

Table 19.1-41—U.S. EPR Important Cutsets - Level 1 Flooding (Top 100 Events)  
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Group No	Cutset Numbers	Cutset Frequencies	Contribution to CDF (%)		Sequence Type and a Representative Cutset		Sequence Description
			Group	Cumulative	Event Identifier	Event Description	
1	2, 3, 7, 11, 12, 15, 39, 40, 50-53, 68-75, 77, 84, 85	2.51E-09 - 4.08E-11	14.3	14.3	<b>Sequence: LOCCW-34: FLD-SIS, RCP LOCA, MHSI, LHSI</b>		Flood due to a SIS pipe break in SAB4 fails IRWST and all division 4 pumps. A loss of the running CCW pump Div. 4, with the standby CCW pump Div. 3 is in PM, leads to a loss of CCW CH2 and a loss of cooling to RCP pump 3 & 4 motor bearings. Failure to trip either pump, auto (priority modeled failure) or manually (operator failure) leads to a RCP seal LOCA, which cannot be mitigated without the IRWST (failure of all injection).
					IE FLD-SIS	Initiator - SIS Pipe Break	
					CCWS/ESWS PM3	CCWS/ESWS Train 3 Pump Unavailable due to Preventive Maintenance	
					JEB30AP001PMNS	RCP, Train 3 Pump JEB10AP001, Priority Module Fails (Non-Self-Monitored)	
					OPF-RCP-30M	Operator Fails to Trip RCPs on a Loss of Bearing Cooling	
2	4, 20, 21, 38, 86, 87, 88, 90-96	1.45E-09 - 3.48E-11	4.0	18.2	<b>Sequence: LOCCW-8: FLD-SIS, MFW, SSS, EFW INV, MHSI FB, LHSI</b>		Flood due to a SIS pipe break in SAB4 fails IRWST and all division 4 pumps. In addition x-tie between EFW tanks will be disabled (no access to crosstie EFW manual valve). Failure of PAS disables MFW/SSS, EFW is disabled by a failure to make-up to EFW tanks, feed and bleed is not available because of a loss of IRWST.
					IE FLD-SIS	Initiator - SIS Pipe Break	
					DWS MAKEUP	DWS/FWDS Fails to Provide Make Up to EFW Tanks	
					PAS	Process Automation System (PAS) Fails (Estimate)	
3	76	5.20E-11	0.1	18.3	<b>Sequence: LOCCW-17: FLD-SIS, MFW, SSS, EFW, MHSI FB, LHSI</b>		Flood due to a SIS pipe break in SAB4 fails IRWST and all division 4 pumps. I/O MOD failure fail entire PS. While DAS backs up PS actuations, it does not backup control functions. The operator action fails long-term control of EFW/MSRT for EFW level control, failing EFW. PS failure also disables MFW/SSS full load line isolation. Feed and bleed is not available because of a loss of IRWST.
					IE FLD-SIS	Initiator - SIS Pipe Break	
					I/O MOD CCF	I/O Module Common Cause Failure	
					OPF-EFW-MSRT-CNTL	Operator Fails to Control EFW/MSRT for Long-Term Cooling Given PS Failure	
4	5, 6, 8, 9, 10, 16-19	1.19E-09 - 2.64E-10	8.9	27.2	<b>Sequence: FLD-ANN-5: FLD-ANN, AFS BRK, AFS ISO</b>		1" equivalent pipe break in annulus, a common cause failure of FWDS isolation MOVs to close on demand, and operator failure to close valves locally, leads to a flooding of annulus penetrations.
					IE FLD-ANN	Initiator - Flood in the RB Annulus	
					BREAK 1IN	FWDS, Break in Pipe With 1" Flow	
					OPF-REC MOV	Operator Fails to Locally Isolate FWDS Ring Header	
					SGB30AA001EFC_D-12	CCF to close FWDS header isolation MOV on train 1 and 4	

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			Group	Cumulative	Event Identifier	Event Description	
5	1	4.00E-09	6.6	33.8	<b>Sequence: FLD-ANN-4: FLD-ANN, AFS BRK, OP AFS-S1, OP AFS-S2</b>		1" equivalent pipe break in annulus, operator failure to isolate the break (modeled in two actions: before and after ground level) leads to a flooding of annulus penetrations.
					IE FLD-ANN	Initiator - Flood in the RB Annulus	
					BREAK 1IN	FWDS, Break in Pipe With 1" Flow	
					OPD-AFS-S2-32H	Operator Fails to Isolate 1" FWDS Break Before Penetration in 32 Hours	
					OPE-AFS-10H	Operator Fails to Isolate 1" FWDS Pipe Break Before Ground Level in 10 Hours	
6	13, 22	4.23E-10 - 2.31E-10	1.1	34.9	<b>Sequence: FLD-ANN-5: FLD-ANN, AFS BRK, AFS ISO</b>		1" equivalent pipe break in annulus, a subsequent LOOP and failure to recover within 12 hours (failure of electrical supply to FWDS isolation MOVs), and operator failure to close valves locally, leads to a flooding of annulus penetrations.
					IE FLD-ANN	Initiator - Flood in the RB Annulus	
					BREAK 1IN	FWDS, Break in Pipe With 1" Flow	
					LOOPCSD+REC 12H	Consequential LOOP and Failure of Recovery Within 12 Hours for IEs Leading to a Controlled Shutdown	
					OPF-REC MOV	Operator Fails to Locally Isolate FWDS Ring Header	
7	27, 28, 56, 57	2.23E-10 - 6.37E-11	0.9	35.9	<b>Sequence: FLD-ANN-12: FLD-ANN, AFS SO, AFS BRK, OP AFS-S1, OP AFS-S2</b>		2" equivalent pipe break in annulus (given a spurious opening of one FWDS MOV), operator failure to isolate the break (modeled in two actions: before and after ground level) leads to a flooding of annulus penetrations.
					IE FLD-ANN	Initiator - Flood in the RB Annulus	
					BREAK MORE 2IN	FWDS, Break in Pipe With More Than 2" Flow	
					OPD-AFS-S2-120M	Operator Fails to Isolate Large (D>2") FWDS Pipe Break Before Penetration in 120 Minutes	
					OPE-AFS-40M	Operator Fails to Isolate Large (D>2") FWDS Pipe Break Before Ground Level in 40 Minutes	
					SGB30AA021EOPY	FWDS, MOV SGB30AA021, Fails to Remain Closed (SO) (1 Year Mission Time)	

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			Group	Cumulative	Event Identifier	Event Description	
8	42-49, 58-65, 78, 83, 99	9.14E-11 - 3.14E-11	2.2	38.1	<b>Sequence: LOCCW-21: IE FLD-SAB14 FB, RCP LOCA, LTC</b>		Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building disables all Div. 4 pumps, CVCS and EBS pumps. A loss of the running CCW pump Div. 4, and flooding of CCW switchover valves, leads to a loss of CCW CH2 and, given that thermal barrier (TB) cooling is provided by CH2, a loss of TB cooling to all RCP pumps. Seal injection from CVCS is also lost. A failure of any RCP isolation valve (Nitrogen Venting or any seal leakoff) would result in a RCP seal LOCA with probability of 0.2. Failure to start standby cooling tower fans results in a loss of CCW heat exchangers and a loss of long term cooling (SAHR pump is disabled by the flood)
					IE FLD-SAB14 FB	Initiator - Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building	
					CONF CH2 TO TB	Configuration 2: CH2 Supplying All RCP TB. Maintenance on CCW 2 Only.	
					JEB30AA020EFC	RCP Seal, RCP3 Seal Nitrogen Venting Isolation MOV JEB30AA020, Fails to Close on Demand	
					PED10AN002EFS_F-ALL	CCF to Start Standby Cooling Tower Fans (At Power)	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	
9	30-37, 100	1.11E-10 - 3.1E-11	1.5	39.6	<b>Sequence: LOCCW-25: IE FLD-SAB14 FB, RCP LOCA, EFW INV, OP FB</b>		Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building disables all Div. 4 pumps, CVCS and EBS pumps. A loss of the running CCW pump Div. 4, and flooding of CCW switchover valves, leads to a loss of CCW CH2 and, given that thermal barrier (TB) cooling is provided by CH2, a loss of TB cooling to all RCP pumps. Seal injection from CVCS is also lost. A failure of any RCP isolation valve (Nitrogen Venting or any seal leakoff) would result in a RCP seal LOCA with probability of 0.2. Failure to refill EFW tanks results in inadequate EFW inventory for 24 hours mission time. Operator failure to initiate feed & bleed, after EFW tanks inventory runs out, results in a total loss of heat removal.
					IE FLD-SAB14 FB	Initiator - Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building	
					CONF CH2 TO TB	Configuration 2: CH2 Supplying All RCP TB. Maintenance on CCW 2 Only.	
					JEB10AA020EFC	RCP Seal, RCP1 Seal Nitrogen Venting Isolation MOV JEB10AA020, Fails to Close on Demand	
					OPD-FB-_90M-LOW	Operator fails to start F&B for transient or low DH transient - low dependency	
					OPF-EFW RF-6H	Operator Fails to Refill EFW Tanks Through DWS/Fire Water Make Up	
					PROB SEAL LOCA	Probability of Seal LOCA Occurring Given a Loss of Seal Cooling	

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Group No	Cutset Numbers	Cutset Frequencies	Contribution to CDF (%)		Sequence Type and a Representative Cutset		Sequence Description
			Group	Cumulative	Event Identifier	Event Description	
10	14, 67	3.20E-10 - 5.6E-11	0.6	40.2	<b>Sequence: LOCCW-10: IE FLD-SAB14 FB, MFW, SSS, EFW INV, OP FB</b>		Flood in Safeguard Building 1 or 4 (Pump Room) including Fuel Building disables all Div. 4 pumps, CVCS and EBS pumps. PAS fails MFW and SSS. Failure to refill EFW tanks results in an inadequate EFW inventory for 24 hours mission time. Operator failure to initiate feed & bleed, after EFW tanks inventory runs out, results in a total loss of heat removal.
					IE FLD-SAB14 FB	Initiator - Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building	
					OPD-FB-_90M-LOW	Operator fails to start F&B for transient or low DH transient - low dependency	
					OPF-EFW RF-6H	Operator Fails to Refill EFW Tanks Through DWS/Fire Water Make Up	
					PAS	Process Automation System (PAS) Fails (Estimate)	
11	66	5.64E-11	0.1	40.3	<b>Sequence: LOCCW-17: IE FLD-SAB14 FB, MFW, SSS, EFW, MHSI FB, LHSI</b>		Flood in the pump room of safeguard building, disables all pumps in Div 4. EDGs in Div 2 & 3 fail to run, while EDG Div.1 is in preventive maintenance. Alternative alignment of Div1 (when EDG is in PM) prevents Div 1 SBO DG to be aligned to EUPS Div 1. These events lead to a total station blackout.
					IE FLD-SAB14 FB	Initiator - Flood in Safeguard Building 1 or 4 (Pump Room) Including Fuel Building	
					EDG PM1	EDG Train 1 Unavailable due to Preventive Maintenance (Alt. Feed Alignment)	
					LOOPCSD+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to a Controlled Shutdown	
					XKA20____DFR	ELEC, Emergency Diesel Generator XKA20, Fails to Run	
					XKA30____DFR	ELEC, Emergency Diesel Generator XKA30, Fails to Run	

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Group No	Cutset Numbers	Cutset Frequencies	Contribution to CDF (%)		Sequence Type and a Representative Cutset		Sequence Description
			Group	Cumulative	Event Identifier	Event Description	
12	23-26, 79-82	2.31E-10 - 4.37E-11	1.8	42.1	<b>Sequence: LBOP-8: IE FLD-TB, EFW INV, OP FB</b>		A flood in the Turbine Building fails MFW and SSS. EFW Div 2 is in preventive maintenance, and operators failure to align or refill EFW tanks, results in an inadequate EFW inventory for 24 hours mission time. Operator failure to initiate feed & bleed, after EFW tanks inventory runs out, results in a total loss of heat removal.
					IE FLD-TB	Initiator - Flood in the Turbine Building	
					EFWS PM2	EFWS Train 2 Unavailable due to Preventive Maintenance	
					OPD-EFWRF/XTIE	Failure to Refill EFW Tanks Within 6 Hrs Given Failure to Xtie Tanks	
					OPD-FB-_90M-LOW	Operator fails to start F&B for transient or low DH transient - low dependency	
OPF-EFW-6H	Operator Fails to Manually Align EFW Tanks Within 6 Hrs						
13	29, 41, 97	1.26E-10 - 3.28E-11	0.4	42.5	<b>Sequence: LBOP-17: IE FLD-TB, EFW, OP FB</b>		A flood in the Turbine Building fails MFW and SSS. CCF of EFW pumps to start requires the operators to initiate Feed and Bleed. Failure to do so results in core damage. A variant of this cutset has EFW failing because of I&C sensor CCF.
					IE FLD-TB	Initiator - Flood in the Turbine Building	
					LAS11AP001EFS_D-ALL	CCF of EFWS Pumps to Start	
OPE-FB-90M	Operator Fails to Initiate Feed & Bleed for Transient						
14	89	3.89E-11	0.1	42.6	<b>Sequence: LBOP-16: IE FLD-TB, EFW, PBL</b>		A flood in the Turbine Building fails MFW and SSS. CC failure of MSSRVs and MSRVs fails steam removal, and results in a total loss of heat removal.
					IE FLD-TB	Initiator - Flood in the Turbine Building	
					LBA11AA191SFO_H-ALL	CCF to Open Main Steam Safety Relief Valves	
LBA13AA001PFO_D-ALL	CCF to Open Main Steam Relief Isolation Valves						

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			Group	Cumulative	Event Identifier	Event Description	
15	55	6.80E-11	0.1	42.7	<b>Sequence: LOCCW-10: IE FLD-EFW, MFW, SSS, EFW INV, OP FB</b>		EFW pipe break in SAB4 disables all Div. 4 pumps, and empties one EFW tank. PAS fails MFW and SSS. Failure to refill EFW tanks results in an inadequate EFW inventory for 24 hours mission time. Operator failure to initiate feed & bleed, after EFW tanks inventory runs out, results in a total loss of heat removal.
					IE FLD-EFW	Initiator - EFW Pipe Break	
					OPD-FB-_90M-LOW	Operator fails to start F&B for transient or low DH transient - low dependency	
					OPF-EFW RF-6H	Operator Fails to Refill EFW Tanks Through DWS/Fire Water Make Up	
					PAS	Process Automation System (PAS) Fails (Estimate)	
16	98	3.20E-11	0.1	42.8	<b>Sequence: LOCCW-7: IE FLD-EFW, MFW, SSS, EFW INV, MHSI FB, LTC</b>		EFW pipe break in SAB4 disables all Div. 4 pumps, and empties one EFW tank. A consequential LOOP fails MFW and SSS and prevents the operator to make-up to the EFW inventory, resulting in total EFW lost. Feed and Bleed will be initiated, but failure of EDGs disables CCW to LHSI heat exchanger. SAHR is loss because of the flood in Div. 4, resulting in a failure of long term heat removal.
					IE FLD-EFW	Initiator - EFW Pipe Break	
					LOOPCSD+REC	Consequential LOOP and Failure of Recovery Within 1 Hour for IEs Leading to a Controlled Shutdown	
					XKA10____DFR_D-ALL	CCF of EDGs to Run	
17	54	7.60E-11	0.1	42.9	<b>Sequence: LOCCW-10: IE FLD-SAB23, MFW, SSS, EFW INV, OP FB</b>		Flood in Safeguard Building 2 or 3 (Pump Room) all Div. 2 pumps. PAS fails MFW and SSS. Failure to refill EFW tanks results in an inadequate EFW inventory for 24 hours mission time. Operator failure to initiate feed & bleed, after EFW tanks inventory runs out, results in a total loss of heat removal.
					IE FLD-SAB23	Initiator - Flood in Safeguard Building 2 or 3 (Pump Room)	
					OPD-FB-_90M-LOW	Operator fails to start F&B for transient or low DH transient - low dependency	
					OPF-EFW RF-6H	Operator Fails to Refill EFW Tanks Through DWS/Fire Water Make Up	
					PAS	Process Automation System (PAS) Fails (Estimate)	