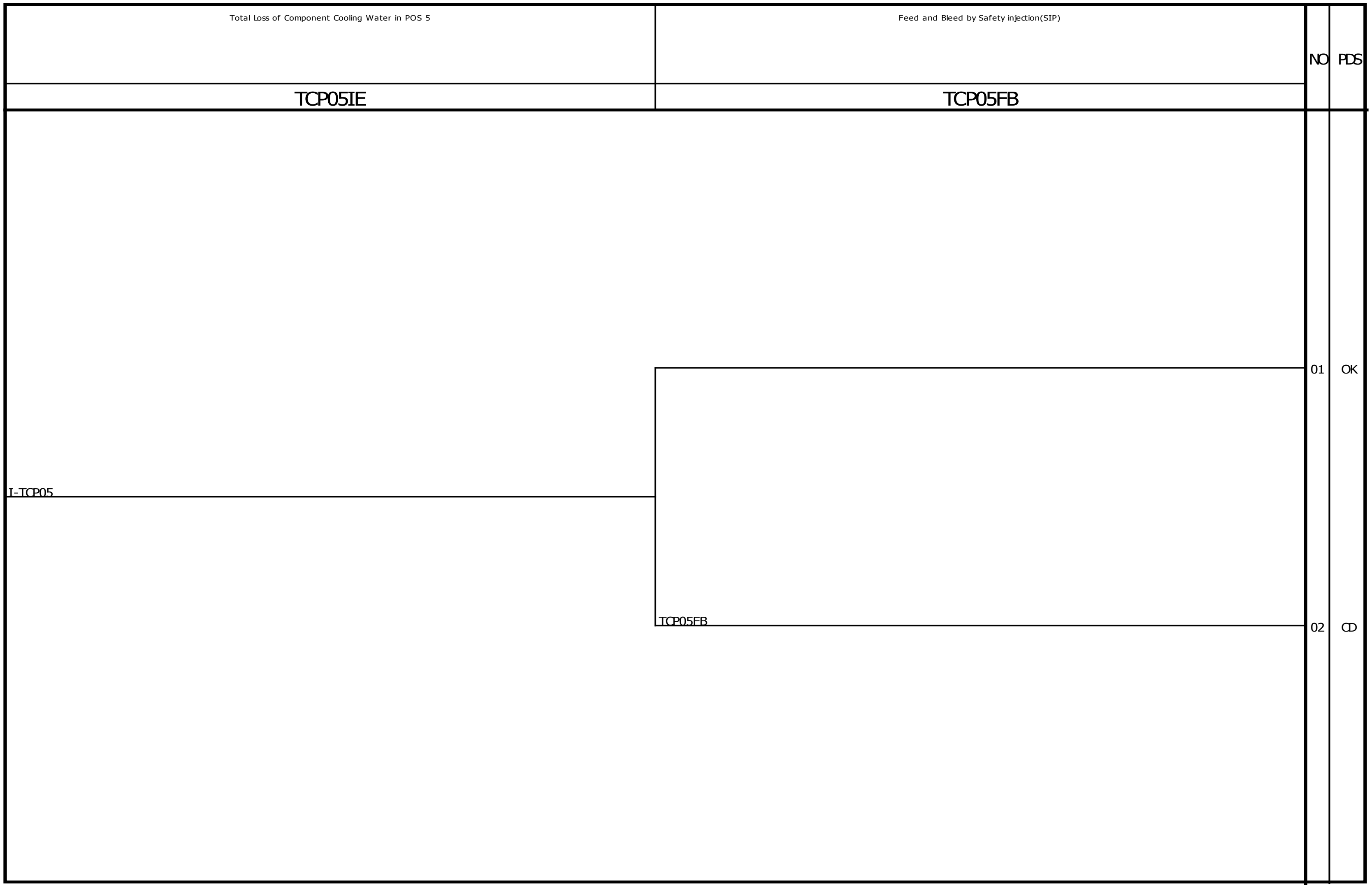

Figure 19.1-60 Partial Loss of Component Cooling (TC) in POS 5

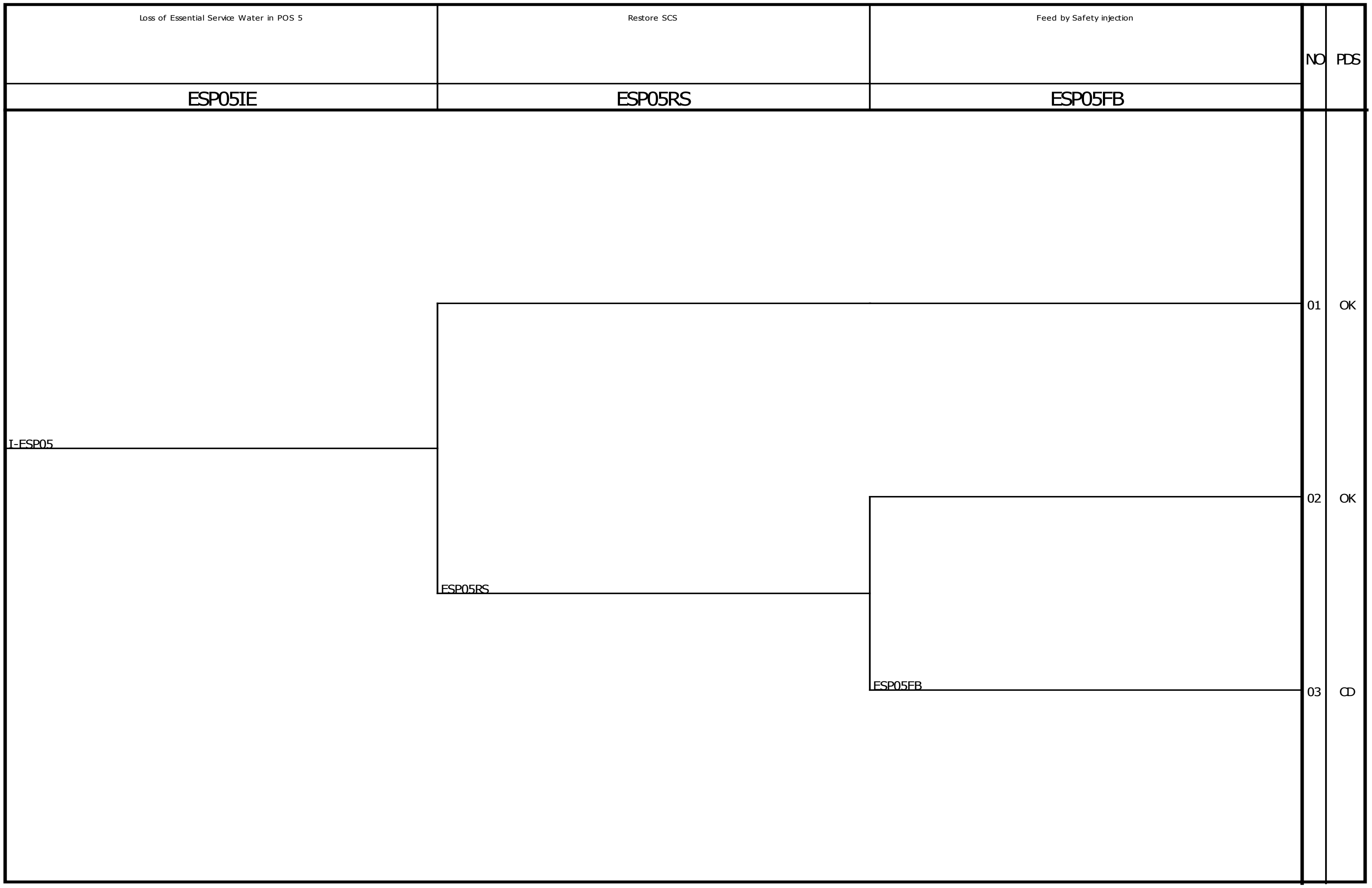

Figure 19.1-61 Partial Loss of Essential Service Water (ES) in POS 5

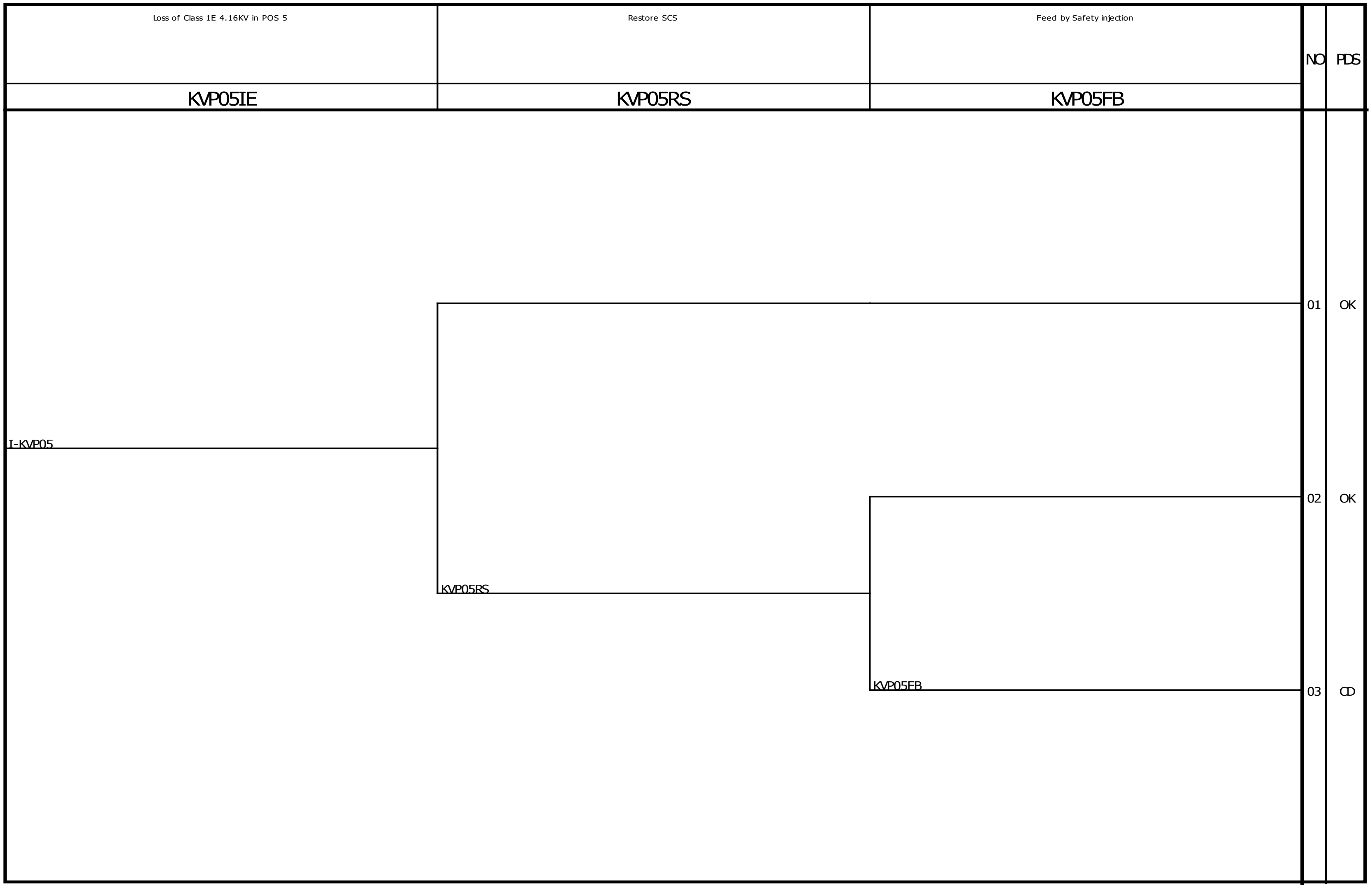

Figure 19.1-62 Loss of 4 kV Emergency Bus (kV) in POS 5

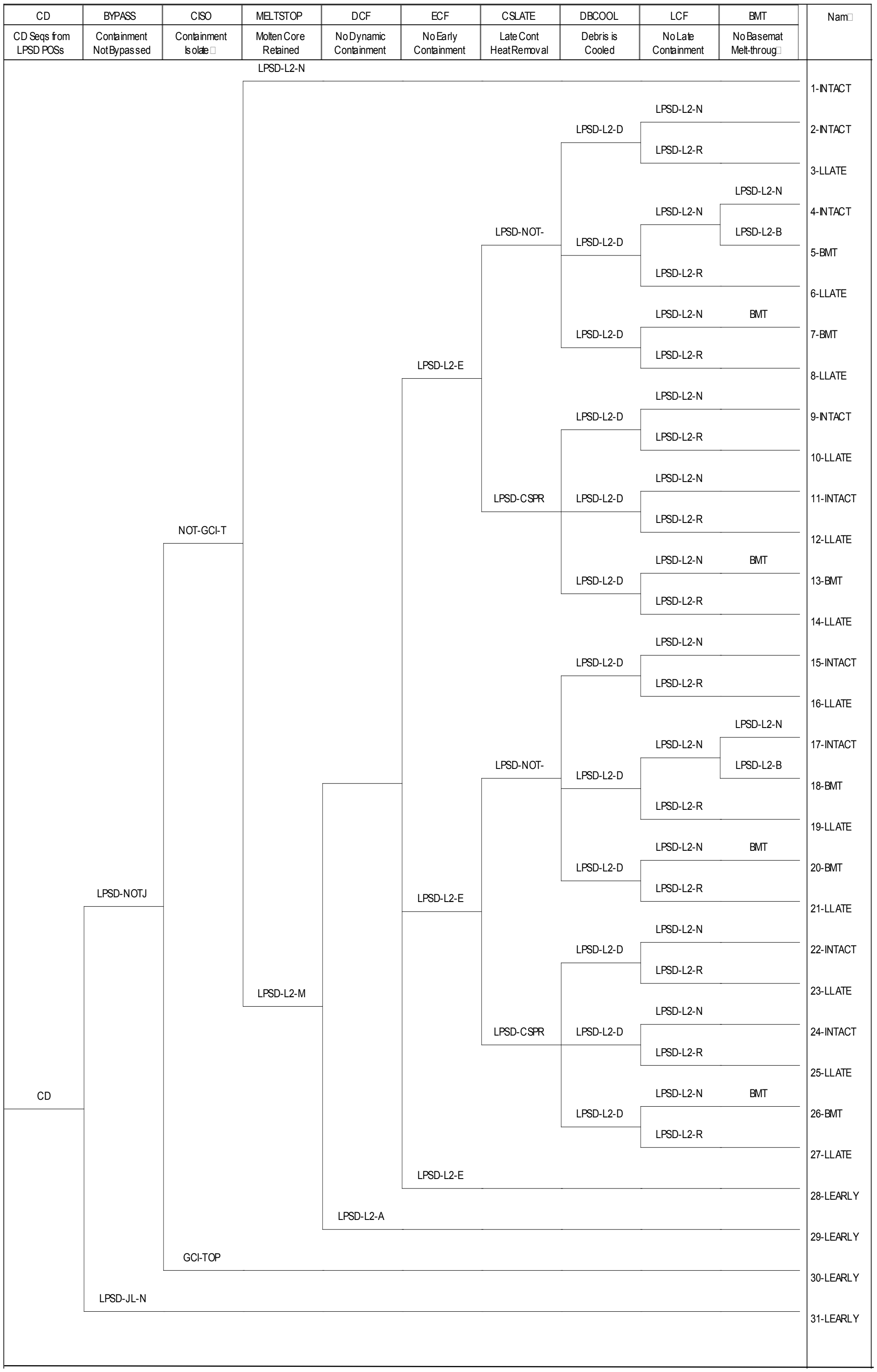

Figure 19.1-63 LPSD Containment Event Tree

19.2 Severe Accident Evaluation

19.2.1 Introduction

This section describes the APR1400 features that are designed to prevent and mitigate severe accidents. The severe accident evaluation for the APR1400 design is consistent with the guidance in SECY-93-087 (Reference 1) as well as the corresponding Staff Requirements Memorandum (SRM), dated July 21, 1993. The reactor and containment system designs are a vital portion of the defense-in-depth philosophy. Current reactors and containments are designed to withstand a loss-of-coolant accident (LOCA) and to comply with the siting criteria of 10 CFR Part 100 (Reference 2), General Design Criteria (GDC) of 10 CFR Part 50 Appendix A (Reference 3), and the Three Mile Island (TMI)-related requirements of 10 CFR 50.34(f) (Reference 4), 10 CFR 50.44 (Reference 5), NRC RG 1.216 (Reference 6), and SECY-90-016 (Reference 7).

19.2.2 Severe Accident Prevention

The APR1400 design includes features aimed at preventing the onset of a severe accident, including the severe accident precursors identified in SECY-90-016 and SECY-93-087. These precursors include anticipated transient without scram (ATWS), mid-loop operation, station blackout (SBO) event, fire, and intersystem loss-of-coolant accident (ISLOCA). Preventive features are described below for each of these events.

19.2.2.1 Anticipated Transient without Scram

An ATWS happens when an anticipated operational occurrence (AOO) occurs but is not followed by an automatic reactor trip. Reactor trip is necessary to terminate the transient and to shut down the plant. The APR1400 design includes a digital safety system and a diverse protection system (DPS) to minimize the possibility of an ATWS.

The plant protection system (PPS) is normally available to prevent and mitigate an ATWS. The PPS includes the electrical and mechanical devices and circuitry required to perform the functions of the reactor protection system (RPS) and the engineered safety features – component control system (ESF-CCS). The RPS is the portion of the PPS that trips the reactor when required. A coincidence of two signals, due to the two-out-of-four trip logic, is required to generate a reactor trip signal. The ESF-CCS is the portion of the PPS that activates the engineered safety feature systems (ESFSs). Additionally, the reactor trip system includes the RPS portion of the PPS, reactor trip switchgear system (RTSS), and components that perform a reactor trip after receiving a signal from the RPS (either automatically or manually).

The DPS provides a diverse backup to the PPS when the PPS is not working. The DPS initiates a reactor trip signal on high pressurizer pressure to decrease the possibility of an ATWS and provides an auxiliary feedwater actuation signal (backup to the ESF-CCS of the PPS) to mitigate an ATWS.

19.2.2.2 Mid-Loop Operation

During plant shutdowns, certain maintenance and testing activities require the controlled drain-down of the reactor coolant system (RCS) to a partially filled condition. When the reduced RCS level is within the hot leg, the risk of losing shutdown cooling is increased due to the possibility of vortex formation at the shutdown cooling suction line interface with the hot leg. If a vortex is formed in the shutdown cooling suction line, a substantial amount of air could be entrained into the shutdown cooling suction piping and degrade or interrupt the SC pump performance. If sufficient shutdown cooling is not reestablished, coolant heatup and vaporization/boiling can lead to uncovery of the reactor core.

The APR1400 design features can accommodate loss of residual heat removal during reduced reactor water inventory operations. These design features include:

a. Instrumentation for shutdown operations

   Diverse, accurate, and redundant instrumentation provides the operator with continuous system status and precise information to monitor reduced reactor water inventory operations and respond to loss of shutdown cooling events.

b. Shutdown cooling system (SCS) design

   System design features that improve SCS performance include:

1) The shutdown cooling suction lines do not contain loop seals, thereby minimizing the potential to trap gas. The suction piping layout allows self-venting of accumulated gas (or air).

2) The two redundant shutdown cooling suction lines are completely independent.

3) There are no auto-closure interlocks on the shutdown cooling suction piping valves, minimizing the potential for shutdown cooling isolation events.

c. Steam generator nozzle dam integrity

The APR1400 design addresses the regulatory concern of preventing significant pressurization in the upper plenum of the reactor vessel during core boiling scenarios. The APR1400 procedural guidance recommends a nozzle dam installation and removal sequence, which consists of the following:

1) Installation: The nozzle dams are installed in the cold legs first and in the hot legs second.

2) Removal: The nozzle dams in the hot legs are removed first and in the cold legs second.

The installation procedure requires that the pressurizer manway be opened so that a hot side vent pathway exists prior to blocking both RCS hot legs with nozzle dams.

In the APR1400 design, the ability of the RCS to withstand abnormal pressurization during reduced-inventory operations with the nozzle dams installed is limited by the design pressure of the nozzle dams. Based on overpressure tests performed on nozzle dams, the design pressure is estimated to be 3.52 kg/cm^2 (50 psia). The design pressure is sufficient to withstand an abnormal pressurization transient.

In order to provide reasonable assurance that the nozzle dam design pressure is not exceeded during reduced-inventory operations with boiling conditions in the reactor vessel, the APR1400 design requires that a mid-loop vent pathway is opened via the pressurizer manway prior to reduced-inventory operation. When the pressurizer manway is opened to the containment atmosphere, the surge line provides sufficient venting capacity to prevent RCS pressurization and preclude subsequent nozzle dam failure. The pressurizer surge line vent pathway has sufficient capacity to prevent core uncovery due to pressurization of the hot side resulting from boiling coolant.

d. Alternate inventory additions and decay heat removal methods

If SCS is lost during Mode 5 reduced water inventory operations, containment spray (CS) pumps or the safety injection (SI) pumps are used to provide makeup. If all above methods of decay heat removal and inventory replenishment are unavailable, a charging pump or a boric acid makeup pump is used to provide makeup for Modes 5 and 6. If no method of pumped inventory addition is available, a source for gravity feed inventory addition can be used via the SI tanks.

19.2.2.3 Station Blackout

One alternate ac (AAC) source is provided to help mitigate the effects of an SBO. The AAC automatically starts and is manually aligned to provide power to a Class 1E 4.16 kV bus in case Class 1E emergency diesel generators (EDGs) fail to start and load during loss-of-offsite-power (LOOP) events. This standby unit is independent and diverse from the Class 1E EDGs. Successful startup of the AAC together with turbine-driven auxiliary feedwater pumps is sufficient to prevent core damage in station blackout events (SBOs).

19.2.2.4 Fire Protection

The systems and components required for safe shutdown are physically separated from functionally similar or redundant systems or components to maintain the ability to perform safe shutdown functions in the event of a fire. Fire protection features such as fire detection, automatic and manual fire suppression, and fixed fire barriers provide reasonable assurance that the plant does not enter an unrecoverable state as a result of a fire incident. Fire protection system is described in Subsection 9.5.1.

19.2.2.5 Intersystem Loss-of-Coolant Accident

An ISLOCA is defined as a class of events in which a break occurs outside the containment in a system connected to the RCS, leading to a loss of primary system water inventory. This is considered as a beyond-design-basis event for systems connected with the RCS. Pressurization of an interfacing system could result from the inadvertent opening of a valve or valves, failure of containment isolation, or valves that are otherwise fully open (e.g., check valves that are stuck open). The APR1400 design addresses ISLOCA challenges by including the following design features:

a. The design pressure of equipment or systems has been increased to 64.3 kg/cm^2 (900 psig) for the low-pressure systems that are connected with the RCS.

b. Equipment and instrumentation has been added to alert the operator to an ISLOCA challenge or terminate and limit the scope of an ISLOCA event.

c. Parts of systems considered unnecessary are deleted because their functions can be replaced by other existing systems.

d. The refueling water tank is located inside containment.

e. Capability is provided for leak testing pressure isolation valves.

f. Pressure isolation valve position indication and control is provided in the main control room (MCR).

g. High-pressure alarms are added to warn the operator when increasing pressure approaches the design pressure of low-pressure systems.

In the APR1400 design, the safety injection system (SIS), SCS, and chemical and volume control system (CVCS) are directly connected to the RCS and are potentially susceptible to one or more ISLOCA events (i.e., they have one or more ISLOCA pressurization pathways).

The safety injection lines are connected to the reactor vessel directly and are primary interfaces through which an ISLOCA can begin. Pressurization is postulated to move from the direct vessel injection (DVI) nozzles and out of containment through the containment isolation valves to the low-pressure sections of the system. The SIS design satisfies the ISLOCA acceptance criteria because all sections of the system and interfaces are designed to withstand full RCS operating pressure or have a leak-test capability. In addition, the valve position indications in the control room function even when the isolation valve operators are de-energized, and high-pressure alarms sound to warn operators when pressure is approaching the design pressure. These design features protect the SIS lines and all interfacing systems from an ISLOCA challenge without adversely affecting performance or operations.

The shutdown cooling suction lines are connected to the RCS directly and are primary interfaces through which an ISLOCA event can begin. Pressurization is postulated from the hot leg and out of containment through the containment isolation valves to the low-pressure sections of the system. The shutdown cooling return lines are directly connected to the RCS directly and are primary interfaces through which an ISLOCA event can begin. Pressurization is postulated from the DVI nozzles and out of containment through the containment isolation valves to the low-pressure sections of the SCS.

This SCS line design satisfies the ISLOCA acceptance criteria because all sections of the system and interfaces are designed to withstand full RCS operating pressure, or they have leak-test capabilities, valve position indications in the control room that function even when isolation valve operators are de-energized, and high-pressure alarms to warn operators when pressure is approaching the design pressure. Deletion of the interfaces from the SCS lines eliminates the potential for an ISLOCA without adversely affecting the performance or operations of the SCS. These design features satisfy the ISLOCA acceptance criteria for the SCS line.

The containment spray system (CSS) is not connected directly to the RCS during the modes of reactor operation for which an ISLOCA challenge can occur. However, there is an indirect interface through the SCS because the CS pumps, CS heat exchangers, SC pumps, and SC heat exchangers are interchangeable respectively. All connected CS sections are designed to 64.3 kg/cm^2 (900 psig). The only low-pressure system interface with the CSS is the spent fuel pool cooling and cleanup system (SFPCCS) connection to the refueling pool. This connection provides the ability to fill the refueling pool directly rather than through the reactor vessel. A spool piece connection is available to provide a method of physical separation of the low-pressure SFPCCS from any pressurization source in the CSS.

The CVCS letdown line is directly connected to the RCS and is a primary interface through which an ISLOCA event can begin. Pressurization is postulated from the letdown nozzle, through the regenerative and letdown heat exchangers, through the letdown orifices, and out of containment through the containment isolation and letdown control valves to the low-pressure sections of the system. The letdown line has a high-pressure alarm that is located downstream of the letdown control valves and warns the operator when the pressure is approaching the low-pressure system design pressure. When a warning is issued, the control room operator isolates the letdown line to terminate any further pressure communication downstream of the containment isolation valve.

The CVCS charging line is connected directly to the RCS and is a primary interface through which an ISLOCA event can begin. Pressurization is postulated from the charging nozzle, through the shell side of the regenerative heat exchanger, the charging control valve, and the charging pump to the low-pressure sections of the system. The charging pump suction line has a high-pressure alarm that warns the operator when the pressure is approaching the low-pressure system design pressure. When a warning is received, the control room operator isolates the charging line to terminate any further pressure communication downstream of the containment isolation valve. These design responses satisfy the ISLOCA acceptance criteria.

19.2.2.6 Other Severe Accident Preventative Features

The APR1400 design uses other features to prevent severe accidents including:

a. Feedwater can be supplied to a steam generator by a turbine-driven auxiliary feedwater pump when the motor-driven auxiliary feedwater pumps are not available. Two independent turbine-driven auxiliary feedwater pumps are available in the APR1400 design.

b. If the CS pumps are inoperable during a LOCA event, then the SC pumps can be used as a backup.

c. The CS pumps and CS heat exchangers can be used as backups for the SC pumps and SC heat exchangers to provide cooling of the IRWST during post-accident feed-and-bleed operations when the steam generators are not available to cool the RCS.

d. Cooling during a loss of all feedwater can be accomplished via feed-and-bleed operation using the SIS and the pilot-operated safety and relief valves (POSRVs).

The component cooling water system (CCWS) is composed of two separate but interconnected two-division systems. The systems are designed to automatically isolate the cross connection in an accident. One or both of these systems operate independently after isolation because their designs provide a high level of performance reliability. If the CCWS is inoperable at any time during RCP operation, the RCP seal injection function is performed by the supply of seal injection via the auxiliary charging pump.

19.2.3 Severe Accident Mitigation

If a severe accident cannot be prevented by the above design features, other APR1400 features mitigate the effects of a severe accident. Of particular importance are the containment design and the ability of mitigating equipment to survive severe accident conditions. This section describes the mitigation features in the context of various severe accident phenomena that could be encountered during severe accident progression.

19.2.3.1 Overview of the Containment Design

19.2.3.1.1 Description of the Containment

The APR1400 containment is a prestressed concrete structure composed of a right circular cylinder with a hemispherical dome and is founded on safety-related common basemat. The APR1400 containment encloses the reactor vessel, steam generators, reactor coolant loops, and portions of the auxiliary and engineered safety features systems. The containment provides reasonable assurance that leakage of radioactive material to the environment does not exceed the acceptable dose limit as defined in 10 CFR 50.34 even if a loss of coolant accident (LOCA) occurred.

The cylindrical containment shell has a constant thickness of 1.37 m (4 ft 6 in) from the top of the foundation basemat to the springline. The shell is thickened locally around the equipment hatch, two personnel airlocks, feedwater, and main steam line penetrations. The containment reinforcing consists primarily of hoop and meridional steel. Prestressing tendons are also arranged in hoop and meridional directions.

The roof of the containment is a hemispherical dome. The inside of the dome is lined with a steel liner plate to provide leak-tightness. The buttresses are extended up to 48 degrees into the dome to provide anchorage for the dome hoop tendons. The 6.0 mm (0.25 in) liner plate is attached to inside of the dome and the cylindrical wall to provide leak-tightness.

The containment provides a large free volume with its internal structures arranged in a manner to (1) protect the inner containment from missile threats, (2) promote mixing throughout the containment atmosphere, and (3) accommodate condensable and non-condensable gas releases from design basis and severe accidents. The internal structures, which are made of reinforced concrete, enclose the reactor vessel and other primary system components. The internal structures provide radiation shielding for the containment interior and missile protection for the reactor vessel and containment shell.

19.2.3.1.2 Containment Pressure Limits

In severe accident scenarios, the containment vessel is the last fission product barrier protecting the public from radiation release. Therefore, it is of paramount importance to provide a strong containment design to meet severe accident internal pressurization challenges.

The containment is designed in accordance with ASME Section III, Division 2(Reference 8), and for the design pressure of 4.218 kg/cm^2 (60 psig) and design basis temperature of 416.5 K (290 °F). The containment is analyzed to determine all membrane, bending, and shear stresses resulting from the specified static and dynamic design loads.

As stated in SECY 93-087, the conditional containment failure probability (CCFP) must be less than 0.1 or meet a deterministic containment performance goal that provides comparable protection so the following general criterion is met: The containment maintains its role as a reliable, leak-tight barrier by providing reasonable assurance that the containment factored load category (FLC) requirements are met for a period of approximately 24 hours following the onset of core damage, and following this 24-hour period, the containment continues to provide a barrier against the uncontrolled release of fission products. The CCFP of APR1400 containment is described in Subsection 19.1.4.2.2. The APR1400 containment meets the FLC requirement of ASME Section III, Division 2, Subarticle CC-3720. The containment structural integrity evaluation is described in Subsection 3.8.1.4.12.

19.2.3.1.3 Containment Penetrations

The containment pressure boundary is made up of the containment shell and several mechanical and electrical containment penetrations. The penetrations include one equipment hatch; two personnel airlocks; containment piping penetration assemblies to provide for the passage of process, service, sampling, and instrumentation pipelines into the containment; electrical penetrations for power, control, and instrumentation; and a fuel transfer tube. All large penetrations are explicitly considered in the containment shell ultimate pressure capacity analyses. Smaller penetrations are sufficiently strong that they do not prematurely compromise the integrity of the containment shell.

19.2.3.2 Severe Accident Progression

This section provides a general description of the processes that may occur during the progression of a severe accident. Information is presented in the context of how these phenomena affect containment performance. Because of the complex processes involved, the progression of core melt scenarios can varies. Previous assessments reported in NUREG/CR-5132 (Reference 9), NUREG/CR-5597 (Reference 10), and NUREG/CR-5564 (Reference 11) provide generic insights that are also applicable to the APR1400 design.

The following subsections summarize key phenomena in the progression of severe accidents for the APR1400 design. Severe accident progression can be separated into in-vessel and ex-vessel phases. The in-vessel phase generally begins with insufficient decay heat removal and can lead to melt-through of the reactor vessel. The ex-vessel phase starts with the release of core debris from the reactor vessel into the containment, which can result in phenomena such as molten core-concrete interaction (MCCI), fuel-coolant interaction (FCI), and direct containment heating (DCH).

19.2.3.2.1 In-Vessel Melt Progression

In severe accidents that proceed to vessel failure, the in-vessel melt progression establishes the initial conditions for the thermal and mechanical loads that may ultimately threaten the integrity of the containment when melt is ejected from the vessel. In-vessel melt progression encompasses the phenomena and processes involved in a severe core damage accident, starting with core uncovery and initial heatup, and continuing until either the degraded core stabilizes and cools within the reactor vessel stabilizes and cools, or breach of the reactor vessel occurs and molten core material is released into the containment. The phenomena and processes in the APR1400 that can occur during in-vessel melt progression include:

a. Core heatup resulting from loss of adequate cooling

b. Metal-water reaction and cladding oxidation

c. Eutectic interactions between core materials

d. Melting and relocation of cladding, structural materials, and fuel

e. Formation of blockages near the bottom of the core as relocating molten materials solidify (wet core scenario)

f. Formation of a melt pool, natural circulation heat transfer, crust formation, and crust failure (wet core scenario)

g Drainage of molten materials to the vessel lower head region (dry core scenario)

h. Formation of a melt pool, natural circulation heat transfer, and crust formation in the lower plenum

i. Reactor vessel breach from a local failure or global creep-rupture

Successful removal of decay heat prevents initiation of a severe accident. However, if decay heat removal fails, the core can heat to the point where coolant is lost and damage to the fuel and fuel cladding may occur.

When decay heat exceeds the available heat removal rate coolant, boil off can result and reduce the water level within the reactor vessel. If the coolant level within the core decreases to the point that the core is exposed then the fuel rods are only cooled by rising steam. The fuel rods begin to overheat and oxidation of the zirconium alloy cladding releases more heat and generates hydrogen from reaction with steam. As the fuel rods continue to heat up from decay heat and reaction energy from the exothermic zirconium oxidation reaction, low melting point materials within the reactor melts first and may form eutectics.

The zirconium alloy, with a melting point near 2,033 K (3,200 °F), eventually begins to melt, breaking down the protective ZrO_2 layer, and exposing unoxidized zirconium alloy. Local melting of the fuel rods may cause changes in the core geometry and reroute the steam flow. This can lead to an increase in oxidation as more steam has access to the unoxidized zirconium alloy, or it could reduce the zirconium alloy surface available for oxidation and thereby decrease the overall reaction process.

In addition to oxidation, the potential exists for the zirconium alloy to interact with the UO_2 fuel, forming low-melting-point eutectics. Formation of eutectics may decrease the effective surface area for oxidation and the overall oxidation rate. Fuel/cladding contact, fuel liquefaction, and melt relocation can affect the oxidation behavior of zirconium alloy-based melt.

Various severe fuel damage (SFD) test programs, sponsored by the NRC, show that the oxidation of zirconium is largely controlled by the availability of steam and high rates of hydrogen generation can continue after melt formation and relocation (Reference 12). Some of these experiments indicate that most hydrogen generation occurs after onset of zirconium melting and fuel dissolution. In steam-rich experiments, oxidation took place over most of the fuel bundle length, and most of the hydrogen generation occurred early. For steam-starved experiments, oxidation was limited to local regions of the fuel bundle, and most hydrogen generation occurred after the onset of Zr/UO_2 liquefaction and relocation.

Hydrogen production and accumulation during a severe accident may challenge the containment in numerous ways, including deflagration, detonation, and pressurization. The APR1400 containment has the containment hydrogen control (HG) system to consume hydrogen as it is produced during a severe accident, thereby decreasing the potential for hydrogen combustion events that would challenge containment integrity.

The SFD tests indicated the potential for incoherent melt relocation as a result of variable temperatures within the test bundles. This is because of the different core materials present with a wide range of melting points and eutectic temperatures. Formation of eutectics results in a non-uniform melting and relocation process. Further differences in the melt relocation process can be attributed to asymmetric bundle heating that can increase upon zirconium alloy oxidation. This process begins when one area of the fuel bundle is initially at a temperature higher than the other areas. The higher temperature zirconium alloy oxidizes at a faster rate. The exponentially increasing oxidation reaction contributes to asymmetric bundle heatup and the potential for incoherent melt relocation behavior.

As the temperature of the core increases, vaporization and release of some fission products occur. Steam or hydrogen carries these fission products throughout the primary system where they can deposit on internal components. The deposition mechanisms include condensation on the heat sinks (diffusiophoresis), gravitational settling, and thermophoresis. The fission products that are not deposited remain airborne and are released to the containment, where the dominant removal mechanisms are gravitational settling and diffusiophoresis.

Core melt progression, including relocation and fission product release, is a very complex process, which becomes increasingly difficult to predict as the scenario unfolds. The core melt could relocate into the lower reactor vessel plenum. If water is present in the lower plenum, the potential could exist for in-vessel steam explosions, wherein molten core material rapidly fragments and transfers its energy, causing rapid steam generation and possible shock waves.

The in-vessel core melt progression contains considerable uncertainty. This uncertainty relates to the following:

a. Potential for in-vessel steam explosion

b. Interaction between core debris and internal vessel structures

c. Time and mode of vessel failure

d. Composition of the core debris released at vessel failure

e. Amount of in-vessel hydrogen generation

f. In-vessel fission-product release and transport

g. Retention of fission products and other core materials in the RCS

19.2.3.2.2 Ex-Vessel Melt Progression

Upon vessel failure, the melt progression moves to the containment (ex-vessel). The following conditions affect ex-vessel severe accident progression:

a. Mode and timing of the reactor vessel failure

b. Primary system pressure at reactor vessel failure

c. Composition, amount, and character of the molten core debris expelled

d. Type of concrete used in containment construction

e. Availability of water to the reactor cavity

The initial response of the containment from ex-vessel severe accident progression depends on RCS pressure at reactor vessel failure and the existence of water within the reactor cavity. If not prevented by design features, early containment failure mechanisms and bypass usually dominate risk consequences. Early containment failure mechanisms result from energetic severe accident phenomena, such as high-pressure melt ejection (HPME) with DCH and ex-vessel steam explosions. The long-term containment pressure and temperature response from ex-vessel severe accident progression is largely a function of an interaction between molten core and concrete, known as MCCI, and the availability of mechanisms to remove heat from the containment.

At high RCS pressures, ejection of the molten core debris from the reactor vessel could occur in jet form, causing fragmentation of the debris into small particles. The potential exists for the ejected debris to be swept out of the reactor cavity and into the upper containment. Finely fragmented and dispersed core debris could rapidly heat the containment atmosphere and lead to a large pressure spike. In addition, exothermic chemical reactions of the core debris particulate with oxygen and steam could add to the pressurization. Hydrogen, preexisting in the containment or produced during DCH, could ignite, further adding to the containment pressure load. These phenomena are together referred to as HPME with DCH.

Reactor vessel failure with discharge of core debris into a wet reactor cavity (i.e. the cavity contains water) induces interactions between fuel and water (coolant) with the potential for rapid steam generation or steam explosions. Rapid steam generation involves non-explosive steam generation that pressurizes containment compartments beyond their ability to withstand or relieve the pressure; thus, the containment fails because of local overpressurization. Steam explosions involve the rapid mixing of finely fragmented core debris with surrounding water, resulting in rapid vaporization and acceleration of surrounding water, creating substantial pressure and impact loads.

The eventual contact of molten core debris with concrete in the reactor cavity leads to MCCI. This interaction decomposes the concrete and can challenge the containment by various mechanisms, including:

a. Pressurization from evolved steam and non-condensable gases, which can cause overpressure failure of containment

b. Transport of high-temperature gases and aerosols into the containment, leading to high-temperatures and possibly failure at the containment seals and penetrations

c. Containment basemat melt-through

d. Reactor support structure melt-through leading to the relocation of the reactor vessel and tearing of containment penetrations

e. Production of combustible gases such as hydrogen and carbon monoxide

Many factors affect MCCI, including the availability of water in the reactor cavity, the containment geometry, the composition and amount of core debris, the core debris superheat, and the type of concrete involved.

19.2.3.3 Severe Accident Mitigation Features

Various APR1400 design features are intended to mitigate the effects of particular severe accident phenomena, as described in the following subsections.

19.2.3.3.1 External Reactor Vessel Cooling

In-vessel retention of core debris as result of external reactor vessel cooling is a potential means to mitigate a severe accident. The goal of external cooling is retention of the molten core debris in the reactor vessel lower plenum and thus prevent vessel failure. In-vessel retention precludes the possible ex-vessel physical phenomena related to debris relocation such as steam explosions and molten core concrete interaction (MCCI).

The APR1400 is designed to allow operators to fill the reactor cavity with water and thereby submerge the reactor vessel in coolant. This can achieve ex-vessel cooling and in-vessel retention. However, in-vessel retention is not credited as a mitigation feature for the APR1400 due to uncertainty surrounding the associated phenomena along with the need for operators to take additional manual actions.

19.2.3.3.2 Hydrogen Generation and Control

19.2.3.3.2.1 Mitigation Features

During a degraded core accident, hydrogen is generated at a greater rate than that of the design basis LOCA. The containment hydrogen control system is designed to accommodate the hydrogen generation from a metal-water reaction of 100 percent of the active fuel cladding and limit the average hydrogen concentration in containment to 10 percent consistent with 10 CFR 50.34(f) and 10 CFR 50.44 (Reference 5) for a degraded core accident. These limits are imposed to preclude detonations in containment that might jeopardize containment integrity or damage essential equipment.

The HG consists of a system of passive autocatalytic recombiners (PARs) complemented by glow plug igniters installed within the containment. The PARs are capable of controlling hydrogen in all accident sequences with moderate hydrogen release rates, and are located throughout the containment. The igniters supplement PARs for accidents in which rapid hydrogen release rates are expected, and are placed near anticipated source locations to promote the combustion of hydrogen in a controlled manner. The HG design is composed of 30 PARs and 8 igniters, which are placed throughout the containment as listed in Table 19.2.3-1. The PAR and igniter locations are shown in Figure 19.2.3-1. The HG PARs are strategically distributed so that the overall average concentration requirements are met. These locations are determined based on equipment and piping proximity as well as inspection and maintenance access. The PAR components and igniter assembly are designed to meet seismic Category I requirements.

The PARs are self-actuated and require no electric power. Therefore, no operator action is required. The igniters, which supplement PARs, are intended to control hydrogen concentration within containment once the operator confirms that an extended core uncovery is in progress. The operators use specific accident management guidance that relies on RCS and containment instrumentation, such as in-vessel level monitoring instrumentation, core-exit thermocouples, containment and RCS pressure indications, and a direct measurement of containment hydrogen concentration.

Once activated, an igniter produces either periodic small local burns or a standing diffusion flame, either of which reduces the containment hydrogen concentration below the upward flammability limit. Thus, the HG system prevents hydrogen from accumulating to the point where a destructive hydrogen detonation might occur within the containment.

19.2.3.3.2.2 Analysis Methodology

Hydrogen control analyses were performed using the Modular Accident Analysis Program (MAAP), version 4.0.8 (Reference 13), to determine hydrogen mixing, distribution, and combustion inside containment. The containment model used for hydrogen control analysis consists of 36 control volumes, 83 flow paths, and heat structures. Figure 19.2.3-2 shows the nodalization scheme of the containment model. Table 19.2.3-2 provides a description of the individual nodes. The analysis also investigated the potential for hydrogen accumulation in the containment and the response of the hydrogen mitigation system.

The accident sequences to be analyzed were selected to cover the most probable core damage sequences from outcomes of Level 1 PRA plus representative LOCA sequences. As a result, five accident sequences — large-break, medium-break, and small-break LOCA (LBLOCA, MBLOCA, and SBLOCA), SBO, and total loss of feedwater (TLOFW) — were selected as representatives.

In addition, the operations of CSS, cavity flooding system (CFS), HG, manual opening of POSRVs for rapid RCS depressurization, and alignment of the three-way valves to discharge to a steam generator (SG) compartment were considered to investigate the effects of accident management strategies for each sequence.

The guidance in 10 CFR 50.34(f) was followed to establish the total generated hydrogen. In principle, the amount generated by an equivalent to a 100 percent metal-water reaction (MWR) of the active fuel cladding was assumed to be generated due to oxidation of fuel cladding. The hydrogen generation due to ex-vessel MCCI is additionally considered in the hydrogen control analysis. This methodology results in more than 100 percent of equivalent MWR, depending on the extent of MCCI that occurs in the sequence.

Within each MAAP calculation, the potential hydrogen combustion events such as flame acceleration (FA) and deflagration-to-detonation transition (DDT) for hydrogen-steam-air mixtures are evaluated using the σ-criterion for FA and the 7λ-criterion for DDT from the Organisation for Economic Co-operation and Development (OECD) report (Reference 14).

An adiabatic isochoric complete combustion (AICC) analysis was performed to determine the peak containment pressure when combustible gases generated during the course of severe accident burn all at once. The results are summarized in Subsection 19.2.4.2.1.

19.2.3.3.2.3 Analysis Results

The MAAP computer code was used for predicting release of hydrogen at various containment compartments under severe accident scenarios. The possible hydrogen release points considered in the analysis include the hot-leg break (for LOCAs), IRWST spargers, failed reactor vessel lower head, and POSRV three-way valves. For LOCAs prior to vessel failure, hydrogen is released from the break in the hot leg into SG compartment. For non-LOCA sequences like SBO and TLOFW, hydrogen is first released to the IRWST through the pressure-lifted POSRVs. When three-way valve manual alignment is actuated, hydrogen is also released to SG compartment via the three-way valve. For high-pressure sequences including an SBO, TLOFW, and SBLOCA, an additional release point could come from hot leg failure due to creep. After vessel failure, the failed lower head provides another hydrogen release point to the cavity area.

Figures 19.2.3-3 through 19.2.3-6 show the hydrogen distribution in the containment when all severe accident mitigation features are available. Based on the results of the analysis, the APR1400 design with all of the severe accident mitigation features available is capable of maintaining a well-mixed containment atmosphere and a hydrogen concentration below 10 percent (Reference 15).

With severe accident mitigation features available, there is no potential for DDT in the containment (Reference 15). The mitigation features include HG, CFS, and manual opening of POSRVs with alignment of the three-way valves.

19.2.3.3.3 <u>MCCI and Core Debris Coolability</u>

After vessel failure, core debris is discharged into containment. Once there, MCCI begins, leading to erosion of the concrete in the reactor vessel cavity. This threatens the integrity of the containment pressure boundary due to the possibility of melt-through of containment liners and the concrete basemat. Concrete ablation also generates non-condensable gases such as CO_2, CO, and H_2, which can lead to containment challenges due to pressurization and hydrogen burns. In order to halt MCCI, debris superheat and decay heat are removed from the corium pool. The APR1400 design accomplishes this by providing for flooding of the reactor cavity using the CFS. This allows heat to be transferred from the corium pool into the overlying pool of water, eventually stopping MCCI. The analysis in this section shows that the CFS feature is capable of protecting against challenges to the containment integrity due to MCCI.

19.2.3.3.3.1 <u>Mitigation Features</u>

19.2.3.3.3.1.1 <u>Reactor Cavity Design</u>

The reactor cavity is configured to promote retention of, and heat removal from, the postulated core debris during a severe accident, thus serving several roles in accident mitigation. The large cavity floor area allows for spreading of the core debris, enhancing its coolability within the reactor cavity region.

The large free volume of the reactor cavity is a benefit when cavity pressurization issues are considered. Large, vented volumes are not prone to significant pressurization resulting from vessel breach or during corium quench processes. This design characteristic is illustrated in the cavity pressurization analysis results in that the possible peak pressure in the reactor cavity during severe accidents stays well below the allowable capacity.

The reactor cavity is designed to maximize the unobstructed floor area available for the spreading of core debris. The cavity floor is free from obstructions and comprises an area available for core debris spreading such that the floor area/reactor thermal power ratio is larger than 0.02 m^2/MWt. Uniform distribution of 100 percent of the corium debris within the reactor cavity results in a relatively shallow debris bed and consequently, effective debris cooling is expected in the reactor cavity.

The containment liner plate in reactor cavity area is embedded 0.91 m (3 ft.) below from the cavity floor at the minimum.

19.2.3.3.3.1.2 Cavity Flooding System

The cavity flooding system (CFS) provides a means of flooding the reactor cavity during a severe accident to cool the core debris in the reactor cavity and to scrub fission product releases. The water delivery from the IRWST to the reactor cavity is accomplished by means of active components. The CFS is designed (in conjunction with the containment spray system) to provide an inexhaustible continuous supply of water to quench the core debris.

The components of the CFS include the IRWST, holdup volume tank (HVT), reactor cavity, connecting piping, valves, and associated power supplies. This system is used in conjunction with the containment spray system to form a closed recirculation water cooling system to provide a continuous cooling water supply to the core debris. The quenching of the corium produces steam, which is condensed by the containment spray flow. The CFS takes water from the IRWST and directs it to the reactor cavity. The water flows first into the HVT by way of the two HVT spillways and then into the reactor cavity by way of two reactor cavity spillways.

Once actuated, movement of the water from the IRWST source to the cavity occurs passively due to the natural hydraulic driving heads of the system. Actuation of the CFS results in the opening of the HVT spillway valves, allowing water from the IRWST to flood the HVT. This flow is driven by the differences in the static heads of water between the IRWST and the HVT. Flooding of the HVT progresses until the water level in the HVT reaches the reactor cavity spillway, at which time reactor cavity flooding commences. Flooding ceases when water levels in the IRWST, HVT, and reactor cavity equalize.

The HVT and cavity spillways are located as low as possible to provide the greatest head and maximize usage of available water in the IRWST and HVT. Both spillways are equipped with remote manual motor-operated valves (MOVs).

HVT flooding valves are normally closed and located in individual flow paths connecting the IRWST to the HVT. Reactor cavity flooding valves are normally closed and located in individual flow paths connecting the HVT to the reactor cavity. The valves are opened by the MCR operator to flood the reactor cavity in the event of a severe accident. Controls are provided to allow the valves to be opened either individually or simultaneously, to initiate reactor cavity flooding.

Flooding of the reactor cavity serves the following purposes in the strategy to mitigate the consequences of a severe accident:

a. Minimize or eliminate corium-concrete attack

b. Minimize the generation of combustible gases (hydrogen and carbon monoxide) and non-condensable gases

c. Scrub fission products released due to corium-concrete interaction

d. Remove heat from the core debris

The manual operation of the CFS provides a mechanism for the operator to most efficiently use plant resources and mitigate the consequences of a severe accident. It is envisioned that the CFS is actuated once a potential core melt condition is imminent or has been diagnosed as being in progress. Typical indications of core uncovery include (1) core-exit thermocouple (CET) temperatures in excess of 922.04 K (1,200 °F), (2) reactor vessel level monitoring system (RVLMS) readings indicative of no liquid above the fuel alignment plate, and (3) significant changes in readings of self-powered neutron detectors (SPND).

It is understood that steam explosions may pose a non-negligible threat to the cavity and containment integrity. Thus, there may be an incentive to delay actuation of the CFS until vessel breach (VB) is imminent or when the reactor vessel lower head has failed. While actuation of the CFS before VB is presently deemed desirable, the consequences of delayed CFS actuation (prior to extensive concrete erosion) may also achieve similar results. Flooding of the HVT progresses until the water levels in IRWST, HVT, and reactor cavity equalize at 6.4 m (21 ft) from the reactor cavity floor (EL. 69 ft 0 in).

Thus, it is currently believed that an acceptable stable state can be achieved ex-vessel as long as the CFS has been actuated prior to VB. Although providing water to the reactor cavity may not immediately terminate the concrete erosion, having a water-filled reactor cavity initially reduces and ultimately terminates the erosion, while simultaneously providing scrubbing of fission products released in the molten core-concrete interaction process.

19.2.3.3.3.2 Analysis Methodology

The MCCI analysis for the reactor cavity is performed with MAAP using model parameters tuned based on the results of the more sophisticated debris coolability code CORQUENCH (Reference 16). CORQUENCH models a broad range of MCCI and debris coolability phenomena, including:

a. Stress-induced cracking of the upper crust and water ingression

b. Melt eruption due to debris entrainment by offgas produced from the decomposition of concrete

c. Particle bed formation due to melt eruption and jet breakup during debris relocation after vessel failure

d. Formation of stable crust bridges that prevent water contact with molten debris

Analysis of MCCI in a flooded reactor cavity and reactor cavity sump is first performed using CORQUENCH for a conservative LBLOCA sequence with early relocation of 100 percent of the core inventory into the reactor vessel cavity. The results of this analysis are then used to tune the model parameters in the MAAP. MAAP is then used to analyze the progression of MCCI in the reactor cavity for several of the most likely core damage sequences as well as a LBLOCA sequence. Each sequence is run with a flooded reactor cavity.

Debris coolability in the sump is evaluated using CORQUENCH for a conservative LBLOCA sequence.

19.2.3.3.3.3 Analysis Result

The corium in the APR1400 reactor cavity is quenched, and the integrity of containment liners is maintained when the CFS is available, based on the analyses presented in this subsection. This is due to the ample corium spreading area in the reactor cavity, which allows for sufficient heat transfer from the corium pool into the overlying pool of water and thus prevents the ablation front from reaching the containment liner plate.

19.2.3.3.3.3.1 CORQUENCH Result for MCCI in the Reactor Cavity

For the MCCI analysis in the reactor cavity, the conservative large-break LOCA (LBLOCA) scenario is calculated by CORQUENCH. This sequence conservatively assumes early relocation of 100 percent of the core inventory into the containment and that no jet breakup occurs when the core debris relocates into the flooded reactor cavity. The depth of concrete ablation in the reactor cavity for the conservative LBLOCA scenario was predicted to be 0.27 m (0.86 ft) by CORQUENCH.

19.2.3.3.3.3.2 CORQUENCH Results for MCCI in the Reactor Cavity Sump

The limiting case for MCCI analysis is large-break LOCA with 100 percent core relocation into the reactor cavity. For the large-break LOCA scenario, corium is predicted to be quenched in the reactor cavity sump before the depth of concrete ablation reaches the buried containment liner. This sequence conservatively assumes early relocation of 100 percent of the core inventory into the containment.

19.2.3.3.3.3.3 MAAP Results for MCCI in the Reactor Cavity

The largest amount of concrete erosion in the reactor cavity is predicted to occur for the large-break LOCA scenario. This scenario models a large-break LOCA with MAAP predicting early vessel failure and some debris retained in the reactor vessel lower plenum. Figures 19.2.3-7 through 19.2.3-11 show the ablation depth in the floor and sidewall. MAAP predicts an ablation depth of 0.24 m (0.79 ft). The final ablation depth is well short of the 0.91 m depth of the containment liner embedded in the reactor cavity. Figure 19.2.3-12 shows the containment pressure. The containment pressure remains below the 8.7 kg/cm^2 (123.7 psia) for 24 hours following the onset of core damage. The basis of pressure 8.7 kg/cm^2 (123.7 psia) is described in Subsection 19.2.4.2.1.

19.2.3.3.4 High-Pressure Melt Ejection and Direct Containment Heating

Accident initiators such as station blackout, loss of feedwater, and small-break LOCA can result in core melt and reactor vessel failure at high pressures. If the reactor vessel fails while the reactor coolant system is still pressurized, particulate core debris can be entrained from the reactor cavity by gas flows and transported directly into the upper containment atmosphere. This can result in a rapid temperature and pressure increase in containment by directly transferring the heat from the core debris into the containment gas space. This process is referred to as direct containment heating (DCH), and the core debris ejection process following reactor vessel failure at high pressure is called high-pressure melt ejection (HPME).

The DCH phenomenon is investigated by looking at three distinct areas: debris entrainment in the reactor cavity, debris de-entrainment in the lower containment compartments, and impacts of debris that reaches the upper containment compartments. Once the reactor vessel fails, core debris is discharged into the reactor cavity. As the reactor vessel depressurizes, high-velocity gas flows fragment and entrain debris from the corium pool. The fragmented debris particles can be dispersed into different areas of containment. During this transport process, a large portion of the entrained debris particles are de-entrained during sharp turns in the flow and are contained in the lower containment compartments. The fraction of core debris that is transported into the upper compartments can interact with the containment atmosphere, resulting in rapid temperature and pressure increases by rapid heat transfer. In addition, metallic constituents of the ejected material, principally zirconium and steel, can exothermically react with oxygen and steam to generate chemical energy and (in reactions with steam) hydrogen. Together with hydrogen combustion, this process can impose additional loads on the containment.

19.2.3.3.4.1 Mitigation Features

Mitigation features provided for HPME and DCH are the rapid depressurization (RD) function and reactor cavity design. The rapid depressurization function provides reasonable assurance that the reactor vessel is at low pressure when the vessel fails. The unique reactor cavity design provides reasonable assurance that even if the vessel fails at high pressure, most of the corium ejected stays in the subcompartment.

19.2.3.3.4.1.1 Rapid Depressurization Function

The RD function is a multi-purpose dedicated system designed to serve important roles in severe accident prevention and mitigation. Figure 19.2.3-13 shows some details of the RD function.

In the APR1400 design, the POSRVs are designed to allow for depressurization of the RCS below the cutoff pressure for HPME to occur. For the APR1400 design, the rapid depressurization function is initiated by operator action as part of the severe accident management strategy. When CET temperature exceeds 922.04 K (1,200 °F), the operator identifies entry into a severe accident condition and starts rapid depressurization by opening the required POSRVs.

The RD function design requirement related to severe accident mitigation is the capability to depressurize the RCS from approximately 175.8 kg/cm^2 (2,500 psia) to approximately 17.6 kg/cm^2 (250 psia) prior to reactor vessel breach. The target pressure of the RD function is determined on the basis of DOE/ID-10271 (Reference 17).

The power for each RD valve is supplied from a respective Class 1E direct current (dc) bus. The power is provided such that a bleed path can be established in case of a loss of offsite power, four emergency diesel generators (EDGs), and the AAC source. Each train of dc loads is provided with a separate and independent battery charger and a standby charger. The battery chargers are powered from the 480 V ac Class 1E power distribution systems of the same trains. A load management strategy provides reasonable assurance of dc power availability for a minimum of 4 hours for Trains A and B and 16 hours for Trains C and D following an SBO.

The RD function provides a manual means of quickly depressurizing the RCS when normal and auxiliary feedwater are unavailable to remove core decay heat through the steam generators. This function is achieved via remote manual operator control. Whenever an event, such as a TLOFW, results in a high RCS pressure with a loss of RCS liquid inventory, the POSRVs may be opened by the operator, causing a controlled depressurization of the RCS. As the RCS pressure decreases, the SI pumps start, initiating feed flow to the RCS and restoring the RCS liquid inventory. The RD function allows for both short- and long-term decay heat removal.

The RD function also serves an important role in severe accident mitigation. In the event a high-pressure meltdown scenario develops and the feed portion of feed and bleed cannot be established due to unavailability of the SI pumps, the RD function can be used to depressurize the RCS and prevent HPME following a VB.

19.2.3.3.4.1.2 Reactor Cavity Design

The reactor cavity is configured to promote retention of core debris during a severe accident. Corium retention in the core debris chamber virtually eliminates the potential for significant DCH-induced containment loadings.

When the vessel is breached under high pressure, the melt is ejected first followed by the high-speed steam and H_2 jet. The melt is entrained by the jet into small particles. The duration of the gas blowdown following melt ejection may be sufficiently long to cause complete sweep-out of the ejected melt. Therefore, it is reasonable, and conservative, to assume complete entrainment of ejected melt. Then, the mixture of steam, gas, and corium particles flow through available flow paths between the reactor cavity and the upper containment.

For flow entering the debris chamber, the lower-inertia steam/hydrogen/gas mixture negotiates right-angle turns and exit the reactor cavity while the corium particles carried by the flow impinge on walls and deposit in the subcompartment. For flow entering the in-core instrumentation (ICI) chase, the presence of the seal table prevents upward corium discharge through the instrument shaft. Even if the seal table fails due to overpressure in the reactor cavity, the flow first impinges on the wall at the end of the cavity and makes a 90-degree (upward) turn to the ICI chase where the seal table is located. It is shown that nearly all the entrained corium is captured by the impingement, and only a small amount corium is released through the failed seal table. Therefore, the only flow path that leads directly to the upper containment without significant de-entrainment is the reactor pressure vessel (RPV) annulus. Because of the multiphase flow, the flow is choked in the reactor cavity, not in the reactor cavity access area. Thus, the fraction of the dispersed corium that enters the upper containment via the RPV annulus is given by the ratio of the area of RPV annulus, 1.96 m^2, to the total flow area, which is the sum of the area of PRV and the area of reactor cavity, 23.76 m^2, or 0.082.

19.2.3.3.4.2 Analysis Methodology

There are two parts to the methodology. The RD analysis evaluates whether the reactor vessel can be depressurized before it can fail, and the DCH analysis evaluates the containment pressure response to a HPME.

19.2.3.3.4.2.1 Rapid Depressurization Analysis

The rapid depressurization analyses were performed using MAAP code to prove the performance of the RCS depressurization. The MAAP code was used to evaluate pressure response of the reactor vessel when two POSRVs are opened following detection of core damage. The analyzed sequences for APR1400 were selected to be a representative sample of Level I PRA sequences, disabling the hot leg creep rupture model as necessary to predict a higher-pressure vessel failure.

19.2.3.3.4.2.2 DCH Analysis

NUREG/CR-6338 methodology (Reference 18) was applied for the DCH/HPME evaluation. This involves assessment of containment integrity by calculating the overall CFP based on phenomenological analysis and the uncertainties of the DCH process. If the CFP is below a certain level, containment integrity is judged to be maintained. For this purpose, the NRC developed a methodology that combines the two-cell equilibrium (TCE) model and Latin hypercube sampling (LHS) methods.

For the TCE/LHS analysis, scenarios defined in NUREG/CR-6075 (Reference 19) are selected as high-pressure sequences. For each selected scenario, initial DCH conditions such as core debris mass and its composition just after failure of the reactor vessel are determined. The ejection characteristics of core debris are determined based upon the geometrical configuration of the containment. Probabilistic distribution functions for uncertainties in parameters such as core debris mass, degree of Zr oxidation, coherence ratio describing heat transfer between dispersed debris and gases in containment, and containment failure pressure are determined. A TCE analysis is performed by sampling inputs using 10,000 samples by LHS processing coupled with all generated data.

19.2.3.3.4.3 Analysis Result

Figure 19.2.3-14 shows the RCS pressure responses during the rapid depressurization. Operation of only two POSRVs within a half hour of the plant entering a severe accident is sufficient to decrease the RCS pressure below the DCH cutoff pressure (17.6 kg/cm^2 [250 psi]) for all sequences considered. Table 19.2.3-3 shows the summary of results for the rapid depressurization analysis about the Total Loss of Essential Service Water (TLOESW) sequence. The analysis results comply with SECY-93-087 (Reference 1).

For each of the three scenarios, no containment failure cases have resulted in 10,000 trials. Based on this outcome, the CFP in APR1400 due to DCH is estimated to be less than 0.01 percent (0.0001). This indicates that APR1400 meets the success criterion established in NUREG/CR-6338 (Reference 18) for PWR large dry containment, where DCH problem is considered resolved if CFP is less than 1 percent (0.01).

19.2.3.3.5 Fuel-Coolant Interactions

The containment integrity and function may be challenged by dynamic loads from a steam explosion resulting from FCI. For the evaluation of the risks associated with FCIs for the APR1400 design, in-vessel steam explosions (IVSEs) and ex-vessel steam explosions (EVSEs) are described and analyzed in accordance with 10 CFR 52.47(a)(23) (Reference 20).

19.2.3.3.5.1 Analysis Methodology

19.2.3.3.5.1.1 In-Vessel Steam Explosion (IVSE)

The alpha-mode failure caused by IVSE has been considered as a threat to containment integrity for many years. The FCI expert review group sponsored by the NRC concluded in NUREG-1116 (Reference 21) and NUREG-1524 (Reference 22) that probability of this failure was vanishingly small or physically unreasonable. The OECD/NEA FCI specialist meeting (Reference 23) confirmed this conclusion. Therefore, the IVSE analysis is performed to confirm the applicability of the experts' conclusions to the APR1400 design.

19.2.3.3.5.1.2 Ex-Vessel Steam Explosion (EVSE)

EVSE has been considered as one of the important threats to containment integrity for many years although no specific requirements are stated in the CFRs. Therefore, the EVSE analysis aims analytically to confirm the maintainability of containment integrity by employing a mechanistic FCI code to calculate EVSE pressure loads. The APR1400 specific analysis consists of four steps:

a. Selection of the initial and boundary conditions for the base case analysis based on MAAP analysis results

b. Evaluation of pressure loads with TEXAS-V (Reference 24) for the base case analysis

c. Assessment of uncertainties associated with the pressure load evaluation

d. Evaluation of containment structural integrity against the pressure loads

The base case of the EVSE analysis is assumed to be a case where the vessel failed at the bottom center of the RPV due to the in-core instrument guide tube ejection resulting in the ejection of oxidic core debris into a subcooled pool of water in the reactor cavity.

19.2.3.3.5.2 Analysis Result

19.2.3.3.5.2.1 In-Vessel Steam Explosion

The key physical processes that can influence in-vessel steam explosions for PWRs are (a) melt relocation into the lower plenum, (b) corium jet breakup and coarse mixing formation in the lower plenum, (c) triggering of coarse mixing, (d) energetic FCIs, and (e) pressure loads to the upper and lower vessel heads and their responses.

Both NUREG-1116 and NUREG-1524, written by the NRC-sponsored Steam Explosion Review Group, concluded that the potential for alpha-mode failure is vanishingly small or physically unreasonable. The OECD/Committee on the Safety of Nuclear Installations (CSNI) also confirmed the conclusion of NUREG-1524 and concluded that the alpha-mode failure issue was resolved from a risk perspective.

Because the APR1400 design is not significantly different from current PWRs, the NUREG-1524 conclusions are applicable to the APR1400 design, thus no mitigation features are provided to prevent or mitigate IVSE.

19.2.3.3.5.2.2 Ex-Vessel Steam Explosion

The initial and boundary conditions for EVSE are largely dependent upon the in-vessel severe accident progression, severe accident management procedure, and vessel failure modes. Thirteen severe accident sequences were chosen to cover the spectrum of key variable parameters and thus characterize the initial and boundary conditions for EVSE analysis. The key parameters considered include corium discharge rates, corium thermal conditions, cavity conditions, and related parameters.

The result of analysis using the MAAP code provided the initial conditions for the TEXAS-V code. TEXAS-V was then used to calculate the peak pressure due to EVSE. The pressure at the nearest cavity wall was then estimated by the TNT method (Reference 25).

The reactor cavity and RPV column support have to maintain structural integrity in events such as an ex-vessel steam explosion. The reactor cavity and RPV column support is designed such that the cavity strength has an adequate capability to withstand the postulated pressure load during a severe accident.

For the assessment of reactor cavity structural integrity against the EVSE pressure loading, the concrete cracks of cavity walls and bottom slab, the stress of the RPV column support anchor bolts, reinforcement rebars, and liner plates were evaluated using LS-DYNA computer program. The results of evaluation confirm that the reactor cavity is capable of maintaining structural integrity when EVSE loads are applied.

The requirements of ACI 349-97 (Reference 26) were used in determining the ultimate static pressure capacity and the dynamic pressure capacity of the reactor cavity wall (except no load factors were applied to the loads because of the highly unlikely occurrence of a severe accident and the one-time loading condition). As such, potential additional margins in reinforcing strength, concrete strength, and the material ductilities beyond those allowable by design code were not used in determining the aforementioned static and dynamic capacities of the structure. The evaluation of the cavity structural analysis indicates that the reactor cavity integrity is preserved during both static and dynamic EVSE loads.

19.2.3.3.6 Containment Bypass

Containment bypass events involve failure of the pressure boundary between the high-pressure reactor coolant system and a low-pressure auxiliary system. For PWRs, this can also occur because of the failure of the steam generator tubes, either as an initiating event or as a result of severe accident conditions.

These scenarios are important because, if core damage occurs, a direct path to the environment can exist. This can lead to an early release of fission products outside containment and public health risks. The following sections describe potential containment bypass events for the APR1400.

19.2.3.3.6.1 Steam Generator Tube Rupture

A thermally induced steam generator tube rupture (SGTR) can occur in severe accident sequences where the primary system is at high pressure during core melt. This condition leads to creep rupture of the steam generator tubes due to the high-pressure and high-temperature conditions. The APR1400 design mitigates this possibility by operator actuation of the required POSRVs. This system is capable of reducing pressure in the reactor vessel below 17.58 kg/cm^2 (250 psia). Once primary system pressure reaches this level, there is essentially no risk of an induced tube rupture occurring.

19.2.3.3.6.2 Intersystem LOCA

Intersystem LOCA is mitigated by the instrumentation and the design pressure of systems which are directly connected to RCS. The pressure isolation valve position indication and high-pressure alarms can alert the operators to an intersystem LOCA challenge, or terminate and limit the scope of an intersystem LOCA event. The intersystem LOCA is described in detail in Subsection 19.2.2.5.

19.2.3.3.7 Equipment Survivability

According to SECY-90-016 and SECY-93-087, the equipment and instrumentation provided for severe accident mitigation do not need to be subjected to the qualification requirement of 10 CFR 50.49 (Reference 27), the quality assurance requirements of 10 CFR Part 50 Appendix B (Reference 28), or the redundancy/diversity requirements of 10 CFR Part 50 Appendix A. It is satisfactory to provide reasonable assurance that the designated equipment and instrumentation can operate in a severe accident environment over the required time span.

The equipment survivability (ES) assessment first requires identification of all essential equipment and instrumentation that are vulnerable to the harsh environmental conditions during a severe accident. Next, the harsh environmental condition expected in each location in the containment is determined. Pressure, atmospheric temperature, and radiation dose are considered. Then, the survivability of each essential piece of equipment or instrumentation is demonstrated with reasonable assurance by comparing the APR1400 severe accident environmental condition to the design basis event / severe accident testing, providing redundancy, performing thermal-lag analyses, or protecting it with thermal shields or conduits. The COL applicant is to perform and submit site-specific equipment survivability assessment in accordance with 10 CFR 50.34(f) and 10 CFR 50.44.

19.2.3.3.7.1 Identification of Required Equipment and Instrumentation for ES Assessment

During a core damage sequence, operators are confronted with multiple failures of essential safety equipment or operator errors. For operators to effectively cope with this plant condition, they are provided with equipment and instrumentation with the ultimate goal of achieving a safe stable state. This equipment and instrumentation can be grouped according to function: RCS inventory control, RCS heat removal, reactivity control, and containment integrity.

RCS inventory control is primarily provided by the SIS. If the SIS is not available and the RCS is depressurized below about 14.06 kg/cm^2 (200 psia), inventory control can be provided via realignment of SC or CS pump to operate in an injection mode.

RCS heat removal following a severe accident is accomplished by establishing auxiliary feedwater system (AFWS) flow to at least one steam generator or using the feed-and-bleed operation. Once a sufficiently low pressure is established in the RCS, long-term heat removal can be accomplished via the SC function using either SC or CS pumps, with associated heat exchangers.

Reactivity control is provided by insertion of control rods and delivering sufficiently borated water into the RCS. Reactivity control is typically achieved early in the transient via insertion of control rods.

Given the highly reliable containment isolation systems, the containment integrity of the APR1400 depends on restoration of containment heat removal function and the performance of seals in the electrical penetration assemblies (EPAs), personnel airlock (PAL), and equipment hatch. When the reactor vessel fails and the molten corium relocates into the containment, the cavity flooding system minimizes the MCCI and resulting non-condensable gas generation. The containment integrity also depends on hydrogen control and mitigation because hydrogen burns can create short but extreme temperature conditions in the containment.

The equipment and instrumentation that require ES assessment are summarized in Table 19.2.3-4.

19.2.3.3.7.2 Determination of Severe Accident Environmental Conditions

19.2.3.3.7.2.1 Bounding Temperature Environment

The bounding harsh environmental conditions are determined by simulating a broad spectrum of accident sequences including LBLOCA, MBLOCA, SBLOCA, TLOFW, and SBO, and dominant PRA sequences using the MAAP code. According to 10 CFR 50.34(f) and 10 CFR 50.44, equipment that is necessary for achieving and maintaining safe shutdown of the plant or maintaining containment integrity has to be demonstrated to be capable of performing its safety function during and after being exposed to the environmental conditions caused by the release of hydrogen generated by the equivalent of a 100 percent fuel-clad metal-water reaction, including the environmental conditions created by activation of the hydrogen control system. Appropriate MAAP inputs are used to calculate the in-vessel hydrogen generation consistent with this requirement.

The emergency containment spray backup system (ECSBS) is assumed to be actuated within 24 hours after the onset of core damage. The harsh environmental condition is removed once the spray is turned on and cools the containment atmosphere. Therefore, the essential equipment needs to be assessed for survivability only for the first 24 hours following the onset of core damage.

Similar to equipment qualification (EQ) profiles, equipment survivability (ES) profiles are constructed to characterize severe accident environmental conditions. To address the random occurrence of temperature spikes due to hydrogen burn, atmospheric temperature histories are discretized and treated as a histogram. The bins in the histogram are then reordered not by time but by decreasing order of magnitude to create a monotonically decreasing characterization of the atmospheric temperature, which has the same integrated value of temperature with respect to time. This preserves the duration and the magnitude of conditions, while minimizing the effect of uncertainty in phenomena timing. Figure 19.2.3-15 shows the temperature histories in the steam generator compartment for various scenarios. The top graph shows a random occurrence of temperature spikes due to hydrogen burn. The bottom graphs shows corresponding reordered temperature histories. A temperature of 900 K (1,160 °F) over 10 seconds envelops the temperature spikes due to hydrogen burn. Long-term atmospheric temperature after temperature spikes is enveloped by a temperature of 460 K (368 °F). The ES profile of each node is constructed to envelop the reordered temperature histograms of individual sequences. The ES curves are used to assess survivability of individual equipment. Severe accident temperature environments can be classified as severely challenging, highly challenging, quite challenging, moderately challenging, or nominally challenging, depending on the magnitude and duration of extreme conditions. Severely challenging environments are identified by highly confined extreme conditions for a relatively long duration, such as in the reactor cavity and the IRWST. Highly challenging environments are areas close to a combustible gas source such as the steam generator compartments or the annular compartment above the IRWST. Quite challenging and moderately challenging environments are areas where combustible gas may accumulate such as the containment dome. Nominally challenging environments are compartments where the containment atmosphere can be considered well-mixed and is inerted by a high steam concentration. The equipment survivability curves constructed for each of the five types of environments are shown in Figures 19.2.3-16 through 19.2.3-20. The bounding temperature profile expected in each containment node during a severe accident is summarized in Table 19.2.3-5.

19.2.3.3.7.2.2 Bounding Pressure Environment

Based on the MAAP results, the bounding containment pressure expected during a severe accident is 7.75 kg/cm^2 (110 psia).

19.2.3.3.7.2.3 Bounding Radiation Environment

MAAP4-DOSE (Reference 29) is used to determine the bounding radiation dose during a severe accident. MAAP4-DOSE is a radiation dose calculation code that reads input from MAAP output. The maximum radiation dose that equipment in the containment is expected to receive during a severe accident is 4.4×10^5 Gy, predicted in the steam generator compartment for the LOFW sequence.

19.2.3.3.7.3 Analysis Methodology

ES is assessed by comparing reliable EQ information such as equipment suppliers' documents, research results, and experimental data with severe accident environmental conditions at the locations where the equipment is installed.

For the comparison with equipment supplier documents, related documents are reviewed and the location of equipment is identified. The assessment of survivability is performed by comparing the equipment data to the ES profile and the accident conditions to which the equipment is exposed. If the equipment data cannot support survivability under the specified severe accident environmental conditions, survivability is confirmed by consulting the equipment vendors.

Major research and experiments for equipment survivability related to qualification of electrical cables, instruments, data transmitters, valves, etc., were performed by Sandia National Laboratories, EPRI, and the Hydrogen Control Owner's Group (HCOG). Some examples are the Nevada Test Site (NTS) experiments (Reference 30), Central Receiver Test Facility (CRTF) experiments (Reference 31), Severe Combined Environment Test Chamber (SCETCh) experiments (Reference 32), and HCOG 1/4-scale experiments (Reference 33). The assessment methodology for equipment survivability compares research results and experimental data with predicted severe accident environmental conditions.

Thermal lag analysis may be used for equipment survivability assessments using analytical methods (Reference 34). A "thermal lag" analysis is one that accounts for the time that it takes for the temperature of the critical component to rise when exposed to a rise in the ambient gas temperature. Although the local atmospheric condition could rise to an extreme temperature momentarily due to hydrogen combustion, the temperature at the surface of the equipment may be much lower than that in the gas space. Hence, the equipment survivability can be assessed using simplified thermal lag analysis methods based on the temperature difference between the containment atmosphere and equipment surface or inside equipment.

19.2.3.3.7.4 Analysis Results

19.2.3.3.7.4.1 Hydrogen Igniters

Eight hydrogen igniters are distributed near hydrogen release points throughout the containment: reactor cavity access area, regenerative heat exchanger room, steam generator compartments, and pressurizer compartment. Of these, the harshest environment is expected in the steam generator compartment. The hydrogen igniters are protected with fire wrap, allowing them to survive a severe accident environment and perform their intended function.

19.2.3.3.7.4.2 Passive Autocatalytic Recombiners

The PARs are made of Pt or Pd catalysis in a stainless steel casing. There are no organic material components susceptible to thermal degradation. Therefore, they are expected to survive the harsh environment of a severe accident and perform their intended functions of hydrogen removal.

19.2.3.3.7.4.3 Cavity Flooding System Motor-Operated Valves

The CFS consists of two spillways between IRWST and HVT, two spillways between HVT and reactor cavity, and related valves. Four MOVs are installed in the HVT. The goal of CFS is pre-flooding the reactor cavity prior to vessel failure to enhance core debris cooling in the reactor cavity floor. Hence, the MOVs need to operate only prior to vessel failure under a relatively mild environment that is bounded by the DBA EQ temperature profile. Therefore, the CFS MOVs are expected to perform their intended function of opening valves for cavity flooding.

19.2.3.3.7.4.4 Post-Accident Sampling System (PASS)

PASS is designed to collect and deliver representative samples of liquids and gases in various process systems to sample stations for chemical and radiological analysis. The RCS hot-leg sample isolation MOVs and their position transmitters are located in the steam generator compartment. The containment air sample isolation MOVs and their position transmitters are located in the annular compartment and steam generator compartment. MOVs were included in the hydrogen burn experiments (Reference 35) and survived many transients.

19.2.3.3.7.4.5 Containment Hydrogen Monitoring System

The containment and IRWST hydrogen monitoring system contains hydrogen monitor inlet valves, hydrogen analyzers, and piping. It samples the containment atmosphere and measures the hydrogen concentration employing sensing devices outside containment.

The hydrogen analyzers and discharge valve are not subject to the harsh environment of the severe accident because they are located outside containment. However, the inlet valves are subjected to the harsh environment located in the dome, the annular compartment, and the IRWST. If the device fails during a severe accident, the primary sampling system can be used to determine containment hydrogen concentrations since relatively uniform concentration is expected throughout the containment.

19.2.3.3.7.4.6 Containment Atmospheric Temperature Sensors

13 temperature sensors are distributed throughout the containment: dome, steam generator compartments, pressurizer room, annular compartment above the operating deck, annular compartment below the operating deck, and reactor cavity.

Although the harsh environmental conditions expected during a severe accident are more severe than the EQ data provided by the equipment vendor in some locations, there are enough temperature sensors distributed throughout the containment to provide redundancy.

19.2.3.3.7.4.7 Containment Radiation Monitoring System

Two RMSs are located in the south side of the upper operating area. The thermally limiting components in the RMS are PEEK insulators in the chamber and cable connectors. Based on the percentage retention of elongation at break after aging test data for PEEK material, the RMS is determined to have a qualified life of 50 hours at 583 K (590 °F). The test temperature is higher than the long-term severe accident environmental temperature of 460 K (368 °F) (see Subsection 19.2.3.3.7.2). Short-term temperature transients due to hydrogen burn would not affect the insulators because of thermal lag. Therefore, the PEEK insulators in RMS are expected to maintain their integrity during severe accidents.

19.2.3.3.7.4.8 Equipment Hatch and Personnel Airlock

The equipment hatch and PALs are located in the annular compartment, two at the operating deck and one above the IRWST.

Thermally limiting components in the equipment hatch and PAL are EPDM O-rings, compression seals, and gaskets. In the Sandia/CBI Personnel Airlock Testing (Reference 36), an actual full-scale airlock assembly was subjected to environmental conditions corresponding to severe accident events. In particular, Test 2C consisted of three thermal and pressure cycles. In the second cycle, air temperature was raised to 700 K (800 °F), and the pressure was increased to 21.09 kg/cm^2 (300 psig). There was no measurable leakage of the inner door seal. In the tests, it was determined that the temperature at which the material deteriorates is approximately 600 K (620 °F). Indeed, the peak temperature recorded on the door surface when the seal failed during the third cycle was 633 K (680 °F). The Test 2C results demonstrated that the EPDM seal material survives the ambient temperature over 24 hours. Hence, the seal and gaskets in the equipment hatch and PALs are expected to maintain their integrity during severe accidents.

19.2.3.3.7.4.9 Electrical Penetration Assembly (EPA)

The EPAs are installed on the containment pressure boundary and are sealed with double O-rings. The EPAs are located in the annular compartment at various elevations above the operating deck. The thermally limiting components in EPAs are Viton O-rings, polysulfone module conductor sealant, and polyimide film conductor insulation. A Conax EPA was tested under severe accident conditions by Sandia National Laboratories (Reference 37). The EPA was a lower voltage penetration assembly with a typical cable mix for power, control, and instrumentation functions. The EPA was first irradiated and then thermally aged. Then, the EPA was exposed to steam at 9.49 kg/cm^2 (135 psia) and 644 K (700 °F) for 8 days. The temperature in the test chamber reached the maximum value, 644 K (700 °F), about 45 minutes into the test. Temperature in the junction box reached the steady-state temperature of about 561 K (550 °F) about four hours into the test. Temperature on the header plate reached the steady-state temperature of about 444 K (340 °F) about four hours into the test. The leak integrity of the Conax EPA was maintained during the entire 10-day period of the severe accident test. The test condition exceeds the long-term severe accident condition. Hence, the seal in the EPA is expected to maintain its integrity during severe accidents.

19.2.3.3.7.4.10 Mechanical Penetrations

Mechanical penetrations include the MS and FW flow penetrations and hot/cold process piping. These penetrations have no organic material and are designed to maintain their sealing function under severe accident environmental conditions.

19.2.3.3.7.4.11 Rapid Depressurization Function

The POSRVs and three-way valves in the pressurizer compartment are manually operated to rapidly depressurize the RCS following onset of core damage. The goal of the system is depressurization of the RCS from 175.8 kg/cm^2 (2,500 psia) to 17.6 kg/cm^2 (250 psia) prior to vessel failure, thereby preventing HPME. The essential components of the system that need to be assessed for harsh environment include:

a. POSRVs and actuation circuitry

b. POSRV position transmitters and indicators

c. POSRV discharge branch line isolation valves and position transmitters, and indicators

d. MOVs for three-way valves

The system is not needed during a LOCA because the break depressurizes the RCS. Therefore, the essential components are not subject to the harsh environment of design basis accidents. Also, prior to actuation of the RD function, the essential components are not subject to the harsh environment of hydrogen burning nor of containment heatup by relocated corium. Hence, the RD function equipment is expected to survive and perform its intended function during severe accidents.

19.2.3.3.7.4.12 Reactor Vessel Level Monitoring System

The RVLMS consists of two probes with heated and unheated junction thermocouples. The heated junction thermocouple (HJTC) probes measure the inventory above the fuel alignment plate. The temperature difference between the heated and unheated junction thermocouple pairs is a direct indication of the presence of liquid inventory. The RVLMS provides useful information as the core uncovers and provides confirmation of core recovery. Individual unheated junction thermocouples may also trend the progression of core degradation by monitoring the reactor vessel upper plenum gas temperature.

The HJTC probes use heated and unheated junction type K thermocouples. Unlike the core-exit thermocouple, the RVLMS thermocouple string is top mounted and it does not pass through the core. These thermocouples are calibrated to operate at very high temperature, in accordance with the RVLMS design requirements. Hence, these instruments are expected to function far into core degradation.

Core-Exit Thermocouples (CETs) and Resistance Temperature Detectors (RTDs)

The CETs and RTDs used to monitor RCS inventory are expected to survive well past design basis conditions and they provide useful information until their temperature limits are exceeded.

Pressurizer Pressure Sensors and Steam Generator Level Monitors

RCS pressure monitoring is necessary to trend RCS depressurization following operator action taken to either establish feed-and-bleed operation or confirm sufficiently low pressure to enter SC operation. In the event the operator has to depressurize the RCS via the steam generator, the water level in the steam generator is monitored to provide reasonable assurance of the presence of steam generator secondary side inventory.

All pressure-transmitting devices are located outside the secondary shield wall. A small, long tube connects the RCS to the high-pressure side of the pressure transmitter. The sensor tap of these pressure-transmitting devices is typically filled with stagnant fluid. The substantial length of the tube provides sufficient heat loss and thermal capacity to maintain the fluid temperature closer to the ambient. Therefore, the in-vessel temperature does not influence the operation of these pressure-transmitting devices.

19.2.3.3.7.4.13 Equipment Located Outside Containment

The active components of the following equipment required for severe accident mitigation and monitoring are located outside containment. They are not subjected to the harsh environment of a severe accident.

a. SIS

b. AFWS

c. CSS

d. ECSBS

e. SCS

f. Containment hydrogen monitors

g. Containment pressure sensor

h. IRWST water level sensors

The check valve at the ECSBS spray headers is located inside containment, but it contains no organic materials that are susceptible to thermal degradation.

19.2.3.3.7.4.14 Radiation Dose ES Results

The EQ report for safety-related equipment contains radiation test data. All safety-related equipment was tested under at least five times the bounding radiation dose in the containment during severe accidents as shown in Table 19.2.3-6.

For most equipment and instrumentation, it is concluded there is reasonable assurance that instrumentation and equipment required to mitigate a severe accident and achieve a safe stable state perform their function as intended under severe accident environmental conditions.

19.2.3.3.8 Other Severe Accident Mitigation Features

According to 10 CFR 50.34(f)(3)(iv), a design is required to "provide one or more dedicated containment penetrations, equivalent in size to a single 3-foot diameter opening, in order not to preclude future installation of systems to prevent containment failure, such as a filtered vented containment system." The APR1400 design meets this requirement by providing a dedicated containment penetration to allow for installation of a filtered vent system.

19.2.4 Containment Performance Capability

The containment pressurization analysis is performed to confirm containment performance. Furthermore, analyses of thermo-hydraulic response of the containment building are carried out to provide basic understanding of the transient plant responses for different severe accident sequences.

19.2.4.1 Containment Performance Goal

According to the requirements for containment performance for the APR1400 design, the containment is designed so that the CCFP is below 0.1 or the containment meets the FLC requirement of ASME Section III, Division 2, Subarticle CC-3720 for approximately 24 hours after the onset of core damage (Reference 1). In order to comply with this requirement, deterministic analysis is performed to confirm that the latter portion of the requirement is met by evaluating the containment loads.

19.2.4.2 Containment Performance Analysis

The containment pressurization scenarios considered in this analysis include overpressurization by steam and non-condensable gases. In order to reflect these phenomena, MAAP analyses are performed for the severe accident scenarios.

19.2.4.2.1 Combustible Gas Control inside Containment

NRC RG 1.216 (Reference 6) describes the requirements for providing reasonable assurance that new reactor designs are capable of coping with combustible gases generated during the course of a severe accident. According to Regulatory Position 2, the containment should be evaluated for the pressure arising from the fuel cladding-water reaction, hydrogen burning, and post-accident inerting (if applicable). Additionally, the containment failure criterion for concrete containments should meet the factored load category requirements of ASME Section III, Division 2, Subarticle CC-3720(Reference 8).

In order to evaluate the ability of the containment to cope with combustible gases generated during the course of a severe accident, an adiabatic isochoric complete combustion (AICC) analysis was performed. This analysis assumed the generation of hydrogen equivalent to the complete reaction of 100 percent of the active fuel cladding with steam. Also, the hydrogen mitigation features are assumed to be unavailable. The hydrogen was then assumed to be burned completely with no heat transfer to heat sinks in the containment with initial containment atmospheric pressure at the highest value possible that would still allow for hydrogen to burn. The maximum pressure load on the containment structure is evaluated to be 7.0 kg/cm^2 (99.8 psia) under the AICC condition. Considering the safety margin of APR1400 containment, for the FLC, the pressure resulting from 100 percent metal water reaction of fuel cladding and resulting from uncontrolled hydrogen burning is determined as 8.7 kg/cm^2 (123.7 psia).

19.2.4.2.2 Containment Pressurization Results

Figure 19.2.3-21 shows the containment pressure response for a large-break LOCA that results in the highest containment pressure at 24 hours following the onset of core damage. For this scenario, the containment pressure does not reach 8.7 kg/cm^2 (123.7 psia) for 24 hours after the onset of core damage.

19.2.4.2.3 Emergency Containment Spray Backup System Performance

For a provision against a beyond-design-basis accident where either two SC pumps and two CS pumps or the IRWST is unavailable, the ECSBS is provided as an alternative to the CSS.

The ECSBS is designed to protect the containment integrity against overpressure and prevent the uncontrollable release of radioactive materials into the environment. The emergency containment spray flow path is from external water sources (the reactor makeup water tank, demineralized water storage tank, fresh water tank, or the raw water tank), through the fire protection system line via the diesel-driven fire pump, to the ECSBS line emergency connection located at ground level near the auxiliary building.

The ECSBS flow rate provides sufficient heat removal to prevent containment pressure from exceeding 8.7 kg/cm^2 (123.7 psia). In order to evaluate the performance of ECSBS, analysis is performed using the MAAP code.

Sequences are analyzed assuming that ECSBS operation began 24 hours after the onset of core damage. Figure 19.2.3-21 shows the containment pressure response following the

ECSBS actuation. The result shows that ECSBS is capable of controlling containment pressure and reducing atmospheric temperature for a period of 48 hours. The maximum pressure and temperature following the initial 24-hour period are enveloped by the maximum pressure and temperature during the initial 24-hour period. This prevents the uncontrolled release of fission products into the environment.

19.2.5 Accident Management

Accident management (AM) encompasses those actions taken during the course of an accident by the plant operating and technical staff to (1) prevent core damage, (2) terminate the progress of core damage if it begins and retain the core within the reactor vessel, (3) maintain containment integrity as long as possible, and (4) minimize offsite releases. In effect, AM extends the defense-in-depth principle to plant operating staff by extending the operating procedures well beyond the plant design basis into severe fuel damage conditions, and by making full use of existing plant equipment and operator skills and creativity to terminate severe accidents and limit offsite releases.

The overall responsibility for AM, including development, implementation, and maintenance of the accident management plan, lies with the nuclear utility, because the utility bears ultimate responsibility for the safety of the plant and for establishing and maintaining an emergency response organization capable of effectively responding to potential accident situations. However, the development and implementation of accident management involves both the reactor designer and the plant owner/operator.

The COL applicant is to develop and submit an accident management plan. The plan provides a commitment to perform a systematic evaluation of plant functions during potential severe accidents and to implement the necessary enhancements within the detailed plant design and organization, including severe accident management guidelines and training. The plan addresses (1) accident management strategies and implementing procedures, (2) training in severe accidents, (3) guidance and computational tools for technical support, (4) instrumentation, and (5) decision making responsibilities.

The following sections provide a framework that discusses the APR1400 design features that are to be considered by the COL applicant when developing a plant-specific accident management plan.

19.2.5.1 Severe Accident Management Framework

19.2.5.1.1 Prevent Core Damage

19.2.5.1.1.1 During Operations at Power

A key accident management goal is prevention of core damage by maintaining coolant level in the reactor core. During operations at power, this can involve operation of secondary cooling, core cooling, containment cooling, as well as isolation of any paths for inventory loss to the outside of containment.

In LOCA scenarios where safety injection is unavailable, the SC or CS pumps are able to be aligned to provide injection to the reactor vessel. These systems remove decay heat and prevent core damage from occurring.

In non-LOCA scenarios, auxiliary feedwater pumps can be used to establish secondary side cooling. The APR1400 design is equipped with two motor-driven and two turbine-driven auxiliary feedwater pumps that are each capable of removing decay heat. If secondary cooling cannot be established, the operators can depressurize the RCS using the POSRVs. Once depressurized, once-through cooling of the core can be established using SI and SC or CS pumps.

In scenarios where secondary cooling cannot be established and containment sprays are not available to remove heat from the containment, SC pumps and heat exchangers can be aligned to discharge to the containment spray header in order to depressurize containment and cool the IRWST water. This allows for IRWST inventory to be continuously circulated through the core to maintain core cooling.

In scenarios where an SGTR has occurred, primary system inventory loss can be terminated by isolation of main steam isolation valves (MSIVs) or turbine bypass valves. If isolation of the ruptured steam generator cannot be established, then operators can terminate inventory loss by depressurizing the primary system using the intact steam generator or RD function.

In LOOP scenarios, the APR1400 design prevents core damage by operation of emergency diesel generators to provide power. If the emergency diesel generators are unavailable, an alternate AC source is available to provide backup power.

19.2.5.1.1.2 During Low-Power Shutdown Operations

During LPSD operations, core damage is prevented by operation of the SI, recovery of water level using the charging pumps, secondary side cooling, and SCS isolation if the water level is insufficient.

If inventory loss is identified during LPSD operations, operators can manually isolate the failed SCS train to terminate the loss of inventory.

If RCS water level decreases too far, it can reach a level that is insufficient for SC pump suction. If this occurs, SC pumps are isolated to prevent damage to the pumps. In this situation, the charging pumps can be used to increase RCS water level and allow resumed operation of the SCS.

In LPSD scenarios where the RCS is fully filled with water, secondary cooling can be used to induce natural circulation in the coolant loops to remove decay heat from the core.

The SIS is isolated during LPSD operations; however, at least two trains are kept in standby so that SI can be available to provide core cooling if necessary; when needed, the SIS is manually activated by the operators.

19.2.5.1.2 Retain the Core within the Reactor Vessel

19.2.5.1.2.1 During Operations at Power

The onset of core damage is identified when core-exit temperature reaches 922.04 K (1,200 °F). The primary way to terminate the progress of core damage is inject water into the reactor vessel. This can be achieved by operation of the SI, SC, or CS pumps. Once core relocation to the lower plenum occurs, another option available to prevent accident progression is ex-vessel cooling.

If the SI pumps can be recovered prior to reactor vessel melt-through, injection may be capable of cooling the core and preventing failure of the reactor vessel. If the SI pumps cannot be recovered, the RCS can be depressurized using the POSRVs to allow injection using the SC or CS pumps. Successful cooling of the core depends on the configuration of core (i.e., whether it is intact, melted, relocated).

Once the core has relocated to the lower plenum, ex-vessel cooling can be established by the operators. This entails using the SC pumps to pump water from the IRWST into the reactor cavity to submerge the reactor vessel lower head in water. This action has the potential to remove decay heat through the lower head wall and prevent vessel failure.

19.2.5.1.2.2 During Low-Power Shutdown Operations

During LPSD operations, the accident management options for terminating the progress of core damage and preventing vessel failure are the same as during operations at power.

19.2.5.1.3 Maintain Containment Integrity

19.2.5.1.3.1 During Operations at Power

In order to maintain containment integrity during an accident, containment isolation provides reasonable assurance that decay heat is removed from containment. In addition, steps are taken to prevent a containment bypass event due to an induced steam generator tube rupture.

Containment isolation usually occurs before core damage. However, once core damage has been detected, it is required that operators reconfirm containment isolation to prevent radiological releases to the environment.

Once core damage has been detected, the reactor cavity is flooded using the CFS. Operation of the CFS allows for removal of decay heat from the molten corium and prevents challenges to containment integrity due to liner melt-through and flammable/non-condensable gas generation during MCCI.

After vessel failure occurs, decay heat is removed from the containment vessel using either the SCS or CSS. If the SCS and CSS are unavailable, ECSBS can be actuated to decrease containment pressure to prevent containment failure due to overpressure.

Operation of hydrogen igniters after core damage allows hydrogen concentration in containment to be maintained at the lower flammability limit. This mitigates the potential for containment failure due to detonation of hydrogen.

Actuation of the POSRVs to depressurize the RCS after core damage is detected helps mitigate the threat of early containment failure due to HPME and DCH. It also minimizes the risk of a containment bypass event due to induced steam generator tube rupture. In addition, actuation of the three-way valves prevents detonable concentrations of hydrogen from accumulating in regions surrounding the IRWST.

Another key step that mitigates the potential for containment bypass due to induced SGTR is providing reasonable assurance that the secondary side of the steam generators is always filled with water. This mitigates the potential for thermally induced tube rupture. FW and AFW systems can be used to perform this function.

Deflagration-to-detonation transition (DDT) in a hydrogen-filled IRWST headspace is prevented because of high steam mole fraction in the headspace. POSRV steam discharge to IRWST preceding the hydrogen discharge raises the pool temperature and the vapor pressure. Any recovery action for IRWST pool cooling includes consideration of the unintended consequence of reducing the steam mole fraction in the hydrogen-filled IRWST headspace, thereby creating a condition conducive to DDT.

19.2.5.1.3.2 During Low-Power Shutdown Operations

During LPSD operations, it is likely that the containment is not isolated at the onset of the accident. Because of this, the primary action to maintain containment integrity during LPSD operations is the isolation of containment. Once containment has been isolated, the options for decay heat removal and maintenance of containment integrity are the same as those during normal operations at power.

19.2.5.1.4 Minimize Offsite Release

19.2.5.1.4.1 During Operations at Power

The key action that can be taken to minimize offsite release during an accident is the operation of containment sprays to remove fission products from the containment gas space by using either the CS or SC pumps. If neither of these two systems is available, ECSBS can be used to serve the same function.

19.2.5.1.4.2 During Low-Power Shutdown Operations

During LPSD operations, the most important action to minimize offsite release is the isolation of containment. Once this is achieved, methods for minimizing offsite release are the same as for normal operations at power.

19.2.6 Consideration of Potential Design Improvements under 10 CFR 50.34(f)

This section provides information related to the potential design improvements as required under 10 CFR 50.34(f)(1)(I) which states that:

> *Perform a plant/site specific probabilistic risk assessment, the aim of which is to seek such improvements in the reliability of core and containment heat removal systems as are significant and practical and do not impact excessively on the plant.*

19.2.6.1 Introduction

The information in this section is based on the evaluation of severe accident mitigation design alternatives (SAMDA) for the APR1400 design, which is performed to address the potential costs and benefits of severe accident mitigation design alternatives. The APR1400 SAMDA document has been developed in accordance with applicable regulatory requirements as follows:

10 CFR 52.47(b)(2) requires the submittal of an environmental report as required by 10 CFR 51.55. 10 CFR 51.55 requires each applicant for a standard design certification to submit with its application a separate document entitled, “Applicant’s Environmental

Report - Standard Design Certification." The environmental report must address the costs and benefits of severe accident mitigation design alternatives, and the bases for not incorporating severe accident mitigation design alternatives in the design.

A detailed SAMDA evaluation is reported in the APR1400 DC Environmental Report (Reference 38) and the SAMDA technical report (Reference 42). The reports document the calculation of the monetary value of unmitigated base risk then evaluates the maximum risk reduction that could be expected from implementing a risk reduction strategy. Consideration of SAMDAs includes identifying a broad range of potential alternatives, and then determining whether implementation of those alternatives is feasible or would be beneficial on a cost-risk reduction basis. The reports also document the identification, screening, and evaluation of SAMDAs for the APR1400 design.

19.2.6.2 <u>Estimate of Risk for Design</u>

The initial step to determine base risk is the development and quantification of internal events, internal fire and internal flooding Level 1 and Level 2 probabilistic risk assessments (PRAs) for operations at-power and for the low-power and shutdown (LPSD) operations. The results of these PRAs provide overall risk measured by core damage frequency (CDF) and the characteristics of any expected radionuclide release following a severe accident, see Section 19.1. Risks from other external events (e.g., high winds, seismic events, etc.) are determined to be negligible.

The next step in determining base risk is the identification of the characteristics of any expected radionuclide release following a severe accident, and to quantify the expected frequency of release. The Level 2 PRA model characterizes releases into 21 source term categories (STCs). For each STC, representative releases are determined. The Level 2 PRA analyzes representative sequences from each STC and develops timing and release characteristic information for representative fission product groups. This information is then used to approximate the radiological release plumes used in the Level 3 PRA.

Offsite consequences are calculated from the Level 3 PRA (Reference 42). The Level 3 PRA provides values for the conditional offsite dose and conditional offsite property damage that would result given that a fission product release with the plume characteristics for each STC. The total expected dose consequence is obtained by multiplying the conditional offsite dose by the expected frequency for each STC, then summing the expected doses for all STCs. Similarly, the total expected property damage is obtained by multiplying the conditional property damage value by the expected frequency for each STC, then summing the expected property damage values for all STCs.

19.2.6.3 Identification of Potential Design Improvements

The list of severe accident mitigation alternative (SAMA) items evaluated for the APR1400 design is based on the generic industry SAMAs that are identified in Table 14 of NEI 05-01 (Reference 39). There are 153 items to be considered. The list of potential SAMDAs was developed from a generic list of sources related to many plant designs, and an initial screening is performed to identify the subset of potential SAMDAs that warranted a detailed evaluation.

As described in NEI 05-01, items can be screened for several reasons: 1) items are not applicable to the design, 2) items that are already implemented in the design, 3) items that would not be feasible to implement if the implementation costs exceed the maximum benefit possible, or 4) items that are of low benefit, if it is from a non-risk-significant system and a change in reliability would have negligible impact on the risk profile.

The potential SAMDA items not screened are further evaluated to determine the potential benefits that could be achieved, if implemented.

19.2.6.4 Risk Reduction Potential of Design Improvements

Each of the potential SAMDAs not screened are evaluated to determine the potential benefits. In evaluating the benefits, a detailed modification is not necessarily considered because exact design details would only be defined once a design option is chosen. SAMDA benefit evaluation is performed using bounding techniques to estimate risk reduction that would be possible.

Evaluation of potential benefits is performed using the methodology described in NEI 05-01 and is performed as follows: 1) the potential reduction in CDF is estimated; 2) the reduction in source term release is estimated; 3) and the potential benefit to offsite consequences is determined and presented in monetary terms.

The important basic events (i.e., FV > 0.5%) from the at-power and LPSD PRA importance analyses have been reviewed, and the basic events included in the top 100 cutsets have been also reviewed. The cost benefits of the basic events associated with 93 SSCs have been reviewed. The total maximum benefit calculated for improving the SSCs associated with the reviewed basic events would be small and much lower than the cost of any plant design change to improve performance of the SSCs.

19.2.6.5 Cost Impacts of Candidate Design Improvements

The unmitigated risk monetary value is calculated using the methodology given in NEI 05-01 for the performance of cost-benefit analyses. The value of unmitigated risk can be used to represent the maximum benefit that could be achieved if all risk was eliminated for at-power events. The methodology of the Producer Price Index (Reference 40) determines the present worth net value of public risk according to the following formula:

NPV = (APE + AOC + AOE + AOSC) – COE

Where:

NPV = present value of current risk ($),

APE = present value of averted public exposure ($),

AOC = present value of averted offsite property damage costs ($),

AOE = present value of averted occupational exposure ($),

AOSC = present value of averted onsite costs ($)

COE = cost of any enhancement implemented to reduce risk ($).

NPV = ($76,794 + $ 104,687 + $ 4,216 + $ 840,820) – $0 = $1,026,517

This value can be viewed as the maximum risk benefit attainable if all core damage scenarios from internal events are eliminated over the 60-years plant life. The detailed calculation is provided in Section 4 of Reference 38.

The conversion factor used for assigning a monetary value to on-site and off-site exposures was $2,000/person-rem averted, which is consistent with the NRC's regulatory analysis guidelines presented in NEI 05-01. The occupational exposure associated with severe accidents was assumed at 23,300 person-rem/accident. This value includes a short-term component of 3,300 person-rem/accident and a long-term component of 20,000 person-rem/accident. These estimates are consistent with the "best estimate" values presented in Subsection 5.7.3 of NUREG/BR-0184 (Reference 41). In calculating base risk, the accident-related onsite exposures were calculated using the best estimate exposure components applied over the on-site cleanup period. For onsite cleanup, the accident-related on-site exposures were calculated over a 10-year cleanup period. Costs associated with immediate dose, long-term dose and total dose are calculated for at-power internal events, internal flooding events, and internal fire events, along with LPSD internal events, internal flooding events, and internal fire events.

The parameters that influence the cost-benefit analyses of the SAMDA evaluations were examined to determine if a change in value for one of the parameters would change the conclusions of the evaluation. Equations for each of the four types of averted costs each contain a term for the real discount rate and evaluation period. Therefore, a change in either of those terms would have a direct impact on the averted costs calculated.

NEI 05-01 recommends using a 7% discount rate for cost-benefit analyses and suggests that a 3% discount rate should be used for sensitivity analyses on the maximum benefit and the unscreened SAMDAs to indicate the sensitivity of the results to the choice of discount rate. The NPV for a 3% discount rate is calculated to be $1,152,850 (Reference 42).Using maximum benefit calculated for the 3% discount rate above, the SAMDA items were reviewed and screened again. No changes to the screening results were identified using the higher maximum benefit value.

19.2.6.6 Cost-Benefit Comparison

As discussed above, all design changes to reduce risk would provide small or negligible benefit and the cost of any associated design change would greatly exceed any potential benefit. Therefore, no specific cost-benefit comparisons are necessary.

19.2.6.7 Conclusions

The analyses described in the previous sections analyzed conceptual alternatives for mitigating severe accident impacts in the APR1400 design. Preliminary screening eliminated all SAMDA candidates from further consideration, based on inapplicability to the design, design features that have already been incorporated into the design, inapplicability to a design certification stage, or extremely high cost of the alternatives considered.

The analysis using a 7% discount rate showed that no design changes to reduce risk associated with contributors to plant risk would be cost-beneficial to implement. A second baseline maximum benefit calculation using a 3% discount rate showed only minor variations in the calculated benefits. Therefore, it is concluded that no design changes would provide a positive cost-benefit if included in the APR1400 design.

19.2.7 Combined License Information

COL 19.2(1) The COL applicant is to perform and submit site-specific equipment survivability assessment in accordance with 10 CFR 50.34(f) and 10 CFR 50.44.

COL 19.2(2) The COL applicant is to develop and submit an accident management plan.

19.2.8 References

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Table 19.2.3-1

Hydrogen Control System Design Status

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-2 (1 of 2)

Containment Node Description

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-2 (2 of 2)

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-3

Summary of Results for Rapid Depressurization Analysis

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-4

<u>Systems and Equipment/Instrumentation Required for Equipment Survivability Assessments</u>

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-5

Summary of Temperature Envelopes for Equipment Survivability Assessment

Security-Related Information – Withhold Under 10 CFR 2.390

Table 19.2.3-6

Test Radiation Dose Level

Security-Related Information – Withhold Under 10 CFR 2.390

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (1 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (2 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (3 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (4 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (5 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (6 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (7 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (8 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-1 Location of PARs and Igniters for APR1400 Containment (9 of 9)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-2 MAAP model for APR1400 Containment (1 of 2)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-2 MAAP model for APR1400 Containment (2 of 2)

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-3 Mole Fraction of Hydrogen in the Dome Region for LBLOCA

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-4   Mole Fraction of Hydrogen in the Dome Region for SBLOCA

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-5 Mole Fraction of Hydrogen in the Dome Region for SBO with Three-Way Valve

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-6 Mole Fraction of Hydrogen in the Dome Region for LOFW with Three-Way Valve

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-7 Ablation Depth in Floor and Sidewall for the PRA Sequence of Loss of Essential Service Water

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-8 Ablation Depth in Floor and Sidewall for the PRA Sequence of Medium Break LOCA

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-9 Ablation Depth in Floor and Sidewall for the PRA Sequence of Loss of Offsite Power

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-10 Ablation Depth in Floor and Sidewall for the PRA Sequence of Loss of AC Power with Short Battery Life

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-11 Ablation Depth in Floor and Sidewall for the PRA Sequence of Large Break LOCA

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-12 Containment Pressure for Different FCHF's

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-13 Rapid Depressurization Function with 3-Way Valve

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-14 Primary System Pressure Responses for TLOESW Sequence when 0, 2, or 4 POSRVs are Manually Opened after Entering Severe Accident Conditions

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-15 Gas Temperatures and Corresponding Rearranged Temperatures in Node 7, S/G Compartment #2 at El. 136.5'

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-16 ES Curve for Nominally Challenging Environments

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-17 ES Curve for Moderately Challenging Environments

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-18 ES Curve for Quite Challenging Environments

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-19 ES Curve for Highly Challenging Environments

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-20 ES Curve for Severely Challenging Environments

Security-Related Information – Withhold Under 10 CFR 2.390

Figure 19.2.3-21 Containment Pressure for Large Break LOCA with ECSBS Actuated 24 Hours after the Onset of Core Damage

19.3 Beyond Design Basis External Event

19.3.1 Introduction

As a result of the Fukushima Dai-Ichi event, additional requirements have been established to manage and mitigate external events that are beyond the design basis of the plant. This section addresses the APR1400 conformance with SECY-12-0025 (Reference 1), including the requirements contained in Nuclear Regulatory Commission (NRC) Orders EA-12-049 (Reference 2) and EA-12-051 (Reference 3) and the related Request for Information (RFI) (Reference 4). The specific details of addressing the Tier 1, 2, and 3 Near-Term Task Force (NTTF) items are provided in technical report APR1400-E-P-NR-14005-P, Rev. 0 (Reference 5).

The following briefly summarizes the NTTF Tier 1 recommendations that are addressed in the APR1400.

19.3.2 NTTF Tier 1 Recommendations

19.3.2.1 NTTF Tier 1 Recommendations

It is expected that the APR1400 will satisfy the seismic requirements since it is designed to meet central and eastern United States (CEUS) seismic requirements.

The COL applicant is to perform site-specific seismic hazard evaluation and seismic risk evaluation as applicable in accordance with NTTF Recommendation 2.1 as outlined in NRC Request for Information (COL 19.3(1)).

In addition, for dry sites, APR1400 will not have a problem in regard to flooding. However, for wet sites, flood protection may be necessary depending on the location of diverse and flexible coping strategies (FLEX) equipment. Therefore, the COL applicant is to address the flood requirements for wet sites (COL 19.3(2)).

19.3.2.2 Recommendation 2.3 – Seismic and Flooding Walkdown

Not applicable to new plants.

19.3.2.3 Recommendations 4.1 and 4.2 – Station Blackout and Mitigation Strategies for Beyond Design Basis External Events

Recommendation 4.1 outlines minimum coping times for extended loss of alternating current (ac) power (ELAP) events. Recommendation 4.2 recommends that licensees provide reasonable protection from beyond design basis external events (BDBEEs) and add any additional equipment necessary to address the Fukushima event. Both Recommendations 4.1 and 4.2 are addressed through the baseline coping strategies described herein.

The APR1400 employs a three-phase approach for mitigating BDBEEs. The initial phase requires the use of installed equipment and resources to maintain or restore core cooling, containment function, and spent fuel pool (SFP) cooling capabilities. The transition phase requires providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase requires obtaining sufficient offsite resources to sustain those functions indefinitely. Specifically, the following is incorporated into the APR1400 design:

a. Strategies to maintain or restore core cooling, containment function, and SFP cooling capabilities following a BDBEE capable of mitigating a simultaneous loss of all ac power and loss of normal access to the ultimate heat sink (LUHS)

b. Reasonable protection for the associated equipment from external events that demonstrates that there is adequate capacity to address challenges to core cooling, containment function, and SFP cooling capabilities

c. Strategies capable of being implemented in all modes of operations

Following is a brief synopsis of the mitigating measures to address these items:

The core cooling safety function includes maintaining core cooling, reactor coolant system (RCS) inventory, RCS boration, and key reactor instrumentation. The containment heat removal safety function includes maintaining containment pressure control, heat removal, and key containment instrumentation. The SFP cooling safety function includes maintaining SFP cooling and key SFP instrumentation. Each of the core cooling, containment function, and SFP cooling strategies is described in detail in Reference 5.

The guidance for developing, implementing, and maintaining mitigation strategies from JLD-ISG-2012-01 (Reference 6) and the methodology to establish baseline coping capability from Nuclear Energy Institute (NEI) 12-06 (Reference 7) were considered in developing the APR1400 FLEX strategy. Each FLEX strategy follows a three-phase approach as required in the Order EA-12-049.

The three phases are:

a. Phase 1 – Initial response phase using installed equipment

b. Phase 2 – Transition phase using portable equipment and consumables

c. Phase 3 – Indefinite sustainment of these functions using offsite resources

19.3.2.3.1 Core Cooling

The APR1400 FLEX strategy can be divided into two sets of operational strategies, as follows:

a. FLEX strategy for Modes 1 through 4 (full-power operation, startup, hot standby, hot shutdown) and Mode 5 operation (cold shutdown) with steam generators (SGs) available

b. FLEX strategy for Modes 5 and 6 operations with SGs not available

Supporting analysis is performed to demonstrate the APR1400 baseline coping capability based on both of the FLEX strategies. In the support analysis, the full-power operation case is selected as a representative one for the operational strategy for the Modes 1 through 5 with SGs available. Mid-loop operation case is selected as a representative one for the operational strategy for Mode 5 and 6 with SGs not available.

The initiating event is assumed to be a loss of offsite power (LOOP) with concurrent loss of all ac power and LUHS during the full-power operation or mid-loop operation. Based on the analysis performed, the APR1400 will consider the three-phase approach as shown in Table 19.3-1 to address FLEX strategies for the various plant operations, namely, full-power operation, low-power, and shutdown operations, with and without SGs available.

The specific mitigating strategies with installed equipment and FLEX equipment used, including offsite resources, timeline, and sequence of events for each of the phases for various modes of operation, is described in detail in Reference 5. The COL applicant is to develop the details for offsite resources (COL 19.3(3)).

19.3.2.3.1.1 Full-Power Operation

The full-power operation case is selected as a representative one for the operational strategy for the Modes 1 through 5 with SGs available.

The initiating event is assumed to be a loss of offsite power (LOOP) with concurrent loss of all ac power and LUHS during full-power operation. Based on the analysis performed, the APR1400 will consider the following event sequence to address FLEX strategy for the full-power operation:

a. Phase 1: zero to 8 hours

b. Phase 2: 8 to 72 hours

c. Phase 3: indefinite time period following Phase 2

Phase 1: 0 to 8 hours

During Phase 1, only the installed plant equipment is used for coping. Specifically, two turbine-driven auxiliary feedwater pumps (TDAFWPs) automatically start on auxiliary feedwater actuation signal (AFAS) to provide core cooling through the SGs. Auxiliary feedwater storage tanks (AFWSTs) are used to supply water to the TDAFWPs, and steam generated in the SGs is released through the main steam safety valves (MSSVs). Class 1E batteries supply direct current (dc) power to essential instrumentation and control (I&C) equipment, and for the operation of the TDAFWPs. Therefore, the RCS is maintained at hot standby condition by the natural circulation cooling (NCC) operation without any operator action during this phase. The reactor coolant pump (RCP) seal leakage is assumed to be 94.64 L/min (25 gpm) per RCP at full-power steady-state condition from the beginning of the event.

Phase 2: 8 to 72 hours

As soon as preparation for Phase 2 is finished, the operator starts to cool down the RCS to a safe shutdown state, hot shutdown or cold shutdown, using the installed plant equipment or the onsite portable equipment.

During Phase 2, two types of core cooling strategies can be applied:

a. Basic operational strategy using installed plant equipment such as TDAFWP, auxiliary charging pump (ACP), and FLEX equipment, such as the 480V mobile gas turbine generator (GTG)

b. Contingency plan using only the onsite portable equipment, which is applied if the installed plant equipment is not operable

Basic Operational Strategy

In the basic operational strategy, the RCS is cooled down to and maintained at the hot shutdown (about 176.67 °C (350 °F)) using installed plant equipment such as TDAFWPs, ACP, as well as the FLEX equipment, such as 480V mobile GTG. The RCS is cooled down to the hot shutdown condition by feed and steaming operation through the secondary side of SG using the TDAFWPs and main steam atmospheric dump valves (MSADVs). The AFWSTs, using the raw water tank (RWT) as a backup water source, continue to supply water to the SGs using the TDAFWPs, while each SG level is maintained between 25 to 40 percent wide range by on-off control of the auxiliary feedwater isolation valves. The ACP is used to provide makeup water for maintaining RCS inventory and provide RCP seal cooling. The suction source for ACP is the boric acid storage tanks (BAST) and in-containment refueling water storage tank (IRWST).

Two 480V, 1,000 kW mobile GTGs are provided to meet N+1 requirement. One of the 480V mobile GTGs is connected to the 480 V Class 1E power system Train A or B, and supply power to the 125 Vdc battery charger, the 480V load center, and the motor control center.

In the contingency strategy, installed plant equipment is assumed to be inoperable even after connection of 480V mobile GTG. In this case, the RCS is further cooled down to approximately 98.89 °C (210 °F) with SGs fed by the secondary side FLEX pumps instead of the plant installed TDAFWPs. RCS makeup is carried out by the primary side high-head FLEX pump instead of the ACP. A primary high-head FLEX pump is connected to a safety injection (SI) line to be used as an alternative RCS makeup pump, when the ACP is unavailable.

Two secondary FLEX pumps are also connected to the SG auxiliary feedwater (AFW) supply lines: one for each AFW line. The secondary FLEX pumps can be used to supply feedwater to the SGs when the TDAFWPs are unavailable.

Two primary high-head FLEX pumps and three secondary FLEX pumps are provided to meet the N+1 requirement.

Additionally, as RCS cooldown continues and RCS pressure decreases to the designed setpoint of safety injection tank (SIT) injection, the SIT automatically discharges 4,000 ppm borated water into the RCS for boration and inventory makeup.

Phase 3: after 72 hours

In Phase 3, offsite resources, including a 4.16 kV mobile GTG, fuel, and cooling water can be assumed to be available for long-term coping with the BDBEE. The 4.16 kV mobile GTG will be used to restore Train A or B of the 4.16 kV Class 1E power system. The plant will be brought to cold shutdown, using the shutdown cooling system (SCS), if the ultimate heat sink (UHS) is available after 4.16 kV Class 1E power is restored. If not, the plant is maintained at the same safe shutdown state as in Phase 2.

In this phase, the primary and secondary makeup water sources and fuel oil for the mobile GTGs will be refilled from offsite resources.

19.3.2.3.1.2 Mid-Loop Operation

In developing the APR1400 baseline coping capability for the shutdown operations with SGs not available, the mid-loop operation case is selected as a representative one. The reason is that the earliest operator action is required for the mid-loop operation case, because the operation mode has lowest RCS inventory.

Based on the analysis performed, the APR1400 will consider the following event sequence to address FLEX strategy for the shutdown operations with SGs not available:

a. Phase 1: 0 to 3 hours

b. Phase 2: 3 to 72 hours

c. Phase 3: indefinite time period following the phase 2

During Phase 1, decay heat is removed as latent heat that developed during the water boil-off in the core. At the same time, the water source for gravity feed from the SITs is utilized to prevent core uncovery. Since the operator can easily identify the initiation of loss of residual heat removal (RHR), the operator can promptly initiate the necessary recovery action for keeping the core covered: manually opening the valves needed for gravity feed. Then, the operator prepares for the next phase. A primary low-head FLEX pump is connected to the SIS injection line. A mobile GTG is connected to Train A or Train B 480 V Class 1E ac power system. All of the operator actions will be finished within 3 hours following the event.

During Phase 2, the RCS inventory makeup is carried out by external injection using the primary side low-head FLEX pump, with a rated flow of 2,839.06 L/min (750 gpm), which is sufficient capacity for removing decay heat.

In Phase 3, the 4.16 kV mobile GTG, fuel, and cooling water are available for long-term coping for the event. The 4.16 kV mobile GTG will be used to restore Train A or Train B of the 4.16 kV Class 1E power system. If the SCS is operable when the 4.16 kV Class 1E power is restored, the plant will be cooled down or maintained by resuming the SCS operation. If not, the RCS inventory is maintained by the primary FLEX pump, as in Phase 2. In this case, the primary makeup water source and fuel oil for the mobile GTGs will be refilled from offsite resources.

19.3.2.3.2 Spent Fuel Pool Cooling

Based on the supporting analyses described in Reference 5, the following is the bulk SFP heatup time and boil-off rate for the worst-case full core offload:

a. The operators have approximately 39.3 hours to restore cooling and/or makeup to the SFP in order to keep the spent fuel covered. Therefore, boiling of the SFP can be credited as the Phase 1 event mitigation method.

b. To maintain at least 3.05 m (10 ft) of water inventory over the fuel assemblies, makeup water to the SFP is provided within 25.03 hours.

c. For Phases 2 and 3 of event mitigation, an SFP makeup rate of 493 L/min (130.31gpm) is needed to match the initial boil-off rate. The boil-off rate decreases over time as the spent fuel decay heat decreases.

Specific details of the SFP mitigation strategies for each phase are provided below:

Phase 1: 0 to 8 hours

In Phase 1, action is taken to open the rollup door to the fuel handling area truck bay at El. 30.5 m (100′-0″) of the auxiliary building, prior to the onset of boiling to establish a vent path from the area for steam generated from the SFP. Based on the analyses, SFP boiling is calculated to occur no sooner than 4.3 hours after the ELAP event occurs, considering the most limiting plant condition, i.e., Mode 6 with full core offload.

No makeup water to the SFP is required and the water level is monitored. Also, there is no non-seismic piping connected to the SFP that could potentially drain water from the SFP during a seismic event. During this phase, a FLEX pump with external makeup water connections to the RWT is established.

The vent path for the spent fuel area that is established in Phase 1 is maintained open in Phases 2 and 3.

Phase 2: 8 hours to 72 hours

For Phase 2 event mitigation, makeup water is required to the SFP. Based on the analyses provided in Reference 5, a minimum flow rate of approximately 493.22 L/min (130.31 gpm) is required to match the worst-case SFP boil-off rate. These SFP makeup and SFP spray flow requirements are bounded, however, by the SFP makeup and SFP spray flow requirements needed to mitigate the effect of loss of large area (LOLA) per 10 CFR

50.54(hh)(2). The self-powered (diesel-driven) FLEX 1,892.5 L/min (500 gpm), 757.1 L/min (200 gpm) SFP makeup pump, and SFP spray pump relied on to mitigate LOLA are therefore credited to mitigate the BDBEE.

Phase 3: after 72 hours

APR1400 continues to use the Phase 2 strategies to provide makeup to the SFP in Phase 3.

19.3.2.3.3 Containment Function

The containment isolation function can be accomplished with the containment isolation valves (CIVs), because containment penetrations that are required to be isolated for the BDBEE are designed to be isolated by either inside containment or outside containment isolation valves, as follows:

a. Normally closed motor-operated valve (fail as-is)

b. Air-operated valve (fail closed)

c. Check valve inside containment (automatic isolation)

The containment design incorporates a prestressed concrete containment with a steel liner to house the nuclear steam supply system. The containment and associated systems are designed to safely withstand environmental conditions that may be expected to occur during the life of the plant, including both short-term and long-term effects following a DBA and beyond DBA. No special means are necessary for the APR1400 to maintain containment function during full-power operation, after a BDBEE with simultaneous loss of all ac power and LUHS. The emergency containment spray backup system (ECSBS) is used to maintain containment pressure and temperature during loss of RHR (Mode 5).

During the BDBEE, no major pipe break is postulated inside the containment, but RCP seal leakage is assumed with the leakage rate of 94.64 L/min (25 gpm) per RCP, a total of 378.5 m^3/min (100 gpm) for four RCPs. The containment pressure and temperature analyses are performed using the GOTHIC (Version 8.0) computer program. The containment pressure reaches the design pressure of 5.25 kg/cm^2 (74.7 psia) in 63 days from beginning of the event. The design temperature of 143 °C (290 °F) is reached in 71 days following the event. The technical report (Reference 5) provides the containment pressure and temperature analyses response for the full-power case with the assumed RCP seal leakage, and confirms that, during the course of the event for all phases, containment integrity is maintained.

Loss of RHR during mid-loop operation in Mode 5 is additionally assumed for the evaluation of containment capability. In this event, steam is assumed to be released from the RCS to the containment through the pressurizer manway due to the boiling of reactor coolant following the loss of RHR. The ECSBS is assumed to start spraying water into the containment atmosphere via a FLEX pump when the containment pressure reaches the UPC value of 12.9 kg/cm^2 (184 psia). After the initial operation, the ECSBS is assumed to be intermittently operated for 2 hours whenever the containment pressure reaches the UPC value. GOTHIC analyses are performed to confirm that the containment pressure and the temperature can be controlled within the UPC limit with the ECSBS operation following the loss of RHR in mode 5.

19.3.2.3.4 Supporting Systems

To mitigate the BDBEE, the following supporting systems have also been evaluated in Reference 5:

a. Electrical system (ac power and dc power)

b. Emergency lighting

c. Communication system

d. Water sources

e. Fuel oil

The design approach meets the NEI 12-06 in meeting the N+1 approach for the FLEX equipment, and primary and alternative connection points for fluids and electrical items. Regarding the storage of robust FLEX equipment and commodities, the N+1 philosophy has been adopted for the storage housing. Reference 5 describes the requirements in detail and the necessary design changes for APR1400 to meet the industry regulations. The

COL applicant is to address details of the storage location for FLEX equipment (COL 19.3(4)).

Also, the COL applicant is to address site-specific strategies to mitigate BDBEEs as specified in NRC Order EA-12-049 (COL 19.3(5)), including but not limited to the following:

a. Evaluation of site-specific external hazards

b. Determination and protection of portable equipment

c. Providing means for acquisition, staging, and installation of equipment

d. Establishing means for maintaining and testing of portable equipment

e. Establishing procedures and guidance on mitigation of BDBEEs

f. Establishing training of personnel to the developed strategies and procedures

19.3.2.4 Recommendation 7.1 – Reliable Spent Fuel Pool Instrumentation

The APR1400 employs reliable indication of the water level in the SFP capable of supporting identification of the following pool water level conditions:

a. Level that is adequate to support operation of the normal fuel pool cooling system

b. Level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck

c. Level at which fuel remains covered and actions to implement makeup water addition should no longer be deferred

The APR1400 SFP water level instrumentation is consistent with the guidelines addressed in NRC EA-12-051, NEI 12-02 (Reference 8), and JLD-ISG-2012-03 (Reference 9).

The primary instrument channel provides level indication through the use of guided wave radar (GWR) technology using the principle of time domain reflectometry (TDR).

The backup instrument channel is identical to the primary channel and is a permanent, fixed channel. The backup instrument channel provides level indication through the use of GWR technology using the principle of TDR.

The primary and backup instrument channels provide continuous level indication over a minimum range from the high SFP alarm elevation 47 m (154'-2") plus the accuracy of the SFP water level instrument channel to the top of the spent fuel racks at elevation 39.5 m (129'-6") minus the accuracy of the SFP water level instrument channel. The GWR design was selected due to its reliability.

The SFP level instrumentation includes design features such as the following:

a. Arrangement and mounting

b. Qualification

c. Power supplies

d. Accuracy

e. Display

The above features are described in detail in Reference 5.

The COL applicant is to address SFP level instrumentation maintenance procedure development and perform training as specified in NRC Order EA-12-051 (COL 19.3(6)).

19.3.2.5 Recommendation 8 – Emergency Response

The COL applicant is to address development of emergency operating procedures (EOPs), severe accident management guidelines (SAMGs), and extensive damage mitigation guidelines (EDMGs), which incorporate lessons learned from Tokyo Electric Power Company’s (TEPCO's) Fukushima Dai-Ichi nuclear power plant accident as addressed in SECY-12-0025 (COL 19.3(7)).

19.3.2.6 Recommendation 9.3 – Emergency Plan

Considering the Request for Information (RFI) on NTTF Recommendation 9.3, " Emergency Preparedness," depicted in Enclosure 5 to SECY-12-0025 and NEI 12-01 (Reference 10), the following design features are incorporated into the onsite plant communication system to enhance emergency preparedness for a BDBEE associated with simultaneous loss of all ac power and LUHS, in addition to the existing design features of the station communication system:

a. Addition of power sources for the wireless communication system

b. Introduction of a satellite telephone link

The COL applicant is to address enhancement of the offsite communication system per NTTF Recommendation 9.3 (COL 19.3(8)).

COL applicants that construct the APR1400 are responsible to conduct staffing evaluations for the unit in response to the emergency planning staffing provisions of Recommendation 9.3. The COL applicant is to address staffing for large-scale natural events as specified in the NRC RFI pertaining to NTTF Recommendation 9.3 (COL 19.3(9)).

19.3.3 NTTF Tier 2 and 3 Recommendations

All of the NTTF Tier 2 and 3 Recommendations are described in Reference 5.

19.3.4 Combined License Information

The following items are COL items that will be addressed by the COL applicant based on the site-specific requirements:

COL 19.3(1) The COL applicant is to perform site-specific seismic hazard evaluation and seismic risk evaluation as applicable in accordance with NTTF Recommendation 2.1 as outlined in the NRC RFI.

COL 19.3(2) The COL applicant is to address the flood requirements for wet sites.

COL 19.3(3) The COL applicant is to develop the details for offsite resources.

COL 19.3(4) The COL applicant is to address the details of storage location for FLEX equipment.

COL 19.3(5) The COL applicant is to address site-specific strategies to mitigate BDBEEs as specified in the NRC Order EA-12-049.

COL 19.3(6) The COL applicant is to address SFP level instrumentation maintenance procedure development and perform training as specified in NRC Order EA-12-051.

COL 19.3(7) The COL applicant is to address development of EOPs, SAMGs, and EDMGs that incorporate lessons learned from TEPCO's Fukushima Dai-Ichi nuclear power plant accident as addressed in SECY-12-0025.

COL 19.3(8) The COL applicant is to address enhancement of the offsite communication system as specified in the NRC Request for Information pertaining to NTTF Recommendation 9.3.

COL 19.3(9) The COL applicant is to address staffing for large-scale natural events as specified in the NRC RFI pertaining to NTTF Recommendation 9.3.

19.3.5 References

1. SECY-12-0025, “Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami,” U.S. Nuclear Regulatory Commission, February 2012.

2. Order EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” U.S. Nuclear Regulatory Commission, March 12, 2012.

3. Order EA-12-051, “Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” U.S. Nuclear Regulatory Commission, March 12, 2012.

4. "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," March 12, 2012.

5. APR1400-E-P-NR-14005-P, "Evaluations and Design Enhancements to Incorporate Lessons Learned from the Fukushima Dai-Ichi Nuclear Accident," Rev. 0, KHNP, December 2014.

6. JLD-ISG-2012-01 "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Rev. 0, U. S. Nuclear Regulatory Commission, August 29, 2012.

7. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Rev. 0, Nuclear Energy Institute, August 2012.

8. NEI 12-02, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,'" Rev. 1, Nuclear Energy Institute, August 2012.

9. JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," Rev. 0, U.S. Nuclear Regulatory Commission, August, 2012.

10 NEI 12-01, "Guideline for Assessing Beyond Design Basis Accident Response Staffing and Communication Capabilities," Rev. 0, Nuclear Energy Institute, May 2012.

Table 19.3-1

Summary of Phase Approaches for Each of the Plant Operation Modes

Phase	Phase Description	Modes 1 through 4 and Mode 5 Operations with SGs Available	Modes 5 and 6 Operations with SGs Not Available
1	Coping with installed plant equipment	0 to 8 hours	0 to 3 hours
2	Coping with installed plant equipment and onsite portable (FLEX) equipment	8 to 72 hours	3 to 72 hours
3	Coping with both onsite portable (FLEX) equipment and offsite resources in addition to installed equipment	Indefinite time period following phase 2	Indefinite period following phase 2

19.4 Loss of Large Area

19.4.1 Introduction and Background

The NRC has issued 10 CFR 50.54(hh)(2) (Reference 1) that requires licensees to develop guidance and strategies for addressing the Loss Of Large Areas (LOLAs) of the plant due to explosions or fires from a beyond design basis event through the use of readily available resources and by identifying potential practicable areas for the use of beyond-readily-available resources. These strategies would address licensee response to events that are beyond the design basis of the facility.

This section identifies the APR1400 strategies that are implemented in the event that a large area of the facility is lost due to explosions or fire. Initiating events classified as LOLAs are beyond the design basis for existing and proposed new nuclear power plants. Existing nuclear power plants have evaluated these beyond design basis events and implemented changes and operational programs to assist in coping with LOLA events.

The operational and programmatic elements of responding to LOLA events are to be addressed by the COL applicant prior to fuel load.

19.4.2 Scope of the Evaluation

The APR1400 plans to approach the LOLA event evaluations in a phased approach similar to the existing plants. Phase 1 LOLA event evaluations focus on the operational aspects of responding to explosions or fire including items such as prearranging for the involvement of outside organizations, planning and preparation activities (e.g., pre-positioning equipment, personnel, and materials to be used for mitigating the event), and developing procedures and training for the event.

Phase 2 LOLA event evaluations focus on issues associated with mitigating an event involving the spent fuel pool (SFP). They include issues such as fuel configuration within the pool and focus on alternative sources of water that could be provided to the SFP for cooling, heat removal, and inventory makeup.

Phase 3 LOLA event evaluations focus on methods to provide sources of alternative cooling water to critical systems as well as mitigating the impact of a radiological release. In addition, they focus on alternative methods to operate critical systems or components in a manner to assist with the mitigation of the event.

19.4.3 Conclusions

Preliminary evaluation on the LOLA mitigative strategies of the APR1400 has been performed using the industry developed guidance in NEI 06-12 (Reference 2). Final LOLA evaluation is to be performed after safeguards information clearance is obtained, and this section is to be revised adequately reflecting final evaluation results. A separate technical report is to be prepared for the security related information (Reference 3).

19.4.4 References

1. 10 CFR 50.54, "Conditions of Licenses," U.S Nuclear Regulatory Commission.

2. NEI 06-12, "B.5.b Phase 2&3 submittal Guideline," Rev. 3, Nuclear Energy Institute, 2009.

3. APR1400-E-P-NR-14004-P, "Loss of Large Area Evaluation Report," Rev. 0, KHNP, December 2014.

19.5 Aircraft Impact Assessment

19.5.1 Introduction and Background

The design of the APR1400 takes into account the potential effects of the impact of a large commercial aircraft. In accordance with 10 CFR 50.150(a) (Reference 1), a design specific assessment is performed using realistic analysis to demonstrate that, in the event the APR1400 is struck by a large commercial aircraft, design features and functional capabilities exist to provide reasonable assurance that the reactor core remains cooled and spent fuel pool (SFP) integrity is maintained.

The assessment is to demonstrate the inherent robustness of the APR1400 design with regard to a potential large aircraft impact. Specific assumptions used in the APR1400 aircraft impact assessment are based on NRC requirements and guidance provided by the NRC and the Nuclear Energy Institute (NEI). The methodology for assessing effects on aircraft impact is described in NEI 07-13 (Reference 2), which is endorsed by RG 1.217 (Reference 3). These guidelines are followed with no exceptions taken.

This section describes the design features and functional capabilities of the APR1400 identified in the detailed assessment to provide reasonable assurance that the reactor core remains cooled and SFP integrity is maintained. These identified design features are designated as “key” design features.

19.5.2 Scope of the Assessment

The evaluation of plant damage caused by the impact of a large commercial aircraft is a complex problem involving phenomena associated with structural damage resulting from the initial impact, shock-induced vibration, and the effects of an aviation fuel-fed fire. The analysis assesses the following effects of a large commercial aircraft impact on the APR1400;

a. Damage resulting from the impact of the aircraft fuselage and wing structure,

b. Shock-induced vibration on structures, systems, and components (SSC),

c. Perforation or penetration of hardened aircraft components, such as engine rotors and landing gear, and

d. The extent of damage from fires fed by aviation fuel.

The analysis assesses the above effects of a large commercial aircraft impact at multiple locations where a large commercial aircraft could potentially strike critical APR1400 structures.

19.5.3 Assessment Methodology

Methods described in NEI 07-13 are followed to assess the effects on the:

a. Structural integrity of the reactor containment building (RCB) and SFP

b. Physical, fire and vibration effects of the aircraft impact on SSCs in the auxiliary building to provide reasonable assurance of continued core cooling capability

19.5.4 Conclusions

Preliminary assessment on the effect of a large commercial aircraft impact has been performed. In accordance with 10 CFR 50.150(a), preliminary structural assessment for the integrity of RCB and SFP has been performed using conservative analysis, and preliminary heat removal assessments have been performed for the potential aircraft impacts on the auxiliary building.

Final aircraft impact assessment is to be performed after safeguard information clearance is obtained. This section is to be revised reflecting the final assessment results. A separate technical report is to be prepared for the security related information (Reference 4).

19.5.5 References

1. 10 CFR 50.150, “Aircraft Impact Assessment,” U.S. Nuclear Regulatory Commission.

2. NEI 07-13, “Methodology for Performing Aircraft Impact Assessments for New Plant Designs,” Rev. 8P, Nuclear Energy Institute, 2011.

3. Regulatory Guide 1.217, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," U.S. Nuclear Regulatory Commission, August 2011.

4. APR1400-E-P-NR-14002-P-SGI, "Aircraft Impact Assessment Report," Rev. 0, KHNP.