

**Table 19.1-21—Failure Modes and Pressure Capacities of the Containment Six Sub-areas under an Accident Temperature Condition of 309°F**

<b>Containment Area</b>	<b>Failure Mode</b>	<b>Median Pressure (psig)</b>	<b>Uncertainty (lognormal standard deviation <math>\beta</math>)</b>
Cylinder wall	Hoop membrane failure	284	0.027
Spherical dome	Membrane failure	217	0.026
Dome belt	Flexural failure	221	0.028
Gusset (Base of cylinder wall)	Flexural failure	331	0.028
Equipment hatch (vertical section V2)	Flexural failure	229	0.09
Equipment hatch (horizontal section H2)	Flexural failure	296	0.09
Equipment hatch	Buckling	317.45	0.196
Construction opening closure	Buckling	266	0.2
Airlock assembly shell	Non-linear buckling	231	0.21
Airlock assembly hatch	Non-linear buckling	316.1	0.19
Main steam lines	Internal pressure	3467	0.217
Feedwater line 3	Flexural	4281.5	0.207
Feedwater line 4	Flexural	4287.5	0.2054
Fuel transfer tube	Buckling	1017.5	0.314

**Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA**  
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CI Valve ID	CI Line Description	Line size (inches)	CI Valve Type	Normal Position	Failure Mode on Loss of Power	Isolation Signal
JMM10AA006	Leak off system – Containment Inflation Deflation Subsystem	10	MO	Closed	As is	CI Stage 1
JMM10AA007	Leak off system – Containment Inflation Deflation Subsystem	10	MO	Closed	As is	CI Stage 1
JMM23AA001	Leak off system – Containment Leakage Exhaust Subsystem	2	MO	Open	As is	CI Stage 2 (no signal listed in the CI SDD)
JMM23AA002	Leak off system - Containment Leakage Exhaust Subsystem	2	MO	Open	As is	CI Stage 2 (no signal listed in the CI SDD)
KLA10AA001	Containment Sweep Vent System, Small Flow Supply Line	20	Butterfly/ air switch damper (2 SOVs)	Open (5% per year)	Closed	CI Stage 1
KLA10AA001A	Pilot Valve Controlling KLA10AA001	N/A	3-way globe valve	Closed <sup>1</sup>	Open	N/A
KLA10AA001B	Pilot Valve Controlling KLA10AA001	N/A	3-way globe valve	Closed <sup>1</sup>	Open	N/A
KLA10AA003	Containment Sweep Vent System, Small Flow Supply Line	20	Gate/ air switch damper (1 SOV)	Open (5% per year)	Closed	CI Stage 1
KLA10AA003A	Pilot Valve Controlling KLA10AA003	N/A	3-way globe valve	Closed <sup>2</sup>	Open	N/A
KLA20AA001	Containment Sweep Vent System, Small Flow Exhaust Line	20	Gate/ air switch damper (3 SOVs)	Open (5% per year)	Closed	CI Stage 1

**Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA**  
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CI Valve ID	CI Line Description	Line size (inches)	CI Valve Type	Normal Position	Failure Mode on Loss of Power	Isolation Signal
KLA20AA001A	Pilot Valve Controlling KLA20AA001	N/A	3-way globe valve	Closed <sup>1</sup>	Open	N/A
KLA20AA003	Containment Sweep Vent System, Small Flow Exhaust Line	20	Butterfly/air switch damper (2 SOVs)	Open (5% per year)	Closed	CI Stage 1
KLA20AA003A	Pilot Valve Controlling KLA20AA003	N/A	3-way globe valve	Closed <sup>1</sup>	Open	N/A
KLA20AA003B	Pilot Valve Controlling KLA20AA003	N/A	3-way globe valve	Closed <sup>1</sup>	Open	N/A
KLA30AA002	Containment Sweep Vent System, Large Flow Supply Line	39	Butterfly/air switch damper (1 SOV)	Closed at Power/ Open in SD	Closed	CI Stage 1
KLA30AA002A <sup>1</sup>	Pilot Valve Controlling KLA30AA002	N/A	3-way globe valve	Open	Open	N/A
KLA30AA003	Containment Sweep Vent System, Large Flow Supply Line	39	Gate/air switch damper (1 SOV)	Closed at Power/ Open in SD	Closed	CI Stage 1
KLA30AA003A <sup>2</sup>	Pilot Valve Controlling KLA30AA003	N/A	3-way globe valve	Open	Open	N/A
KLA40AA001	Containment Sweep Vent System, Large Flow Exhaust Line	39	Butterfly/air switch damper (1 SOV)	Closed at Power/ Open in SD	Closed	CI Stage 1
KLA40AA001A <sup>2</sup>	Pilot Valve Controlling KLA40AA001	N/A	3-way globe valve	Open	Open	N/A
KLA40AA002	Containment Sweep Vent System, Large Flow Exhaust Line	39	Butterfly/air switch damper (1 SOV)	Closed at Power/ Open in SD	Closed	CI Stage 1

**Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA**  
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CI Valve ID	CI Line Description	Line size (inches)	CI Valve Type	Normal Position	Failure Mode on Loss of Power	Isolation Signal
KLA40AA002A	Pilot Valve Controlling KLA40AA002	N/A	3-way globe valve	Open	Open	N/A
KPL84AA002	Gaseous Waste Processing, Inflow Line	2	MO	Open	As is	CI Stage 1
KPL84AA003	Gaseous Waste Processing, Inflow Line	2	MO	Open	As is	CI Stage 1
KPL84AA007	Gaseous Waste Processing	1	Check	Open	As is	N/A
KPL84AA013	Gaseous Waste Processing	1	Check	Open	As is	N/A
KPL85AA003	Gaseous Waste Processing, Outflow Line	2	MO	Open	As is	CI Stage 1
KPL85AA004	Gaseous Waste Processing, Outflow Line	2	MO	Open	As is	CI Stage 1
KTA10AA018	Reactor Building Primary Drain	3	MO	Open <sup>3</sup> (modeled as open 1% per year)	As is	CI Stage 1
KTA10AA017	Reactor Building Primary Drain	3	MO	Open <sup>3</sup> (modeled as open 1% per year)	As is	CI Stage 1
KTC10AA005	Contaminated Containment Sump	2	MO	Closed <sup>4</sup> (modeled as open 1% per year)	As is	CI Stage 1

**Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA  
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CI Valve ID	CI Line Description	Line size (inches)	CI Valve Type	Normal Position	Failure Mode on Loss of Power	Isolation Signal
KTC10AA006	Contaminated Containment Sump	2	MO	Closed <sup>4</sup> (modeled as open 1% per year)	As is	CI Stage 1
KTC10AA010	Contaminated Containment Sump Reinjection Line	2	MO	Closed <sup>5</sup> (modeled as open 1% per year)	As is	CI Stage 1
KTC10AA029	Contaminated Containment Sump Reinjection Line	2	Check	Closed <sup>5</sup> (modeled as open 1% per year)	N/A	N/A
KTD10AA015	Non-Contaminated Containment Sump	2	MO	Closed <sup>6</sup> (modeled as open 1% per year)	As is	CI Stage 1
KTD10AA024	Non-Contaminated Containment Sump	2	MO	Closed <sup>6</sup> (modeled as open 1% per year)	As is	CI Stage 1
LBA40AA002	Main Steam Isolation Valve	27.5	Hydraulic	Open	Closed	Stage 1
LBA40AA441	Main Steam Drain Line	2	MO	Closed	As is	Stage 1
LBA41AA191	Main Steam Safety Valve	8	Spring Safety	Closed	N/A	N/A
LBA42AA191	Main Steam Safety Valve	8	Spring Safety	Closed	N/A	N/A
LBA43AA001	Main Steam Relief Train	14	Oleo-Pneumatic (porv)	Closed (modeled as open)	Closed	ESF

**Table 19.1-22—Containment Isolation Valves Assessed in Level 2 PRA  
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CI Valve ID	CI Line Description	Line size (inches)	CI Valve Type	Normal Position	Failure Mode on Loss of Power	Isolation Signal
LBA43AA101	Main Steam Relief Train	14	MO	Closed (modeled as open)	As is	ESF
LBA44AA001	Main Steam line MSIV bypass	6	MO	Closed	As is	Stage 1
LCQ51AA002	SG Blowdown Demin Line	6	MO	Open	As is	CI Stage 1
LCQ51AA003	SG Blowdown Demin Line	6	MO	Open	As is	CI Stage 1
LCQ52AA001	SG Blowdown Flash Line	12	MO	Open	As is	CI Stage 1
LCQ52AA002	SG Blowdown Flash Line	12	MO	Open	As is	CI Stage 1

**Notes:**

1. It is assumed that the SOVs controlling the pneumatic damper function in a reversed mode compared to the damper.
2. Since the pilot valve controlling the pneumatic damper remains in its normal position on loss of electrical power (at power operation), its failure is not modeled. The only failure modeled is that of the pneumatic damper not remaining closed.
3. Although these valves are open, the upstream valves KTA10AA15/16 are mostly closed and opened if the reactor coolant drain tank level reaches a maximum setpoint.
4. Valves KTC10AA005/6 are normally closed but could be opened if the reactor building sump reaches a maximum setpoint. They are therefore modeled as open 1% of the time.
5. Valves KTC10AA010/029 are normally closed but could be opened if reinjection is needed. They are therefore modeled as open 1% of the time.
6. Valves KTC10AA015/24 are normally closed but could be opened if the reactor building floor drains tank reaches a maximum setpoint. They are therefore modeled as open 1% of the time.

**Table 19.1-23—Evaluation of Equipment Survivability for Level 2  
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System	Relevant CET Headers	Support Systems	Comments and Evaluation of Survivability
Containment isolation system	Containment isolation	<p>No support systems inside containment</p> <p>Note: For each of the containment penetrations, the isolation valves are supplied from 480V buses that are located in the applicable train’s Safeguard Building. Pneumatically operated dampers on ventilation penetrations fail closed on loss of pneumatic supply or power to the pilot solenoids.</p>	<p>Evaluation of survivability:</p> <p>With the containment successfully isolated all pathways to the active components of this system are isolated from the containment environmental conditions. In the event of any other containment failure, the operation of this system is irrelevant. All signals modeled (in the fault tree model) required for actuation of the containment isolation system are present before the onset of core damage and therefore not subjected to severe accident conditions.</p> <p>Therefore the CET model assumes no impact of severe accident conditions on the operation of this system.</p>
<p>Pressurizer safety valves</p> <p>Severe accident depressurization valves</p>	Depressurization before vessel failure	<p>No support systems inside containment:</p> <p>Note: The pressurizer safety valves are pilot operated valves with power supplied from 120V buses that are located in the applicable train’s Safeguard Building.</p> <p>The Severe Accident Depressurization valves are Motor-Operated Valves (MOVs) with power supplied from 480V buses that are located in the applicable train’s Safeguard Building.</p>	<p>Evaluation of survivability:</p> <p>These systems are to be qualified for severe accident conditions. Therefore the Level 2 PRA assumes no impact of accident conditions on equipment survivability. Qualification will include any connecting/controlling cables needed for actuation.</p>

**Table 19.1-23—Evaluation of Equipment Survivability for Level 2  
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System	Relevant CET Headers	Support Systems	Comments and Evaluation of Survivability
Secondary relief and safety valves	No Induced SGTR	No support systems inside containment – these valves are located in the main steam line “bridge” areas, that are physically separated from the Reactor Building	<p>Evaluation of survivability:</p> <p>These valves will not be subject to severe accident temperatures or pressures, as the temperature and pressure conditions are controlled by the valve setpoint pressure. Therefore the Level 2 PRA assumes no impact of accident conditions on equipment survivability and only normal “failure to reclose” probabilities will be modeled.</p>
Hydrogen recombiners	<p>Operation is implicitly assumed for the following headers:</p> <p>No containment failure before vessel breach</p> <p>No containment failure at the time of vessel breach</p> <p>No late containment failure due to hydrogen deflagration or FA/DDT</p>	No support systems – these hydrogen recombiners are passive catalytic media that require no motive power or other support.	<p>Evaluation of survivability:</p> <p>This system will be qualified for severe accidents. However, there are a number of recombiners in the MAAP containment nodes 3, 5, 6, 7, 10, and 23 that have a small susceptibility to the phenomenon of flame acceleration. The phenomenological evaluation for Hydrogen includes the susceptibility of these recombiners to this failure mode. Otherwise, the CET model assumes that the performance of this system is not degraded or impacted by severe accident conditions.</p>



**Table 19.1-23—Evaluation of Equipment Survivability for Level 2  
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System	Relevant CET Headers	Support Systems	Comments and Evaluation of Survivability
Safety Injection System	<p>Melt retention in-vessel</p> <p>Containment Steam Pressurization Controlled</p>	<p>No support systems inside containment</p> <p>The MHSI and LHSI systems are normally lined up for injection into the primary system, and there are no motor operator valves inside containment that need to operate for safety injection success.</p>	<p>Evaluation of survivability</p> <p>The active, electrically actuated components in this system are not exposed to severe accident conditions. The system connects directly to the RCS but is protected by check valves in the case that it is not operating. Therefore there is no impact of severe accident conditions on the operation of the system.</p> <p>The system model for SIS also includes failure probabilities for the clogging of the suction strainers during accident conditions. These probabilities are considered reasonable for severe accident conditions.</p>
SAHRS passive flooding	Melt stabilization ex-vessel	No support systems inside containment	<p>Evaluation of survivability:</p> <p>This system will be qualified for severe accidents. Furthermore, the passive nature of the operation of the system reduces any potential susceptibility to adverse environmental conditions. On this basis, the CET models will assume that the performance of this system is not degraded or impacted by severe accident conditions.</p>

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System	Relevant CET Headers	Support Systems	Comments and Evaluation of Survivability
SAHRS active flooding	<p>Melt stabilization ex-vessel</p> <p>Containment steam pressurization controlled</p> <p>No basemat failure (implicitly assumes continued op of melt stabilization)</p>	<p>No support systems inside containment</p> <p>The valve that operates to initiate active flooding is an MOV with power supplied from a 480V bus that is located in the Train 4’s safeguard building</p>	<p>Evaluation of survivability:</p> <p>This system will be qualified for severe accident conditions. Therefore the CET models will assume that the performance of this system is not degraded or impacted by severe accident conditions.</p>
SAHRS Sprays	<p>Melt stabilization ex-vessel</p> <p>Containment steam pressurization controlled</p> <p>No basemat failure (implicitly assumes continued op of melt stabilization)</p>	<p>No support systems inside containment</p> <p>The valve that operates to initiate active flooding is an MOV with power supplied from a 480V buses that is located in the Train 4’s SB</p>	<p>Evaluation of survivability:</p> <p>This system will be qualified for severe accidents. Therefore the CET models will assume that the performance of this system is not degraded or impacted by severe accident conditions.</p>

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<b>System</b>	<b>Relevant CET Headers</b>	<b>Support Systems</b>	<b>Comments and Evaluation of Survivability</b>
SAHRS sprays (continued operation following containment failure)	Melt stabilization ex-vessel  SAHRS sprays actuated to control source term	The dedicated train of CCWS provides cooling water to the SAHRS Heat Exchanger. This CCWS train is supported by a dedicated, separate ESWS train.  SAHRS and its support components are supplied by the 480 and 6900V networks of electrical Division 4, and are provided with power from the Division 4 Emergency Diesel Generator and the Division 4 Station Blackout (SBO) Diesel Generator.	Evaluation of survivability:  This system will be qualified for severe accidents. Furthermore, the containment is expected to fail at the base of the dome, a location that will not lead to releases into compartments containing SAHRS components.
SAHRS active flooding (continued operation following containment failure for continued melt stabilization)	Melt stabilization ex-vessel	The dedicated train of CCWS provides cooling water to the SAHRS Heat Exchanger. This CCWS trains is supported by a dedicated, separate ESWS train.  SAHRS components are supplied by the 480 and 6900V networks of electrical Division 4, and are provided with power from the Division 4 Emergency Diesel Generator and the Division 4 Station Blackout Diesel Generator.	Evaluation of survivability:  This system will be qualified for severe accidents. As discussed above, containment failure is not expected to lead to releases into compartments containing SAHRS components, nor to components of its support systems.

**Table 19.1-23—Evaluation of Equipment Survivability for Level 2  
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System	Relevant CET Headers	Support Systems	Comments and Evaluation of Survivability
<p>Safety injection (continued operation with isolation failure of containment or very early containment failure)</p>	<p>Melt retention in-vessel</p>	<p>The CCWS and ESWS support the LHSI heat exchanger for all four trains, and the LHSI Trains 2 and 3 and MHSI motor pumps and the corresponding sealing fluid. The cooling coils of the LHSI pump motor and seals Trains 1 and 4 are supplied from the air cooled SCWS QK</p> <p>SIS components are supplied by the 480 and 6900V networks of electrical Divisions 1- 4, and are provided with power from the division’s Emergency Diesel Generator.</p>	<p>Evaluation of survivability:</p> <p>The evaluation performed for in-vessel recovery applies here, except as follows:</p> <ol style="list-style-type: none"> <li>1. The possibility of long term water loss with a failed containment is considered to be unimportant since once sub-cooled conditions are achieved in the RCS there will be no further water loss.</li> <li>2. As with the SAHRS system, containment failure is not expected to lead to releases into compartments containing SIS components, nor to components of its support systems.</li> </ol>

**Table 19.1-24—Internal Events Release Category Results - Large Release Frequency**  
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<b>Internal Events Release Category</b>	<b>Description</b>	<b>Internal Events RC Frequency</b>	<b>Contribution to Internal LRF</b>	<b>Conditional Containment Failure Probability</b>
RC201	Containment fails before vessel breach due to isolation failure, melt retained in vessel	5.01E-10	3.40%	0.0021
RC202	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI, melt not flooded ex vessel, with containment spray	1.08E-11	0.07%	0.0
RC203	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI, melt not flooded ex vessel, without containment spray	1.28E-09	8.72%	0.0053
RC204	Containment fails before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex vessel with containment spray	9.73E-10	6.62%	0.0040
RC205	Containment failures before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex vessel without containment spray	3.04E-10	2.06%	0.0013
RC206	Small containment failure due to failure to isolate 2" or smaller lines	2.44E-08	n/a	0.1011
RC301	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex vessel, with containment spray	5.89E-13	0.00%	0.0
RC302	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex vessel, without containment spray	6.89E-12	0.05%	0.0

**Table 19.1-24—Internal Events Release Category Results - Large Release  
Frequency  
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<b>Internal Events Release Category</b>	<b>Description</b>	<b>Internal Events RC Frequency</b>	<b>Contribution to Internal LRF</b>	<b>Conditional Containment Failure Probability</b>
RC303	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex vessel, with containment spray	6.98E-11	0.47%	0.0003
RC304	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex vessel, without containment spray	4.44E-10	3.02%	0.0018
RC401	Containment failures after breach and up through debris quench due to containment rupture, with MCCI, without debris flooding, with containment spray	1.01E-12	0.01%	0.0
RC402	Containment failures after breach and up through debris quench due to containment rupture, with MCCI, without debris flooding, without containment spray	1.62E-12	0.01%	0.0
RC403	Containment failures after breach and up through debris quench due to containment rupture, without MCCI, with debris flooding, with containment spray	7.59E-11	0.52%	0.0003
RC404	Containment failures after breach and up through debris quench due to containment rupture, without MCCI, with debris flooding, without containment spray	5.93E-11	0.40%	0.0002
RC501	Long term containment failure after debris quench due to rupture, with MCCI, without debris flooding, with containment spray	1.43E-12	n/a	0.0000

**Table 19.1-24—Internal Events Release Category Results - Large Release  
Frequency  
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<b>Internal Events Release Category</b>	<b>Description</b>	<b>Internal Events RC Frequency</b>	<b>Contribution to Internal LRF</b>	<b>Conditional Containment Failure Probability</b>
RC502	Long term containment failure after debris quench due to rupture, with MCCI, without debris flooding, without containment spray	1.03E-10	n/a	0.0004
RC503	Long term containment failure after debris quench due to rupture, without MCCI, with debris flooding, with containment spray	1.10E-09	n/a	0.0046
RC504	Long term containment failure after debris quench due to rupture, without MCCI, with debris flooding, without containment spray	5.58E-09	n/a	0.0231
RC601	Long term containment failure due to basemat failure, without debris flooding, with containment sprays	0.00E+00	n/a	0.0
RC602	Long term containment failure due to basemat failure, without debris flooding, without containment spray	9.68E-09	n/a	0.0401
RC701	Steam Generator Tube Rupture with Fission Product Scrubbing	2.83E-08	n/a	0.1169
RC702	Steam Generator Tube Rupture without Fission Product Scrubbing	1.07E-08	72.78%	0.0443
RC801	Interfacing System LOCA with Fission Product Scrubbing	0.00E+00	n/a	0.0
RC802	Interfacing System LOCA without Fission Product Scrubbing but with building deposition credited	2.74E-10	1.86%	0.0011
Internal LRF:		1.47E-08	100.00%	0.0608
RS Internal LRF:		1.46E-08		

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1a	RC201	1, 2, 3, 4	1.35E-10	0.93%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is successful with power supply from the non-safety electrical buses</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• In-vessel recovery is successful after power recovery leading to RC201</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	
P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)						



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1b	RC201	5, 6, 9, 10, 11, 12, 40, 41, 42, 43, 44, 45	2.90E-11	0.20%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-124	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM3	CCWS/ESWS Train 3 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is successful with power supply from the non-safety electrical buses</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• In-vessel recovery is successful after power recovery leading to RC201</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2a	RC201	7, 8, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 34, 35, 36, 39, 50	3.09E-11	0.21%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. Failure of HVAC supply fans results in the loss of HVAC in divisions 1 & 4. This results in the loss of the both running CCW trains. Operator fails to switch to the standby CCW trains and results in the loss of CH1 & 2. This results in a total loss of HVAC.
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SAC01AN001EFS_B-ALL	CCF to Start Normal Air Supply Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Sequence enters CET LO PRESSURE</li> <li>Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>Hot leg rupture occurs precluding creep induced SGTR and leading to a low pressure sequence</li> <li>Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>In-vessel recovery is successful after power recovery leading to RC201</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2b	RC201	15, 20, 29, 46, 47, 48, 49	6.56E-12	0.04%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. Failure of EDGs 1 & 2 plus SBODG 5 in PM results in loss of power to divisions 1 & 2. Failure of EDG 3 results in failure of QKA30 plus QKA40 in preventive maintenance results in failure of HVAC 3 & 4. Total loss of HVAC.
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SBODG5 PM5	SBO-DG Train 5 Unavailable due to Preventive Maintenance	
					XKA10 _____ DFR_D-ALL	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 7 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Sequence enters CET LO PRESSURE</li> <li>Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>Hot leg rupture occurs precluding creep induced SGTR and leading to a low pressure sequence</li> <li>Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>In-vessel recovery is successful after power recovery leading to RC201</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 8 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2c	RC201	27, 28, 38	2.63E-12	0.02%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence, no recovery of OSP in 2 hours, the CCF of all 4 EDGs and the failure of both SBODGs results in a station blackout (loss of all AC power).
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SBODG8 PM8	SBO-DG Train 8 Unavailable due to Preventive Maintenance	
					XKA10 ____DFR_D-ALL	CCF of EDGs to Run	
					XKA50 ____DFR	ELEC, SBO Diesel Generator XKA50, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 9 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Sequence enters CET LO PRESSURE</li> <li>Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>Hot leg rupture occurs precluding creep induced SGTR and leading to a low pressure sequence</li> <li>-Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>In-vessel recovery is successful after power recovery leading to RC201</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 10 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 11 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3a	RC201	30, 31, 32, 33	3.72E-12	0.03%	IE LOCCW	Initiator - Loss of CCW	<b>Level 1:</b> LOCCW sequence resulting in the loss of CH2 followed by a consequential LOOP resulting in. Failure of division 1 battery fails EDG and SBODB connection to Div. 1. Failure of CH2 plus QKA40 in preventive maintenance results in HVAC trains 3 & 4 failure. Failure of train 1 1E 2hr battery prevents starting of EDG1 and connecting SBODG to train 1. EFW 2 fails due to a loss of room cooling.
					31BTD01_BATST	ELEC, 250V 1E 2-hr Battery 31BTD01, Fails on Demand	
					KAB20AA192SPO	CCWS, CCWS CH2 Return Safety Valve KAB20AA192, Premature Opening	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 12 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Sequence enters CET LO PRESSURE</li> <li>Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety) due to HVAC failure and loss random failure of the non-safety DC power</li> <li>Hot leg rupture occurs precluding creep induced SGTR and leading to a low pressure sequence</li> <li>Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>In-vessel recovery is successful leading to RC201</li> </ul>
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 13 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3b	RC201	37	3.72E-13	0.00%	IE GT	Initiator - General Transient (Includes Turbine Trip and Reactor Trip)	<b>Level 1:</b> GT sequence: consequential LOOP results in loss of MFW & SSS. Failure of EDG 3 and QKA40 in PM results in loss of HVAC in Divs. 3 & 4. Failure of Div. 1 1E 2-hr Battery fails EDG 1 and connection of SBODG. This results in the loss of CCW running pump and inability to switch over to standby CCW pump. This results in total loss of HVAC.
					31BTD01_BATST	ELEC, 250V 1E 2-hr Battery 31BTD01, Fails on Demand	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	
					XKA30____DFR	ELEC, Emergency Diesel Generator XKA30, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 14 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Sequence enters CET LO PRESSURE</li> <li>Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>Hot leg rupture occurs precluding creep induced SGTR and leading to a low pressure sequence</li> <li>Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>In-vessel recovery is successful leading to RC201</li> </ul>
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 15 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC202	1, 2	8.06E-13	0.01%	IE LOOP	Initiator - Loss Of Offsite Power	<p><b>Level 1:</b>            LOOP sequence causes failure of CVCS. Failure of EDGs 1 &amp; 2 and failure of operator to connect SBODGs results in a loss of CCW CH1 (supplying RCP Thermal Barrier) and a RCP seal LOCA with a probability of 0.2. Failure of EDG 4 results in loss of running CCW pump. Loss of 3 electrical division prevents switchover to standby CCW pump and results in CH2. Total loss of HVAC.</p>
					CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10____DFR_D-124	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 16 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no pit overpressure failure in case where complete circumferential failure of the vessel does not occur</li> <li>• dependent operator failure to open the MOVs on the passive flooding lines leading to significant MCCI (debris not flooded)</li> <li>• SAHRS sprays are successful after power recovery</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	
					OPD-L2-SAHRSPF-LOW	Operator fails to open MOVs to enable passive cooling - low dependency	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 17 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC203	1, 2	1.69E-11	0.12%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence: Failure of Train 1 & 4 supply fans disables HVAC in Safeguard Buildings 1 & 4. Loss of power in these building prevents PCD ability and fails bleed function.
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC01AN001EFR_B-ALL	CCF to Run Normal Air Supply Fans (Trains 1 & 4)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 18 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>• -Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no pit overpressure failure in case where complete circumferential failure of the vessel does not occur</li> <li>• dependent operator failure to open the MOVs on the passive flooding lines leading to significant MCCI (debris not flooded)</li> <li>• SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 19 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2a	RC203	3, 4, 5, 6, 12, 13, 14, 15, 16, 17, 18, 19, 20, 43	3.47E-11	0.24%	IE BDA	Initiator - Loss of Divisional Emergency AC	<b>Level 1:</b> Loss of BDA sequence: Failure of electrical Div 1 fails running CCW pump. CCW 2 is in preventive maintenance resulting in loss of CH1. Failure of train 4 supply fan with Maintenance HVAC in maintenance causes loss of running CCW pump and operator failure to switch to standby pump resulting in loss of CH2. Total loss of HVAC.
					31BDA____OFL	ELEC, 6.9kV Switchgear 31BDA, Fails During Operation	
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC04AN001EFR	SAC, Normal Air Supply Fan SAC04AN001, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 20 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					SAC08 PM8	Maintenance SAC Safety System Train 8 Unavailable due to Preventive Maintenance	
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 21 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 22 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2b	RC203	7, 8, 9, 10, 44, 45, 47	1.66E-11	0.11%	IE GT	Initiator - General Transient (Includes Turbine Trip and Reactor Trip)	<b>Level 1:</b> GT sequence: consequential LOOP results in loss of MFW & SSS. Common cause failure of train 1 & 4 supply fans results in loss of Div. 1 & 4 HVAC causing the loss of the running CCW pumps. Operator fails to switch to standby CCW pumps cause loss of CH1 and 2. Total loss of HVAC.
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC01AN001EFS_B-ALL	CCF to Start Normal Air Supply Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 23 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 24 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2c	RC203	21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40	3.32E-11	0.23%	IE LOCCW	Initiator - Loss of CCW	<b>Level 1:</b> LOCCW sequence resulting in the loss of CH2. Failure of train 1 supply fan plus SAC05 in maintenance results in loss of running CCW pump. Operator fails to switch to standby CCW causing loss of CH1 and HVAC trains 1 & 2. Failure of train 4 supply fan plus both common headers results in failure of HVAC trains 3 & 4. Total loss of HVAC.
					KAB20AA192SPO	CCWS, CCWS CH2 Return Safety Valve KAB20AA192, Premature Opening	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC01AN001EFR_B-ALL	CCF to Run Normal Air Supply Fans (Trains 1 & 4)	
					SAC05 PM5	Maintenance SAC Safety System Train 5 Unavailable due to Preventive Maintenance	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 26 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4 (safety and non-safety) due to HVAC failure</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 27 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
3a	RC203	11	2.33E-12	0.02%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 28 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	<ul style="list-style-type: none"> <li>no pit overpressure failure following ex-vessel steam explosion</li> <li>Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>SAHRS sprays failed although power was recovered between 2 and 7 hours because of HVAC failure</li> </ul>
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 29 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3b	RC203	41, 42	2.88E-12	0.02%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. Failure of HVAC supply fans results in the loss of HVAC in divisions 1 & 4. This results in the loss of the both running CCW trains. Operator fails to switch to the standby CCW trains and results in the loss of CH1 & 2. This results in a total loss of HVAC.
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SAC31AN001EFS_B-ALL	CCF to Start Normal Air Exhaust Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 30 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no pit overpressure failure following ex-vessel steam explosion</li> <li>• Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>• SAHRS sprays failed</li> <li>• power not recovered before 31 hours</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 31 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
4	RC203	48, 49	2.28E-12	0.02%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence causes failure of CVCS. Failure of EDGs 1 & 2 and failure of operator to connect SBODGs results in a loss of CCW CH1 (supplying RCP Thermal Barrier) and a RCP seal LOCA with a probability of 0.2. Failure of EDG 4 results in loss of running CCW pump. Loss of 3 electrical division prevents switchover to standby CCW pump and results in CH2. Total loss of HVAC.
					CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 32 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10____DFR_D-124	CCF of EDGs to Run	
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no pit overpressure failure in cases without complete circumferential failure of the vessel</li> <li>• Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>• SAHRS sprays failed</li> <li>• Power not recovered before 31 hours</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 33 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5	RC203	50	1.10E-12	0.01%	IE LOCCW	Initiator - Loss of CCW	<b>Level 1:</b> LOCCW sequence resulting in the loss of CH2. RCP LOCA occurs with a probability of 0.2 because of loss of CVCS due to a consequential LOOP and flow diversion through CH2 Return Safety Valve. Loss of CH2 and failure QKA40 in maintenance results in loss of HVAC to Safeguard Buildings 3 & 4. EFW train 1 fails due to failure of EDG 10 to run and operator failing to connect SBODG. EFW train 2 fails due to failure of power to MSRTs.
					CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	
					KAB30AA192SPO	CCWS, RCP Thermal Barrier to CCWS CH2 Return Safety Valve KAB30AA192, Premature Opening	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 34 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	
					XKA10____DFR	ELEC, Emergency Diesel Generator XKA10, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 35 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no pit overpressure failure in cases without complete circumferential failure of the vessel</li> <li>• Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>• SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 36 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
6	RC203	46	1.20E-12	0.01%	IE GT	Initiator - General Transient (Includes Turbine Trip and Reactor Trip)	<b>Level 1:</b> Plant trip (GT) followed by a consequential LOOP, with the CCF of all EDGs and operator failure to connect the SBODGs results in the loss of all 1E AC power.
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					OPF-XTLDSBO-2H	Operator Fails to Connect and Load SBO DGs	
					XKA10____DFR_D-ALL	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 37 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● Significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 38 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					OPD-SAC-2H-MED	Operator fails to start local room cooling - medium dependency	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
1a	RC204	1, 3, 4, 5	1.35E-10	0.93%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 39 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1b	RC204	2, 6, 7, 8	1.28E-10	0.87%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● in-vessel recovery failure due to failure of power recovery within 7 hours</li> <li>● no ex-vessel steam explosion</li> <li>● No Significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 41 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2	RC204	9, 10, 19, 20, 25, 26, 35, 36, 46	3.53E-11	0.24%	IE LOOP	Initiator - Loss Of Offsite Power	<p><b>Level 1:</b>            LOOP sequence causes failure of CVCS. Failure of EDGs 3 &amp; 4 and failure of operator to connect SBODGs results in a loss of CCW CH2 (supplying RCP Thermal Barrier) and a RCP seal LOCA with a probability of 0.2. Failure of EDG 1 results in loss of running CCW pump. Loss of 3 electrical division prevents switchover to standby CCW pump and results in CH1. Total loss of HVAC.</p>
					CONF CH2 TO TB	Configuration 2: CH2 Supplying All RCP TB. Maintenance on CCW 2 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10____DFR_D-134	CCF of EDGs to Run	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 42 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• No pit overpressure failure in cases without complete circumferential failure of the vessel</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 43 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3a	RC204	11, 12, 21, 22, 27, 28	2.49E-11	0.17%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-134	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 44 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 45 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3b	RC204	13, 14, 23, 24, 31, 32	2.35E-11	0.16%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-124	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM3	CCWS/ESWS Train 3 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 46 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• Failure of power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 47 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4a	RC204	15, 16, 29, 30, 33, 34, 41, 42, 43, 48, 50	2.26E-11	0.16%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. Failure of HVAC supply fans results in the loss of HVAC in divisions 1 & 4. This results in the loss of the both running CCW trains. Operator fails to switch to the standby CCW trains and results in the loss of CH1 & 2. This results in a total loss of HVAC.
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SAC31AN001EFS_B-ALL	CCF to Start Normal Air Exhaust Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 48 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 49 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4b	RC204	17, 18, 37, 38, 40, 44, 45	1.77E-11	0.12%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. Failure of HVAC supply fans results in the loss of HVAC in divisions 1 & 4. This results in the loss of the both running CCW trains. Operator fails to switch to the standby CCW trains and results in the loss of CH1 & 2. This results in a total loss of HVAC.
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					SAC31AN001EFS_B-ALL	CCF to Start Normal Air Exhaust Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 51 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• Failure of power recovery within 7 hours</li> <li>• no pit overpressure failure following ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 52 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 53 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5	RC204	33, 39, 47, 49	5.87E-12	0.04%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with failure to recover OSP in 2hrs. Common cause failure of all EDGs and failure of the operator to connect the SBODGs results in the total loss of HVAC.
					OPD-SAC-2H-MED	Operator fails to start local room, cooling - medium dependency	
					OPF-XTLDSBO-2H	Operator Fails to Connect and Load SBO DGs	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	
					XKA10____DFR_D-ALL	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Low pressure sequence</li> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>● Hot leg rupture leading to depressurization and precluding steam generator tube rupture</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>● no pit overpressure failure following ex-vessel steam explosion</li> <li>● No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1a	RC205	1, 10, 11, 12, 13	4.22E-11	0.29%	IE LOOP	Initiator - Loss Of Offsite Power	Level 1: LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 57 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>● Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>● no ex-vessel steam explosion</li> <li>● No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>● SAHRS sprays failed</li> <li>● Power not recovered before 31 hours</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1b	RC205	9, 27	4.67E-12	0.03%	IE LOOP	Initiator - Loss Of Offsite Power	Level 1: LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 59 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to operator action</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					OPF-L2-SPRAYSTCI-2HL	Operator Fails to Start Containment Spray to stop/ decrease release from SAB (CI failure)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1c	RC205	3, 5, 25, 26, 42, 43, 44	2.19E-11	0.15%	IE LOOP	Initiator - Loss Of Offsite Power	Level 1: LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to failure of the dedicated cooling chain</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
					SA-ESWS UHS4 SBO	Failure of SA-ESWS/UHS4 in SBO Conditions	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1d	RC205	4, 6, 30, 31, 32, 47, 48, 49	2.17E-11	0.15%	IE LOOP	Initiator - Loss Of Offsite Power	Level 1: LOOP sequence where a loss of all 1E 2hr batteries prevents starting of EDGs and results in a loss of all instrumentation.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 63 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to failure of the dedicated cooling chain</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
					SA-ESWS UHS4 SBO	Failure of SA-ESWS/UHS4 in SBO Conditions	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 64 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2	RC205	2, 7, 8, 16, 17, 18, 19, 20, 23, 24	4.44E-11	0.30%	IE GT	Initiator - General Transient (Includes Turbine Trip and Reactor Trip)	<b>Level 1:</b> Plant trip (GT) followed by a consequential LOOP. The CCF of all 1E 2hr batteries prevents the starting of the EDGs and connecting the SBODGs; resulting in the loss of all 1E AC power.
					BTD01_BAT__ST_D-ALL	CCF of Safety Related Batteries on Demand	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to failure of power supply</li> </ul>
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3	RC205	14, 15, 38	5.85E-12	0.04%	IE LOMFW	Initiator - Total Loss of Main Feedwater	<b>Level 1:</b> Loss of Main Feedwater followed by a consequential LOOP. The CCF of all 1E 2hr batteries prevents the starting of the EDGs and connecting the SBODGs; resulting in the loss of all 1E AC power.
					BTD01_BAT__ST_D-ALL	CCF of Safety Related Batteries on Demand	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 67 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to failure of power supply</li> </ul>
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4a	RC205	21, 22, 28, 29	6.02E-12	0.04%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-134	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 69 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>• SAHRS sprays failed</li> <li>• Power not recovered before 31 hours</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4b	RC205	50	6.60E-13	0.00%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-134	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 71 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Depressurization is failed due to a loss of electrical Divisions 1 and 4</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris not flooded) with failure to open the MOVs on the passive flooding lines</li> <li>• SAHRS sprays failed</li> <li>• Power not recovered within 7 hours</li> </ul>
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
					SA-ESWS UHS4 SBO	Failure of SA-ESWS/UHS4 in SBO Conditions	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4c	RC205	45, 46	1.40E-12	0.01%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with no recovery of OSP in 2 hours. CCF of 3 1E 2hr batteries and ESWS in PM results in loss of all EDGs and prevents the connection of the SBO DGs to trains 1 & 4. This results in the loss of EFW, MHSI and LHSI.
					BTD01_BAT_ST_D-134	CCF of Safety Related Batteries on Demand	
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 73 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Low pressure sequence</li> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• in-vessel recovery phenomenological failure with sufficient injection after power recovery within 7 hours</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS failure due to cooling chain failure</li> </ul>
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	
					L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
					SA-ESWS UHS4 SBO	Failure of SA-ESWS/UHS4 in SBO Conditions	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5	RC205	33, 34, 35, 36, 37, 39, 40, 41	6.06E-12	0.04%	IE LOCCW	Initiator - Loss of CCW	<b>Level 1:</b> Loss of CCWS followed by a consequential LOOP. The CCF of all 1E 2hr batteries prevents the starting of the EDGs and connecting the SBODGs; resulting in the loss of all 1E AC power.
					BTD01_BAT_ST_D-ALL	CCF of Safety Related Batteries on Demand	
					KAB20AA192SPO	CCWS, CCWS CH2 Return Safety Valve KAB20AA192, Premature Opening	
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JMM23 01/02 SCFL	Probability that Secondary Containment/ Annulus Venting Fails	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Large containment isolation failure because the leak off system lines are open and fail to close due to loss of electrical Divisions 1 and 4 followed by a containment annulus venting failure</li> <li>• no ex-vessel steam explosion</li> <li>• No significant MCCI (debris flooded) with successful opening of the MOVs on the passive flooding lines</li> <li>• SAHRS fails due to failure of power supply</li> </ul>
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	
1	RC301	1, 2	5.70E-14	0.00%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; a CCF of all MSRIVs fails the PCD function; failure of operator to initiate F&B results in a loss of all cooling.
					LBA13AA001PFO_D-ALL	CCF to Open Main Steam Relief Isolation Valves	
					OPE-FB-40M	Operator Fails to Initiate Feed & Bleed for SLOCA	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● High pressure sequence</li> <li>● Very early containment failure due to hydrogen flame acceleration loads</li> <li>● Extensive MCCI with failed basemat flooding due to failure of operator to open the MOVs on basemat flooding</li> <li>● No ex-vessel steam explosion pit failure</li> <li>● Operator failures to open the MOVs on the passive flooding lines and failure to start LHSI in-vessel cooling</li> <li>● Successful SAHRS sprays</li> </ul>
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	
					OPD-L2-SAHRSPF-LOW	Operator fails to open MOVs to enable passive cooling - low dependency	
					OPD-L2-STRTSI-HIGH	Operator fails to start LHSI for in-vessel cooling - high dependency	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC302	1	4.98E-12	0.03%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; a CCF of common IRWST suction strainers to MHSI/LHSI pumps results in the loss of all injection.
					JNK10AT001SPG_P-ALL	CCF of IRWST Sump Strainers - Plugged	
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● High pressure sequence</li> <li>● Very early containment failure due to hydrogen flame acceleration loads</li> <li>● Extensive MCCI with failed basemat flooding due to IRWST strainers plugging</li> <li>● No ex-vessel steam explosion pit failure</li> <li>● Failure of SAHRS sprays</li> </ul>
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	
1	RC303	1	3.60E-12	0.02%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; a CCF to open MHSI/ACC/LHSI common discharge check valves results in the loss of all injection.
					JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• High pressure sequence</li> <li>• Very early containment failure due to hydrogen flame acceleration loads</li> <li>• Extensive MCCI with failed basemat flooding due to IRWST strainers plugging</li> <li>• No ex-vessel steam explosion pit failure</li> <li>• Failure of SAHRS sprays</li> </ul>
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	
1	RC304	1, 6, 11, 12, 20, 25, 26, 27, 33, 34, 35, 36, 37, 38, 47	5.18E-11	0.36%	IE SLBI	Initiator - Steam Break Inside Containment	<b>Level 1:</b> SLBI sequence: CCF of SAS results in failure to control EFW steam relief and LHSI heat exchanger cooling, SAHR train in PM, results in a loss of all long term cooling (LTC)> <b>Level 2:</b> <ul style="list-style-type: none"> <li>• Containment overpressure failure following SLBI due to SAHRS sprays failure</li> </ul>
					SAHR PM4	SAHR Train Unavailable due to Preventive Maintenance	
					SAS CCF-ALL	CCF of SAS Divisions	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2	RC304	2, 3, 4, 5, 10, 19, 21, 22, 24, 28, 29, 30, 31, 32, 39, 41, 42, 43, 44, 46, 48, 49, 50	6.01E-11	0.41%	IE SLBI	Initiator - Steam Break Inside Containment	<p><b>Level 1:</b>  SLBI sequence: consequential LOOP with CCF of all EDGs and one SBODG in preventive maintenance results in loss of steam relief and bleed ability.</p> <p><b>Level 2:</b></p> <ul style="list-style-type: none"> <li>Containment overpressure failure following SLBI due to SAHRS sprays failure</li> </ul>
					LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	
					SBODG5 PM5	SBO-DG Train 5 Unavailable due to Preventive Maintenance	
					XKA10____DFR_D-ALL	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3	RC304	7, 8, 13, 14, 15, 17, 18, 40, 45	1.39E-11	0.10%	IE SLBI	Initiator - Steam Break Inside Containment	<p><b>Level 1:</b>                      SBLI sequence: Failure of train 1 exhaust fan and SAC05 in maintenance results in loss of HVAC in Safeguard Building 1 and loss of a running CCW pump. Operator fails to switch to standby pump resulting in loss of CH1 and HVAC in Safeguard Building 2. EFW 3 is in maintenance. Initiator disables EFW 4. Bleed function fails due to loss of power in division 1.</p> <p><b>Level 2:</b></p> <ul style="list-style-type: none"> <li>• Containment overpressure failure following SLBI due to SAHRS sprays failure</li> </ul>
					EFWS PM3	EFWS Train 3 Unavailable due to Preventive Maintenance	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC05 PM5	Maintenance SAC Safety System Train 5 Unavailable due to Preventive Maintenance	
					SAC31AN001EFR	SAC, Normal Air Exhaust Fan SAC31AN001, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
4	RC304	9, 16	3.38E-12	0.02%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; CCF failure to start SB CT fans (or CCF to open CCWS MOVs to LHSI HTX), SAHR train in PM, results in a loss of all long term cooling (LTC).
					PED10AN002EFS_F-ALL	CCF to Start Standby Cooling Tower Fans (At Power)	
					SAHR PM4	SAHR Train Unavailable due to Preventive Maintenance	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● High pressure sequence</li> <li>● Very early containment failure due to hydrogen flame acceleration loads</li> <li>● No MCCI with successful opening of the MOVs on the passive flooding lines</li> <li>● No ex-vessel steam explosion</li> <li>● Failure of SAHRS sprays</li> </ul>
					L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	
					L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5	RC304	23	1.21E-12	0.01%	IE SLBI	Initiator - Steam Break Inside Containment	<b>Level 1:</b> SLBI sequence: CCF of MSRIVs fails EFW steam relief. Operator fails to initiate feed & bleed.
					LBA13AA001PFO_D-ALL	CCF to Open Main Steam Relief Isolation Valves	
					OPE-FB-90M	Operator Fails to Initiate Feed & Bleed for Transient	
					SAHR PM4	SAHR Train Unavailable due to Preventive Maintenance	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment overpressure failure following SLBI due to SAHRS sprays failure</li> </ul>
1	RC401	1	4.49E-14	0.00%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; CCF of all MHSI pumps; operator fails to initiate FCD leads to a loss of all injection.
					JND10AP001EFR_D-ALL	CCF of MHSI Pumps to Run	
					OPE-FCD-40M	Operator Fails to Initiate Fast Cooldown for SLOCA	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 83 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CBV HP	Complete circumferential rupture of vessel (gives vessel rocket in HP sequences)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• High pressure sequence failure of the operator to depressurize</li> <li>• Early failure of containment at the time of vessel failure due to vessel rocketing</li> <li>• No pit overpressure failure with complete circumferential failure of the vessel</li> <li>• Successful SAHRS sprays</li> <li>• significant MCCI due to failure of the operator open the MOVs on the passive flooding lines</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF CBV=N	Pit overpressure at high pressure vessel failure fails melt plug given CBV occurs	
					OPD-L2-DEPRESS-40M	Operator Fails to Open Sufficient RCS Depressurization Valves	
					OPD-L2-DEPRESS-LOW	Operator fails to open PDS to depressurize RCS - low dependency	
					OPD-L2-SAHRS PF-HIGH	Operator fails to open MOVs to enable passive cooling -high dependency	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC402	1	1.68E-14	0.00%	IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	<b>Level 1:</b> SLOCA sequence; CCF of common IRWST strainers results in loss of MHSI; operator failure to initiate FCD results in loss of all injection.
					JNK10AT001SPG_P-ALL	CCF of IRWST Sump Strainers - Plugged	
					OPE-FCD-40M	Operator Fails to Initiate Fast Cooldown for SLOCA	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2PH CBV HP	Complete circumferential rupture of vessel (gives vessel rocket in HP sequences)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• High pressure sequence failure of the operator to depressurize</li> <li>• Early failure of containment at the time of vessel failure due to vessel rocketing</li> <li>• No pit overpressure failure with complete circumferential failure of the vessel</li> <li>• Failure of SAHRS sprays due to IRWST strainers plugging</li> <li>• significant MCCI due to failure of the operator open the MOVs on the passive flooding lines</li> </ul>
					L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	
					L2PH PF-VF CBV=N	Pit overpressure at high pressure vessel failure fails melt plug given CBV occurs	
					OPD-L2-DEPRESS-40M	Operator Fails to Open Sufficient RCS Depressurization Valves	
					OPD-L2-DEPRESS-LOW	Operator fails to open PDS to depressurize RCS - low dependency	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC403	1, 2	1.58E-12	0.01%	IE LOOP	Initiator - Loss Of Offsite Power	<p><b>Level 1:</b>            LOOP sequence causes failure of CVCS. Failure of EDGs 1 &amp; 2 and failure of operator to connect SBODGs results in a loss of CCW CH1 (supplying RCP Thermal Barrier) and a RCP seal LOCA with a probability of 0.2. Failure of 3 electrical divisions prevents PCD function through MSRTs and bleed function.</p>
					CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10____DFR_D-123	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 87 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● High pressure sequence</li> <li>● Early failure of containment at the time of vessel failure due to vessel rocketing</li> <li>● No pit overpressure failure with complete circumferential failure of the vessel</li> <li>● Successful SAHRS sprays</li> <li>● No significant MCCI with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2PH CBV HP	Complete circumferential rupture of vessel (gives vessel rocket in HP sequences)	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH PF-VF CBV=N	Pit overpressure at high pressure vessel failure fails melt plug given CBV occurs	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC404	1, 2	2.28E-13	0.00%	IE LOOP	Initiator - Loss Of Offsite Power	<p><b>Level 1:</b>            LOOP sequence causes failure of CVCS. Failure of EDGs 1 &amp; 2 and failure of operator to connect SBODGs results in a loss of CCW CH1 (supplying RCP Thermal Barrier) and a RCP seal LOCA with a probability of 0.2. Failure of 3 electrical divisions prevents PCD function through MSRTs and bleed function.</p>
					CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10____DFR_D-123	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 89 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	<b>Level 2:</b> <ul style="list-style-type: none"> <li>High pressure sequence</li> <li>Early failure of containment at the time of vessel failure due to vessel rocketing</li> <li>No pit overpressure failure with complete circumferential failure of the vessel</li> <li>Failure SAHRS sprays due to failure of power recovery within 31 hours</li> <li>No significant MCCI with successful opening of the MOVs on the passive flooding lines</li> </ul>
					L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	
					L2PH CBV HP	Complete circumferential rupture of vessel (gives vessel rocket in HP sequences)	
					L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	
					L2PH PF-VF CBV=N	Pit overpressure at high pressure vessel failure fails melt plug given CBV occurs	
1	RC702	1, 2, 73	1.89E-10	1.29%	IE IND SGTR	Initiator - Induced Steam Generator Tube Rupture	<b>Level 1:</b> Initiator is an Induced SGTR with a failure of 2-9 tubes. Operator fails to depressurize and initiate RHR cooling in time to prevent an excessive inventory loss.
					2-9 TUBES	2-9 Ruptured SG Tubes	
					OPE-RHR-3H	Operator Fails to Initiate RHR Within 3 Hours	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					OPD-L2-SCRUBSGTR-LOW	Operator fails to fill SG to scrub unisolated SGTR - low dependency	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass after SGTR and dependent failure of the operator to start EFW on the faulted steam generator to scrub the release</li> </ul>
2	RC702	3, 4, 7, 8, 10, 11, 12, 13, 16, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60,	1.28E-09	8.76%	IE SGTR	Initiator - Steam Generator Tube Rupture	<b>Level 1:</b> SGTR sequence with train 4 HVAC in maintenance. Initiator disables maintenance HVAC train leading to loss of HVAC in Safeguard Building 4 and a loss of a running CCW pump. Operator fails to switch to standby CCW pump resulting in loss of CH2 and HVAC 3. Tube rupture is assumed to be in SG 4 and loss of HVAC 3 & 4 prevents isolation of affected SG. RHR train 1 discharge valve left in wrong position resulting in failure of 3 RHR pumps and failure to provide required heat removal.
							<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass after SGTR and failure of EFW on the faulted steam generator to scrub the release</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 91 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
		61, 62, 63, 64, 65, 66, 67, 68, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100			JNG10AA006MEC3	LHSI, LHSI CL1 Discharge Manual CHECK Valve JNG10AA006, Left in Wrong Position	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC04 CM4	Normal SAC04 Train Unavailable due to Corrective Maintenance	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3	RC702	5, 6	6.84E-11	0.47%	IE SGTR	Initiator - Steam Generator Tube Rupture	<p><b>Level 1:</b>            SGTR sequence: Common cause failure of HVAC train 1 &amp; 4 supply fails results in the failure of the running CCWS pumps. Operator fails to switch over to standby CCWS resulting in the loss of both common headers. Total loss of HVAC.</p> <p><b>Level 2:</b></p> <ul style="list-style-type: none"> <li>Containment bypass after SGTR and failure of EFW on the faulted steam generator to scrub the release</li> </ul>
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC01AN001EFR_B-ALL	CCF to Run Normal Air Supply Fans (Trains 1 & 4)	
4	RC702	9, 19	5.10E-11	0.35%	IE IND SGTR	Initiator - Induced Steam Generator Tube Rupture	<p><b>Level 1:</b>            Initiator is an Induced SGTR with a failure of 10 or more tubes. Operator fails to depressurize and initiate RHR cooling in time to prevent an excessive inventory loss.</p>
					10 TUBES	10 or More Ruptured Tubes	
					OPE-RHR/SG10TR	Likelihood to Survive Multiple (10+) Ruptured Tubes	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					EFWS PM4	EFWS Train 4 Unavailable due to Preventive Maintenance	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass after SGTR and failure of EFW on the faulted steam generator to scrub the release</li> </ul>
5	RC702	14, 15, 45, 46	1.09E-10	0.75%	IE LOOP	Initiator - Loss Of Offsite Power	<b>Level 1:</b> LOOP sequence with failure to recover OSP in 1hr. Failure of EDGs 1 & 2 results in failure of HVAC in Safeguard Buildings 1 & 2 and CH1. RCP Thermal Barriers are aligned to CH2 and failure of EDG 3 with QKA40 in maintenance results in the loss of CH2. Loss of both common headers results in the loss of CVCS and a seal LOCA with a probability of 0.2. Total loss of HVAC.
					CONF CH2 TO TB	Configuration 2: CH2 Supplying All RCP TB. Maintenance on CCW 2 Only.	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	
					REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	
					XKA10_____DFR_D-123	CCF of EDGs to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• High pressure sequence</li> <li>• Failure of depressurization due to failure of electrical Divisions 1 and 4</li> <li>• Seal LOCA with secondary depressurized</li> <li>• recovery of offsite power within 7 hours</li> <li>• Thermally induced creep rupture</li> </ul>
					L2CP SS2"DIAM	Level 2 conditional probability: Seal LOCA has 2" diameter	
					L2PH ISGTR-SS2D=Y	Induced SGTR. 2" Seal LOCA (Pwr)	
6	RC702	17, 18, 47, 48, 74, 75, 76, 77	1.21E-10	0.83%	IE SGTR	Initiator - Steam Generator Tube Rupture	<b>Level 1:</b> SGTR sequence. Common cause failure of HVAC train 1 & 4 supply fails results in the failure of the running CCWS pumps. CCW pump 2 in maintenance results in the failure of CH1. Switch over to CCW 3 fails due to loss of required power resulting in loss of CH2. Total loss of HVAC. <b>Level 2:</b> <ul style="list-style-type: none"> <li>• Containment bypass after SGTR and failure of EFW on the faulted steam generator to scrub the release</li> </ul>
					CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					SAC31AN001EFR_B-ALL	CCF to Run Normal Air Exhaust Fans (Trains 1 & 4)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
7	RC702	66	1.32E-11	0.09%	IE SGTR	Initiator - Steam Generator Tube Rupture	<b>Level 1:</b> SGTR sequence with failure to isolate impacted steam generator and operator fails to initiate RHR cooling.
					LBA40AA002PFC	MSS, Train 4 Main Steam Isolation Valve LBA40AA002, Fails to Close on Demand	
					OPE-RHR-L12H	Operator Fails to Initiate RHR (Longer than 12 Hours)	
					OPD-L2-SCRUBSGTR-LOW	Operator fails to fill SG to scrub unisolated SGTR - low dependency	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass after SGTR and failure of EFW on the faulted steam generator to scrub the release</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
8	RC702	69, 70, 71, 72	5.12E-11	0.35%	IE LOCCW	Initiator - Loss of CCW	<p><b>Level 1:</b>            Loss of CCW sequence due to CCWS train 3 in maintenance and failure of ESWS train 4 resulting in loss of CH2. Failure of train 1 HVAC supply fan results in the failure of a running CCW pump and failure of the operator to switch to standby CCW results in the loss of CH1. Loss of both common headers results in the loss of CVCS combined with the loss of CCW to the RCP Thermal Barrier results in a seal LOCA with a probability of 0.2. The loss of both common headers also results in a total loss of HVAC.</p>
					CCWS/ESWS PM3	CCWS/ESWS Train 3 Pump Unavailable due to Preventive Maintenance	
					OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	
					OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	
					PEB40AP001EFR	ESWS, Train 4 Motor Driven Pump PEB40AP001, Fails to Run	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
					SAC01AN001EFR	SAC, Normal Air Supply Fan SAC01AN001, Fails to Run	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					SAC05 PM5	Maintenance SAC Safety System Train 5 Unavailable due to Preventive Maintenance	
					L2CP SS2"DIAM	Level 2 conditional probability: Seal LOCA has 2" diameter	<b>Level 2:</b> <ul style="list-style-type: none"> <li>● High pressure sequence</li> <li>● Failure of depressurization due to failure of electrical Divisions 1 and 4</li> <li>● Seal LOCA with secondary depressurized</li> <li>● recovery of offsite power within 7 hours</li> <li>● Thermally induced creep rupture</li> </ul>
					L2PH ISGTR-SS2D=Y	Induced SGTR. 2" Seal LOCA (Pwr)	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
1	RC802	1, 5, 24, 38	9.80E-11	0.67%	IE-ISLSISMHSI-CVIR2	Initiator - ISLOCA - Break in MHSI Cold Leg Injection CV with MHSI Ln Brk in Respect. SAB - 2 CV IR	<b>Level 1:</b> ISLOCA conditions from break in MHSI cold leg injection line.
					JND10AA003CIRIE	MHSI, MHSI Pump 10 Discharge Manual CHECK Valve JND10AA003, Internal Rupture	
					JND10AA007CFC	MHSI, MHSI Pump 10 Discharge Check Valve JND10AA007 (CIV), Fails to Close on Demand	
					JNG13AA005CIRY	LHSI, MHSI/LHSI Train 1 First SIS Isolation Check Valve JNG13AA005, Internal Rupture (Year)	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
2	RC802	2, 3, 6, 7, 21, 36, 37	9.72E-11	0.67%	IE-ISLSISRHR-MVIR2	Initiator - ISLOCA - FI of Suction Line Iso MOVs and Subsequent RHR Line Break in Respect. SAB - 2 MOV IR	<b>Level 1:</b> ISLOCA conditions from break in RHR suction line.
					JNA10AA001EIRY	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA001, Internal Rupture (Year)	
					JNA10AA002EIR	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA002, Internal Rupture	
					V_SIS_HL_RUP	Rupture of HL Suction 930 Psi Pipe from BNL Est.	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
3	RC802	4, 14, 25, 42, 43, 48, 49	1.19E-11	0.08%	IE ISL-CCW RCPTB	Initiator - ISLOCA - CCWS RCP Thermal Barrier Tube Break	<b>Level 1:</b> ISLOCA conditions from CCWS RCP thermal barrier tube break. Operator fails to initiate RHR cooling.
					2ND TUBE-BETA	2nd Tube Leak Conditional Probability	
					HTX AF	Heat Exchanger Size Adjustment Factor	
					JEB10AC001TLKY	RCP Thermal Barrier, Tube Rupture During Year	
					KAB30CF068-SNFFL	CCW TB Flow Rate - Flow Sensor Fails (Includes Transmitter)	
					OPD-RHR-4H-MED	Operator fails to initiate RHR within 4hrs - medium dependency	
					OPF-ISLTBCC 4H	Operator Fails to Isolate ISLOCA (RCP Thermal Barrier Cooling Coil Break) Within 4 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
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Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>
4a	RC802	8, 9, 22, 23, 29	1.17E-11	0.08%	IE ISL-CVCS REDS	Initiator - ISLOCA - Spurious Opening of Reducing Station	<b>Level 1:</b> ISLOCA conditions from spurious opening of CVCS reducing station. Operator fails to initiate RHR cooling.
					KBA10AA001EFC_B-ALL	CCF to Close CVCS Letdown Isolation MOVs (Suction Side of HP Coolers)	
					KBA12AA102EOPY	CVCS, HP Cooler 2 Reducing Station MOV KBA12AA102, Fails To Remain Closed (SO) During Year	
					OPD-RHR-4H-MED	Operator fails to initiate RHR within 4hrs - medium dependency	
					OPF-ISLCV2 4H	Operator Fails to isolate ISLOCA (CVCS Letdown line) Within 4 Hours	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 102 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>
4b	RC802	28, 30, 31, 32, 33, 34, 39	1.89E-12	0.01%	IE ISL-CVCS REDS	Initiator - ISLOCA - Spurious Opening of Reducing Station	<b>Level 1:</b> ISLOCA conditions from spurious opening of CVCS reducing station. CCF of pressurizer pressure sensors causes failure of EFW.
					KBA12AA102EOPY	CVCS, HP Cooler 2 Reducing Station MOV KBA12AA102, Fails To Remain Closed (SO) During Year	
					OPF-ISLCV2 4H	Operator Fails to isolate ISLOCA (CVCS Letdown line) Within 4 Hours	
					PZR PRES CCF-ALL	CCF of pressurizer (RCS) pressure sensors	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 103 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5a	RC802	10, 11, 19, 20, 26, 27, 44, 45, 46, 47	8.73E-12	0.06%	IE-ISLCVCSHPTR-MVFC3	Initiator - ISLOCA - Tube Rupture High Pressure Letdown Cooler - 3 MOVs Fail to Close	<b>Level 1:</b> ISLOCA conditions from CVCS high pressure letdown cooler tube rupture. Operator fails to initiate RHR cooling.
					2ND TUBE-BETA	2nd Tube Leak Conditional Probability	
					KBA10AA001EFC	CVCS, Letdown Line Isolation MOV KBA10AA001, Fails to Close on Demand	
					KBA10AA002EFC	CVCS, Letdown Line Isolation MOV KBA10AA002, Fails to Close on Demand	
					KBA11AC001TLKY	CVCS, HP Cooler HTX KBA11AC001, Single Tube Leakage During Year	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 104 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					KBA12AA001EFC	CVCS, HP Cooler 2 Suction MOV KBA12AA001, Fails to Close on Demand	
					OPE-RHR-4H	Operator Fails to Initiate RHR Within 4 Hours	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 105 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
5b	RC802	40, 41	2.62E-13	0.00%	IE-ISLCVCSHPTR-MVFC3	Initiator - ISLOCA - Tube Rupture High Pressure Letdown Cooler - 3 MOVs Fail to Close	<b>Level 1:</b> ISLOCA conditions from CVCS high pressure letdown cooler tube rupture. CCF of MSRIVs fails EFW.
					2ND TUBE-BETA	2nd Tube Leak Conditional Probability	
					KBA10AA001EFC	CVCS, Letdown Line Isolation MOV KBA10AA001, Fails to Close on Demand	
					KBA10AA002EFC	CVCS, Letdown Line Isolation MOV KBA10AA002, Fails to Close on Demand	
					KBA11AC001TLKY	CVCS, HP Cooler HTX KBA11AC001, Single Tube Leakage During Year	



**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 106 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					KBA12AA001EFC	CVCS, HP Cooler 2 Suction MOV KBA12AA001, Fails to Close on Demand	
					LBA13AA001PFO_D-ALL	CCF to Open Main Steam Relief Isolation Valves	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>
5c	RC802	50	9.31E-14	0.00%	IE-ISLCVCSHPTR-MVFC3	Initiator - ISLOCA - Tube Rupture High Pressure Letdown Cooler - 3 MOVs Fail to Close	<b>Level 1:</b> ISLOCA conditions from CVCS high pressure letdown cooler tube rupture. CCF to start standby UHS fans fails RHR due to insufficient cooling of the RHR heat exchangers.
					2ND TUBE-BETA	2nd Tube Leak Conditional Probability	
					KBA10AA001EFC	CVCS, Letdown Line Isolation MOV KBA10AA001, Fails to Close on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 107 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					KBA10AA002EFC	CVCS, Letdown Line Isolation MOV KBA10AA002, Fails to Close on Demand	
					KBA11AC001TLKY	CVCS, HP Cooler HTX KBA11AC001, Single Tube Leakage During Year	
					KBA12AA001EFC	CVCS, HP Cooler 2 Suction MOV KBA12AA001, Fails to Close on Demand	
					PED10AN002EFS_F-ALL	CCF to Start Standby Cooling Tower Fans (At Power)	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 108 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
6	RC802	12, 13, 35	5.95E-12	0.04%	IE-ISLSISLHSI-CVIR3	Initiator - ISLOCA - Break in LHSI Cold Leg Inj. CV with LHSI Line Break in Respect. SAB - 3 CVs IR	<b>Level 1:</b> ISLOCA conditions from break in LHSI cold leg injection line.
					JNG10AA006CIRIE	LHSI, LHSI CL1 Discharge Manual CHECK Valve JNG10AA006, Internal Rupture	
					JNG10AA009CFC	LHSI, LHSI Pump 10 Discharge Check Valve JNG10AA009 (CIV), Fail to Close	
					JNG10AA011CIRY	LHSI, LHSI Pump 10 Discharge Check Valve JNG10AA011, Internal Rupture (Year)	
					JNG13AA005CIRY	LHSI, MHSI/LHSI Train 1 First SIS Isolation Check Valve JNG13AA005, Internal Rupture (Year)	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 109 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>
7	RC802	15, 16, 17, 18	5.40E-12	0.04%	IE-ISLCVCSINJ-CVFC3	Initiator - ISLOCA - High Pressure CVCS Pipe Rupture Outside Containment - 3 CVs Fail to Close	<b>Level 1:</b> ISLOCA from high pressure CVCS pipe rupture outside containment.
					CV3/4_RUP	Rupture of CVCS Charging Line Outside of Containment	
					JEB10AA004CFC	RCP Seals, RCP Pump 10 Seal Water Injection Line Check Valve JEB10AA004, Fails to Close on Demand	
					JEB10AA005CFC	RCP Seals, RCP Pump 10 Seal Water Injection Line Check Valve JEB10AA005, Fails to Close on Demand	

**Table 19.1-25—Level 2 Internal Events Large Release Significant Cutsets**  
**Sheet 110 of 110**

Group	Release Category	Cutsets	Freq/yr	Contribution to LRF (%)	Event Identifier	Event Description	Sequence of events that lead to CD and to Containment Failure
					JEW01AA006CFC	RCP Seals, RCP Seal Water Injection Line Isolation Check Valve JEW01AA006, Fails to Close on Demand	
					L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	<b>Level 2:</b> <ul style="list-style-type: none"> <li>• Containment bypass following ISLOCA initiator with unscrubbed releases</li> </ul>

**Table 19.1-26—U.S. EPR Core Damage End States Contributions - Level 2 Internal Events**

<b>CDES</b>	<b>LRF (1/yr)</b>	<b>Contribution (Total)</b>
SG	6.0E-09	43.8%
SSD	2.7E-09	20.1%
SPD	1.7E-09	12.1%
TP	1.3E-09	9.3%
TR	1.1E-09	8.1%
SP	3.1E-10	2.3%
IS	2.7E-10	1.9%
SS	2.3E-10	1.7%
SL	4.8E-11	0.4%
SLD	3.8E-11	0.3%
TRD	6.8E-12	0.1%
RV	5.5E-14	0.0%
LL	1.8E-14	0.0%
AT	4.3E-15	0.0%
ML	2.2E-15	0.0%
Total	1.4E-08	100%

**Table 19.1-27—U.S. EPR Initiating Events Contributions - Level 2 Internal Events Sheet 1 of 2**

<b>Internal Event IE</b>	<b>Description</b>	<b>Frequency</b>	<b>LRF (1/yr)</b>	<b>Contribution (Total)</b>
IE SGTR	Initiator - Steam Generator Tube Rupture	3.5E-03	5.5E-09	40%
IE LOOP	Initiator - Loss Of Offsite Power	2.5E-01	3.3E-09	24%
IE LOCCW	Initiator - Loss of CCW	1.9E-02	3.2E-09	23%
IE BDA	Initiator - Loss of Divisional Emergency AC	3.5E-02	6.4E-10	5%
IE IND SGTR	Initiator - Induced Steam Generator Tube Rupture	1.2E-06	4.1E-10	3%
IE SLBI	Initiator - Steam Break Inside Containment	1.0E-03	4.0E-10	3%
IE GT	Initiator - General Transient (Includes Turbine Trip and Reactor Trip)	7.5E-01	2.0E-10	1%
IE SLOCA	Initiator - Small LOCA (0.6 to 3-Inch Diameter)	9.8E-11	8.6E-11	0.6%
IE ISL-CCW RCPTB	Initiator - ISLOCA - CCWS RCP Thermal Barrier Tube Break	9.7E-11	3.1E-11	0.2%
IE LOMFW	Initiator - Total Loss of Main Feedwater	1.4E-03	2.1E-11	0.2%
IE LOC	Initiator - Loss of Main Condenser (Includes MSIV Closure etc.)	3.8E-10	1.4E-11	0.1%
IE ISL-CVCS REDS	Initiator - ISLOCA - Spurious Opening of Reducing Station	9.6E-02	8.9E-12	0.1%
IE LBOP	Initiator - Loss of Balance of Plant - Closed Loop Cooling Water or Aux Cooling Water	8.0E-09	6.7E-12	0.05%
IE ISL-CVCS HPTR	Initiator - ISLOCA - Tube Rupture High Pressure Letdown Cooler	8.1E-02	2.2E-12	0.02%
IE MSSV	Initiator - Spurious Opening of Steam Safety Valve	4.3E-10	2.1E-12	0.01%
IE SLBO	Initiator - Steam Break Downstream of MSIV	5.0E-02	2.4E-13	0.002%
IE LLOCA	Initiator - Large LOCA (>6-Inch Diameter)	8.4E-12	1.8E-14	0.0001%

**Table 19.1-27—U.S. EPR Initiating Events Contributions - Level 2 Internal Events Sheet 2 of 2**

<b>Internal Event IE</b>	<b>Description</b>	<b>Frequency</b>	<b>LRF (1/yr)</b>	<b>Contribution (Total)</b>
IE ISL-SIS MHSI	Initiator - ISLOCA - Break in MHSI Cold Leg Injection CV with MHSI Line Break in Respective SAB	5.7E-12	6.6E-15	0.00005%
IE ISL-SIS RHR	Initiator - ISLOCA - Fl of Suction Line Iso MOVs and Subsequent RHR Line Break in Respective SAB	1.0E-03	3.3E-15	0.00002%
IE MLOCA	Initiator - Medium Break LOCA (3 to 6-Inch Diameter)	2.1E-03	2.2E-15	0.00002%
IE ISL-CVCS INJ	Initiator - ISLOCA - High Pressure CVCS Pipe Rupture Outside Containment	1.4E-05	0.0E+00	0%
IE ISL-SIS LHSI	Initiator - ISLOCA - Break in LHSI Cold Leg Inj. CV with LHSI Line Break in Respective SAB	1.3E-06	0.0E+00	0%
		<b>Total</b>	<b>1.4E-08</b>	<b>100%</b>



**Table 19.1-28—U.S. EPR Risk-Significant Phenomena based on FV Importance - Level 2 Internal Events**  
**Sheet 1 of 2**

Rank	ID	Description	Nominal Value	FV	RAW
1	L2PH ISGTR-SS2D=Y	Induced SGTR. 2" Seal LOCA (Pwr)	7.9E-01	<b>0.187</b>	1.1
2	L2PH ISGTR-SS0.6D=Y	Induced SGTR occurs. 0.6" LOCAs, secondary side depressurized	5.5E-01	<b>0.121</b>	1.1
3	L2PH ISGTR-TR=N	Induced SGTR. Transients, secondary not depressurized	1.0E+00	<b>0.114</b>	1.0
4	L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	9.5E-01	<b>0.112</b>	1.0
5	L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	1.0E+00	<b>0.100</b>	1.0
6	L2PH STMEXP EX=N	Level 2 phenomena: Pit damage given ex-vessel steam explosion	1.0E+00	<b>0.100</b>	1.0
7	L2PH NO CCI	Level 2 phenomena: NO MCCI, no system failures	1.0E+00	<b>0.093</b>	1.0
8	L2PH CCI-DRY	Significant MCCI occurs, debris not flooded. P = 1.0	1.0E+00	<b>0.089</b>	1.0
9	L2PH STMEXP EXV=N	Level 2 Phenomena: Steam explosion avoided in dry pit sequences	1.0E+00	<b>0.039</b>	1.0
10	L2PH PF-VF NO-CBV=N	Level 2 phenomena. Pit overpressure failure (not CBV case)	1.0E+00	<b>0.036</b>	1.0
11	L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	5.0E-01	<b>0.031</b>	1.0
12	L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	5.0E-01	<b>0.031</b>	1.0
13	L2PH CPIHLR-SS,SL=Y	Induced hot leg rupture. Conditional probability, given no SGTR. SS,SL cases.	1.0E+00	<b>0.010</b>	1.0
14	L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	6.3E-04	<b>0.008</b>	13.4
15	L2PH CBV HP	Complete circumferential rupture of vessel (gives vessel rocket in HP sequences)	1.0E-02	<b>0.008</b>	1.8

**Table 19.1-28—U.S. EPR Risk-Significant Phenomena based on FV Importance - Level 2 Internal Events  
Sheet 2 of 2**

<b>Rank</b>	<b>ID</b>	<b>Description</b>	<b>Nominal Value</b>	<b>FV</b>	<b>RAW</b>
16	L2PH PF-VF CBV=N	Pit overpressure at high pressure vessel failure fails melt plug given CBV occurs	1.0E+00	<b>0.008</b>	1.0
17	L2PH ISGTR-SS,SL=N	No ISGTR in SL, SS cases with secondary pressurized	1.0E+00	<b>0.006</b>	1.0

**Table 19.1-29—U.S. EPR Risk-Significant Phenomena based on RAW Importance - Level 2 Internal Events**

<b>Rank</b>	<b>ID</b>	<b>Description</b>	<b>Nominal Value</b>	<b>RAW</b>	<b>FV</b>
1	L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	6.3E-04	13.4	0.008
2	L2PH STM EXP INV LP	Level 2 phenomena: containment failure due to in-vessel steam explosion. Low pressure CET sequences.	5.6E-06	10.3	0.000
3	L2PH VECF-H2DEF(H)L	V early CF due to hydrogen deflagration. High pressure CDES, in-vessel - PRV cycling phase - leak	2.0E-06	3.7	0.000

**Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events**  
**Sheet 1 of 5**

Rank	System	Component ID	Component Description	FV	RAW
1	SCWS	30QKA40GH001	SCWS, Train 4 Chiller Unit QKA40GH001	0.280	10.3
2	ESWS	30PEB20AP001	ESWS, Train 2 Motor Driven Pump PEB20AP001	0.180	6.8
3	ELEC	30XKA10	ELEC, Emergency Diesel Generator XKA10	0.140	3.1
4	ELEC	30XKA30	ELEC, Emergency Diesel Generator XKA30	0.140	3.1
5	ESWS	30PEB30AP001	ESWS, Train 3 Motor Driven Pump PEB30AP001	0.140	4.7
6	ELEC	30XKA20	ELEC, Emergency Diesel Generator XKA20	0.120	2.8
7	ELEC	30XKA40	ELEC, Emergency Diesel Generator XKA40	0.100	2.3
8	HVAC	30SAC04AA003	SAC, Normal Air Inlet Motor Operated Damper SAC04AA003	0.080	104.0
9	CCWS	30KAA32AA101	CCWS, Common Header 2 QKA30 Chiller Return 3-Way MOV KAA32AA101	0.070	51.6
10	HVAC	30SAC04AN001	SAC, Normal Air Supply Fan SAC04AN001	0.060	162.0
11	HVAC	30SAC34AN001	SAC, Normal Air Exhaust Fan SAC34AN001	0.060	162.0
12	ELEC	31BTD01	ELEC, 250V 1E 2-hr Battery 31BTD01	0.060	21.3
13	ELEC	34BTD01	ELEC, 250V 1E 2-hr Battery 34BTD01	0.060	17.8
14	OCWS	30QNA24AN001	OCWS, Chiller Unit QNA24AN001	0.050	1.1
15	ESWS	30PEB10AP001	ESWS, Train 1 Motor Driven Pump PEB10AP001	0.050	312.0
16	SCWS	30QKA10GH001	SCWS, Train 1 Chiller Unit QKA10GH001	0.050	10.0
17	SCWS	30QKA40AA101	SCWS, Train 4 Chiller By-pass MOV QKA40AA101	0.050	9.8
18	SCWS	30QKA20GH001	SCWS, Train 2 Chiller Unit QKA20GH001	0.050	2.9
19	SCWS	30QKA30GH001	SCWS, Train 3 Chiller Unit QKA30GH001	0.050	49.9
20	MSS	30LBA40AA002	MSS, Train 4 Main Steam Isolation Valve LBA40AA002	0.040	53.5
21	HVAC	30SAC05AA003	SAC, Maintenance Division Outside Air Supply Damper SAC05AA003	0.040	1.7
22	CCWS	30KAA10AP001	CCWS, Train 1 Motor Driven Pump KAA10AP001	0.040	295.0
23	ELEC	33BTD01	ELEC, 250V 1E 2-hr Battery 33BTD01	0.040	2.9
24	ELEC	32BTD01	ELEC, 250V 1E 2-hr Battery 32BTD01	0.040	2.4
25	ELEC	30XKA50	ELEC, SBO Diesel Generator XKA50	0.040	1.3

**Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events**  
**Sheet 2 of 5**

Rank	System	Component ID	Component Description	FV	RAW
26	HVAC	30SAC08AA003	SAC, Maintenance Division Outside Air Supply Damper SAC08AA003	0.030	1.4
27	EFWS	30LAS41AP001	EFWS, Train 4 Motor Driven Pump LAS41AP001	0.030	1.6
28	ESWS	30PEB40AP001	ESWS, Train 4 Motor Driven Pump PEB40AP001	0.030	163.0
29	ELEC	31BDA	ELEC, 6.9kV Switchgear 31BDA	0.030	IE
30	ESWS	30PEB20AA005	ESWS, Train 2 Pump Discharge Isolation MOV PEB20AA005	0.030	6.6
31	UHS	30PED20AA010	UHS, Cooling Tower Train 2 Spray MOV PED20AA010	0.030	6.6
32	HVAC	30SAC01AN001	SAC, Normal Air Supply Fan SAC01AN001	0.020	60.1
33	HVAC	30SAC31AN001	SAC, Normal Air Exhaust Fan SAC31AN001	0.020	60.1
34	CCWS	30KAA40AP001	CCWS, Train 4 Motor Driven Pump KAA40AP001	0.020	148.0
35	CCWS	30KAB30AA192	CCWS, RCP Thermal Barrier to CCWS CH2 Return Safety Valve KAB30AA192	0.020	IE
36	CCWS	30KAB20AA192	CCWS, CCWS CH2 Return Safety Valve KAB20AA192	0.020	IE
37	CCWS	30KAB20AA193	CCWS, FPCS Train 2 Cooling Header Safety Valve KAB20AA193	0.020	IE
38	CCWS	30KAB70AA191	CCWS, CVCS HP Cooler 2 Return Safety Valve KAB60AA191	0.020	IE
39	SIS/RHR	30JNA10AA001	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA001	0.020	8.6
40	SIS/RHR	30JNA10AA002	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA002	0.020	IE
41	ELEC	30XKA80	ELEC, SBO Diesel Generator XKA80	0.020	1.2
42	ESWS	30PEB30AA005	ESWS, Train 3 Pump Discharge Isolation MOV PEB30AA005	0.020	4.5
43	UHS	30PED30AA010	UHS, Cooling Tower Train 3 Spray MOV PED30AA010	0.020	4.5
44	SIS/RHR	30JNG40AP001	LHSI, Train 4 Motor Driven Pump JNG40AP001	0.020	1.3
45	MSS	30LBA43AA001	MSS, Train 4 MSRIV LBA43AA001	0.020	5.1
46	SIS/RHR	30JNG10AA006	LHSI, LHSI CL1 Discharge Manual CHECK Valve JNG10AA006	0.020	3.2

**Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events**  
**Sheet 3 of 5**

Rank	System	Component ID	Component Description	FV	RAW
47	ELEC	34BRA	ELEC, 480V MCC 34BRA	0.020	137.0
48	SIS/RHR	30JNG10AP001	LHSI, Train 1 Motor Driven Pump JNG10AP001	0.020	3.2
49	SIS/RHR	30JNG20AA006	LHSI, LHSI CL2 Discharge Manual CHECK Valve JNG20AA006	0.020	3.2
50	SIS/RHR	30JNA10AA003	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA003	0.020	157.0
51	ELEC	34BDA	ELEC, 6.9kV SWGR 34BDA	0.020	IE
52	CCWS	30KAA20AP001	CCWS, Train 2 Motor Driven Pump KAA20AP001	0.020	5.5
53	CCWS	30KAA12AA005	CCWS, Train 1 to LHSI HTX 10 Cooling MOV KAA12AA005	0.020	3.3
54	SIS/RHR	30JNG20AP001	LHSI, Train 2 Motor Driven Pump JNG20AP001	0.010	3.0
55	CCWS	30KAA22AA005	CCWS, Train 2 to LHSI HTX 20 Cooling MOV KAA22AA005	0.010	3.1
56	UHS	30PED10AN002	UHS, Cooling Tower Train 1 Cooling Fan PED10AN002	0.010	3.5
57	SIS/RHR	30JNG10AA004	LHSI, Train 1 Min Flow MOCV JNG10AA004	0.010	3.3
58	SIS/RHR	30JNG10AA001	LHSI, LHSI Pump 10 Suction from IRWST MOV JNG10AA001	0.010	3.3
59	SCWS	30QKC40AA101	SCWS, Return from SAC Div 4 MOV QKC40AA101	0.010	144.0
60	HVAC	30SAC04AA004	SAC, Div 4 Recirculation Motor Operated Damper SAC04AA004	0.010	144.0
61	SIS/RHR	30JNA20AA001	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA001	0.010	3.1
62	SIS/RHR	30JNA20AA002	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA002	0.010	3.1
63	SIS/RHR	30JNA20AA003	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA003	0.010	3.1
64	SIS/RHR	30JND10AP001	MHSI, Train 1 Motor Driven Pump JND10AP001	0.010	1.6
65	UHS	30PED20AN001	UHS, Cooling Tower Train 2 Cooling Fan PED20AN001	0.010	3.1
66	UHS	30PED20AN002	UHS, Cooling Tower Train 2 Cooling Fan PED20AN002	0.010	3.1

**Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events**  
**Sheet 4 of 5**

Rank	System	Component ID	Component Description	FV	RAW
67	SIS/RHR	30JNG20AA004	LHSI, Train 2 Min Flow MOCV JNG20AA004	0.010	3.1
68	SIS/RHR	30JNG20AA001	LHSI, LHSI Pump 20 Suction from IRWST MOV JNG20AA001	0.010	3.1
69	CCWS	30KAA22AA013	CCWS, Train 2 LHSI Pump Seal Cooler MOV KAA22AA013	0.010	3.1
70	HVAC	30SAC01AA003	SAC, Normal Air Inlet Motor Operated Damper SAC01AA003	0.010	24.6
71	CCWS	30KAB30AA191	CCWS, RCP Thermal Barrier to CCWS CH1 Return Safety Valve KAB30AA191	0.010	IE
72	EFWS	30LAS31AP001	EFWS, Train 3 Motor Driven Pump LAS31AP001	0.010	1.2
73	SCWS	30QKA20AA101	SCWS, Train 2 Chiller By-pass MOV QKA20AA101	0.010	2.7
74	SGBD	30LCQ40AA003	SGBD, SG4 Blowdown Line Isolation MOV LCQ40AA003	0.010	2.6
75	CCWS	30KAB10AA192	CCWS, CCWS CH1 Return Safety Valve KAB10AA192	0.010	IE
76	CCWS	30KAB10AA193	CCWS, FPCS Train 1 Cooling Header Safety Valve KAB10AA193	0.010	IE
77	CCWS	30KAB60AA191	CCWS, CVCS HP Cooler 1 Return Safety Valve KAB60AA191	0.010	IE
78	SIS/RHR	30JNA10AA101	RHR, LHSI Train 1 HTX Bypass MOV JNA10AA101	0.010	3.2
79	EFWS	30LAS21AP001	EFWS, Train 2 Motor Driven Pump LAS21AP001	0.010	1.2
80	CCWS	30KAA30AP001	CCWS, Train 3 Motor Driven Pump KAA30AP001	0.010	3.1
81	ELEC	33BDA	ELEC, 6.9kV SWGR 33BDA	0.010	IE
82	SIS/RHR	30JNA20AA101	RHR, LHSI Train 2 HTX Bypass MOV JNA20AA101	0.010	3.0
83	SAHR	30JMQ40AP001	SAHR, Motor Driven Pump JMQ40AP001	0.010	1.1
84	SIS/RHR	30JND10AA007	MHSI, MHSI Pump 10 Discharge Check Valve JND10AA007 (CIV)	0.010	282.0
85	ELEC	33BNB02	ELEC, 480V MCC 33BNB02	0.010	72.2
86	SIS/RHR	30JND40AP001	MHSI, Train 4 Motor Driven Pump JND40AP001	0.010	1.3

**Table 19.1-30—U.S. EPR Risk-Significant Equipment based on FV Importance - Level 2 Internal Events**  
**Sheet 5 of 5**

Rank	System	Component ID	Component Description	FV	RAW
87	EFWS	30LAS11AP001	EFWS, Train 1 Motor Driven Pump LAS11AP001	0.010	1.1
88	SIS/RHR	30JNG10AC001	LHSI, LHSI Train 1 HTX JNG10AC001	0.010	253.0
89	SIS/RHR	30JNG30AP001	LHSI, Train 3 Motor Driven Pump JNG30AP001	0.010	1.2
90	ELEC	31BDC	ELEC, 6.9kV SWGR 31BDC	0.010	232.0
91	ELEC	31BDB	ELEC, 6.9kV SWGR 31BDB	0.010	232.0
92	ELEC	31BMB	ELEC, 480V Load Center 31BMB	0.010	232.0
93	ELEC	31BMT02	ELEC, 6.9kV-480V Transformer 31BMT02	0.010	232.0
94	ELEC	32BDA	ELEC, 6.9kV SWGR 32BDA	0.010	IE



**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 1 of 16**

Rank	System	Component ID	Description	RAW	FV
1	ESWS	30PEB10AP001	ESWS, Train 1 Motor Driven Pump PEB10AP001	312.0	0.050
2	CCWS	30KAA10AP001	CCWS, Train 1 Motor Driven Pump KAA10AP001	295.0	0.040
3	SIS/RHR	30JND10AA007	MHSI, MHSI Pump 10 Discharge Check Valve JND10AA007 (CIV)	282.0	0.010
4	SIS/RHR	30JNG10AC001	LHSI, LHSI Train 1 HTX JNG10AC001	253.0	0.010
5	ELEC	31BDB	ELEC, 6.9kV SWGR 31BDB	232.0	0.010
6	ELEC	31BDC	ELEC, 6.9kV SWGR 31BDC	232.0	0.010
7	ELEC	31BMB	ELEC, 480V Load Center 31BMB	232.0	0.010
8	ELEC	31BMT02	ELEC, 6.9kV-480V Transformer 31BMT02	232.0	0.010
9	CCWS	30KAA10BB001	CCWS, Train 1 Surge Tank KAA10BB001	214.0	0.000
10	ESWS	30PEB10AA005	ESWS, Train 1 Pump Discharge Isolation MOV, PEB10AA005	186.0	0.000
11	UHS	30PED10AA010	UHS, Cooling Tower Train 1 Spray MOV PED10AA010	186.0	0.000
12	UHS	30PED10AA011	UHS, Cooling Tower Train 1 Bypass Line MOV PED10AA011	186.0	0.000
13	CCWS	30KAA10AA112	CCWS, Train 1 Heat Exchanger Bypass MOV KAA10AA112	185.0	0.000
14	CCWS	30KAA10AC001	CCWS, Train 1 HTX 10 KAA10AC001	176.0	0.000
15	ESWS	30PEB40AP001	ESWS, Train 4 Motor Driven Pump PEB40AP001	163.0	0.030
16	HVAC	30SAC04AN001	SAC, Normal Air Supply Fan SAC04AN001	162.0	0.060
17	HVAC	30SAC34AN001	SAC, Normal Air Exhaust Fan SAC34AN001	162.0	0.060
18	SIS/RHR	30JNA10AA003	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA003	157.0	0.020
19	ELEC	1BDB1BMT02	ELEC, 6.9kV SWGR 31BDB to Transformer 31BMT02 Circuit Breaker	154.0	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 2 of 16**

Rank	System	Component ID	Description	RAW	FV
20	ELEC	1BDC_1BDB1	ELEC, 6.9kV SWGR 31BDC to 6.9kV SWGR 31BDB Circuit Breaker	154.0	0.000
21	ELEC	1BDC_1BDB2	ELEC, 6.9kV SWGR 31BDC to 6.9kV SWGR 31BDB Circuit Breaker	154.0	0.000
22	ELEC	1BMT021BMB	ELEC, Transformer 31BMT02 to 480V Load Center 31BMB Circuit Breaker	154.0	0.000
23	ELEC	1BDA_1BDC1	ELEC, 6.9kV SWGR 31BDA to 6.9kV SWGR 31BDC Circuit Breaker	153.0	0.000
24	ELEC	1BDA_1BDC2	ELEC, 6.9kV SWGR 31BDA to 6.9kV SWGR 31BDC Circuit Breaker	153.0	0.000
25	CCWS	30KAA40AP001	CCWS, Train 4 Motor Driven Pump KAA40AP001	148.0	0.020
26	ESWS	30PEB10AA204	ESWS, Train 1 Pump Discharge Check Valve PEB10AA204	146.0	0.000
27	CCWS	30KAA10AA004	CCWS, Train 1 Discharge from CCW HTX 10 Check Valve KAA10AA004	145.0	0.000
28	SCWS	30QKC40AA101	SCWS, Return from SAC Div 4 MOV QKC40AA101	144.0	0.010
29	HVAC	30SAC04AA004	SAC, Div 4 Recirculation Motor Operated Damper SAC04AA004	144.0	0.010
30	ELEC	34BRA	ELEC, 480V MCC 34BRA	137.0	0.020
31	ELEC	34BDC	ELEC, 6.9kV SWGR 34BDC	122.0	0.000
32	SIS/RHR	30JNG40AC001	LHSI, LHSI Train 4 HTX JNG40AC001	119.0	0.000
33	ELEC	31BNB02	ELEC, 480V MCC 31BNB02	110.0	0.000
34	ELEC	31BNT01	ELEC, Constant Voltage Transformer 31BNT01	110.0	0.000
35	ELEC	34BDB	ELEC, 6.9kV SWGR 34BDB	105.0	0.000
36	ELEC	34BMB	ELEC, 480V Load Center 34BMB	105.0	0.000
37	ELEC	34BMT02	ELEC, 6.9kV-480V Transformer 34BMT02	105.0	0.000
38	HVAC	30SAC04AA003	SAC, Normal Air Inlet Motor Operated Damper SAC04AA003	104.0	0.080
39	HVAC	30SAC34AA002	SAC, Normal Air Exhaust Motor Operated Damper SAC34AA002	103.0	0.000
40	SCWS	30QKA30AA102	SCWS, Train 3 Discharge Xtie MOV QKA30AA102	102.0	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 3 of 16**

Rank	System	Component ID	Description	RAW	FV
41	SCWS	30QKA30AA103	SCWS, Train 3 Suction Xtie MOV QKA30AA103	102.0	0.000
42	SCWS	30QKA40AA102	SCWS, Train 4 Discharge Xtie MOV QKA40AA102	102.0	0.000
43	SCWS	30QKA40AA103	SCWS, Train 4 Suction Xtie MOV QKA40AA103	102.0	0.000
44	ESWS	30PEB80AA002	ESWS, SA-ESWS Pump 80 Discharge Manual CHECK Valve PEB80AA002	96.1	0.000
45	CCWS	30KAA40BB001	CCWS, Train 4 Surge Tank KAA40BB001	93.6	0.000
46	HVAC	30SAC04AA005	SAC, Normal Air Inlet Supply Fan Discharge Check Damper SAC04AA005	93.3	0.000
47	HVAC	30SAC34AA003	SAC, Normal Air Exhaust Supply Fan Discharge Check Damper SAC34AA003	93.3	0.000
48	ELEC	4BDA_4BDC1	ELEC, 6.9kV SWGR 34BDA to 6.9kV SWGR 34BDC Circuit Breaker	82.1	0.000
49	ELEC	4BDA_4BDC2	ELEC, 6.9kV SWGR 34BDA to 6.9kV SWGR 34BDC Circuit Breaker	82.1	0.000
50	UHS	30PED40AA010	UHS, Cooling Tower Train 4 Spray MOV PED40AA010	74.5	0.000
51	UHS	30PED40AA011	UHS, Cooling Tower Train 4 Bypass Line MOV PED40AA011	74.5	0.000
52	ESWS	30PEB40AA005	ESWS, Train 4 Pump Discharge MOV, PEB40AA005	74.3	0.000
53	ELEC	33BDB	ELEC, 6.9kV SWGR 33BDB	72.7	0.000
54	ELEC	33BMB	ELEC, 480V Load Center 33BMB	72.7	0.000
55	ELEC	33BMT02	ELEC, 6.9kV-480V Transformer 33BMT02	72.7	0.000
56	CCWS	30KAA40AA112	CCWS, Train 4 Heat Exchanger Bypass MOV KAA40AA112	72.2	0.000
57	ELEC	33BNB02	ELEC, 480V MCC 33BNB02	72.2	0.010
58	ELEC	33BNT01	ELEC, Constant Voltage Transformer 33BNT01	72.2	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 4 of 16**

Rank	System	Component ID	Description	RAW	FV
59	ELEC	1BMB1BNT01	ELEC, 480V Load Center 31BMB to Transformer 31BNT01 Circuit Breaker	71.2	0.000
60	ELEC	1BNT011BNB02	ELEC, Transformer 31BNT01 to 480V MCC 31BNB02 Circuit Breaker	71.2	0.000
61	CCWS	30KAA40AC001	CCWS, Train 4 HTX 40 KAA40AC001	68.6	0.000
62	ELEC	4BDB4BMT02	ELEC, 6.9kV SWGR 34BDB to Transformer 34BMT02 Circuit Breaker	63.8	0.000
63	ELEC	4BDC_4BDB1	ELEC, 6.9kV SWGR 34BDC to 6.9kV SWGR 34BDB Circuit Breaker	63.8	0.000
64	ELEC	4BDC_4BDB2	ELEC, 6.9kV SWGR 34BDC to 6.9kV SWGR 34BDB Circuit Breaker	63.8	0.000
65	ELEC	4BMT024BMB	ELEC, Transformer 34BMT02 to 480V Load Center 34BMB Circuit Breaker	63.8	0.000
66	HVAC	30SAC01AN001	SAC, Normal Air Supply Fan SAC01AN001	60.1	0.020
67	HVAC	30SAC31AN001	SAC, Normal Air Exhaust Fan SAC31AN001	60.1	0.020
68	ELEC	3BDA_3BDB1	ELEC, 6.9kV SWGR 33BDA to 6.9kV SWGR 33BDB Circuit Breaker	54.3	0.000
69	ELEC	3BDA_3BDB2	ELEC, 6.9kV SWGR 33BDA to 6.9kV SWGR 33BDB Circuit Breaker	54.3	0.000
70	ELEC	3BDB3BMT02	ELEC, 6.9kV SWGR 33BDB to Transformer 33BMT02 Circuit Breaker	54.3	0.000
71	ELEC	3BMT023BMB	ELEC, Transformer 33BMT02 to 480V Load Center 33BMB Circuit Breaker	54.3	0.000
72	ELEC	3BMB3BNT01	ELEC, 480V Load Center 33BMB to Transformer 33BNT01 Circuit Breaker	54.0	0.000
73	ELEC	3BNT013BNB02	ELEC, Transformer 33BNT01 to 480V MCC 33BNB02 Circuit Breaker	54.0	0.000
74	MSS	30LBA40AA002	MSS, Train 4 Main Steam Isolation Valve LBA40AA002	53.5	0.040
75	ESWS	30PEB40AA204	ESWS, Train 4 Pump Discharge Check Valve PEB40AA204	52.2	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 5 of 16**

Rank	System	Component ID	Description	RAW	FV
76	CCWS	30KAA32AA101	CCWS, Common Header 2 QKA30 Chiller Return 3-Way MOV KAA32AA101	51.6	0.070
77	CCWS	30KAA40AA004	CCWS, Train 4 Discharge from CCW HTX 40 Check Valve KAA40AA004	51.0	0.000
78	SCWS	30QKA30GH001	SCWS, Train 3 Chiller Unit QKA30GH001	49.9	0.050
79	SCWS	30QKC10AA101	SCWS, Return from SAC Div 1 MOV QKC10AA101	47.5	0.000
80	HVAC	30SAC01AA004	SAC, Div 1 Recirculation Motor Operated Damper SAC01AA004	47.5	0.000
81	SCWS	30QKA10AA102	SCWS, Train 1 Discharge Xtie MOV QKA10AA102	46.7	0.000
82	SCWS	30QKA10AA103	SCWS, Train 1 Suction Xtie MOV QKA10AA103	46.7	0.000
83	SCWS	30QKA20AA102	SCWS, Train 2 Discharge Xtie MOV QKA20AA102	46.7	0.000
84	SCWS	30QKA20AA103	SCWS, Train 2 Suction Xtie MOV QKA20AA103	46.7	0.000
85	SCWS	30QKA30AA101	SCWS, Train 3 Chiller By-pass MOV QKA30AA101	44.1	0.000
86	ELEC	31BDD	ELEC, 6.9kV SWGR 31BDD	41.6	0.000
87	ELEC	31BMD	ELEC, 480V Load Center 31BMD	41.6	0.000
88	ELEC	31BMT04	ELEC, 6.9kV-480V Transformer 31BMT04	41.6	0.000
89	ELEC	34BRW72BUW73	ELEC, 24V DC I&C Power Rack 34BRW72/34BUW73	36.4	0.000
90	ELEC	33BMT03	ELEC, 6.9kV-480V Transformer 33BMT03	36.0	0.000
91	ELEC	33BNA02	ELEC, 480V MCC 33BNA02	36.0	0.000
92	ELEC	33BDA3BMT03	ELEC, 6.9kV SWGR 33BDA to Transformer 33BMT03 Circuit Breaker	31.0	0.000
93	ELEC	33BMT033BNA02	ELEC, Transformer 33BMT03 to 480V MCC 33BNA02 Circuit Breaker	31.0	0.000
94	ESWS	30PEB10AA002	ESWS, Train 1 Pump Recirc MOV PEB10AA002	27.6	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 6 of 16**

Rank	System	Component ID	Description	RAW	FV
95	ELEC	34BNB02	ELEC, 480V MCC 34BNB02	25.9	0.000
96	ELEC	34BNT01	ELEC, Constant Voltage Transformer 34BNT01	25.9	0.000
97	ELEC	1BDA_1BDD1	ELEC, 6.9kV SWGR 31BDA to 6.9kV SWGR 31BDD Circuit Breaker	24.9	0.000
98	ELEC	1BDA_1BDD2	ELEC, 6.9kV SWGR 31BDA to 6.9kV SWGR 31BDD Circuit Breaker	24.9	0.000
99	ELEC	1BDD1BMT04	ELEC, 6.9kV SWGR 31BDD to Transformer 31BMT04 Circuit Breaker	24.9	0.000
100	ELEC	1BMT041BMD	ELEC, Transformer 31BMT04 to 480V Load Center 31BMD Circuit Breaker	24.9	0.000
101	HVAC	30SAC01AA003	SAC, Normal Air Inlet Motor Operated Damper SAC01AA003	24.6	0.010
102	HVAC	30SAC31AA002	SAC, Normal Air Exhaust Motor Operated Damper SAC31AA002	24.6	0.000
103	ELEC	34BNB01	ELEC, 480V MCC 34BNB01	22.9	0.000
104	ELEC	31BTD01	ELEC, 250V 1E 2-hr Battery 31BTD01	21.3	0.060
105	ELEC	32BRA	ELEC, 480V MCC 32BRA	19.9	0.000
106	HVAC	30SAC01AA005	SAC, Normal Air Inlet Supply Fan Discharge Check Damper SAC01AA005	19.8	0.000
107	HVAC	30SAC31AA003	SAC, Normal Air Exhaust Supply Fan Discharge Check Damper SAC31AA003	19.8	0.000
108	ELEC	34BTD01	ELEC, 250V 1E 2-hr Battery 34BTD01	17.8	0.060
109	ELEC	4BMB4BNT01	ELEC, 480V Load Center 34BMB to Transformer 34BNT01 Circuit Breaker	13.6	0.000
110	ELEC	4BNT014BNB02	ELEC, Transformer 34BNT01 to 480V MCC 34BNB02 Circuit Breaker	13.6	0.000
111	ELEC	31BUC	ELEC, 1E 250V DC Switchboard 31BUC	13.2	0.000
112	ELEC	32BDB	ELEC, 6.9kV SWGR 32BDB	13.2	0.000
113	ELEC	32BMB	ELEC, 480V Load Center 32BMB	13.2	0.000
114	ELEC	32BMT02	ELEC, 6.9kV-480V Transformer 32BMT02	13.2	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
115	MSS	30LBA41AA191	MSS, Train 4 Main Steam Safety Relief Valve LBA41AA191	11.9	0.000
116	MSS	30LBA42AA191	MSS, Train 4 Main Steam Safety Relief Valve LBA42AA191	11.9	0.000
117	ELEC	31BRA	ELEC, 480V MCC 31BRA	11.9	0.000
118	ELEC	34BUC	ELEC, 1E 250V DC Switchboard 34BUC	11.8	0.000
119	ELEC	32BNB02	ELEC, 480V MCC 32BNB02	10.7	0.000
120	ELEC	4BMB4BNB01	ELEC, 480V Load Center 34BMB to 480V MCC 34BNB01 Circuit Breaker	10.6	0.000
121	SCWS	30QKA40GH001	SCWS, Train 4 Chiller Unit QKA40GH001	10.3	0.280
122	SCWS	30QKA10GH001	SCWS, Train 1 Chiller Unit QKA10GH001	10.0	0.050
123	ELEC	4BRU014BRA	ELEC, Inverter 34BRU01 to 480V MCC 34BRA Circuit Breaker	10.0	0.000
124	ELEC	2BDB2BMT02	ELEC, 6.9kV SWGR 32BDB to Transformer 32BMT02 Circuit Breaker	9.9	0.000
125	ELEC	2BMT022BMB	ELEC, Transformer 32BMT02 to 480V Load Center 32BMB Circuit Breaker	9.9	0.000
126	ELEC	2BDA_2BDB1	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDB Circuit Breaker	9.9	0.000
127	ELEC	2BDA_2BDB2	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDB Circuit Breaker	9.9	0.000
128	SCWS	30QKA40AA101	SCWS, Train 4 Chiller By-pass MOV QKA40AA101	9.8	0.050
129	ELEC	34BDD	ELEC, 6.9kV SWGR 34BDD	9.6	0.000
130	ELEC	34BMD	ELEC, 480V Load Center 34BMD	9.6	0.000
131	ELEC	34BMT04	ELEC, 6.9kV-480V Transformer 34BMT04	9.6	0.000
132	SIS/RHR	30JNA10AA001	RHR, LHSI Pump 10 Hot Leg Suction from RCS MOV JNA10AA001	8.6	0.020
133	HVAC	30SAC02AN001	SAC, Normal Air Supply Fan SAC02AN001	8.5	0.000
134	HVAC	30SAC32AN001	SAC, Normal Air Exhaust Fan SAC32AN001	8.5	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 8 of 16**

Rank	System	Component ID	Description	RAW	FV
135	SCWS	30QKC20AA101	SCWS, Return from SAC Div 2 MOV QKC20AA101	7.9	0.000
136	HVAC	30SAC02AA004	SAC, Div 2 Recirculation Motor Operated Damper SAC02AA004	7.9	0.000
137	ELEC	2BMB2BNT01	ELEC, 480 Load Center 32BMB to Transformer 32BNT01 Circuit Breaker	7.8	0.000
138	ELEC	2BNT012BNB02	ELEC, Transformer 32BNT01 to 480V MCC 32BNB02 Circuit Breaker	7.8	0.000
139	ELEC	31BNB01	ELEC, 480V MCC 31BNB01	7.6	0.000
140	ELEC	32BNB01	ELEC, 480V MCC 32BNB01	7.2	0.000
141	ELEC	33BRA	ELEC, 480V MCC 33BRA	6.9	0.000
142	ELEC	32BNT01	ELEC, Constant Voltage Transformer 32BNT01	6.9	0.000
143	ESWS	30PEB20AP001	ESWS, Train 2 Motor Driven Pump PEB20AP001	6.8	0.180
144	HVAC	30SAC02AA003	SAC, Normal Air Inlet Motor Operated Damper SAC02AA003	6.7	0.000
145	HVAC	30SAC32AA002	SAC, Normal Air Exhaust Motor Operated Damper SAC32AA002	6.7	0.000
146	ESWS	30PEB20AA005	ESWS, Train 2 Pump Discharge Isolation MOV PEB20AA005	6.6	0.030
147	UHS	30PED20AA010	UHS, Cooling Tower Train 2 Spray MOV PED20AA010	6.6	0.030
148	ELEC	2BMB2BNB01	ELEC, 480V Load Center 32BMB to 480V MCC 32BNB01 Circuit Breaker	6.5	0.000
149	HVAC	30SAC02AA005	SAC, Normal Air Inlet Supply Fan Discharge Check Damper SAC02AA005	6.5	0.000
150	HVAC	30SAC32AA003	SAC, Normal Air Exhaust Supply Fan Discharge Check Damper SAC32AA003	6.5	0.000
151	ELEC	2BRU012BRA	ELEC, Inverter 32BRU01 to 480V MCC 32BRA Circuit Breaker	6.2	0.000
152	CCWS	30KAA20AP001	CCWS, Train 2 Motor Driven Pump KAA20AP001	5.5	0.020
153	MSS	30LBA43AA001	MSS, Train 4 MSRIV LBA43AA001	5.1	0.020



**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
154	SCWS	30QKA30AP107	SCWS, Train 3 Motor Driven Safety Chiller Pump QKA30AP107	5.0	0.000
155	SCWS	30QKA30AP108	SCWS, Train 3 Motor Driven Safety Chiller Pump QKA30AP108	5.0	0.000
156	ELEC	32BNT04	ELEC, Voltage Regulating Transformer 32BNT04	4.8	0.000
157	ESWS	30PEB30AP001	ESWS, Train 3 Motor Driven Pump PEB30AP001	4.7	0.140
158	UHS	30PED10AN001	UHS, Cooling Tower Train 1 Cooling Fan PED10AN001	4.6	0.000
159	ESWS	30PEB30AA005	ESWS, Train 3 Pump Discharge Isolation MOV PEB30AA005	4.5	0.020
160	UHS	30PED30AA010	UHS, Cooling Tower Train 3 Spray MOV PED30AA010	4.5	0.020
161	SCWS	30QKA10AA101	SCWS, Train 1 Chiller By-pass MOV QKA10AA101	4.3	0.000
162	CCWS	30KAA40AA006	CCWS, Train 4 Discharge from Common Header 2 Hydraulic Valve KAA40AA006	3.8	0.000
163	CCWS	30KAA40AA010	CCWS, Train 4 Return from Common Header 2 Hydraulic Valve KAA40AA010	3.8	0.000
164	UHS	30PED10AN002	UHS, Cooling Tower Train 1 Cooling Fan PED10AN002	3.5	0.010
165	ELEC	31BTB01	ELEC, 250V Non 1E 12-hr Battery 31BTB01	3.5	0.000
166	ELEC	34BNC01	ELEC, 480V MCC 34BNC01	3.5	0.000
167	CCWS	30KAA10AA006	CCWS, Train 1 Discharge to Common Header 1 Hydraulic Valve KAA10AA006	3.4	0.000
168	CCWS	30KAA10AA010	CCWS, Train 1 Return from Common Header 1 Hydraulic Valve KAA10AA010	3.4	0.000
169	CCWS	30KAA12AA005	CCWS, Train 1 to LHSI HTX 10 Cooling MOV KAA12AA005	3.3	0.020
170	SIS/RHR	30JNG10AA001	LHSI, LHSI Pump 10 Suction from IRWST MOV JNG10AA001	3.3	0.010

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
171	SIS/RHR	30JNG10AA004	LHSI, Train 1 Min Flow MOCV JNG10AA004	3.3	0.010
172	ELEC	32BTB01	ELEC, 250V Non 1E 12-hr Battery 32BTB01	3.3	0.000
173	ESWS	30PEB40AA002	ESWS, Train 4 Pump Recirc MOV PEB40AA002	3.2	0.000
174	SIS/RHR	30JNA10AA101	RHR, LHSI Train 1 HTX Bypass MOV JNA10AA101	3.2	0.010
175	SIS/RHR	30JNG10AP001	LHSI, Train 1 Motor Driven Pump JNG10AP001	3.2	0.020
176	SIS/RHR	30JNG10AA006	LHSI, LHSI CL1 Discharge Manual CHECK Valve JNG10AA006	3.2	0.020
177	SIS/RHR	30JNG20AA006	LHSI, LHSI CL2 Discharge Manual CHECK Valve JNG20AA006	3.2	0.020
178	CCWS	30KAA30AP001	CCWS, Train 3 Motor Driven Pump KAA30AP001	3.1	0.010
179	UHS	30PED20AN001	UHS, Cooling Tower Train 2 Cooling Fan PED20AN001	3.1	0.010
180	UHS	30PED20AN002	UHS, Cooling Tower Train 2 Cooling Fan PED20AN002	3.1	0.010
181	ELEC	30XKA30	ELEC, Emergency Diesel Generator XKA30	3.1	0.140
182	ELEC	33BRW50BUW51	ELEC, 24V DC I&C Power Rack 33BRW50/33BUW51	3.1	0.000
183	SIS/RHR	30JNG10AA102	LHSI, LHSI Pump 10 Control MOV JNG10AA102	3.1	0.000
184	ELEC	30XKA10	ELEC, Emergency Diesel Generator XKA10	3.1	0.140
185	CCWS	30KAA22AA005	CCWS, Train 2 to LHSI HTX 20 Cooling MOV KAA22AA005	3.1	0.010
186	CCWS	30KAA22AA013	CCWS, Train 2 LHSI Pump Seal Cooler MOV KAA22AA013	3.1	0.010
187	SIS/RHR	30JNA20AA001	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA001	3.1	0.010
188	SIS/RHR	30JNA20AA002	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA002	3.1	0.010

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
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Rank	System	Component ID	Description	RAW	FV
189	SIS/RHR	30JNA20AA003	RHR, LHSI Pump 20 Hot Leg Suction from RCS MOV JNA20AA003	3.1	0.010
190	SIS/RHR	30JNG20AA001	LHSI, LHSI Pump 20 Suction from IRWST MOV JNG20AA001	3.1	0.010
191	SIS/RHR	30JNG20AA004	LHSI, Train 2 Min Flow MOCV JNG20AA004	3.1	0.010
192	SIS/RHR	30JNA20AA101	RHR, LHSI Train 2 HTX Bypass MOV JNA20AA101	3.0	0.010
193	SIS/RHR	30JNG20AP001	LHSI, Train 2 Motor Driven Pump JNG20AP001	3.0	0.010
194	ELEC	4BDA_4BDD1	ELEC, 6.9kV SWGR 34BDA to 6.9kV SWGR 34BDD Circuit Breaker	2.9	0.000
195	ELEC	4BDA_4BDD2	ELEC, 6.9kV SWGR 34BDA to 6.9kV SWGR 34BDD Circuit Breaker	2.9	0.000
196	ELEC	4BDD4BMT04	ELEC, 6.9kV SWGR 34BDD to Transformer 34BMT04 Circuit Breaker	2.9	0.000
197	ELEC	4BMT044BMD	ELEC, Transformer 34BMT04 to 480V Load Center 34BMD Circuit Breaker	2.9	0.000
198	SIS/RHR	30JNG13AA005	LHSI, MHSI/LHSI Train 1 First SIS Isolation Check Valve JNG13AA005	2.9	0.000
199	ELEC	1BMB1BNB01	ELEC, 480V Load Center 31BMB to 480V MCC 31BNB01 Circuit Breaker	2.9	0.000
200	CCWS	30KAA20AA005	CCWS, Discharge from CCW HTX 20 Manual Valve KAA20AA005	2.9	0.000
201	CCWS	30KAA20AA007	CCWS, Pump 20 Cooling Manual Valve KAA20AA007	2.9	0.000
202	CCWS	30KAA20AA008	CCWS, Pump 20 Cooling Manual Valve KAA20AA008	2.9	0.000
203	CCWS	30KAA20AA011	CCWS, Pump 20 Suction from CCST Manual Valve KAA20AA011	2.9	0.000
204	CCWS	30KAA20AA015	CCWS, Pump 20 Suction Manual Valve KAA20AA015	2.9	0.000
205	CCWS	30KAA20AA018	CCWS, Pump 20 Discharge Manual Valve KAA20AA018	2.9	0.000
206	CCWS	30KAA20AA140	CCWS, Pump 20 Cooling Manual Valve KAA20AA140	2.9	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
207	ESWS	30PEB20AA007	ESWS, Train 2 Manual Valve PEB20AA007	2.9	0.000
208	ESWS	30PEB20AA009	ESWS, Train 2 Manual Valve PEB20AA009	2.9	0.000
209	ESWS	30PEB20AA027	ESWS, Train 2 Manual Valve PEB20AA027	2.9	0.000
210	ESWS	30PEB20AA029	ESWS, Train 2 Manual Valve PEB20AA029	2.9	0.000
211	SIS/RHR	30JNG20AA102	LHSI, LHSI Pump 20 Control MOV JNG20AA102	2.9	0.000
212	ELEC	33BTD01	ELEC, 250V 1E 2-hr Battery 33BTD01	2.9	0.040
213	SCWS	30QKA20GH001	SCWS, Train 2 Chiller Unit QKA20GH001	2.9	0.050
214	ELEC	1BRU011BRA	ELEC, Inverter 31BRU01 to 480V MCC 31BRA Circuit Breaker	2.8	0.000
215	SIS/RHR	30JNG23AA005	LHSI, MHSI/LHSI Train 2 First SIS Isolation Check Valve JNG23AA005	2.8	0.000
216	ELEC	30XKA20	ELEC, Emergency Diesel Generator XKA20	2.8	0.120
217	SCWS	30QKA20AA101	SCWS, Train 2 Chiller By-pass MOV QKA20AA101	2.7	0.010
218	SGBD	30LCQ40AA003	SGBD, SG4 Blowdown Line Isolation MOV LCQ40AA003	2.6	0.010
219	ELEC	32BUC	ELEC, 1E 250V DC Switchboard 32BUC	2.6	0.000
220	MSS	30LBA43AA726	MSS, Train 4b MSRIV Solenoid Pilot Valve LBA43AA726	2.5	0.000
221	CCWS	30KAA12AA011	CCWS, Train 1 from LHSI HTX 10 Cooling Manual Valve KAA12AA011	2.5	0.000
222	SCWS	30QKC10AA026	SCWS, LHSI Pump 10 Motor Cooling Manual Valve QKC10AA026	2.5	0.000
223	SCWS	30QKC10AA027	SCWS, LHSI Pump 10 Sealing Fluid Cooling Manual Valve QKC10AA027	2.5	0.000
224	CCWS	30KAA22AA007	CCWS, LHSI Pump 20 Cooling Manual Valve KAA22AA007	2.4	0.000
225	CCWS	30KAA22AA010	CCWS, LHSI Pump 20 Cooling Manual Valve KAA22AA010	2.4	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
226	CCWS	30KAA22AA011	CCWS, Train 2 from LHSI HTX 20 Cooling Manual Valve KAA22AA011	2.4	0.000
227	CCWS	30KAA22AA116	CCWS, LHSI Pump 20 Motor Cooling Manual Valve KAA22AA116	2.4	0.000
228	CCWS	30KAA22AA127	CCWS, LHSI Pump 20 Sealing Fluid Cooling Manual Valve KAA22AA127	2.4	0.000
229	ELEC	31BRW12BUW13	ELEC, 24V DC I&C Power Rack 31BRW12/31BUW13	2.4	0.000
230	ELEC	31BNB03	ELEC, 480V MCC 31BNB03	2.4	0.000
231	HVAC	30SAC03AN001	SAC, Normal Air Supply Fan SAC03AN001	2.4	0.000
232	HVAC	30SAC33AN001	SAC, Normal Air Exhaust Fan SAC33AN001	2.4	0.000
233	ELEC	32BTD01	ELEC, 250V 1E 2-hr Battery 32BTD01	2.4	0.040
234	ELEC	32BNB03	ELEC, 480V MCC 32BNB03	2.3	0.000
235	ELEC	31BRW10BUW11	ELEC, 24V DC I&C Power Rack 31BRW10/31BUW11	2.3	0.000
236	ELEC	30XKA40	ELEC, Emergency Diesel Generator XKA40	2.3	0.100
237	CCWS	30KAA22AA101	CCWS, Common Header 1 QKA20 Chiller Return 3-Way MOV KAA22AA101	2.3	0.000
238	ELEC	32BRW32BUW33	ELEC, 24V DC I&C Power Rack 32BRW32/32BUW33	2.3	0.000
239	ELEC	32BUD	ELEC, Non 1E 250V DC Switchboard 32BUD	2.3	0.000
240	SIS/RHR	30JNA10AA191	RHR, LHSI Train 1 Safety Valve JNA10AA191	2.3	0.000
241	SIS/RHR	30JNA20AA191	RHR, LHSI Train 2 Safety Valve JNA20AA191	2.3	0.000
242	MSS	30LBA43AA716	MSS, Train 4b MSRIV Piston Pilot Valve LBA43AA716	2.3	0.000
243	ESWS	30PEB20AA204	ESWS, Train 2 Pump Discharge Check Valve, PEB20AA204	2.3	0.000
244	ELEC	31BUD	ELEC, Non 1E 250V DC Switchboard 31BUD	2.2	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
245	CCWS	30KAA20AA004	CCWS, Train 2 Discharge from CCW HTX 20 Check Valve KAA20AA004	2.2	0.000
246	SIS/RHR	30JNG10AA009	LHSI, LHSI Pump 10 Discharge Check Valve JNG10AA009 (CIV)	2.2	0.000
247	SIS/RHR	30JNG10AA011	LHSI, LHSI Pump 10 Discharge Check Valve JNG10AA011	2.2	0.000
248	SIS/RHR	30JNG20AA009	LHSI, LHSI Pump 20 Discharge Check Valve JNG20AA009 (CIV)	2.2	0.000
249	SIS/RHR	30JNG20AA011	LHSI, LHSI Pump 20 Discharge Check Valve JNG20AA011	2.2	0.000
250	CCWS	30KAA12AA012	CCWS, Train 1 from LHSI HTX 10 Discharge Check Valve KAA12AA012	2.2	0.000
251	CCWS	30KAA22AA012	CCWS, Train 2 Discharge of LHSI HTX Check Valve KAA22AA012	2.2	0.000
252	CCWS	30KAA22AA014	CCWS, Train 2 Discharge of LHSI Pump Seal Cooler Check Valve KAA22AA014	2.2	0.000
253	SCWS	30QKC10AA028	SCWS, Train 1 Discharge of LHSI Pump Seal Cooler Check Valve QKC10AA028	2.2	0.000
254	ELEC	30XKA30_3BDA	ELEC, EDG XKA30 to 6.9kV SWGR 33BDA Circuit Breaker	2.2	0.000
255	ELEC	BDT01_3BDA	ELEC, Aux Transformer 30BDT01 to 6.9kV SWGR 33BDA Circuit Breaker	2.2	0.000
256	ELEC	BDT02_3BDA	ELEC, Aux Transformer 30BDT02 to 6.9kV SWGR 33BDA Circuit Breaker	2.2	0.000
257	ELEC	32BRW30BUW31	ELEC, 24V DC I&C Power Rack 32BRW30/32BUW31	2.1	0.000
258	SIS/RHR	30JND10AA003	MHSI, MHSI Pump 10 Discharge Manual CHECK Valve JND10AA003	2.1	0.000
259	SIS/RHR	30JND20AA003	MHSI, MHSI Pump 20 Discharge Manual CHECK Valve JND20AA003	2.1	0.000
260	SIS/RHR	30JNG10AA003	LHSI, LHSI Train 1 to Radial Miniflow Motor Operated Check Valve JNG10AA003	2.1	0.000
261	SIS/RHR	30JNG10AA060	LHSI, LHSI Pump 10 Discharge MOV JNG10AA060	2.1	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
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Rank	System	Component ID	Description	RAW	FV
262	SIS/RHR	30JNG10AA106	LHSI, LHSI Pump 10 Control MOV JNG10AA106	2.1	0.000
263	SIS/RHR	30JNG12AA001	LHSI, LHSI Train 1 Hot Leg Injection MOV JNG12AA001	2.1	0.000
264	SIS/RHR	30JNG20AA003	LHSI, LHSI Train 2 to Radial Miniflow Motor Operated Check Valve JNG20AA003	2.1	0.000
265	SIS/RHR	30JNG20AA060	LHSI, LHSI Pump 20 Discharge MOV JNG20AA060	2.1	0.000
266	SIS/RHR	30JNG20AA106	LHSI, LHSI Pump 20 Control MOV JNG20AA106	2.1	0.000
267	SIS/RHR	30JNG20AC001	LHSI, LHSI Train 2 HTX JNG20AC001	2.1	0.000
268	SIS/RHR	30JNG22AA001	LHSI, LHSI Train 2 Hot Leg Injection MOV JNG22AA001	2.1	0.000
269	CCWS	30KAA20AA112	CCWS, Train 2 Heat Exchanger Bypass MOV KAA20AA112	2.1	0.000
270	CCWS	30KAA20BB001	CCWS, Train 2 Surge Tank KAA20BB001	2.1	0.000
271	ESWS	30PEB20AA002	ESWS, Train 2 Pump Recirc MOV PEB20AA002	2.1	0.000
272	UHS	30PED20AA011	UHS, Cooling Tower Train 2 Bypass Line MOV PED20AA011	2.1	0.000
273	SCWS	30QKC10AA025	SCWS, Train 1 LHSI Pump Seal Cooler MOV QKC10AA025	2.1	0.000
274	ELEC	32BDD	ELEC, 6.9kV SWGR 32BDD	2.1	0.000
275	ELEC	32BMD	ELEC, 480V Load Center 32BMD	2.1	0.000
276	ELEC	32BMT04	ELEC, 6.9kV-480V Transformer 32BMT04	2.1	0.000
277	UHS	30PED40AN001	UHS, Cooling Tower Train 4 Cooling Fan PED40AN001	2.1	0.000
278	ELEC	31BMC	ELEC, 480V Load Center 31BMC	2.1	0.000
279	ELEC	31BMT03	ELEC, 6.9kV-480V Transformer 31BMT03	2.1	0.000
280	ELEC	31BNC01	ELEC, 480V MCC 31BNC01	2.1	0.000
281	ELEC	30XKA10_1BDA	ELEC, EDG XKA10 to 6.9kV SWGR 31BDA Circuit Breaker	2.1	0.000

**Table 19.1-31—U.S. EPR Risk-Significant Equipment based on RAW  
Importance - Level 2 Internal Events  
Sheet 16 of 16**

<b>Rank</b>	<b>System</b>	<b>Component ID</b>	<b>Description</b>	<b>RAW</b>	<b>FV</b>
282	ELEC	BDT01_1BDA	ELEC, Aux Transformer 30BDT01 to 6.9kV SWGR 31BDA Circuit Breaker	2.1	0.000
283	ELEC	BDT02_1BDA	ELEC, Aux Transformer 30BDT02 to 6.9kV SWGR 31BDA Circuit Breaker	2.1	0.000
284	ELEC	1BNB021BNB031	ELEC, 480V MCC 31BNB02 to 480V MCC 31BNB03 Circuit Breaker	2.0	0.000
285	ELEC	1BNB021BNB032	ELEC, 480V MCC 31BNB02 to 480V MCC 31BNB03 Circuit Breaker	2.0	0.000



**Table 19.1-32—U.S. EPR Risk-Significant Human Actions based on FV Importance - Level 2 Internal Events**

Rank	ID	Description	Nominal Value	FV	RAW
1	OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	1.2E-02	<b>0.789</b>	66.5
2	OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	1.6E-01	<b>0.240</b>	2.3
3	OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs During Non-SBO Conditions	1.0E-01	<b>0.061</b>	1.6
4	OPF-L2-SCRUB-SGTR	Operators fail to start EFW to faulted SG to scrub source term	3.5E-02	<b>0.032</b>	1.9
5	OPE-RHR-3H	Operator Fails to Initiate RHR Within 3 Hours	2.2E-03	<b>0.014</b>	7.4
6	OPF-XTIE-LHSI	Operator Fails to Xtie LHSI Trains During PM	5.5E-02	<b>0.012</b>	1.2
7	OPF-QKA-FTI	Operator Fails to Isolate QKA Xtie When Required	1.0E-01	<b>0.010</b>	1.1
8	OPD-L2-SCRUBSGTR-LOW	Operator fails to fill SG to scrub unisolated SGTR - low dependency	8.3E-02	<b>0.009</b>	1.1

**Table 19.1-33—U.S. EPR Risk-Significant Human Actions based on RAW Importance - Level 2 Internal Events**

Rank	ID	Description	Nominal Value	RAW	FV
1	OPF-SAC-2H	Operator Fails to Recover Room Cooling Locally	1.2E-02	66.5	0.789
2	OPE-RHR-L12H	Operator Fails to Initiate RHR (Longer than 12 Hours)	5.5E-05	57.4	0.003
3	OPF-ISLSI 24H	Operator Fails to Isolate ISLOCA (High Temperature and Pressure Signal) Within 24 Hours	1.0E-05	53.3	0.001
4	OPF-EFW-6H	Operator Fails to Manually Align EFW Tanks Within 6 Hrs	2.0E-05	15.8	0.000
5	OPF-SAC-1H	Operator Fails to Start Maintenance HVAC Trains After Failure of Normal SAC Safety Train	1.1E-04	15.7	0.002
6	OPF-SGTR-1H	Operator Fails to Isolate SGTR and Initiate Cooldown	1.1E-04	15.0	0.001
7	OPE-RHR-3H	Operator Fails to Initiate RHR Within 3 Hours	2.2E-03	7.4	0.014
8	OPF-ISLTBCC 4H	Operator Fails to Isolate ISLOCA (RCP Thermal Barrier Cooling Coil Break) Within 4 Hours	2.0E-04	6.6	0.001
9	OPF-ISLCV2 4H	Operator Fails to isolate ISLOCA (CVCS Letdown line) Within 4 Hours	2.0E-04	5.7	0.001
10	OPE-FB-90M	Operator Fails to Initiate Feed & Bleed for Transient	3.8E-04	4.8	0.001
11	OPF-XTLDSBO-2H	Operator Fails to Connect and Load SBO DGs	6.0E-04	3.1	0.001
12	OPF-ISLCV1 12H	Operator Fails to Isolate ISLOCA (Tube Rupture in HP Cooler) Within 12 Hours	5.5E-05	2.9	0.000
13	OPF-SAC-8H	Operator Fails to Maintain Cooling to SB1(4) using Maintenance Train After Failure of SAC1/2 (3/4)	4.1E-04	2.6	0.001
14	OPF-CCWS TR SO	Operator Fails to Switch CH Supply to Standby CCW Train Before A Loss of the Running Train	1.6E-01	2.3	0.240

**Table 19.1-34—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 2 Internal Events**  
**Sheet 1 of 3**

Rank	System	ID	Description	Nominal Value	RAW
1	ELEC	BTD01_BAT__ST_D-ALL	CCF of Safety Related Batteries on Demand	1.6E-07	194,000.0
2	ESWS	PEB10AP001EFR_B-ALL	CCF of ESWS Pumps 1 and 4 to Run (Normally Running)	1.9E-06	5,960.0
3	CCWS	KAA10AP001EFR_B-ALL	CCF of CCWS Pumps 1 and 4 to Run (Normally Running)	9.6E-07	5,350.0
4	HVAC	SAC01AN001EFR_B-ALL	CCF to Run Normal Air Supply Fans (Trains 1 & 4)	5.1E-06	4,250.0
5	HVAC	SAC31AN001EFR_B-ALL	CCF to Run Normal Air Exhaust Fans (Trains 1 & 4)	5.1E-06	4,250.0
6	HVAC	SAC01AA005CFO_D-ALL	CCF to Open Normal SAC Supply Fan Discharge Check Dampers	4.5E-07	2,540.0
7	HVAC	SAC31AA003CFO_D-ALL	CCF to Open Normal Air Exhaust Fan Discharge Check Damper	4.5E-07	2,540.0
8	HVAC	SAC01AN001EFS_B-ALL	CCF to Start Normal Air Supply Fans (Trains 1 & 4)	1.4E-05	513.0
9	HVAC	SAC31AN001EFS_B-ALL	CCF to Start Normal Air Exhaust Fans (Trains 1 & 4)	1.4E-05	513.0
10	SCWS	QKA10GH001_FR_B-ALL	CCF of the Running SCWS Chiller Units to Run	2.2E-05	271.0
11	UHS	PED10AN002EFS_F-ALL	CCF to Start Standby Cooling Tower Fans (At Power)	3.3E-05	167.0
12	ELEC	XKA10____DFR_D-ALL	CCF of EDGs to Run	1.0E-04	147.0
13	UHS	PED10AN001EFR_B-ALL	CCF to Run Normally Running Cooling Tower Fans (At Power)	1.0E-05	132.0
14	ELEC	XKA10____DFS_D-ALL	CCF of EDGs to Start	6.7E-06	119.0
15	IRWST	JNK10AT001SPG_P-ALL	CCF of IRWST Sump Strainers - Plugged	5.7E-06	117.0
16	SIS/RHR	JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	4.1E-06	116.0

**Table 19.1-34—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 2 Internal Events**  
**Sheet 2 of 3**

Rank	System	ID	Description	Nominal Value	RAW
17	EFWS	LAS11AP001EFS_D-ALL	CCF of EFWS Pumps to Start	1.0E-05	103.0
18	EFWS	LAS11AP001EFR_D-ALL	CCF of EFWS Pumps to Run	7.7E-06	102.0
19	UHS	PED10AN002EFR_F-ALL	CCF to Run Standby Cooling Tower Fans (At Power)	1.9E-06	99.6
20	ELEC	BDT01_BDA_BFO_D-ALL	CCF to Open Normal Supply 6.9kV Circuit Breakers from Aux. Xfrm to Safety Related SWGRs	1.4E-06	90.9
21	ELEC	BDT02_BDA_BFO_D-ALL	CCF to Open Backup Supply 6.9kV Circuit Breakers from Aux. Xfrm to Safety Related SWGRs	1.4E-06	90.9
22	ESWS	PEB10AA204CFO_D-ALL	CCF to Open ESWS Pump Discharge Check Valves	4.5E-07	73.9
23	CCWS	KAA12AA005EFO_D-ALL	CCF to Open CCWS to LHSI HTX Cooling MOV	2.2E-05	51.1
24	SCWS	QKA10AP107EFR_D-ALL	CCF of SCWS Running Pumps to Run	5.2E-07	47.2
25	SIS/RHR	JNA10AA001EFO_D-ALL	CCF to Open LHSI Pump Suction from RCS MOVs	1.1E-05	40.8
26	SIS/RHR	JNA10AA002EFO_D-ALL	CCF to Open LHSI Pump Suction from RCS Angled MOVs	1.1E-05	40.8
27	SIS/RHR	JNA10AA003EFO_D-ALL	CCF to Open LHSI Pump Suction from RCS MOVs	1.1E-05	40.8
28	SIS/RHR	JNG10AP001EFS_D-ALL	CCF of LHSI Pumps to Start	1.7E-06	38.4
29	ESWS	PEB20AP001EFS_B-ALL	CCF of ESWS Pumps 2 and 3 to Start (Standby)	8.1E-05	35.1
30	SCWS	QKA10GH001_FS_B-ALL	CCF of the Running SCWS Chiller Units to Start	1.5E-04	27.8
31	MSS	LBA13AA001PFO_D-ALL	CCF to Open Main Steam Relief Isolation Valves	4.6E-05	24.9
32	SIS/RHR	JNG10AP001EFR_D-ALL	CCF of LHSI Pumps to Run	4.6E-07	23.7
33	CCWS	KAA12AA012CFO_D-ALL	CCF to Open CCWS from LHSI HTX Discharge Check Valve	4.5E-07	23.7

**Table 19.1-34—U.S. EPR Risk-Significant Common Cause Events based on RAW Importance - Level 2 Internal Events**  
**Sheet 3 of 3**

<b>Rank</b>	<b>System</b>	<b>ID</b>	<b>Description</b>	<b>Nominal Value</b>	<b>RAW</b>
34	SIS/RHR	JNG10AA006CFO_D-ALL	CCF to Open LHSI Check Valves (SIS Second Isolation Valves)	2.3E-07	<b>22.3</b>
35	SIS/RHR	JNG10AA009CFO_D-ALL	CCF to Open LHSI Discharge CVs (CIVs)	2.3E-07	<b>22.3</b>
36	SIS/RHR	JNG10AA011CFO_D-ALL	CCF to Open LHSI Discharge Check Valves	2.3E-07	<b>22.3</b>
37	SCWS	QKA20GH001_FS_B-ALL	CCF of the Standby SCWS Chiller Units to Start	1.5E-04	<b>21.9</b>
38	MSS	MSRIVSCPFO_P-ALL	CCF to Open Main Steam Relief Isolation Steam Operated Pistion Valve Pilot Valves	3.7E-06	<b>20.5</b>

**Table 19.1-35—U.S. EPR Risk-Significant I&C Events based on RAW Importance - Level 2 Internal Events**

<b>Rank</b>	<b>ID</b>	<b>Description</b>	<b>Nominal Value</b>	<b>RAW</b>
1	SAS CCF-ALL	CCF of SAS Divisions	5.0E-07	<b>7,700.0</b>
2	I/O MOD CCF	I/O Module Common Cause Failure	6.5E-06	<b>220.0</b>
3	SG LVL CCG	Common Cause Failure of the SG Level Sensors (32)	4.9E-08	<b>198.0</b>
4	ALU/APU NS-ALL	CCF of ALU and APU Protection System Computer Processors (Non-Self-Monitored)	3.3E-07	<b>138.0</b>
5	CL-PS-EDG-SWCCF	CCF of EDG Start Function in PS Diversity Groups A&B Software	1.0E-05	<b>123.0</b>
6	BUS UV CCF-ALL	CCF of 6.9KV bus undervoltage sensors	4.3E-06	<b>112.0</b>
7	CL-TXS-OSCCF	CCF of TXS Operating System or Other Common Software	1.0E-07	<b>105.0</b>
8	EFW FLOW CCF-ALL	CCF of EFW pump discharge flow sensors	2.7E-06	<b>101.0</b>
9	ALU/APU SM-ALL	CCF of ALU and APU Protection System Computer Processors (Self-Monitored)	9.0E-08	<b>91.6</b>
10	PZR PRES CCF-ALL	CCF of pressurizer (RCS) pressure sensors	6.7E-07	<b>74.3</b>
11	CL-PS-B-SWCCF	CCF of Protection System Diversity Group B Application Software	1.0E-05	<b>36.2</b>

**Table 19.1-36—U.S. EPR Risk-Significant PRA Parameters - Level 2 Internal  
Sheet 1 of 3**

ID	Description	Nominal Value	FV	RAW
<b>PRA Modeling Parameters</b>				
1 TUBE	1 Ruptured SG Tube	4.99E-01	0.006	1.01
10 TUBES	10 or More Ruptured Tubes	1.00E-03	0.004	5.37
2-9 TUBES	2-9 Ruptured SG Tubes	5.00E-01	0.019	1.02
CONF CH1 TO TB	Configuration 1: CH1 Supplying All RCP TB. Maintenance on CCW 3 Only.	5.00E-01	0.083	1.08
CONF CH2 TO TB	Configuration 2: CH2 Supplying All RCP TB. Maintenance on CCW 2 Only.	5.00E-01	0.093	1.09
CVCS VCT	CVCS Switchover to IRWST is required	1.00E-01	0.005	1.05
JMM23 01/02 SCFL	Probability that Secondary Containment/Annulus Venting Fails	1.00E-01	0.165	2.48
L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	1.00E+00	0.019	1.00
L2CP SL0.6"DIAM	Level 2 conditional probability: Small LOCA has 0.6" diameter	5.00E-01	0.124	1.12
L2CP SS2"DIAM	Level 2 conditional probability: Seal LOCA has 2" diameter	5.00E-01	0.188	1.19
L2PH CP STMEXP	Probability of ex-vessel steam explosion given a wet pit.	1.00E+00	0.100	1.00
L2PH CPIHLR-SS,SL=Y	Induced hot leg rupture. Conditional probability, given no SGTR. SS,SL cases.	1.00E+00	0.010	1.00
L2PH CPIHLR-TR,TP=Y	Induced hot leg rupture. Conditional probability given no ISGTR. TR, TRD, TP, TPD cases.	9.50E-01	0.112	1.01
P JMM23 01/02 OP-P	Probability that Leak Off System Line JMM23 is Open (Pwr)	1.00E+00	0.165	1.00
P KTA10 17/18 OP-P	Probability that Primary Drain Line KTA10 is Open (Pwr)	1.00E-02	0.012	2.15
P KTC10 05/06 OP-P	Probability that Containment Sump Line KTC is Open (Pwr)	1.00E-02	0.012	2.23
P KTD10 24/15 OP-P	Probability that NCS line is open. (Pwr)	1.00E-02	0.012	2.23
PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	2.00E-01	0.355	2.42
STUCK ROD	CCF of 38 out of 89 Control Rods being stuck - NUREG/CR-5500, 50% control rods CCF	4.10E-08	0.000	110.00
SUP UHS NS	Failure of the Ultimate Heat Sink (Non-Safety)	2.80E-05	0.000	4.27

**Table 19.1-36—U.S. EPR Risk-Significant PRA Parameters - Level 2 Internal  
Sheet 2 of 3**

ID	Description	Nominal Value	FV	RAW
<b>Maintenance</b>				
CCWS/ESWS PM2	CCWS/ESWS Train 2 Pump Unavailable due to Preventive Maintenance	1.00E-01	0.141	2.27
CCWS/ESWS PM3	CCWS/ESWS Train 3 Pump Unavailable due to Preventive Maintenance	1.00E-01	0.111	1.99
EDG PM1	EDG Train 1 Unavailable due to Preventive Maintenance (Alt. Feed Alignment)	5.00E-02	0.021	1.40
EDG PM2	EDG Train 2 Unavailable due to Preventive Maintenance (Alt. Feed Alignment)	5.00E-02	0.015	1.28
EDG PM3	EDG Train 3 Unavailable due to Preventive Maintenance (Alt. Feed Alignment)	5.00E-02	0.015	1.28
EDG PM4	EDG Train 4 Unavailable due to Preventive Maintenance (Alt. Feed Alignment)	5.00E-02	0.019	1.36
EFWS PM4	EFWS Train 4 Unavailable due to Preventive Maintenance	5.00E-02	0.024	1.45
LHSI PM1	LHSI Train 1 Unavailable due to Preventive Maintenance	5.00E-02	0.012	1.22
LHSI PM2	LHSI Train 2 Unavailable due to Preventive Maintenance	5.00E-02	0.009	1.16
LHSI PM3	LHSI Train 3 Unavailable due to Preventive Maintenance	5.00E-02	0.005	1.10
LHSI PM4	LHSI Train 4 Unavailable due to Preventive Maintenance	5.00E-02	0.017	1.33
QKA20 PM2	Normal QKA20 Train Unavailable due to Preventive Maintenance	7.00E-02	0.030	1.40
QKA40 PM4	Normal QKA40 Train Unavailable due to Preventive Maintenance	7.00E-02	0.200	3.65
QNA24 PM	OCWS Standby Chiller 24 Unavailable due to Preventive Maintenance	3.00E-01	0.054	1.13
SAC01 CM1	Normal SAC01 Train Unavailable due to Corrective Maintenance	8.00E-04	0.011	14.70
SAC02 CM2	Normal SAC02 Train Unavailable due to Corrective Maintenance	8.00E-04	0.004	6.28
SAC04 CM4	Normal SAC04 Train Unavailable due to Corrective Maintenance	8.00E-04	0.083	104.00
SAC05 PM5	Maintenance SAC Safety System Train 5 Unavailable due to Preventive Maintenance	7.00E-02	0.040	1.53



**Table 19.1-36—U.S. EPR Risk-Significant PRA Parameters - Level 2 Internal  
Sheet 3 of 3**

<b>ID</b>	<b>Description</b>	<b>Nominal Value</b>	<b>FV</b>	<b>RAW</b>
SAC08 PM8	Maintenance SAC Safety System Train 8 Unavailable due to Preventive Maintenance	7.00E-02	0.033	1.44
SAHR PM4	SAHR Train Unavailable due to Preventive Maintenance	7.00E-02	0.007	1.09
SBODG5 PM5	SBO-DG Train 5 Unavailable due to Preventive Maintenance	7.00E-02	0.018	1.24
SBODG8 PM8	SBO-DG Train 8 Unavailable due to Preventive Maintenance	7.00E-02	0.008	1.11
<b>Offsite Power Related Events</b>				
L2 REC OSP 2-7H	Offsite power not recovered between 2 and 7 hours	3.21E-01	0.031	1.06
L2 REC OSP 7-31H	Offsite power not recovered between 7 and 31 hours	3.04E-01	0.006	1.01
L2 REC=Y OSP 2-7H	Offsite power recovered between 2 and 7 hours	6.79E-01	0.087	1.04
LOOP24+REC	Loss Of Offsite Power During Mission Time and Failure of Recovery Within 1 Hour	4.80E-05	0.001	21.70
LOOPCON+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to Auto Scram	1.80E-03	0.096	54.40
REC OSP 1HR	Failure to Recover Offsite Power Within 1 Hour	5.30E-01	0.144	1.13
REC OSP 2HR	Failure to Recover Offsite Power Within 2 Hours	3.18E-01	0.062	1.13

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
Sheet 1 of 14**

Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
LOOP	AC	---	---	No secondary cooling (SC) and F&B
LOOP	I&C	---	---	No automatic actuation or instrumentation for operators (including no auto-start of the EDGs)
LOOP	EDG	---	---	No AC power
LOOP	DC	---	---	No DC (fails diesels)
LOOP	ESWS	---	---	No service water (fails diesels)
LOOP	1EUPS	---	---	EFW fails due to loss of power to the SG level control valves, PSRVs are also dependent on 1EUPS so feed and bleed also fails
LOOP	HVAC (SAC)	---	OPF-SAC-2H	No room cooling (fails AC & I&C)
LOOP	EFW	---	OPE-FB-90M	Secondary Cooling (SC) failure (EFW) and operator fails F&B
LOOP	CCWS	PROB SEAL LOCA	---	CCWS challenges RCP seals, seal LOCA occurs (0.2 probability) and there is no IRWST cooling.
LOOP	CCWS	QKA40 PM4 “OR” EDG 4 fails to start/run	OPF-EFW-6H OPF-SAC-2H	Loss of HVAC results in loss of divisions 3 and 4, EFW fails long-term as EFW Pools 1 and 2 eventually deplete, Feed and Bleed fails due to loss of divisions 3 and 4.
LOOP	---	CCWS/ESWS PM2 and EDG1, EDG3 or EDG4 fails to start/run,	OPF-EFW-6H	EFW fails long term as 2 EDGs fail and operator fails to align stranded EFW inventory to an operable train; Feed and Bleed fails due to loss of power to one or more PSRVs
LOOP	---	CCWS/ESWS PM3 and EDG1, EDG2 or EDG4 fails to start/run,	OPF-EFW-6H	EFW fails long term as 2 EDGs fail and operator fails to align stranded EFW inventory to an operable train; Feed and Bleed fails due to loss of power to one or more PSRVs

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
Sheet 2 of 14**

Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
LOOP	EFW	Any EDG fails to run/start	---	EFW fails due to the seismic event and single EDG failure and operator failure results in loss of DC at two hours which fails one or more PSVs which fails feed and Bleed (F&B)
LOOP	CCWS	EDG1 fails to start/run	OPF-EFW-6H OPF-SAC-2H	Loss of HVAC results in loss of divisions 1 and 2, EFW fails long-term as EFW Pools 3 and 4 eventually deplete, Feed and Bleed fails due to loss of divisions 1 and 2.
LOOP	---	EDG1 fails to start/run and QKA20 PM2	OPF-EFW-6H OPF-SAC-2H	EDG and HVAC faults result in loss of divisions 1 and 2, EFW fails long-term as EFW Pools 3 and 4 eventually deplete, Feed and Bleed fails due to loss of divisions 1 and 2.
LOOP	---	EDG3 fails to start/run and QKA40 PM4	OPF-EFW-6H OPF-SAC-2H	EDG and HVAC faults result in loss of divisions 3 and 4, EFW fails long-term as EFW Pools 1 and 2 eventually deplete, Feed and Bleed fails due to loss of divisions 3 and 4.
LOOP	---	(EDG1 or EDG2 fails) and (EDG3 or EDG4 fails)	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
LOOP	---	(EDG1 and EDG2) or (EDG 3 and EDG4)	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
LOOP	---	EDG1 fails and maintenance unavailability of an EDG or EFW pump in divisions 2,3 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
LOOP	---	EDG2 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,3 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
LOOP	---	EDG3 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,2 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
LOOP	---	EDG4 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,2,or 3	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
LOOP	RT	---	OPF-EBS-30M-	No reactivity control. LOOP is not a limiting ATWS event and therefore it is recommended that RT (and maintenance of core geometry) be considered as an important function for seismic events (SMA and/or SPRA).
ILOOP	I&C	---	OPF-RT-6M	Reactor Trip Fails due to seismically induced I&C failures, and no power (EDG start dependent on Protection System)
LOOP	DC	---	OPF-RT-6M	Reactor Trip Fails due to seismically induced DC failures (loss of power to RPS), and no power to support accident mitigation (EDG start and load dependent on DC)
SLOCA	AC	---	---	No secondary cooling (SC) and F&B
SLOCA	I&C	---	---	No automatic actuation or instrumentation for operators (including no auto-start of the EDGs)
SLOCA	EDG	---	---	Fails all AC power (ESWS and CCWS)
SLOCA	DC	---	---	No DC (fails diesels)
SLOCA	ESWS	---	---	Fails EDGs (and AC power since offsite power and SBO DGs are assumed unavailable)
SLOCA	SAC	---	OPF-SAC-2H	No room cooling (fails AC & I&C)
SLOCA	CCWS	---	---	Fails MHSI and containment heat removal

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
SLOCA	LHSI	---	---	Containment heat removal fails due to LHSI failure (SAHRS fails due to non-seismic).
SLOCA	EFW or MSRT	---	OPE-FB-40M	PCD failure (EFW or MSRT) and operator fails F&B
SLOCA	MHSI	---	OPE-FCD-40M	PCD success, but MHSI fails and operators fail fast cooldown (FCD)
SLOCA	1EUPS	---	---	Fails EFW, MSRTs and PSRVs
SLOCA	EFW	Any EDG fails to run/start	---	EFW fails due to the seismic event and F&B fails due to loss of power to one or more PSVs.
SLOCA	MSRT	Any EDG fails to run/start	---	PCD fails due to MSRT failure, and F&B fails due to loss of power to one or more PSVs.
SLOCA	---	CCWS/ESWS PM2 “AND” (EDG1, EDG3 or EDG4 fails to start/run)	OPF-EFW-6H	EFW fails long term as 2 EDGs fail and operator fails to align stranded EFW inventory to an operable train; Feed and Bleed fails due to loss of power to one or more PSRVs
SLOCA	---	CCWS/ESWS PM3 “AND” (EDG1, EDG2 or EDG4 fails to start/run)	OPF-EFW-6H	EFW fails long term as 2 EDGs fail and operator fails to align stranded EFW inventory to an operable train; Feed and Bleed fails due to loss of power to one or more PSRVs
SLOCA	---	EDG1 fails to start/run and QKA20 PM2	OPF-EFW-6H OPF-SAC-2H	EDG and HVAC faults result in loss of divisions 1 and 2, EFW fails long-term as EFW Pools 3 and 4 eventually deplete, Feed and Bleed fails due to loss of divisions 1 and 2.
SLOCA	---	EDG3 fails to start/run and QKA40 PM4	OPF-EFW-6H OPF-SAC-2H	EDG and HVAC faults result in loss of divisions 3 and 4, EFW fails long-term as EFW Pools 1 and 2 eventually deplete, Feed and Bleed fails due to loss of divisions 3 and 4.

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
SLOCA	---	(EDG1 or EDG2 fails) and (EDG3 or EDG4 fails)	---	MSRTs fail as they have a long term dependency on power (and need train 1 &2 or 3&4 power). F&B fails due to loss of power to one or more PSVs.
SLOCA	---	(EDG1 and EDG2) or (EDG 3 and EDG4)	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
SLOCA	---	EDG1 fails and maintenance unavailability of an EDG or EFW pump in divisions 2,3 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
SLOCA	---	EDG2 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,3 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
SLOCA	---	EDG3 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,2 or 4	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
SLOCA	---	EDG4 fails and maintenance unavailability of an EDG or EFW pump in divisions 1,2,or 3	OPF-EFW-6H	EFW fails long term due to depletion of pools for operable EFW pumps due to operator inaction; F&B fails due to loss of power to one or more PSVs
MLOCA	AC	---	---	No AC power results in failure of secondary cooling (SC) and F&B
MLOCA	I&C	---	---	No automatic actuation or instrumentation for operators (including no auto-start of the EDGs)
MLOCA	EDG	---	---	Fails all AC power
MLOCA	DC	---	---	No DC (fails diesels)
MLOCA	ESWS	---	---	Fails EDGs (and AC power since offsite power and SBO DGs are assumed unavailable)

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
MLOCA	SAC	---	OPF-SAC-2H	No room cooling (fails AC & I&C)
MLOCA	CCWS	---	---	Fails MHSI and containment heat removal
MLOCA	LHSI	---	---	Containment heat removal fails due to LHSI failure (SAHRS fails due to non-seismic).
MLOCA	MHSI	---	OPE-FCD-30M	PCD success, but MHSI fails and fast cooldown (FCD) fails due to operator inaction
MLOCA	1EUPS	---	---	Fails MSRTs and PSVs
MLOCA	MSRT	---	OPE-FB-30M	PCD fails due to MSRT failure, and F&B fails due to operator inaction
MLOCA	MSRT	Any EDG fails to run/start	---	PCD fails due to MSRT failure, and F&B fails due to loss of power to one or more PSVs.
MLOCA	---	(EDG1 and EDG2) or (EDG 3 and EDG4)	---	MSRTs fail as they have a long term dependency on power (and need train 1 &2 or 3&4 power). F&B fails due to loss of power to one or more PSVs.
LLOCA	AC	---	---	No AC power results in failure of secondary cooling (SC) and F&B
LLOCA	I&C	---	---	No automatic actuation or instrumentation for operators (including no auto-start of the EDGs)
LLOCA	EDG	---	---	Fails all AC power
LLOCA	DC	---	---	No DC (fails diesels)
LLOCA	ESWS	---	---	Fails EDGs (and AC power since offsite power and SBO DGs are assumed unavailable)
LLOCA	SAC	---	OPF-SAC-2H	No room cooling (fails AC & I&C)
LLOCA	CCWS	---	---	Fails containment heat removal (two LHSI are cooled by SCWS)

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
LLOCA	ACC	---	---	LLOCA requires accumulators
LLOCA	LHSI	---	---	RCS inventory control and Containment heat removal fails due to LHSI failure.
LLOCA	---	EDG2 and EDG3 both fail to start/run “OR” EDG2 or EDG 3 both fail due to one unavailable for maintenance and the other fails due to start/run	---	For Large LOCA the PRA model assumes that trains 1 and 4 are ineffective (one directly from flow diversion via the break and the adjacent train from steam entrainment). Therefore failures of LHSI 2 and 3 results in inadequate RCS inventory control.
IE SD RHR (POS C)	AC or DC or EDG or ESWS	---	---	Station Blackout
IE SD RHR (POS C)	I&C	---	---	No automatic actuation or instrumentation for operators
IE SD RHR (POS C)	SAC	---	OPF-SAC-2H	Loss of HVAC event eventually morphs into a loss of all AC power event if operator action is not credited
IE SD RHR (POS C)	CCWS	PROB SEAL LOCA	---	RHR fails on loss of CCW, and if seal LOCA occurs LTC is guaranteed failure (due to CCW failure).
IE SD RHR (POS C)	CCWS or LHSI	Any DG fail to run	OPF-EFW-6H	RHR Fails due to LHSI or CCWS seismic failure, EFW fails due to inadequate inventory (one EDF and OPF-EFW-6H), Primary Bleed Fails due to EDG failure (DRVs assumed unavailable due to non-seismic design),
IE SD RHR (POS C)	CCWS	EDG1 fail to run	OPF-SAC-2H	RHR Fails due to CCWS seismic failure, EFW1 fails due to power failure, EFW2 failed by loss of HVAC SB2 (QKA10 failed by power, QKA20 failed by loss of CCW, and alternate HVAC failed by OPF-SAC-2H)), EFW3 and 4 assumed unavailable for maintenance, and FB is guaranteed failure (DRVs and at least 1 PSV failed)



**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD RHR (POS C)	---	EDG2 and EDG3	OPF-RHR-Cau (state Cau) “OR” OPF-RHR-Cbu (State Cbu)	In operating states with two RHR pumps initially operating (Cbu, Cau) failure of EDG2 and 3 fails the two operating RHR pumps, EFW fails due to failure of the MSRTs when class batteries 2 and 3 deplete, and bleed is failed due to insufficient PSRVs)
IE SD RHR (POS D)	AC or DC or EDG or ESWS	---	---	Station Blackout
IE SD RHR (POS D)	I&C	---	---	No automatic actuation or instrumentation for operators
IE SD RHR (POS D)	CCWS	---	OPF-LHSIRHR	Loss of MHSI (due to failure of CCW) and failure to start LHSI results in inadequate RCS inventory control
IE SD LOCA (POS C)	AC or DC or EDG or ESWS	---	---	Station Blackout
IE SD LOCA (POS C)	I&C	---	---	No automatic actuation or instrumentation for operators
IE SD LOCA (POS C)	CCWS	---	---	Failure of CCW results in failure of MHSI and although LHSI is successful CHR is unavailable (SAHRS unavailable due to non-seismic).
IE SD LOCA (POS C)	LHSI	---	---	Although RCS inventory control can be achieved with MHSI success, containment heat removal requires LHSI for success (SAHRS assumed failed for seismic event).
IE SD LOCA (POS C)	SAC	---	OPF-SAC-2H	Loss of HVAC event eventually morphs into a loss of all AC power event if operator action is not credited
IE SD LOCA (POS C)	EFW or MSRT	---	OPF-RHRLOCA-Cxx and OPF-FB-Cxx	Failure to restart RHR after a LOCA, failure to start feed and bleed, and failure of EFW or MSRT causes loss of secondary cooling (Note 2)

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD LOCA (POS C)	MHSI	---	OPF-FB-Cxx (Note 5)	Failure of MHSI on small LOCA event tree requires feed and bleed utilizing LHSI which fails due to operator error (Note 2)
IE SD LOCA (POS C)	1EUPS	---	OPF-RHRLOCA-Cxx	Small LOCA, RHR fails due to operator error, and failure of the 1EUPS results in failure of EFW (via MSRTS) and failure of feed and bleed (PSRVs require 1EUPS power). Note (2)
IE SD LOCA (POS C)	---	One EDG fails to start/run (Note 3)	OPF-EFW-6H OPD-EFWRP/ XTIE OPF-RHRLOCA-Cxx	Small LOCA with 1 EDG failure, the operators fails to supply the EFW inventory in the failed train to an operating pump resulting in long term failure of EFW, RHR cooling fails due to operator inaction,
IE SD LOCA (POS C)	---	One EFW pump fails to start/run (Note 4)	OPF-EFW-6H OPD-EFWRP/ XTIE OPF-RHRLOCA-Cxx OPE-FB-Cxx	Small LOCA with 1 EFW failure, the operators fail to supply the EFW inventory in the failed train to an operating pump resulting in long term failure of EFW, and RHR and Feed and Bleed fail due to operator inaction,
IE SD LOCA (POS C)	MHSI	One EDG fails to start/run (Note 3)	---	Failure of MHSI on small LOCA event tree requires feed and bleed utilizing LHSI which fails due to loss of power to one or more PSVs
IE SD LOCA (POS C)	EFW or MSRT	One EDG fails to start/run (Note 3)	OPE-RHRLOCA-Cxx	Failure to restart RHR after a small LOCA, failure of EFW or MSRT causes loss of secondary cooling and feed and bleed fails due to loss of power to one or more PSVs
IE SD LOCA (POS C)	---	(EDG1 or EDG2 fails) and (EDG3 or EDG4 fails)	OPE-RHRLOCA-Cxx	Failure to restart RHR after a small LOCA, the MSRTs fail due to the EDG failures resulting in loss of secondary cooling, and feed and bleed fails due to loss of power to one or more PSVs

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)**  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD LOCA (POS C)	---	EDG1 and EDG2	OPE-RHRLOCA-Cxx	Failure to restart RHR after a small LOCA, Both EFW pumps that are credited in the shutdown analysis fail due to loss of power resulting in loss of secondary cooling, and feed and bleed fails due to loss of power to one or more PSVs
IE SD LOCA (POS D/E)	AC or DC or EDG or ESWS	---	---	Station Blackout
IE SD LOCA (POS D/E)	I&C	---	---	No automatic actuation or instrumentation for operators
IE SD LOCA (POS D/E)	SAC	---	OPF-SAC-2H	Loss of HVAC event eventually morphs into a loss of all AC power event if operator action is not credited
IE SD LOCA (POS D/E)	CCWS or MHSI	---	OPF-LHSILO-xx	Loss of MHSI (due to either loss of CCW or MHSI) and failure to start LHSI results in inadequate RCS inventory control
IE SD ULD C	---	---	OPF-ISOCSLPRS-CR	Operator action is required to terminate the draindown following a seismic event (automatic actuation is non-safety and non-seismic).
IE SD ULD C	AC or DC or EDG or ESWS	---	---	Station Blackout
IE SD ULD C	I&C	---	---	No automatic actuation or instrumentation for operators
IE SD ULD C	CCWS	---	---	Failure of CCW results in failure of MHSI and although LHSI is successful CHR is unavailable (SAHRS unavailable due to non-seismic).
IE SD ULD C	SAC	---	OPF-SAC-2H	Loss of HVAC event eventually morphs into a loss of all AC power event if operator action is not credited

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)**  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD ULD C	EFW or MSRT	---	OPF-RHRULD-Cbd and OPF-FB-Cbd	Failure to restart RHR after a ULD, failure to start feed and bleed, and failure of EFW or MSRT causes loss of secondary cooling (Note 2)
IE SD ULD C	MHSI	---	OPF-FB-Cbd	Failure of MHSI requires feed and bleed utilizing LHSI which fails due to operator error (Note 2)
IE SD ULD C	1EUPS	---	OPF-RHRULD-Cbd	RHR fails due to operator error, and failure of the 1EUPS results in failure of EFW (via MSRTS) and failure of feed and bleed (PSRVs require 1EUPS power). Note (2)
IE SD ULD C	---	One EDG fails to start/run (Note 3)	OPF-EFW-6H OPD-EFWRF/XTIE OPF-RHRULD-Cbd	ULD with 1 EDG failure, the operators fails to supply the EFW inventory in the failed train to an operating pump resulting in long term failure of EFW, RHR cooling fails due to operator inaction,
IE SD ULD C	---	One EFW pump fails to start/run (Note 4)	OPF-EFW-6H OPD-EFWRF/XTIE OPF-RHRULD-Cbd OPE-FB-Cbd	ULD with 1 EFW failure, the operators fail to supply the EFW inventory in the failed train to an operating pump resulting in long term failure of EFW, and RHR and Feed and Bleed fail due to operator inaction,
IE SD ULD C	MHSI	One EDG fails to start/run (Note 3)	---	Failure of MHSI after a ULD event requires feed and bleed which fails due to loss of power to one or more PSVs
IE SD ULD C	EFW or MSRT	One EDG fails to start/run (Note 3)	OPE-RHRULD-Cbd	Failure to restart RHR after a ULD, failure of EFW or MSRT causes loss of secondary cooling and feed and bleed fails due to loss of power to one or more PSVs

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)**  
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Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD ULD C	LHSI	Any EDG Fail to Run	OPF-EFW-6H OPD-EFWRF/ XTIE	RHR fails due to seismic induced failure of LHSI/RHR pumps, the operators fails to supply the EFW inventory in the failed train to an operating EFW pump resulting in long term failure of EFW, and feed and bleed fails due to loss of power to one or more PSRVs.
IE SD ULD C	---	(EDG1 or EDG2 fails) and (EDG3 or EDG4 fails)	OPE- RHRULD-Cbd	Failure to restart RHR after a small LOCA, the MSRTs fail due to the EDG failures resulting in loss of secondary cooling, and feed and bleed fails due to loss of power to one or more PSVs
IE SD ULD C	---	EDG1 and EDG2	OPE- RHRULD-Cbd	Failure to restart RHR after a ULD, Both EFW pumps that are credited in the shutdown analysis fail due to loss of power resulting in loss of secondary cooling, and feed and bleed fails due to loss of power to one or more PSVs
IE SD ULD C	1EUPS	EDG3	OPE- ISOCSLPRS-L	Isolation of CVCS reducing station, and isolation of RHR train 3 fails due to 1EUPS and EDG3 failure, and local isolation of CVCS piping fails
IE SD ULD C		EDG3 and EDG4	OPF-SAC-2H OPE- ISOCSLPRS-L	HVAC fails in SB 3 and 4, results in failure to isolate letdown from the control room, and local isolation also fails (UPS powered isolation valves are conservatively modeled as dependent on HVAC)
IE SD ULD C	1EUPS	EDG4	OPF-SAC-2H OPE- ISOCSLPRS-L	HVAC fails in SB 3 and 4, results in failure to isolate letdown from the control room, and local isolation also fails (UPS powered isolation valves are conservatively modeled as dependent on HVAC)

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)**  
**Sheet 13 of 14**

Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD ULD C	SAC	EDG2	OPF-EFW-6H OPD-EFWRF/ XTIE	RHR trains 1 and 4 fail from loss of QKA, RHR 2 fails from loss of power and RHR 3 unavailable to allow RHR3 isolation to isolate CVCS break, the operators fails to supply the EFW inventory in the failed train to an operating EFW pump resulting in long term failure of EFW, and feed and bleed fails due to loss of power to one or more PSRVs
IE SD ULD D	---	---	OPE- ISOCSLPRS- CR	Operator action is required to terminate the draindown following a seismic event (automatic actuation is non-safety and non-seismic).
IE SD ULD D	AC or DC or EDG or ESWS	---	-	Station Blackout
IE SD ULD D	I&C	---	-	No automatic actuation or instrumentation for operators
IE SD ULD D	SAC	---	OPF-SAC-2H	Loss of HVAC event eventually morphs into a loss of all AC power event if operator action is not credited
IE SD ULD D	CCWS or MHSI	---	OPF- LHSIULD-Du	Loss of MHSI (due to either loss of CCW or MHSI) and failure to start LHSI results in inadequate RCS inventory control
IE SD ULD D	1EUPS	EDG3	OPE- ISOCSLPRS-L	Isolation of CVCS reducing station, and isolation of RHR train 3 fails due to 1EUPS and EDG3 failure, and local isolation of CVCS piping fails
IE SD ULD D	CCWS	EDG4	OPF-SAC-2H OPE- ISOCSLPRS-L	HVAC fails in SB 3 and 4, results in failure to isolate letdown from the control room, and local isolation also fails (UPS powered isolation valves are conservatively modeled as dependent on HVAC)

**Table 19.1-37—Summary of SMA Cutsets (from the at-power and shutdown PRA)**  
**Sheet 14 of 14**

Initiating Event	Seismic Failures <sup>1</sup>	Random / Non-Seismic Failures	Operator Actions <sup>5</sup>	Description
IE SD ULD D		EDG3 and EDG4	OPF-SAC-2H OPE- ISOCSLPRS-L	HVAC fails in SB 3 and 4, results in failure to isolate letdown from the control room, and local isolation also fails (UPS powered isolation valves are conservatively modeled as dependent on HVAC)
IE SD ULD D	1EUPS	EDG4	OPF-SAC-2H OPE- ISOCSLPRS-L	HVAC fails in SB 3 and 4, results in failure to isolate letdown from the control room, and local isolation also fails (UPS powered isolation valves are conservatively modeled as dependent on HVAC)
IE SD ULD D	---	KBA14AA106EFC	OPE- ISOCSLPRS	RHR fails due to failure of the LP Reducing Station isolation valve to close, and operator inaction to close other isolation valves
IE SD RHR LOCA (POS C/D)	RHR piping	---	OPF- ISORHRBRK	In the event that the seismic 1 RHR piping fails due to the seismic event, operator action is required to manually isolate the break (auto isolation is a non-safety function). RHR piping break assumed in initiating event
IE SD RHR LOCA (POS C/D)	DC and RHR piping failure (assumed in initiating event)	---	---	DC seismic failure prevents start/load of the EDGs and fails the 1EUPS powered RHR isolation valve. RHR piping break assumed in initiating event.
IE SD RHR LOCA (POS C/D)	1EUPS and RHR piping failure assumed in IE	Failure of the EDG in the train with the ruptured RHR train	---	Seismic failure of the 1EUPS fails the UPS powered MOV, and the EDG failure results in failure to close the non-UPS powered MOV. RHR piping break assumed in initiating event.

**Note:**

1. Only single element seismic failure cutsets are shown except as required to show random equipment failure and human action failure contributions.
2. For POS C, the sequence results for operating state Cad are shown as representative (for operating states Cau, Cbd, and Cbu the operator errors appropriate for those states are utilized in the accident sequence analysis rather than the Cad operator actions).
3. Basic events contributing to EDG failure include EDG fails to start, EDG fails to run, ESW pump fails to start, offsite power supply breakers fail to open due to priority module fault, EDG circuit breaker fails to close due to priority module fault, and ESW pump breaker fails to close due to priority module fault.
4. Basic Events contributing to EFW failure include EFW pump fails to start, EFW pump fails to run, EFW flow control valve fails to control flow, SG level control valve fails to control flow, flow control valve fails due to priority module fault, level control valve fails due to priority module fault, EFW pump fails due to priority module fault, or EFW fails due to loss of HVAC (SAC fan priority module fault and OPF-SAC-2H).
5. Where the cutsets for various states that are combined in Table 19.1-37 have essentially the same form except that they utilize separate basic event names such that differences in operator timing can be accounted for in the shutdown PRA, the general form of the operator error basic event is shown. For example, the 4 State C states (Cad, Cbd, Cau, and Cbu) have been combined into a single table entry and the operator error OPF-FB-Cxx is utilized to represent OPF-FB-Cad, OPF-FB-Cbd, OPF-FB-Cau, or OPF-FB-Cbu depending on the operating state being evaluated (for the SMA, all operator errors have been set to 1.0, so all operator errors have the same basic event probability).



**Table 19.1-38—Changes in U.S. EPR Flooding Scenarios and Frequency Calculation**

U.S. EPR Location	Systems Considered in the Flooding Frequency Calculation	Flooding Frequency (1/yr)	Basis for Frequency
Safeguard Building 1 or 4	CCWS, DWS, ESWS, FWDS, SIS<2", Seal Water System	1.7E-03	Segment count for the systems considered
	EFWS	4.0E-04	Segment count for the EFW system
	SIS	7.3E-05	Segment count for the SIS system (larger than 2")
Safeguard Building 2 or 3	CCWS, DWS, ESWS, FWDS, SIS	9.7E-04	Segment count for the systems considered
	EFWS	4.3E-04	Segment count for the EFW system
	SIS	7.3E-05	Segment count for the SIS system (larger than 2")
Fuel Building	CCWS, CVCS, DWS, FPCS, FPPS, RBWMS, Seal Water System	4.5E-03	Segment count for the systems considered
Reactor Building Annulus	FWDS	4.0E-04	Segment count for the FWD system
ESW Cooling Tower Structures – 1 or 2 or	ESWS, FWDS	1.7E-04	Segment count for the systems considered
ESW Cooling Tower Structures - 4	ESWS, FWDS	2.2E-04	Segment count for the systems considered
Turbine Building	N/A	3.3E-02	Generic frequency from NUREG/CR-2300

**Table 19.1-39—Flooding Scenarios Description and Frequency Calculation**

<b>Flooding Scenario</b>	<b>Description</b>	<b>Unavailable Mitigating Systems</b>	<b>Frequency (1/yr)</b>	<b>Distribution Type (parameter)</b>	<b>Basis for Frequency</b>
FLD-SAB 14 FB	Flood in the Safeguard Building 1 or 4 (Pump Room) including the FB, from all flooding sources except EFW and SIS piping >2"	SB 4 systems (CCW4, CCW SWO, EFW4, MHSI4, LHSI4, SAHRS), FB systems (EBS and CVCS), EFW crosstie	8.0E-03	Log (EF=5)	SB 1 + SB 4 + FB frequency (excluding EFW and SIS)
FLD-SAB 23	Flood in the Safeguard Building 2 or 3 (Pump Room), from all flooding sources except EFW and SIS piping >2"	SB2 systems (CCW2, MHSI2, LHSI2, EFW2), EFW crosstie	1.9E-03	Log (EF=5)	SB2 + SB 3 frequency (excluding EFW and SIS)
FLD-EFW	EFW-caused flood in the SB 1 or SB 4 propagating to the FB	SB 4 systems (CCW4, EFW4, MHSI4, LHSI4, SAHRS), FB systems (EBS/CVCS), EFW crosstie	1.7E-03	Log (EF=5)	SB 1 + SB2 + SB 3 + SB 4 EFW frequency
FLD-SIS	SIS (larger than 2" piping)-caused flood in the SB 1 or SB 4 propagating to the FB	SB 4 systems (CCW4, EFW4, MHSI4, LHSI4, SAHRS), FB systems (EBS/CVCS), EFW crosstie	2.9E-4	Log (EF=5)	SB 1 + SB2 + SB 3 + SB 4 SIS larger than 2"frequency
FLD-TB	Flood in the TB	MFV and SSS (LBOP)	3.3E-02	Log (EF=5)	NUREG/CR-2300
FLD-ESW	Flood in the ESW Building	UHS4 / SAHRS	7.4E-04	Log (EF=5)	4*ESWB frequency
FLD-ANN ALL	Flood in the RB Annulus (FWDS pipe break)	Failure of the connection boxes to the containment (general failure)	4.0E-04	Log (EF=5)	FWDS annulus frequency

**Table 19.1-40—U.S. EPR Initiating Events Contributions - Level 1 Internal Flooding (Contributing More than 1% to Internal Flooding CDF)**

<b>IE</b>	<b>Description</b>	<b>IE Frequency (1/yr)</b>	<b>CDF 1/yr</b>	<b>Contribution</b>
FLD-SAB14 FB	Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building	8.0E-03	3.2E-08	49.8%
FLD-SIS	Flood Due to SIS Pipe Break	2.9E-04	1.6E-08	24.0%
FLD-ANN	Flood in the RB Annulus (FWDS Pipe Break)	4.0E-04	1.1E-08	17.0%
FLD-EFW	Flood Due to EFW Pipe Break	1.7E-03	2.8E-09	4.4%
FLD-TB	Flood in the Turbine Building	3.3E-02	2.8E-09	4.3%
		Total:	6.5E-08	
		Total RS:	6.1E-08	

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