Table 19.1-110—Level 2 Low Power Shutdown Plant Operating States Definition

Plant State	CA	CB	D	E
RCS status	Closed	Closed	Open	Open
Containment status	Open	Open	Closed	Open
RCS Inventory	Normal	Mid-loop	Mid-loop	Cavity flooded
Corresponding Level 1 POSs	CAd & CAu	CBd & CBu	Dd & Du	E
Decay heat (MW)	37.2 & 13.2	23.7 & 13.2	18.5 & 13.2	17.3

Table 19.1-111—Level 2 Low Power Shutdown Core Damage End States Definition

CDES	Description
TR(C)	Core damage transient sequences where the RCS system was not depressurized in POSs CA and CB
TR(D)	Core damage transient sequences with the RCS system depressurized in POS D
SL(CA)	Core damage small LOCA sequences where the RCS system was not depressurized in POS CA
SL(CB)	Core damage small LOCA sequences where the RCS system was not depressurized in POS CB
SL(D)	Core damage small LOCA sequences with the RCS system depressurized in POS D
SL(E)	Core damage small LOCA sequences with the RCS system depressurized in POS E
PL(CA)	Core damage LOCA sequences with the opening of the Pressurizer valves in POS CA
PL(CB)	Core damage LOCA sequences with the opening of the Pressurizer valves in POS CB
SS(CA)	Core damage seal LOCA sequences where the RCS system was not depressurized in POS CA.
IS	Core damage Interfacing System LOCA sequences

Table 19.1-112—Level 2 Low Power Shutdown Containment Isolation

Valve ID	System	Fraction of time open at Power	Fraction of time open at shutdown
JMM10AA006/007	Leak-Off	0	0.01
KLA10/20AA001/003	Containment Ventilation	0.05	1
KLA30AA002/003 KLA40AA001/002	Containment Ventilation	0	1
KPL84AA002/003	Gaseous Waste Processing	1	1
KPL85AA003/004	Gaseous Waste Processing	0.1[1]	0.1
KTA10AA018/017	NI Drain and Vent	0.01	1
KTC10AA005/006/010/029 KTD10AA015/024	NI Drain and Vent	0.01	0.1

Notes:

1. Overpressure failure probability.

Table 19.1-113—Level 2 Low Power Shutdown Source Term for Plant State CA

Release Category	Plant State CA								
	Release Fraction								
	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC101	6.36E-3	2.40E-5	1.72E-5	6.75E-5	1.26E-6	9.99E-6	1.53E-7	2.28E-6	7.59E-6
RC201	1.00E+0	1.04E-1	5.33E-2	1.48E-1	2.59E-3	1.42E-2	3.75E-4	5.83E-3	1.44E-2
RC202	1.00E+0	1.04E-2	5.33E-3	1.48E-2	2.59E-4	1.42E-3	3.75E-5	5.83E-4	1.44E-3
RC203	1.00E+0	1.04E-1	5.33E-2	1.48E-1	2.59E-3	1.42E-2	3.75E-4	5.83E-3	1.44E-2
RC204	1.00E+0	1.04E-2	5.33E-3	1.48E-2	2.59E-4	1.42E-3	3.75E-5	5.83E-4	1.44E-3
RC205	1.00E+0	1.04E-1	5.33E-2	1.48E-1	2.59E-3	1.42E-2	3.75E-4	5.83E-3	1.44E-2
RC206	1.85E-1	5.61E-3	4.98E-3	8.99E-3	1.24E-3	7.25E-3	5.49E-5	1.80E-4	4.20E-3
RC301	1.00E+0	1.04E-2	5.33E-3	1.48E-2	2.59E-4	1.42E-3	3.75E-5	5.83E-4	1.44E-3
RC302	1.00E+0	1.04E-1	5.33E-2	1.48E-1	2.59E-3	1.42E-2	3.75E-4	5.83E-3	1.44E-2
RC303	1.00E+0	1.04E-2	5.33E-3	1.48E-2	2.59E-4	1.42E-3	3.75E-5	5.83E-4	1.44E-3
RC304	1.00E+0	1.04E-1	5.33E-2	1.48E-1	2.59E-3	1.42E-2	3.75E-4	5.83E-3	1.44E-2
RC401	9.73E-1	2.03E-3	1.04E-3	1.23E-3	3.82E-4	2.05E-4	1.14E-5	4.93E-5	7.34E-4
RC402	9.73E-1	2.03E-2	1.04E-2	1.23E-2	3.82E-3	2.05E-3	1.14E-4	4.93E-4	7.34E-3
RC403	9.73E-1	2.03E-3	1.04E-3	1.23E-3	3.82E-4	2.05E-4	1.14E-5	4.93E-5	7.34E-4
RC404	9.73E-1	2.03E-2	1.04E-2	1.23E-2	3.82E-3	2.05E-3	1.14E-4	4.93E-4	7.34E-3
RC501	1.00E+0	4.09E-5	6.94E-6	6.13E-5	8.45E-7	4.43E-6	2.83E-8	7.32E-8	2.40E-6
RC502	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC503	1.00E+0	4.09E-5	6.94E-6	6.13E-5	8.45E-7	4.43E-6	2.83E-8	7.32E-8	2.40E-6
RC504	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC602	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC701	1.09E-1	4.21E-3	4.35E-3	6.94E-3	6.00E-4	4.80E-3	2.25E-5	1.12E-4	2.72E-3
RC702	1.09E-1	8.42E-2	8.70E-2	1.39E-1	1.20E-2	9.60E-2	4.49E-4	2.24E-3	5.45E-2
RC802	9.76E-1	7.06E-1	6.93E-1	6.42E-1	1.25E-1	5.69E-1	3.85E-3	2.22E-2	3.80E-1

Table 19.1-114—Level 2 Low Power Shutdown Source Term for Plant State CB

Release Category	Plant State CB								
	Release Fraction								
	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC101	7.54E-3	2.77E-5	1.69E-5	9.17E-5	2.19E-6	1.26E-5	2.96E-7	4.45E-6	7.12E-6
RC201	1.00E+0	6.17E-2	2.94E-2	1.45E-1	2.16E-3	1.34E-2	3.47E-4	5.18E-3	9.82E-3
RC202	1.00E+0	6.17E-3	2.94E-3	1.45E-2	2.16E-4	1.34E-3	3.47E-5	5.18E-4	9.82E-4
RC203	1.00E+0	6.17E-2	2.94E-2	1.45E-1	2.16E-3	1.34E-2	3.47E-4	5.18E-3	9.82E-3
RC204	1.00E+0	6.17E-3	2.94E-3	1.45E-2	2.16E-4	1.34E-3	3.47E-5	5.18E-4	9.82E-4
RC205	1.00E+0	6.17E-2	2.94E-2	1.45E-1	2.16E-3	1.34E-2	3.47E-4	5.18E-3	9.82E-3
RC206	1.85E-1	5.61E-3	4.98E-3	8.99E-3	1.24E-3	7.25E-3	5.49E-5	1.80E-4	4.20E-3
RC301	1.00E+0	6.17E-3	2.94E-3	8.99E-4	2.16E-4	1.34E-3	3.47E-5	5.18E-4	9.82E-4
RC302	1.00E+0	6.17E-2	2.94E-2	1.45E-1	2.16E-3	1.34E-2	3.47E-4	5.18E-3	9.82E-3
RC303	1.00E+0	6.17E-3	2.94E-3	1.45E-2	2.16E-4	1.34E-3	3.47E-5	5.18E-4	9.82E-4
RC304	1.00E+0	6.17E-2	2.94E-2	1.45E-1	2.16E-3	1.34E-2	3.47E-4	5.18E-3	9.82E-3
RC401	9.73E-1	2.03E-3	1.04E-3	1.23E-3	3.82E-4	2.05E-4	1.14E-5	4.93E-5	7.34E-4
RC402	9.73E-1	2.03E-2	1.04E-2	1.23E-2	3.82E-3	2.05E-3	1.14E-4	4.93E-4	7.34E-3
RC403	9.73E-1	2.03E-3	1.04E-3	1.23E-3	3.82E-4	2.05E-4	1.14E-5	4.93E-5	7.34E-4
RC404	9.73E-1	2.03E-2	1.04E-2	1.23E-2	3.82E-3	2.05E-3	1.14E-4	4.93E-4	7.34E-3
RC501	1.00E+0	4.09E-5	6.94E-6	6.13E-5	8.45E-7	4.43E-6	2.83E-8	7.32E-8	2.40E-6
RC502	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC503	1.00E+0	4.09E-5	6.94E-6	6.13E-5	8.45E-7	4.43E-6	2.83E-8	7.32E-8	2.40E-6
RC504	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC602	1.00E+0	4.09E-4	6.94E-5	6.13E-4	8.45E-6	4.43E-5	2.83E-7	7.32E-7	2.40E-5
RC701	1.09E-1	4.21E-3	4.35E-3	6.94E-3	6.00E-4	4.80E-3	2.25E-5	1.12E-4	2.72E-3
RC702	1.09E-1	8.42E-2	8.70E-2	1.39E-1	1.20E-2	9.60E-2	4.49E-4	2.24E-3	5.45E-2
RC802	9.76E-1	7.06E-1	6.93E-1	6.42E-1	1.25E-1	5.69E-1	3.85E-3	2.22E-2	3.80E-1

Table 19.1-115—Level 2 Low Power Shutdown Source Term for Plant States D and E

Release Category	Plant States D and E								
	Release Fraction								
	XE/KR	I	Cs	Te	Sr	Ru	La	Ce	Ba
RC101	7.54E-03	1.66E-04	1.69E-04	7.33E-04	2.19E-05	1.26E-04	3.56E-06	5.34E-05	7.12E-05
RC201	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC202	1.00E+00	3.70E-02	2.94E-02	1.16E-01	2.16E-03	1.34E-02	4.16E-04	6.22E-03	2.16E-03
RC203	1.00E+00	3.70E-01	2.94E-01	1.16E+00	2.16E-02	1.34E-01	4.16E-03	6.22E-02	9.82E-02
RC204	1.00E+00	3.70E-02	2.94E-02	1.16E-01	2.16E-03	1.34E-02	4.16E-04	6.22E-03	9.82E-03
RC205	1.00E+00	3.70E-01	2.94E-01	1.16E+00	2.16E-02	1.34E-01	4.16E-03	6.22E-02	9.82E-02
RC206	1.85E-01	3.37E-02	4.98E-02	7.19E-02	1.24E-02	7.25E-02	6.59E-04	2.16E-03	4.20E-02
RC301	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC302	1.00E+00	3.70E-01	2.94E-01	1.16E+00	2.16E-02	1.34E-01	0.00E+00	6.22E-02	9.82E-02
RC303	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC304	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC401	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC402	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC403	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC404	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC501	1.00E+00	4.09E-05	6.94E-06	6.13E-05	8.45E-07	4.43E-06	2.83E-08	7.32E-08	2.40E-06
RC502	1.00E+00	4.09E-04	6.94E-05	6.13E-04	8.45E-06	4.43E-05	2.83E-07	7.32E-07	2.40E-05
RC503	1.00E+00	4.09E-05	6.94E-06	6.13E-05	8.45E-07	4.43E-06	2.83E-08	7.32E-08	2.40E-06
RC504	1.00E+00	4.09E-04	6.94E-05	6.13E-04	8.45E-06	4.43E-05	2.83E-07	7.32E-07	2.40E-05
RC602	1.00E+00	4.09E-04	6.94E-05	6.13E-04	8.45E-06	4.43E-05	2.83E-07	7.32E-07	2.40E-05
RC701	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC702	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RC802	9.76E-01	7.06E-01	6.93E-01	1.45E-01	1.25E-01	5.69E-01	3.85E-03	2.22E-02	3.80E-01

Table 19.1-116—U.S. EPR Large Release Category Results - Level 2 Shutdown
Sheet 1 of 2

Release Category (RC)	Description	Mean	Contribution to LRF	Conditional Containment Failure Probability
RC201	Containment fails before vessel breach due to isolation failure, melt retained in vessel	1.6E-09	26.6%	0.028
RC202	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI, melt not flooded ex vessel, with containment sprays	1.2E-12	0.0%	0.000
RC203	Containment fails before vessel breach due to isolation failure, melt released from vessel, with MCCI, melt not flooded ex vessel, without containment sprays	5.6E-13	0.0%	0.000
RC204	Containment fails before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex vessel with containment sprays	1.0E-09	17.3%	0.018
RC205	Containment failures before vessel breach due to isolation failure, melt released from vessel, without MCCI, melt flooded ex vessel without containment sprays	4.9E-10	8.1%	0.008
RC301	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex vessel, with containment sprays	6.7E-13	0.0%	0.000
RC302	Containment fails before vessel breach due to containment rupture, with MCCI, melt not flooded ex vessel, without containment sprays	4.9E-13	0.0%	0.000
RC303	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex vessel, with containment sprays	9.5E-10	15.8%	0.016
RC304	Containment fails before vessel breach due to containment rupture, without MCCI, melt flooded ex vessel, without containment sprays	2.9E-10	4.8%	0.005
RC702	Steam Generator Tube Rupture without Fission Product Scrubbing	1.0E-13	0.0%	0.000
RC801	Interfacing System LOCA with Fission Product Scrubbing	0.0E+00	0.0%	0.000

Table 19.1-116—U.S. EPR Large Release Category Results - Level 2 Shutdown
Sheet 2 of 2

Release Category (RC)	Description	Mean	Contribution to LRF	Conditional Containment Failure Probability
RC802	Interfacing System LOCA without Fission Product Scrubbing but building credited	1.6E-09	27.3%	0.028
	Shutdown LRF:	**6.0E-09**	**100.0%**	**0.104**
	RS Shutdown LRF:	**5.7E-09**		**0.099**

Table 19.1-117—U.S. EPR Large Release Frequency for each POS - Level 2 Shutdown

Statistics	State					
	All	C (All)	CA	CB	D	E
Shutdown CDF	5.8E-08	4.2E-08	9.9E-09	3.2E-08	1.4E-08	9.9E-10
Large Release Frequency	5.7E-09	4.3E-09	1.4E-09	3.0E-09	3.6E-10	1.0E-09
Conditional Containment Failure Probability	0.099	0.10	0.14	0.092	0.026	1

Table 19.1-118—U.S. EPR Large Release Frequency for each Initiating Event - Level 2 Shutdown

Initiator	Description	LFF per Initiator (1/yr)	LRF per Initiator (%)
LOCA CAD	LOCA During Shutdown State CAd	6.5E-11	1.1%
LOCA CAU	LOCA During Shutdown State CAu	2.9E-11	0.5%
LOCA CBD	LOCA During Shutdown State CBd	1.1E-09	18.6%
LOCA CBU	LOCA During Shutdown State CBu	5.1E-10	8.9%
LOCA DD	LOCA During Shutdown State Dd	2.1E-12	0.0%
LOCA DU	LOCA During Shutdown State Du	3.2E-12	0.1%
LOCA E	LOCA During Shutdown State E	2.0E-10	3.6%
RHR CAD	RHR in Shutdown State CAd	5.8E-10	10.2%
RHR CAU	RHR in Shutdown State CAu	3.8E-10	6.7%
RHR CBD	RHR in Shutdown State CBd	2.5E-10	4.4%
RHR CBU	RHR in Shutdown State CBu	5.4E-10	9.6%
RHR DD	RHR in Shutdown State Dd	4.4E-11	0.8%
RHR DU	RHR in Shutdown State Du	1.3E-10	2.3%
RHR ISLOCA CAD	RHR ISLOCA During Shutdown State CAd	2.4E-10	4.2%
RHR ISLOCA CAU	RHR ISLOCA During Shutdown State CAu	7.9E-11	1.4%
RHR ISLOCA CBD	RHR ISLOCA During Shutdown State CBd	2.4E-10	4.2%
RHR ISLOCA CBU	RHR ISLOCA During Shutdown State CBu	1.2E-10	2.1%
RHR ISLOCA DD	RHR ISLOCA During Shutdown State Dd	5.9E-11	1.0%
RHR ISLOCA DU	RHR ISLOCA During Shutdown State Du	1.2E-10	2.1%
RHR ISLOCA E	RHR ISLOCA During Shutdown State E	7.9E-10	13.9%
ULD CBD	Uncontrolled Level Drop in Shutdown State CBd	2.5E-10	4.4%
ULD CBU	Uncontrolled Level Drop in Shutdown State CBu	4.0E-13	0.0%
ULD DD	Uncontrolled Level Drop in Shutdown State Dd	0.0E+00	0.0%
ULD DU	Uncontrolled Level Drop in Shutdown State Du	1.8E-12	0.0%
LRF	Large Release Frequency	**5.7E-09**	100.0%

Table 19.1-119—U.S. EPR Release Category Frequencies for each POS - Level 2 Shutdown

Release Category Frequency (1/yr) (Bolded are LRF)	State					
	All	C	CA	CB	D	E
RC 101	5.8E-08	4.4E-08	1.2E-08	3.2E-08	1.4E-08	0.0E+00
RC201	**1.6E-09**	**1.4E-09**	**4.7E-10**	**9.7E-10**	**1.5E-10**	**1.6E-10**
RC202	**1.2E-12**	**9.8E-13**	**2.2E-13**	**7.6E-13**	**1.5E-14**	**2.0E-13**
RC203	**5.6E-13**	**4.3E-13**	**1.1E-13**	**3.1E-13**	**9.6E-14**	**4.0E-14**
RC204	**1.0E-09**	**8.5E-10**	**1.9E-10**	**6.6E-10**	**1.3E-11**	**1.8E-10**
RC205	**4.9E-10**	**3.7E-10**	**1.0E-10**	**2.7E-10**	**8.4E-11**	**3.5E-11**
RC206	1.3E-09	7.1E-10	2.9E-10	4.2E-10	5.9E-10	0.0E+00
RC301	**6.7E-13**	**6.7E-13**	**1.5E-13**	**5.2E-13**	**0.0E+00**	**0.0E+00**
RC302	**4.9E-13**	**4.1E-13**	**1.0E-13**	**3.1E-13**	**7.7E-14**	**0.0E+00**
RC303	**9.5E-10**	**9.5E-10**	**2.9E-10**	**6.7E-10**	**0.0E+00**	**0.0E+00**
RC304	**2.9E-10**	**2.9E-10**	**8.9E-11**	**2.0E-10**	**0.0E+00**	**0.0E+00**
RC401	2.5E-15	2.5E-15	1.5E-15	9.9E-16	0.0E+00	0.0E+00
RC402	1.2E-15	1.2E-15	1.8E-16	1.1E-15	0.0E+00	0.0E+00
RC403	1.6E-13	1.6E-13	9.6E-14	6.0E-14	0.0E+00	0.0E+00
RC404	1.0E-13	1.0E-13	4.1E-14	6.3E-14	0.0E+00	0.0E+00
RC501	1.4E-13	1.0E-13	3.0E-14	7.2E-14	3.9E-14	0.0E+00
RC502	7.3E-12	5.9E-12	1.6E-12	4.3E-12	1.4E-12	0.0E+00
RC503	1.2E-10	8.5E-11	2.6E-11	5.9E-11	3.2E-11	0.0E+00
RC504	6.2E-09	5.1E-09	1.4E-09	3.7E-09	1.2E-09	0.0E+00
RC602	2.8E-11	2.2E-11	5.0E-12	1.7E-11	6.5E-12	0.0E+00
RC702	**1.0E-13**	**1.0E-13**	**6.4E-14**	**3.8E-14**	**0.0E+00**	**0.0E+00**
RC802	**1.6E-09**	**6.7E-10**	**3.2E-10**	**3.6E-10**	**1.8E-10**	**7.9E-10**

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
1	802	1, 2, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 24, 25, 26, 27, 43, 44, 45, 80, 81, 82	3.43E-10 – 7.56E-12	26.7	26.7	IE SD RHR ISLOCA E	RHR ISLOCA During Shutdown State E	**Shutdown State E:** Level 1: Interfacing system LOCA from an un-isolated RHR pipe break
						OPF-ISORHRBRK	Operator Fails to Isolate RHR Pipe Break	
						PAS	Process Automation System (PAS) Fails (Estimate)	
						RHR TR1 PIPE BRK	Pipe Break in RHR Train 1	
						L2CP ISL BL NO WATER	Level 2 conditional probability: break location not under water (ISL)	Level 2: Containment bypass. Interfacing System LOCA release, unscrubbed by submergence This sequence also occurs in shutdown states CAu, CAd, CBu, CBd, Du, & Dd.

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
2	204	18, 19, 20, 21, 22, 23, 28, 29, 30, 31	3.87E-11 – 2.90E-11	6.1	43.6	IE SD LOCA CBD	Initiator - LOCA During Shutdown State CBd	**Shutdown State CBd:** Level 1: A LOCA IE is caused by a premature opening of an RHR/ LHSI safety valve and an operator failure to isolate flow diversion; MHSI/ LHSI injection fails due to a CC failure of common cold leg injection check valves.
						JNA30AA191SPO	RHR, LHSI Train 3 Safety Valve JNA30AA191, Premature Opening	
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						OPF-ISORHRFD-CB	Operator Fails to Isolate RHR Flow Diversion (LOCA) in State CB	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour. This sequence also occurs in shutdown state CBu.

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
3	303	7, 16, 17, 32, 33, 41, 42, 61	5.51E-11 – 1.18E-11	4.1	32.5	IE SD RHR CBD	Initiator - RHR in Power State CBd	**Shutdown State CBd:** Level 1: A loss of RHR IE is caused by a LOOP during the CBd state and a CC failure of all EDGs; failure of SBODG Division 1 disables all EFW (only SG1 & 2 are assumed to be available in the CBd state); a loss of CCW (not supplied from SBODGs) disables MHSI and RHR heat exchangers; a loss of Division 1 disables SAHR.
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	
						XKA50_____DFR	ELEC, SBO Diesel Generator XKA50, Fails to Run	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	Level 2: Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences). With recovery of offsite power, SAHR is available for core spray. This sequence also occurs in shutdown states CAu, CAd, & CBu.
						L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
4	303	34, 35, 36, 37, 38, 39, 47, 48, 49, 50	2.06E-11 – 1.55E-11	3.2	48.9	IE SD LOCA CBD	Initiator - LOCA During Shutdown State CBd	**Shutdown State CBd:** Level 1: A LOCA IE is caused by a premature opening of an RHR/ LHSI safety valve and an operator failure to isolate flow diversion; MHSI/ LHSI injection fails due to a CC failure of common cold leg injection check valves.
						JNA30AA191SPO	RHR, LHSI Train 3 Safety Valve JNA30AA191, Premature Opening	
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						OPF-ISORHRFD-CB	Operator Fails to Isolate RHR Flow Diversion (LOCA) in State CB	
						L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	Level 2: Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences). This sequence also occurs in shutdown state CBu.

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
5	204	3	1.48E-10	2.6	29.3	IE SD LOCA E	Initiator - LOCA During Shutdown State E	**Shutdown State E**: Level 1: SLOCA sequence, CC failure to open MHSI/LHSI common discharge check valves results in a loss of all injection. Level 2: Containment is open in POS E.
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						SLOCA24	Small LOCA - 24 Hour	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
6	205	52, 53, 54, 55, 56, 57, 64, 65, 66, 67	1.31E-11 – 9.86E-12	2.1	45.7	IE SD LOCA CBD	Initiator - LOCA During Shutdown State CBd	**Shutdown State CBd:** Level 1: A LOCA IE is caused by a premature opening of an RHR/ LHSI safety valve and an operator failure to isolate flow diversion; MHSI injection fails due to a CC failure of the pumps; SAHR is unavailable for long term heat removal.
						JND10AP001EFR_D-ALL	CCF of MHSI Pumps to Run	
						JNG20AA192SPO	LHSI, LHSI/RHR Train 20 Overpressure Protection Safety Valve JNG20AA192, Premature Opening	
						OPF-ISORHRFD-CB	Operator Fails to Isolate RHR Flow Diversion (LOCA) in State CB	
						SAHR PM4	SAHR Train Unavailable	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(NR)=Y	In vessel recovery phenomenological success. Default, depressurized recoverable cases	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour. This sequence also occurs in shutdown state CBu.
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
7	303	51, 62, 63, 86	1.42E-11 – 7.09E-12	0.8	34.5	IE SD RHR CBD	Initiator - RHR in Power State CBd	**Shutdown State CBd**: Level 1: A loss of RHR IE is caused by a LOOP during the CBd state and a CC failure of all EDGs; failure of SBODG Division 1 disables all EFW (only SG1 & 2 are assumed to be available in the CBd state); a loss of CCW (not supplied from SBODGs) disables MHSI and RHR heat exchangers; a loss of Division 1 disables SAHR.
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	
						XKA50_____DFR	ELEC, SBO Diesel Generator XKA50, Fails to Run	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2 REC OSP 2-7H SD	Non-Recovery of OSP after 7 hours in Shutdown. Dependent on non-recovery in 1 hour	Level 2: Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences). With offsite power not recovered within 7 hours, RHR heat exchangers are unavailable for in-vessel recovery. With recovery of offsite power after 7 hours, SAHR is available for core spray. This sequence also occurs in shutdown states CAu, CAd, & CBu.
						L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
8	201	87, 88, 89, 90, 91, 92	6.77E-12	0.7	37.0	IE SD RHR CAD	Initiator - RHR in Power State CAd	**Shutdown State CBd:** Level 1: A loss of RHR IE is caused by a LOOP during the CBd state and a CC failure of all batteries (disabling all EDGs and possibility to connect SBODGs). Result is a total station blackout. This sequence also occurs in shutdown state CAd.
						BTD01_BAT__ST_D-ALL	CCF of Safety Related Batteries on Demand	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	Level 2: Containment bypass due to two containment isolation lines in open position. With recovery of offsite power, SAHR is available for core spray.
						PROB KTA10 17/18 OP	Probability that Primary Drain line KTA10 is open.	
						PROB KTD10 24/15 OP	Probability that NCS line is open.	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
9	201	58, 59, 77	1.29E-11 – 8.61E-12	0.6	35.4	IE SD RHR CAD	Initiator - RHR in Power State CAd	**Shutdown State CAd**: Level 1: A loss of RHR IE is caused by a LOOP during the CAd state and a CC failure of all EDGs; failure of SBODG Division 1 disables all EFW (only SG1 & 2 are assumed to be available in the CBd state); a loss of CCW (not supplied from SBODGs) disables MHSI and RHR heat exchangers; a loss of Division 1 disables SAHR.
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	
						XKA50_____DFR	ELEC, SBO Diesel Generator XKA50, Fails to Run	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	Level 2: Failure of containment due to operator failure to close containment hatch in 2 hours. This sequence also occurs in shutdown states CAu, & CBu.
						OPF HTCH-2H	Operator fails to close the equipment hatch in 2 hrs when power is available.	
10	205	72, 73, 74, 75	9.13E-12	0.6	50.2	IE SD ULD CBD D	Initiator - Uncontrolled Level Drop in Shutdown State CBd (Demand)	**Shutdown State CBd**: Level 1: An uncontrolled level drop IE is caused by the operator failing to stop draindown. A LOOP with CC failure of all EDGs disables MHSI; failure of electrical bus disables SAHR for long term cooling.
						34BDC_____OFL	ELEC, 6.9kV SWGR 34BDC, Fails During Operation	
						JND10AP001EFR_D-ALL	CCF of MHSI Pumps to Run	
						OPF-ULD	Operator Fails to Stop Draindown at Mid-Loop	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(NR)=Y	In vessel recovery phenomenological success. Default, depressurized recoverable cases	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour (no power).
						OPF HTCH-1H NP	Operator fails to close the equipment hatch manually in less than 1hr P=1	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
11	204	68, 69, 70	9.67E-12	0.5	35.9	IE SD RHR DU	Initiator - RHR in Power State Du	**Shutdown State Du:** Level 1: A loss of RHR IE is caused by a LOOP during the Du state and a CC failure of all batteries (disabling all EDGs and the possibility to connect SBODGs). The result is a total station blackout.
						BTD01_BAT__ST_D-ALL	CCF of Safety Related Batteries on Demand	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						L2PH INVREC(NR)=Y	In vessel recovery phenomenological success. Default, depressurized recoverable cases	Level 2: Containment bypass due to two containment isolation lines in open position. With recovery of offsite power, SAHR is available for core spray.
						PROB KTA10 17/18 OP	Probability that Primary Drain line KTA10 is open.	
						PROB KTD10 24/15 OP	Probability that NCS line is open.	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
12	205	97, 98, 99, 100	6.00E-12	0.4	37.5	IE SD RHR DU	Initiator - RHR in Power State Du	**Shutdown State Du:** Level 1: A loss of RHR IE is caused by a CC failure of SAC air supply fans during the Du state and two operator failures to recover HVAC, disabling all divisions. Result is a total station blackout (SAHR is disabled due to HVAC failure).
						OPF-SAC-1H	Operator Fails to Start Maintenance HVAC Trains After Failure of Normal SAC Safety	
						OPD-SAC2H/ SAC1H	Dependency (MED) Between OAs for Starting HVAC Maintenance Trains Recovering Room Cooling Locally	
						SAC01AN001EFR _D-ALL	CCF to Run Normal Air Supply Fans	
						PROB KTA10 17/ 18 OP	Probability that Primary Drain line KTA10 is open.	Level 2: Containment bypass due to two containment isolation lines in open position. SAHR is disabled due to HVAC failure.
						PROB KTD10 24/ 15 OP	Probability that NCS line is open.	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
13	205	40	1.87E-11	0.3	29.6	IE SD LOCA E	Initiator - LOCA During Shutdown State E	**Shutdown State E**: Level 1: SLOCA sequence, a CC failure of common IRWST suction strainers to MHSI/LHSI pumps results in a loss of all injection. Level 2: Containment is open in POS E.
						JNK10AT001SPG_P-ALL	CCF of IRWST Sump Strainers - Plugged	
						SLOCA24	Small LOCA - 24 Hour	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
14	204	46	1.66E-11	0.3	50.7	IE SD ULD CBD D	Initiator - Uncontrolled Level Drop in Shutdown State CBd (Demand)	**Shutdown State CBd**: Level 1: An uncontrolled level drop IE is caused by CC failure of CVCS LP reducing station MOVs to close, this also fails a second chance to isolate, the injection systems MHSI and LHSI fail because of a CC failure of the common injection check valves
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						KBA14AA004EFC_B-ALL	CCF to Close CVCS Low Pressure Reducing Station MOVs	
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour.

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
15	204	78, 79	7.60E-12	0.3	34.8	IE SD RHR CBU	Initiator - RHR in Power State CBu	**Shutdown State CBu:** Level 1: A loss of RHR IE is caused by a LOOP during the CBu state and a CC failure of all batteries (disabling all EDGs and possibility to connect SBODGs). Result is a total station blackout.
						OPF-XTDIV-NSC	Operator Fails to Xtie Division 1 to Division 2 or Division 4 to Division 3 During Non-SBO Conditions	
						OPF-XTLDSBO-NSC	Operator Fails to Connect and Load SBO DGs to Div 1 or 4 During Non-SBO Conditions	
						QKA10GH001_FS	SCWS, Train 1 Chiller Unit QKA10GH001, Fails to Start on Demand	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-234	CCF of EDGs to Run	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(NR)=Y	In vessel recovery phenomenological success. Default, depressurized recoverable cases	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour (no power). With recovery of offsite power, SAHR is available for core spray. This sequence also occurs in shutdown states CAd.
						OPF HTCH-1H NP	Operator fails to close the equipment hatch manually in less than 1hr P=1	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
16	201	83, 84	7.23E-12	0.3	36.2	IE SD RHR CAD	Initiator - RHR in Power State CAd	**Shutdown State CAd**: Level 1: A loss of RHR IE is caused by a LOOP during the CAd state and a CC failure of all EDGs; operator failure to x-tie divisions disables all MSRTs and EFW; a loss of CCW (not supplied from SBODGs) disables MHSI and RHR heat exchangers; a loss of SBO DG4 disables SAHR.
						OPF-XTDIVSBO-2H	Operator Fails to Xtie Division 1 to Division 2 or Division 4 to Division 3 During SBO Conditions	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	
						XKA80_____DFR	ELEC, SBO Diesel Generator XKA80, Fails to Run	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	Level 2: Failure of containment due to operator failure to close containment hatch in 2 hours (no power). This sequence also occurs in shutdown states CBu.
						OPF HTCH-2H NP	Operator fails to close the equipment hatch in 2 hrs when no power is available.	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
17	204	93, 94, 95	6.45E-12	0.3	49.2	IE SD LOCA CBD	Initiator - LOCA During Shutdown State CBd	**Shutdown State CBd:** Level 1: A LOCA IE is caused by the opening of a MHSI check valve and an operator failure to isolate flow diversion; MHSI/ LHSI injection fails due to a CC failure of common cold leg injection check valves.
						JND30AA003CIR	MHSI, MHSI Pump 30 Discharge Manual CHECK Valve JND30AA003, Internal Rupture	
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						OPF-ISORHRFD-CB	Operator Fails to Isolate RHR Flow Diversion (LOCA) in State CB	
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour.

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
18	204	60	1.23E-11	0.2	49.4	IE SD ULD CBD D	Initiator - Uncontrolled Level Drop in Shutdown State CBd (Demand)	**Shutdown State CBd**: Level 1: An uncontrolled level drop IE is caused by the operator failing to stop Draindown. A LOOP with CC failure of all EDGs disables MHSI; failure of SBODG Train 2 disables SAHR for long term cooling.
						OPF-ULD	Operator Fails to Stop Draindown at Mid-Loop	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	
						XKA80_____DFR	ELEC, SBO Diesel Generator XKA80, Fails to Run	

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(NR)=Y	In vessel recovery phenomenological success. Default, depressurized recoverable cases	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour (no power). With recovery of offsite power, SAHR is available for core spray.
						OPF HTCH-1H NP	Operator fails to close the equipment hatch manually in less than 1hr P=1	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
19	204	71	9.24E-12	0.2	49.6	IE SD ULD CBD D	Initiator - Uncontrolled Level Drop in Shutdown State CBd (Demand)	**Shutdown State CBd**: Level 1: An uncontrolled level drop IE is caused by the operator failing to stop Draindown, the failure of the CVCS LP reducing station isolation MOV to close fails a second chance to isolate; the injection systems MHSI and LHSI fail because of a CC failure of the common injection check valves.
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						KBA14AA004EFC	CVCS, Low Pressure Reducing Station Isolation MOV KBA14AA004, Fails to Close on Demand	
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour.

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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
20	303	76	8.82E-12	0.2	50.4	IE SD ULD CBD D	Initiator - Uncontrolled Level Drop in Shutdown State CBd (Demand)	**Shutdown State CBd**: Level 1: An uncontrolled level drop IE is caused by CC failure of CVCS LP reducing station MOVs to close, this also fails a second chance to isolate, the injection systems MHSI and LHSI fail because of a CC failure of the common injection check valves
						JNG13AA005CFO_D-ALL	CCF to Open LHSI/MHSI Common Injection Check Valves (SIS First Isolation Valves)	
						KBA14AA004EFC_B-ALL	CCF to Close CVCS Low Pressure Reducing Station MOVs	
						L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	Level 2: Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
21	303	85	7.09E-12	0.1	36.3	IE SD RHR CBD	Initiator - RHR in Power State CBd	**Shutdown State CBd**: Level 1: A loss of RHR IE is caused by a LOOP during the CBd state and a CC failure of all EDGs; operator failure to x-tie divisions disables all MSRTs and EFW; a loss of CCW (not supplied from SBODGs) disables MHSI and RHR heat exchangers; a loss of UHS4 disables SAHR.
						OPF-XTDIVSBO-2H	Operator Fails to Xtie Division 1 to Division 2 or Division 4 to Division 3 During SBO Conditions	
						SA-ESWS UHS4 SBO	Failure of SA-ESWS/UHS4 in SBO Conditions	
						SD LOOP24+REC	Loss Of Offsite Power During Shutdown and Failure of Recovery Within 1 Hour	
						XKA10_____DFR_D-ALL	CCF of EDGs to Run	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
						L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	Level 2: Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences). With recovery of offsite power, SAHR is available for core spray.
						L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	

Table 19.1-120—U.S. EPR Important Cutset Groups - Level 2 Shutdown
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Group No.	Release Category	Cutset Numbers	Group Frequencies	Contribution to LRF (%)		Sequence Type and a Representative Cutset		Sequence Description
				Group	Cumulative	Event Identifier	Event Description	
22	205	96	6.04E-12	0.1	37.1	IE SD RHR CAD	Initiator - RHR in Power State CAd	**Shutdown State CAd**: Level 1: A loss of RHR IE is caused by a CC failure of the LHSI/ RHR pumps during the CAd state. Failure of the PSRVs cause a transient induced LOCA; SAHR is unavailable for long term heat removal.
						JEF-PSRV-FRC	PZR, Pressurizer Safety Relief Valve Fails to Reclose or to Reseat	
						JNG10AP001EFR_ D-ALL	CCF of LHSI Pumps to Run	
						SAHR PM4	SAHR Train Unavailable	
						OPF HTCH-1H	Operator fails to close the equipment hatch manually in less than 1hr when power is available.	Level 2: Failure of containment due to operator failure to close containment hatch in 1 hour.

Table 19.1-121—U.S. EPR CDES Contribution to the LRF - Level 2 Shutdown

ID	CDES Description	LRF (1/yr)	Contribution (Total)
IS	Core Damage from Interfacing System LOCA sequences	1.6E-09	28.8%
PL(CA)	Core Damage sequences with the opening of the Pressurizer valves during POS CA.	3.8E-10	6.6%
PL(CB)	Core Damage sequences with the opening of the Pressurizer valves during POS CB.	7.4E-10	13.0%
SL(CA)	Core damage from SLOCA sequences where the RCS system was not depressurized during POS CA.	7.4E-11	1.3%
SL(CB)	Core damage from SLOCA sequences where the RCS system was not depressurized during POS CB.	1.3E-09	22.2%
SL(D)	Core damage from SLOCA sequences with the RCS system depressurized during POS D.	7.1E-12	0.1%
SL(E)	Core damage from SLOCA sequences with the RCS system depressurized during POS E.	2.0E-10	3.6%
SS(CA)	Core damage from seal LOCA sequences where the RCS system was not depressurized during POS CA.	5.2E-12	0.1%
TR(C)	Core damage from transient sequences where the RCS system was not depressurized during POS CA and CB.	1.2E-09	21.2%
TR(D)	Core damage from transient sequences with the RCS system depressurized during POS D.	1.8E-10	3.1%
Total		5.7E-09	100.0%

Table 19.1-122—U.S. EPR Risk-Significant Phenomena based on FV Importance - Level 2 Shutdown

Rank	Basic Event	Description	Nominal Value	FV	RAW
1	L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	3.2E-02	0.198	7.0
2	L2PH INVREC(NR)=Y	In vessel recovery, phenomenological success. Default, depressurized recoverable cases	1.0E+00	0.182	1.0
3	L2PH INVREC(T-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during transient CDES	7.0E-01	0.115	1.0
4	L2PH INVREC(T-DEP)=N	In-vessel recovery fails - hot leg rupture or operator depressurization during transient CDES	3.0E-01	0.048	1.1
5	L2PH INVREC(S-DEP)=Y	In-vessel recovery success - hot leg rupture or operator depressurization during seal/small LOCA CDES	9.0E-01	0.023	1.0
6	L2PH INVREC(LOOP)=Y	In-vessel recovery, phenomenological success given sufficient injection. LOOP	5.0E-01	0.015	1.0
7	L2PH INVREC(LOOP)=N	In-vessel recovery, phenomenological failure given sufficient injection. LOOP	5.0E-01	0.006	1.0

Table 19.1-123—U.S. EPR Risk-Significant Phenomena based on RAW Importance - Level 2 Shutdown

Rank	Basic Event	Description	Nominal Value	RAW	FV
1	L2PH STM EXP INV LP	Containment failure due to in-vessel steam explosion (Low pressure sequences)	5.6E-06	9.5	0.000
2	L2PH VECF-FA(H)	Very early containment failure due to H2 Flame Acceleration (Hi pressure sequences)	3.2E-02	7.0	0.198
3	L2PH VECF-H2DEF(H)	Very early CF due to hydrogen deflagration. High pressure CDES, in-vessel - PRV cycling phase	8.7E-06	4.5	0.000

Table 19.1-124—U.S. EPR Risk Significant Level 2 Human Actions based on either FV or RAW Importance - Level 2 Shutdown

ID	Description	Nominal value	FV	RAW
OPF HTCH-1H	Operator fails to close the equipment hatch in less than 1hr when power is available.	6.0E-02	0.244	4.8
OPF HTCH-1H NP	Operator fails to close the equipment hatch in less than 1hr P=1	1.0E+00	0.119	1.0
OPF HTCH-2H	Operator fails to close the equipment hatch in 2 hrs when power is available.	1.0E-02	0.023	3.3
OPF HTCH-2H NP	Operator fails to close the equipment hatch in 2 hrs when no power is available.	8.0E-02	0.035	1.4

Table 19.1-125—U.S. EPR Risk Significant Components based on FV Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown

Rank	System	Component ID	Description	FV	RAW
1	SAHRS	30JMQ40AP001	SAHR, Motor Driven Pump JMQ40AP001	0.092	3.2
2	SIS/RHRS	30JNA20AA002	RHR, LHSI Pump 20 Hot Leg Isolation MOV JNA20AA002	0.016	5.1
3	SIS/RHRS	30JNA20AA001	RHR, LHSI Pump 20 Hot Leg Isolation MOV JNA20AA001	0.015	5.0
4	SIS/RHRS	30JND30AA003	MHSI, MHSI Pump 30 Discharge Manual CHECK Valve JND30AA003	0.010	IE-NA[1]
5	RCS	30JEF-PSRV	PZR, Pressurizer Safety Relief Valve Fails to Reclose or to Reseat	0.010	4.4
6	ELEC	34BDB	ELEC, 6.9kV SWGR 34BDB	0.009	357.2
7	ELEC	34BDC	ELEC, 6.9kV SWGR 34BDC	0.009	357.2
8	ELEC	34BMB	ELEC, 480V Load Center 34BMB	0.009	357.2
9	ELEC	34BMT02	ELEC, 6.9kV-480V Transformer 34BMT02	0.009	357.2
10	SIS/RHRS	30JNG30AA003	LHSI, LHSI Train 3 to Radial Miniflow Motor Operated Check Valve JNG30AA003	0.007	IE-NA

Notes:

1. IE-NA denotes a component whose failure also leads to an initiating event, hence the calculated RAW value is not valid.

Table 19.1-126—U.S. EPR Risk Significant Components based on RAW Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown
Sheet 1 of 4

Rank	System	Component ID	Description	RAW	FV
1	ELEC	34BNB01	ELEC, 480V MCC 34BNB01	14.2	0.000
2	ELEC	34BMB4BNB01	ELEC, 480V Load Center 34BMB to 480V MCC 34BNB01 Circuit Breaker	9.7	0.000
3	SIS/RHRS	30JNG30AA006	LHSI, LHSI CL3 Discharge Manual CHECK Valve JNG30AA006	9.7	0.003
4	SIS/RHRS	30JNG30AA009	LHSI, LHSI Pump 30 Discharge Check Valve JNG30AA009	9.7	0.003
5	SIS/RHRS	30JNG20AP001	LHSI, LHSI Train 2 Motor Driven Pump JNG20AP001	8.2	0.025
6	ESWS	30PEB20AT001	ESWS, Train 2 Tube Cleaning Strainer PEB20AT001	7.5	0.001
7	SIS/RHRS	30JNG20AA006	LHSI, LHSI CL2 Discharge Manual CHECK Valve JNG20AA006	7.0	0.003
8	SIS/RHRS	30JNG20AA009	LHSI, LHSI Pump 20 Discharge Check Valve JNG20AA009	7.0	0.003
9	SIS/RHRS	30JNG20AC001	LHSI, LHSI Train 2 HTX JNG20AC001	6.7	0.000
10	ELEC	32BDD	ELEC, 6.9kV SWGR 32BDD	6.7	0.000
11	ELEC	32BDA	ELEC, 6.9kV SWGR 32BDA	6.3	0.000
12	SIS/RHRS	30JNA30AA004	RHR, LHSI Train 3 HTX Bypass to Letdown MOV JNA30AA004	6.3	0.000
13	SIS/RHRS	30JNA30AA101	RHR, LHSI Train 3 HTX Bypass MOV JNA30AA101	6.3	0.000
14	SIS/RHRS	30JNA30AA103	RHR, LHSI Train 3 Discharge to Letdown MOV JNA30AA103	6.3	0.000
15	SIS/RHRS	30JNG30AA060	LHSI, LHSI Pump 30 Discharge MOV JNG30AA060	6.3	0.000
16	SIS/RHRS	30JNG30AA102	LHSI, LHSI Pump 30 Discharge MOV JNG30AA102	6.3	0.000
17	CCWS	30KAA32AA013	CCWS, Train 3 LHSI Pump Seal Cooler MOV KAA32AA013	6.3	0.000
18	ELEC	33BDA	ELEC, 6.9kV SWGR 33BDA	5.6	0.000

Table 19.1-126—U.S. EPR Risk Significant Components based on RAW Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown
Sheet 2 of 4

Rank	System	Component ID	Description	RAW	FV
19	CCWS	30KAA20BB001	CCWS, Train 2 Surge Tank KAA20BB001	5.5	0.000
20	ELEC	32BRA	ELEC, 480V MCC 32BRA	5.4	0.001
21	ELEC	31BRA	ELEC, 480V MCC 31BRA	5.3	0.001
22	CCWS	30KAA32AA014	CCWS, Train 3 Discharge of LHSI Seal Cooler Check Valve KAA32AA014	5.3	0.000
23	ELEC	33BUC	ELEC, 250V DC Bus 33BUC	5.2	0.000
24	SIS/RHRS	30JNA20AA002	RHR, LHSI Pump 20 Hot Leg Isolation MOV JNA20AA002	5.1	0.016
25	ELEC	32BNB02	ELEC, 480V MCC 32BNB02	5.0	0.001
26	SIS/RHRS	30JNA20AA001	RHR, LHSI Pump 20 Hot Leg Isolation MOV JNA20AA001	5.0	0.015
27	ELEC	32BDB	ELEC, 6.9kV SWGR 32BDB	4.9	0.000
28	ELEC	32BMB	ELEC, 480V Load Center 32BMB	4.9	0.000
29	ELEC	32BMT02	ELEC, 6.9kV-480V Transformer 32BMT02	4.9	0.000
30	ELEC	32BNT01	ELEC, Constant Voltage Transformer 32BNT01	4.9	0.000
31	CCWS	30KAA20AA112	CCWS, Train 2 Heat Exchanger Bypass MOV KAA20AA112	4.9	0.000
32	SIS/RHRS	30JNA20AA101	RHR, LHSI Train 2 HTX Bypass MOV JNA20AA101	4.8	0.000
33	SIS/RHRS	30JNG20AA060	LHSI, LHSI Pump 20 Discharge MOV JNG20AA060	4.8	0.000
34	SIS/RHRS	30JNG20AA102	LHSI, LHSI Pump 20 Flow Control MOV JNG20AA102	4.8	0.000
35	CCWS	30KAA22AA005	CCWS, Train 2 to LHSI HTX 20 Cooling MOV KAA22AA005	4.8	0.000
36	CCWS	30KAA22AA013	CCWS, Train 2 LHSI Pump Seal Cooler MOV KAA22AA013	4.8	0.000
37	ELEC	31BRU011BRA	ELEC, Inverter 31BRU01 to 480V MCC 31BRA Circuit Breaker	4.7	0.000
38	ELEC	32BDB2BMT02	ELEC, 6.9kV SWGR 32BDB to Transformer 32BMT02 Circuit Breaker	4.7	0.000

Table 19.1-126—U.S. EPR Risk Significant Components based on RAW Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown
Sheet 3 of 4

Rank	System	Component ID	Description	RAW	FV
39	ELEC	32BMB2BNT01	ELEC, 480 Load Center 32BMB to Transformer 32BNT01 Circuit Breaker	4.7	0.000
40	ELEC	32BMT022BMB	ELEC, Transformer 32BMT02 to 480V Load Center 32BMB Circuit Breaker	4.7	0.000
41	ELEC	32BNT012BNB02	ELEC, Transformer 32BNT01 to 480V MCC 32BNB02 Circuit Breaker	4.7	0.000
42	ELEC	32BRU012BRA	ELEC, Inverter 32BRU01 to 480V MCC 32BRA Circuit Breaker	4.7	0.000
43	CCWS	30KAA20AA004	CCWS, Train 2 Discharge from CCW HTX 20 Check Valve KAA20AA004	4.6	0.000
44	CCWS	30KAA20AC001	CCWS, Train 2 HTX 20 KAA20AC001	4.6	0.000
45	ELEC	32BDA_2BDD1	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDD Circuit Breaker	4.6	0.000
46	ELEC	32BDA_2BDD2	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDD Circuit Breaker	4.6	0.000
47	CCWS	30KAA22AA012	CCWS, Train 2 Discharge of LHSI HTX Check Valve KAA22AA012	4.5	0.000
48	CCWS	30KAA22AA014	CCWS, Train 2 Discharge of LHSI Pump Seal Cooler Check Valve KAA22AA014	4.5	0.000
49	RCS	30JEF-PSRV	PZR, Pressurizer Safety Relief Valve	4.4	0.010
50	CCWS	30KAA30BB001	CCWS, Train 3 Surge Tank KAA30BB001	4.3	0.000
51	CCWS	30KAA30AA112	CCWS, Train 3 Heat Exchanger Bypass MOV KAA30AA112	3.7	0.000
52	ESWS	30PEB30AA005	ESWS, Train 3 Pump Discharge Isolation MOV PEB30AA005	3.7	0.000
53	ELEC	32BUC	ELEC, 250V DC Bus 32BUC	3.6	0.000
54	CCWS	30KAA30AC001	CCWS, Train 3 HTX 30 KAA30AC001	3.5	0.000

Table 19.1-126—U.S. EPR Risk Significant Components based on RAW Importance Measure Related to Level 2 Specific Importance - Level 2 Shutdown
Sheet 4 of 4

Rank	System	Component ID	Description	RAW	FV
55	ELEC	33BDA_3BDD1	ELEC, 6.9kV SWGR 33BDA to 6.9kV SWGR 33BDD Circuit Breaker	3.5	0.000
56	ELEC	33BDA_3BDD2	ELEC, 6.9kV SWGR 33BDA to 6.9kV SWGR 33BDD Circuit Breaker	3.5	0.000
57	ELEC	31BDA_1BDC1	ELEC, 6.9kV SWGR 31BDA to 6.9kV SWGR 31BDC Circuit Breaker	3.4	0.000
58	ELEC	32BDA_2BDB1	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDB Circuit Breaker	2.8	0.000
59	ELEC	32BDA_2BDB2	ELEC, 6.9kV SWGR 32BDA to 6.9kV SWGR 32BDB Circuit Breaker	2.8	0.000
60	ESWS	30PEB20AA005	ESWS, Train 2 Pump Discharge Isolation MOV PEB20AA005	2.7	0.000
61	CCWS	30KAA30AA004	CCWS, Train 3 Discharge from CCW HTX 30 Check Valve KAA30AA004	2.6	0.000
62	ESWS	30PEB30AA004	ESWS, Train 3 Pump Discharge Check Valve PEB30AA004	2.6	0.001
63	ESWS	30PEB20AA004	ESWS, Train 2 Pump Discharge Check Valve PEB20AA004	2.0	0.001

Next File