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Your ref: Docket No. 52-006  
Our ref: DCP/NRC1625

September 19, 2003

**SUBJECT: Transmittal of Revised Responses to AP1000 DSER Open Items**

This letter transmits Westinghouse revised responses to Open Items in the AP1000 Design Safety Evaluation Report (DSER). A list of the revised DSER Open Item responses transmitted with this letter is Attachment 1. The non-proprietary responses are transmitted as Attachment 2.

Please contact me at 412-374-5355 if you have any questions concerning this submittal.

Very truly yours,

A handwritten signature in black ink, appearing to read "M. M. Corletti".

M. M. Corletti

Passive Plant Projects & Development  
AP600 & AP1000 Projects

/Attachments

1. List of the AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses transmitted with letter DCP/NRC1625
2. Non-Proprietary AP1000 Design Certification Review, Draft Safety Evaluation Report Open Item Responses dated September 19, 2003

D063

September 19, 2003

**Attachment 1**

**List of  
Non-Proprietary Responses**

<b>Table 1</b> <b>"List of Westinghouse's Responses to DSER Open Items Transmitted in DCP/NRC1625"</b>	
19.1.10.2-1 Rev. 1	
19.1.10.2-4 Rev. 1	
19.1.10.3-1 Rev. 2	
19.2.6-2 Rev. 1	

**Westinghouse Non-Proprietary Class 3**

**DCP/NRC1625  
Docket No. 52-006**

**September 19, 2003**

**Attachment 2**

**AP1000 Design Certification Review  
Draft Safety Evaluation Report Open Item Non-Proprietary Responses**

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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DSER Open Item Number: 19.1.10.2-1 (Response Revision 1)

Original RAI Number(s): 720.099

**Summary of Issue:** Shutdown Risk Due to Vacuum Refill Operations

The reported CDF from internal events during shutdown operation (1.2E-07/year) covers two plant operational states:

- safe shutdown/cold shutdown with the RCS filled and intact, and
- mid-loop/vessel flange operations with the RCS vented and drained.

Mid-loop/vessel flange operations include: (1) draining to mid-loop, and (2) drained maintenance, and post-refueling maintenance.

Vacuum refill of the RCS from drained conditions (mid-loop) was mentioned in the PRA. However, no risk assessment was performed for this configuration. Vacuum refill of the RCS helps to reduce non-condensable gas pockets in the RCS, eliminating the need for dynamic venting of the RCS and the multiple reactor coolant pump start and stop operations that it requires.

The applicant stated that the shutdown risk due to vacuum refill operations is included in the calculation of shutdown risk during vented drained conditions. The staff is reviewing the applicant's response to RAI 720.99 to determine if the shutdown risk due to vacuum refill operations is included in the calculation of shutdown risk during vented drained conditions. The staff noted during their review of the applicant's response to RAI 720.99 that Investment Protection Short term Availability Controls do not include RNS and its support systems such as Component Cooling Water System, Service Water system, and ac power supplies during vacuum refill operations. Assuming an extended loss of RNS during vacuum refill operations, the staff questions using the RNS suction relief valve to relief RCS pressure should the operators not open the ADS valves. The operators may instead isolate the RNS suction relief valve to isolate RCS leakage. As discussed in Section 19.1.10.2 of this report, this vacuum refill issue is considered to be Open Item 19.1.10.2-1.

### Westinghouse Response: Revision 1

The Revision 0 response to this DSER Open Item was discussed with the NRC staff on a teleconference. The response has been updated to address the NRC comments.

Westinghouse provided its response to RAI 720.099 in order to address this NRC concern about whether vacuum refill operations are bounded by the current AP1000 shutdown PRA. This response (rev. 0) was submitted to the NRC on March 28, 2003 in letter DCP/NRC1558.

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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The following discussion provides further support of the treatment of vacuum refill operation in the AP1000 PRA. Vacuum refill is performed during Mode 5 conditions, and the RNS is in service to provide core cooling during vacuum refill operations. The short-term availability controls provided for AP1000 address the availability of the RNS and its support systems to be available during Mode 5. No special designation of vacuum refill in the short-term availability controls is required.

Vacuum refill operations do not pose additional shutdown risk to the AP1000 because of the following reasons:

1. The decay heat during vacuum refill will be about 50% of that during drained conditions early in a shutdown, which is already considered in the shutdown PRA.
2. Although ADS stage 1/2/3 will be closed, 9 of the 10 ADS paths are required by Technical Specifications to be operable. As a result, at least 3 of 4 ADS stage 4 valves will be operable instead of the 2 of 4 during RCS drained / open conditions.
3. The time spent in vacuum refill is small compared to the time spent in drained / open shutdown conditions.
4. During vacuum refill operations, both RNS pumps and support systems are required to be available by the short-term availability controls (Mode 5, reduced inventory conditions). Therefore, there is a high probability that the RNS pumps will continue to operate during vacuum refill. The probability of a loss of RNS or its support systems in Mode 5 is adequately addressed in the shutdown PRA.

The AP1000 Emergency Response Guidelines (ERG – SDG-2, Step 6) provide direction for the operators for a loss of RNS during shutdown conditions, and the ERG response is applicable during vacuum refill operations in Mode 5.

For a loss of RNS during vacuum refill operations, the operators are immediately directed to open the ADS Stage 1, 2, and 3 valves, whether the RNS cooling was lost or whether the loss of RNS resulted from a loss of RCS inventory. There are two significant reasons why the operators would not be expected to isolate the RNS. First, on a loss of RNS cooling, the operators primary goal is to restore the RNS to operation. The operators would not isolate RNS since the RNS can not be restored to service if the system is isolated from the RCS.

Second, RNS provides the low-temperature overpressure protection for the plant during Mode 5 conditions (including vacuum refill operations), in accordance with Technical Specification 3.4.14. The operators are trained on brittle fracture prevention and the RCS pressure-temperature limits, so they thoroughly understand their priority to maintain the RCS overpressure protection flow path to the RNS during low-pressure, low-temperature shutdown conditions. Therefore, it is extremely unlikely that they would take any intentional or unintentional actions to isolate RNS following a loss of RNS cooling, with one specific exception.

# **AP1000 DESIGN CERTIFICATION REVIEW**

## **Draft Safety Evaluation Report Open Item Response**

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**Design Control Document (DCD) Revision:**

None

**PRA Revision:**

None

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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**DSER Open Item Number:** 19.1.10.2-4 (Revision 1 Response)

**Original RAI Number(s):** None

***Summary of Issue:***

The staff will confirm that the results of the sensitivity studies (including cutsets) are documented into the AP1000 Shutdown PRA. This is Open Item 19.1.10.2-4.

In the bases of AP1000 TS, there is no discussion that planned maintenance of these three systems should be avoided during cold shutdown. The frequency and duration of IRWST, ADS, and RNS maintenance performed by a future COL holder has considerable uncertainty. Therefore, the staff asked the applicant to perform a sensitivity study assuming minimal compliance with AP1000 TS. This sensitivity study provides an upper bound of the shutdown CDF assuming the COL holder chooses to always perform planned maintenance on one IRWST injection path and recirculation path, two ADS stage 4 valves, and RNS valve V-23 during cold shutdown. The shutdown CDF for this sensitivity study increases to 2.2E-06 per year (a factor of ten higher than the full power CDF). Since no cutsets were submitted in the RAI response for this sensitivity study, this documentation issue is considered part of Open Item 19.1.10.2-4

**Westinghouse Response: (Revision 1)**

The sensitivity case 1 in AP1000 PRA Section 54.9.1 examines the case where there is minimum equipment allowed by tech specs during shutdown drained conditions. The CDF from the drained conditions for this case was reported to be 1.95E-06/year. The dominant cutsets, as requested in this OI, are given in Table 1 below.

**Design Control Document (DCD) Revision:**

None

**PRA Revision:**

Westinghouse discussed the Revision 0 response during a teleconference with the NRC and agreed to add Table 1 from the Revision 0 response to PRA Chapter 54.

PRA Chapter 54.9.1 will be revised as follows:

The results of the sensitivity analysis are summarized in Tables 54-9 and 54-9A.

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

**Table 54-9A Dominant CDF Cutsets for Drained Conditions only for AP1000 Shutdown PRA Sensitivity Case 1**

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
1	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	7.16E-04 3.00E-04	IEV-CCWD IDCBSDS1TM
2	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	7.16E-04 3.00E-04	IEV-CCWD IDCBSDD1TM
3	2.15E-07	11.01	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	7.16E-04 3.00E-04	IEV-CCWD IDCBSDK1TM
4	1.72E-07	8.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS IRWST DISCHARGE LINE "B" STRAINER PLUGGED	7.16E-04 2.40E-04	IEV-CCWD IWB-PLUG
5	1.72E-07	8.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CONTAINMENT SUMP LINE B STRAINER PLUGGED	7.16E-04 2.40E-04	IEV-CCWD REB-PLUG
6	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 123B FAILS TO OPEN CHECK VALVE 124B FAILS TO OPEN	7.16E-04 8.76E-03 8.76E-03	IEV-CCWD IWBCV123AO IWBCV124AO
7	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 122B FAILS TO OPEN CHECK VALVE 125B FAILS TO OPEN	7.16E-04 8.76E-03 8.76E-03	IEV-CCWD IWBCV122AO IWBCV125AO
8	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 123B FAILS TO OPEN CHECK VALVE 125B FAILS TO OPEN	7.16E-04 8.76E-03 8.76E-03	IEV-CCWD IWBCV123AO IWBCV125AO
9	5.49E-08	2.81	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 122B FAILS TO OPEN CHECK VALVE 124B FAILS TO OPEN	7.16E-04 8.76E-03 8.76E-03	IEV-CCWD IWBCV122AO IWBCV124AO



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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
10	4.17E-08	2.14	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS FAILURE OF POWER INTERFACE OUTPUT BOARD	7.16E-04 5.83E-05	IEV-CCWD IRAEP121BSAX
11	3.32E-08	1.7	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF ACTUATION LOGIC GROUPS	7.16E-04 4.63E-05	IEV-CCWD CCX-PMAMOD1X
12	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	9.69E-05 3.00E-04	IEV-RNSD IDCBSDD1TM
13	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	9.69E-05 3.00E-04	IEV-RNSD IDCBSDK1TM
14	2.91E-08	1.49	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	9.69E-05 3.00E-04	IEV-RNSD IDCBSDS1TM
15	2.86E-08	1.47	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	7.16E-04 4.00E-05	IEV-CCWD IWX-CV-AO
16	2.72E-08	1.39	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	7.16E-04 3.80E-05	IEV-CCWD ADX-EV-SA
17	2.36E-08	1.21	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	7.16E-04 3.30E-05	IEV-CCWD IWX-EV4-SA
18	2.33E-08	1.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS IRWST DISCHARGE LINE "B" STRAINER PLUGGED	9.69E-05 2.40E-04	IEV-RNSD IWB-PLUG
19	2.33E-08	1.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CONTAINMENT SUMP LINE B STRAINER PLUGGED	9.69E-05 2.40E-04	IEV-RNSD REB-PLUG
20	1.86E-08	0.95	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN	7.16E-04 2.60E-05	IEV-CCWD IWX-EV-SA

# AP1000 DESIGN CERTIFICATION REVIEW

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
21	1.50E-08	0.77	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
22	1.45E-08	0.74	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			OPERATOR FAILS TO ISOLATE RNS PIPE RUPTURE	5.50E-02	RHN-MAN04
			COND. PROB. OF IWN-MAN00 (OP. FAILS TO ACTUATE IRWST INJ)	5.00E-02	IWN-MAN00C
23	1.25E-08	0.64	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
24	1.25E-08	0.64	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
25	9.88E-09	0.51	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
26	9.27E-09	0.47	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
27	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
28	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	1.20E-05	REX-FL-GP

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
29	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS FUSE DISCONNECT SWITCH (FD7) SPURIOUSLY OPENS	7.16E-04 1.20E-05	IEV-CCWD IDCFD007RQ
30	8.59E-09	0.44	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS FUSE DISCONNECT SWITCH (FD8) SPURIOUSLY OPENS	7.16E-04 1.20E-05	IEV-CCWD IDCFD008RQ
31	7.88E-09	0.4	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS SOFTWARE CCF OF OUTPUT LOGIC I/Os	7.16E-04 1.10E-05	IEV-CCWD CCX-PMAMOD1-SW
32	7.53E-09	0.39	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN RELAY FAILS TO OPERATE	7.16E-04 1.20E-02 8.76E-04	IEV-CCWD IRWMOD03 IWCRS120BFA
33	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 123B FAILS TO OPEN CHECK VALVE 124B FAILS TO OPEN	9.69E-05 8.76E-03 8.76E-03	IEV-RNSD IWBCV123AO IWBCV124AO
34	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 122B FAILS TO OPEN CHECK VALVE 125B FAILS TO OPEN	9.69E-05 8.76E-03 8.76E-03	IEV-RNSD IWBCV122AO IWBCV125AO
35	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 123B FAILS TO OPEN CHECK VALVE 125B FAILS TO OPEN	9.69E-05 8.76E-03 8.76E-03	IEV-RNSD IWBCV123AO IWBCV125AO
36	7.44E-09	0.38	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CHECK VALVE 122B FAILS TO OPEN CHECK VALVE 124B FAILS TO OPEN	9.69E-05 8.76E-03 8.76E-03	IEV-RNSD IWBCV122AO IWBCV124AO
37	6.95E-09	0.36	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR BATTERY DB1 UNAVAILABLE FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 2.70E-03 1.16E-03	IEV-LOSPD OTH-R1 ED1MOD03 PMA0301ASA

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
38	6.95E-09	0.36	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
39	5.74E-09	0.29	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			OPERATOR FAILS TO ACTUATE IRWST INJECTION	1.15E-03	IWN-MAN00
40	5.65E-09	0.29	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			FAILURE OF POWER INTERFACE OUTPUT BOARD	5.83E-05	IRAEP121BSAX
41	5.56E-09	0.28	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
42	5.14E-09	0.26	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
43	5.14E-09	0.26	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
44	4.49E-09	0.23	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF ACTUATION LOGIC GROUPS	4.63E-05	CCX-PMAMOD1X
45	3.88E-09	0.2	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	4.00E-05	IWX-CV-AO

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
46	3.68E-09	0.19	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	9.69E-05	IEV-RNSD
				3.80E-05	ADX-EV-SA
47	3.67E-09	0.19	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI OFFSITE AC POWER RECOVERED IN 1 HOUR SOFTWARE CCF OF ALL CARDS	5.28E-03	IEV-LOSPD
				5.80E-01	SUC-R1S
				1.20E-06	CCX-SFTW
48	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	1.15E-05	IEV-LOCA24D
				3.00E-04	IDCBSDS1TM
49	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	1.15E-05	IEV-LOCA24D
				3.00E-04	IDCBSDK1TM
50	3.45E-09	0.18	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	1.15E-05	IEV-LOCA24D
				3.00E-04	IDCBSD1TM
51	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS IDSC-DS-1 FAILS (ALL MODES)	7.16E-04	IEV-CCWD
				4.80E-06	IDCBSDS1LF
52	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS IDSC-DK-1 FAILS (ALL MODES)	7.16E-04	IEV-CCWD
				4.80E-06	IDCBSDK1LF
53	3.44E-09	0.18	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS BUS IDSC-DD-1 FAILS (ALL MODES)	7.16E-04	IEV-CCWD
				4.80E-06	IDCBSD1LF
54	3.38E-09	0.17	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE FAILURE OF PMS OUTPUT LOGIC I/Os	5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				7.30E-04	ECX-CB-GC
				2.09E-03	PMAMOD11
55	3.20E-09	0.16	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	9.69E-05	IEV-RNSD
				3.30E-05	IWX-EV4-SA

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
56	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
57	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
58	3.09E-09	0.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
59	2.76E-09	0.14	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
60	2.76E-09	0.14	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
61	2.66E-09	0.14	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
62	2.60E-09	0.13	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF ORIFICES	3.63E-06	CCX-ORY-SPX
63	2.52E-09	0.13	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF 6/6 IRWST HP SQUIB VALVES TO OPEN	2.60E-05	IWX-EV-SA

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64	2.29E-09	0.12	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
65	2.28E-09	0.12	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
66	2.11E-09	0.11	FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
67	2.04E-09	0.1	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF THE POWER INTERFACE OUTPUT BOARDS IN PMS	2.94E-06	CCX-EP-SAMX
68	2.03E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO RUN	4.40E-04	ZOX-DG-DR
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
69	1.90E-09	0.1	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
70	1.89E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
70	1.89E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

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71	1.88E-09	0.1	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF PRESSURE TRANSMITTERS	7.16E-04 2.63E-06	IEV-CCWD CCX-XMTRX
72	1.88E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 7.30E-04 1.16E-03	IEV-LOSPD OTH-R1 ECX-CB-GC PMA0301ASA
73	1.88E-09	0.1	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 7.30E-04 1.16E-03	IEV-LOSPD OTH-R1 ECX-CB-GC PMA0301BSA
74	1.83E-09	0.09	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS HARDWARE FAILURE OF SQUIB VALVE 118B HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	7.16E-04 1.46E-03 1.75E-03	IEV-CCWD IRWMOD11 REBCV119GO
75	1.80E-09	0.09	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR BATTERY DB1 UNAVAILABLE BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	5.28E-03 4.20E-01 2.70E-03 3.00E-04	IEV-LOSPD OTH-R1 ED1MOD03 IDABSDS1TM
76	1.70E-09	0.09	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN HARDWARE FAILURE OF SQUIB VALVE 120B	9.69E-05 1.20E-02 1.46E-03	IEV-RNSD IRWMOD03 IRWMOD12
77	1.53E-09	0.08	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS HARDWARE FAILURE OF SQUIB VALVE 118B HARDWARE FAILURE OF SQUIB VALVE 120B	7.16E-04 1.46E-03 1.46E-03	IEV-CCWD IRWMOD11 IRWMOD12



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78	1.47E-09	0.08	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
79	1.47E-09	0.08	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
80	1.44E-09	0.07	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			CCF OF IRWST LEVEL TRANSMITTERS	2.01E-04	IWX-XMTR
			OPER. FAILS TO ACT. SUMP RECIRC GIVEN IRW LEVEL SIGNAL FAILURE	1.00E-02	REN-MAN04
81	1.44E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
82	1.44E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
83	1.43E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

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84	1.41E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
85	1.39E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
86	1.37E-09	0.07	FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
			LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
87	1.34E-09	0.07	FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			CCF OF LOGIC GROUP PROCESSING	1.38E-05	CCX-PMA030X
			LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
88	1.33E-09	0.07	FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
89	1.30E-09	0.07	FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11

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90	1.27E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
91	1.27E-09	0.07	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
92	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
93	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
94	1.26E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF PMS OUTPUT LOGIC I/Os	6.53E-04	PMAMOD11X
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
95	1.20E-09	0.06	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
96	1.20E-09	0.06	OVERDRAINING OF RCS DURING DRAIN DOWN TO MID-LOOP INITIATING EV	5.28E-06	IEV-RCSOD
			RHN-MAN04-SUCC	9.45E-01	RHN-MAN04-SUCC
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG

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97	1.16E-09	0.06	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF STRAINERS IN IRWST TANK	9.69E-05 1.20E-05	IEV-RNSD IWV-FL-GP
98	1.16E-09	0.06	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CCF PLUGGING OF BOTH RECIRC LINES DUE TO SUMP SCREENS	9.69E-05 1.20E-05	IEV-RNSD REX-FL-GP
99	1.15E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR BREAKER 100 FAILS TO OPEN [#3 D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE FAILURE OF PMS OUTPUT LOGIC I/Os	5.28E-03 4.20E-01 1.23E-02 2.02E-02 2.09E-03	IEV-LOSPD OTH-R1 EC1CB100VO ZO2MOD01 PMAMOD11
100	1.15E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE BREAKER 200 FAILS TO OPEN [#5 FAILURE OF PMS OUTPUT LOGIC I/Os	5.28E-03 4.20E-01 2.02E-02 1.23E-02 2.09E-03	IEV-LOSPD OTH-R1 ZO1MOD01 EC2CB200VO PMAMOD11
101	1.13E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE STANDBY DG TO RUN FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 4.40E-04 1.16E-03	IEV-LOSPD OTH-R1 ZOX-DG-DR PMA0301ASA
102	1.13E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE STANDBY DG TO RUN FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 4.40E-04 1.16E-03	IEV-LOSPD OTH-R1 ZOX-DG-DR PMA0301BSA
103	1.11E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR FAILURE OF PLS OUTPUT LOGIC I/Os IRWST DISCHARGE LINE "B" STRAINER PLUGGED	5.28E-03 4.20E-01 2.09E-03 2.40E-04	IEV-LOSPD OTH-R1 PL5MOD11 IWB-PLUG

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104	1.11E-09	0.06	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
105	1.10E-09	0.06	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
106	1.07E-09	0.05	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			SOFTWARE CCF OF OUTPUT LOGIC I/Os	1.10E-05	CCX-PMAMOD1-SW
107	1.06E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
108	1.06E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
109	1.05E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
110	1.05E-09	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

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111	1.02E-09	0.05	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS	9.69E-05	IEV-RNSD
			HARDWARE FAILURE CAUSES RECIRC MOV 117B FAILS TO OPEN	1.20E-02	IRWMOD03
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA
112	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
113	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
114	9.98E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM
115	9.74E-10	0.05	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
116	9.16E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			HARDWARE FAILURE OF SQUIB VALVE 120B	1.46E-03	IRWMOD12
117	9.16E-10	0.05	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE OF SQUIB VALVE 118B	1.46E-03	IRWMOD11
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
118	8.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
119	8.59E-10	0.04	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
120	8.44E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
121	8.44E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
122	8.35E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE	7.30E-04	ECX-CB-GC
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
123	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
124	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

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125	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD11
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
126	8.15E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FIXED COMPONENTS FAILURE	3.17E-04	ED1MOD113
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
127	7.98E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
128	7.95E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
129	7.95E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO	1.53E-02	RNBMOD07S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
130	7.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA



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131	7.72E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
132	7.20E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
133	7.20E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE STANDBY DG TO START	2.80E-04	ZOX-DG-DS
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
134	7.01E-10	0.04	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
135	6.54E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
136	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

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137	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
138	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
139	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
140	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
141	6.39E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
142	6.27E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	5.00E-04	REBMV117TM
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO

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143	6.25E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO START OF ENGINE-DRIVEN FUEL PUMPS	2.00E-03	ZOX-PD-ES
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1
144	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301BSA
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
145	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301ASA
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
146	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301ASA
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
147	6.17E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND	1.16E-03	PL50301BSA
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
148	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
149	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM

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150	6.13E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
151	6.03E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
152	5.93E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF PMS OUTPUT LOGIC I/Os	2.09E-03	PMAMOD11
153	5.80E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			CCF OF LOGIC GROUP PROCESSING	9.69E-05	CCX-PMA030
154	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS121TM
155	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			BUS UNAVAILABLE DUE TO UNSCHEDULED MAINTENANCE	2.70E-03	EC1BS012TM
156	5.80E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
			UNAVAILABILITY OF BUS ECS ES 1 DUE TO UNSCHEDUL MAINTENANCE	2.70E-03	EC1BS001TM

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157	5.66E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
158	5.66E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO START OF THE PUMPS	7.70E-04	RNX-PM-FS
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG
159	5.64E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
160	5.49E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			RELAY FAILS TO OPERATE	8.76E-04	IWARS118BFA
			RELAY FAILS TO OPERATE	8.76E-04	IWCRS120BFA
161	5.40E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
162	5.40E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA

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163	5.32E-10	0.03	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI CCF OF ACTUATION LOGIC GROUPS	1.15E-05	IEV-LOCA24D
				4.63E-05	CCX-PMAMOD1X
164	5.23E-10	0.03	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN HARDWARE FAILURE OF SQUIB VALVE 120B	7.16E-04	IEV-CCWD
				5.00E-04	REBMOV117TM
				1.46E-03	IRWMOD12
165	5.13E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				7.30E-04	ECX-CB-GC
				3.17E-04	IDAMOD04
166	5.03E-10	0.03	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE STANDBY DG TO RUN FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				4.40E-04	ZOX-DG-DR
				5.16E-04	IDAMOD05
167	4.86E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR COMMON CAUSE FAILURE 4KV BREAKER TO CLOSE BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				7.30E-04	ECX-CB-GC
				3.00E-04	IDABSDS1TM
168	4.84E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO BREAKER 100 FAILS TO OPEN [#3 FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				1.53E-02	RNBMOD07S
				1.23E-02	EC1CB100VO
169	4.84E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO BREAKER 100 FAILS TO OPEN [#3 FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
				5.28E-03	IEV-LOSPD
				4.20E-01	OTH-R1
				1.53E-02	RNBMOD07S
				1.23E-02	EC1CB100VO
				1.16E-03	PMA0301ASA

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
170	4.79E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BATTERY DB1 UNAVAILABLE	2.70E-03	ED1MOD03
			FAILURE OF MIMIC BUS SELECTOR BOARD	8.00E-05	PMAXS00ASA
171	4.67E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			D/G FAILS TO START & RUN OR BKR 202 FAILS TO CLOSE	2.02E-02	ZO2MOD01
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
172	4.60E-10	0.02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF GRAVITY INJECTION CHECK VALVES TO OPEN	4.00E-05	IWX-CV-AO
173	4.49E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			FAILURE OF PLS OUTPUT LOGIC I/Os	2.09E-03	PL5MOD11
			CCF OF LOGIC GROUP PROCESSING	9.69E-05	CCX-PMA030
174	4.48E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO OPEN OF THE STOP CHECK VALVES	6.10E-04	RNX-KV-GO
			IRWST DISCHARGE LINE "B" STRAINER PLUGGED	2.40E-04	IWB-PLUG
175	4.48E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			OFFSITE AC POWER RECOVERED IN 1 HOUR	5.80E-01	SUC-R1S
			CCF TO OPEN OF THE STOP CHECK VALVES	6.10E-04	RNX-KV-GO
			SUMP SCREEN B PLUGS AND PREVENTS FLOW	2.40E-04	REB-PLUG

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB.	IDENTIFIER
176	4.46E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR FAILURE OF PLS OUTPUT LOGIC I/Os FAILURE OF PMS OUTPUT LOGIC I/Os STANDBY DG UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.28E-03 4.20E-01 2.09E-03 2.09E-03 4.60E-02	IEV-LOSPD OTH-R1 PL5MOD11 PMAMOD11 ZO1DG001TM
177	4.37E-10	0.02	LOC/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI CCF OF ADS 4TH STAGE SQUIB VALVES TO OPEN	1.15E-05 3.80E-05	IEV-LOCA24D ADX-EV-SA
178	4.30E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR CCF TO START OF ENGINE-DRIVEN FUEL PUMPS CCF OF LOGIC GROUP PROCESSING	5.28E-03 4.20E-01 2.00E-03 9.69E-05	IEV-LOSPD OTH-R1 ZOX-PD-ES CCX-PMA030
179	4.10E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR CCF TO START OF THE PUMPS SUMP SCREEN B PLUGS AND PREVENTS FLOW	5.28E-03 4.20E-01 7.70E-04 2.40E-04	IEV-LOSPD OTH-R1 RNX-PM-FS REB-PLUG
180	4.10E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR CCF TO START OF THE PUMPS IRWST DISCHARGE LINE "B" STRAINER PLUGGED	5.28E-03 4.20E-01 7.70E-04 2.40E-04	IEV-LOSPD OTH-R1 RNX-PM-FS IWB-PLUG
181	4.08E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE FAILURE OF UNDERVOLTAGE RELAY FAILURE OF PMS OUTPUT LOGIC I/Os	5.28E-03 4.20E-01 2.02E-02 4.36E-03 2.09E-03	IEV-LOSPD OTH-R1 ZO1MOD01 EC1REDG2GA PMAMOD11



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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
182	3.89E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
183	3.89E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			BREAKER 200 FAILS TO OPEN [#5	1.23E-02	EC2CB200VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
184	3.80E-10	0.02	LOCA/RNS-V024 OPENS INITIATING EVENT OCCURS WITH RCS DRAI	1.15E-05	IEV-LOCA24D
			CCF OF 2/2 IRWST LP SQUIB VALVES TO OPEN	3.30E-05	IWX-EV4-SA
185	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDD1TM
186	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDK1TM
187	3.76E-10	0.02	LOSS OF CCS/SWS WITH RCS DRAINED INITIATING EVENT OCCURS	7.16E-04	IEV-CCWD
			HARDWARE FAILURE CAUSE RECIRC. CV 119B FAILS TO OPEN	1.75E-03	REBCV119GO
			BUS UNAVAILABLE DUE TO TEST OR CORRECTIVE MAINTENANCE	3.00E-04	IDABSDS1TM
188	3.75E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			COMMON CAUSE FAILURE 4KV BREAKERS TO OPEN	1.20E-03	ECX-CB-GO
			CCF OF OUTPUT LOGIC I/O BOARDS	1.41E-04	CCX-PMAMOD1

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
189	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR FIXED COMPONENTS FAILURE FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.28E-03 4.20E-01 3.17E-04 5.16E-04	IEV-LOSPD OTH-R1 ED1MOD11 IDAMOD05
190	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR FIXED COMPONENTS FAILURE FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.28E-03 4.20E-01 3.17E-04 5.16E-04	IEV-LOSPD OTH-R1 ED1MOD113 IDAMOD05
191	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND CCF OF OUTPUT LOGIC I/O BOARDS	5.28E-03 4.20E-01 1.16E-03 1.41E-04	IEV-LOSPD OTH-R1 PL50301ASA CCX-PMAMOD1
192	3.63E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR PLS LOGIC GROUP PROCESSING FAILURE UPON DEMAND CCF OF OUTPUT LOGIC I/O BOARDS	5.28E-03 4.20E-01 1.16E-03 1.41E-04	IEV-LOSPD OTH-R1 PL50301BSA CCX-PMAMOD1
193	3.55E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR CCF TO START OF ENGINE-DRIVEN FUEL PUMPS FAILURE OF MIMIC BUS SELECTOR BOARD	5.28E-03 4.20E-01 2.00E-03 8.00E-05	IEV-LOSPD OTH-R1 ZOX-PD-ES PMAXS00ASA
194	3.54E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI FAILURE TO RECOVER AC POWER IN 1 HOUR PUMP 01B FAILS & ST CK V007B & C B FTC & RE FTC & CB ECS221 SPO D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.28E-03 4.20E-01 1.53E-02 2.02E-02 5.16E-04	IEV-LOSPD OTH-R1 RNBMOD07S ZO1MOD01 IDAMOD05
195	3.52E-10	0.02	LOSS OF RNS WITH RCS DRAINED INITIATING EVENT OCCURS CCF OF ORIFICES	9.69E-05 3.63E-06	IEV-RNSD CCX-ORY-SPX

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NUMBER	CUTSET PROB	PERCENT	BASIC EVENT NAME	EVENT PROB. IDENTIFIER	
196	3.46E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			D/G FAILS TO START & RUN OR BKR 102 FAILS TO CLOSE	2.02E-02	ZO1MOD01
			LOSS OF DIST. PANEL OR BREAKER A07 SPURIOUSLY OPENS	3.17E-04	IDAMOD04
197	3.43E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP MP 01B SEGMENT HARDWARE FAILURE OR DIVERTED FLOW	2.44E-02	SWBMOD02
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE OF INV., STATIC SWITCH AND ASSOC. BREAKERS	5.16E-04	IDAMOD05
198	3.34E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA
199	3.34E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			CCF TO RUN OF ENGINE-DRIVEN FUEL PUMPS	1.30E-04	ZOX-PD-ER
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301ASA
200	3.29E-10	0.02	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS WITH RCS DRAI	5.28E-03	IEV-LOSPD
			FAILURE TO RECOVER AC POWER IN 1 HOUR	4.20E-01	OTH-R1
			PUMP SUBLOOP B HARDWARE FAILURE OR DIVERTED FLOW	1.04E-02	CCBMOD01S
			BREAKER 100 FAILS TO OPEN [#3	1.23E-02	EC1CB100VO
			FAILURE UPON DEMAND OF LOGIC GROUP PROCESSING	1.16E-03	PMA0301BSA

# **AP1000 DESIGN CERTIFICATION REVIEW**

## **Draft Safety Evaluation Report Open Item Response**

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**DSER Open Item Number: 19.1.10.3-1 (Response Revision 2)**

**Original RAI Number(s): None**

### ***Summary of Issue:***

#### **Representative Sequences for Assigning Source Terms**

The accident sequences used to represent the various release categories are identified and briefly described in PRA Chapter 45. Additional sequence information is provided in PRA Chapter 34. The basis for selecting the representative sequence for each release category is not provided. Such information is necessary in order to confirm that the sequence selected to represent each release category is reasonably representative of the collection of sequences assigned that category, in terms of the magnitude, timing, energy, and elevation of release. Based on the limited information that was provided, the staff noted a number of inconsistencies. Specifically, for release category CFE releases from the ADS Stage 4 valves enter directly into containment rather than into the IRWST, and given the location of the valves relative to the containment shell, would not result in containment failure from diffusion flames as assumed in the PRA. For release category CFL containment failure is assumed at 3 hours, which is inconsistent with the time frame for late containment failure. Also, important details impacting the release characteristics need to be documented, such as whether an additional decontamination factor is credited in determining the source term for SGTR events (as it was in AP600), and the containment isolation failure location and size assumed for containment isolation sequences. This is Open Item 19.1.10.3-1.

#### **Westinghouse Response (Revision 2):**

The Revision 1 response to this DSER Open Item included major revisions to Chapters 34 and 45 of the AP1000 PRA. In discussions with the staff, they indicated editorial mistakes with the revised PRA Chapter 45. These corrections will be incorporated in the PRA and are shown in the attached markup of Chapter 45.

#### **Design Control Document (DCD) Revision:**

None

#### **PRA Revision:**

See attached PRA markup.

## CHAPTER 45

### FISSION-PRODUCT SOURCE TERMS

This chapter discusses the fission-product source terms that are used in the offsite dose analysis (Chapter 49) for each of the release categories, or end states, of the containment event tree, as discussed in Chapter 35. The source terms are taken from the MAAP4 analyses results presented in Chapter 34. They are used as the input to the offsite dose analysis presented in Chapter 49.

#### 45.1 Summary of AP1000 Release Categories

The release categories group similar fission-product source terms from the Level 2 analysis to bound the offsite consequences and reduce the number of sequences to be analyzed. The AP1000 prevents large releases with design features of the containment that provide redundant, diverse mitigation of challenging phenomena in the unlikely event of a severe accident. These features include the reactor coolant automatic depressurization system (ADS), the ability to flood the reactor vessel cavity, hydrogen igniters in the large dry containment, and the passive containment cooling system (PCS). The design features act to maintain reactor coolant system (RCS) integrity, prevent containment overpressurization from hydrogen detonation or deflagration, and remove heat from the containment. The mitigation features maintain the potential for fission-product release from the AP1000 containment very low.

Given a severe accident, a release of fission products occurs through normal containment leakage, a breach of the containment or a bypass of the containment.

A large pre-existing opening, or containment isolation failure, produces containment leakage beyond the design basis. The failure of a large purge line isolation valve is assumed for containment isolation failure.

A breach of the containment shell is assumed to occur based on the containment pressure and the conditional containment failure probability discussed in Chapter 42. The containment is also assumed to fail if hydrogen detonation occurs.

Containment bypass in the AP1000 is typically caused by steam generator tube rupture initiated events that progress to severe accident or by steam generator tube ruptures induced by high pressure and temperature core damage events.

The containment release categories are described in Section 35.6. For each of these categories, the release fractions are determined over a 72-hour period following the onset of core damage. For all containment failure release categories, the release is assumed to be directly from the containment to the environment at ground level. For the intact containment (IC) category, a decontamination factor (DF) of three is applied (Reference 45-2) due to deposition in the auxiliary building.

For each of the release categories, a representative source term is used to complete the Level 3 analysis. This representative source term was identified as the bounding release for the accident sequences in the specific release category.

The release fractions at 24 and 72 hours for each fission-product group are presented in Tables 45-1 and 45-2, respectively.

## **45.2 Release Category Source Terms**

### **45.2.1 Release Category IC**

Release Category IC represents the release of fission products from an intact containment during a severe accident. Normal containment leakage accounts for the fission-product releases to the environment. The likely normal leakage release pathway is via containment penetration leakage into the auxiliary building.

The fission product release fractions from an accident class 3BE sequence with cavity flooding, hydrogen control, and passive containment cooling are used to represent the IC release. A decontamination factor of 3 is applied to the aerosol-release fractions to model deposition in the auxiliary building. A direct release sensitivity analysis to the decontamination factor is discussed in section 45.3.

The source term releases for Release Category IC are presented in Figures 45-1 through 45-12.

### **45.2.2 Release Category BP**

Release category BP represents containment bypass releases to the environment. Fission products are released from the reactor coolant system via failed steam generator tubes to the secondary system and to the environment through a stuck-open safety valve. Release category BP contributes to the large, early release frequency (LERF) of the AP1000. The fission product release fractions from a steam generator tube initiated core damage sequence in accident class 1A are used to represent the BP release.

6E

The source term releases for Release Category BP are presented in Figures 45-13 through 45-24.

### **45.2.3 Release Category CI**

Release category CI represents fission product releases to the environment from an unisolated containment. Fission products are released from the reactor coolant system to the containment; however, the containment is not isolated from the environment from the beginning of the accident. Release category CI contributes to the LERF of the AP1000.

The fission product release fractions from an accident class 3C sequence with the failure of containment isolation are used to represent the CI release category.

The source term releases for Release Category CI are presented in Figures 45-25 through 45-36.

### **45.2.4 Release Category CFE**

Release category CFE represents fission product releases to the environment from containment failure induced by severe accident phenomena that may occur during the core melting and

relocation phase of the accident sequence. Fission products are released from the reactor coolant system to the containment. Before significant deposition of the aerosol fission products, the containment fails due to a high-energy event (i.e. hydrogen combustion or steam explosion). Release category CFE contributes to the LERF of the AP1000.

The fission product release fractions from an accident class 3D sequence with early containment failure induced by hydrogen detonation were used to represent release category CFE.

The source term releases for Release Category CFE are presented in Figures 45-37 through 45-48.

#### 45.2.5 Release Category CFI

Release category CFI represents fission product releases to the environment from containment failure that may occur after the melting and relocation phenomena and within 24 hours after the onset of core damage. Fission products are released from the reactor coolant system to the containment. The containment atmosphere is well-mixed and significant aerosol deposition has begun when the containment fails due to severe accident phenomena (i.e. hydrogen combustion or long-term containment pressurization from decay heat). Release category CFI contributes to the large release frequency of the AP1000, but is not an early release contributing to LERF.

The fission product release fractions from an accident class ~~3BE~~<sup>CFE</sup> sequence with intermediate containment failure induced by hydrogen detonation were used to represent release category CFI.

The source term releases for Release Category CFI are presented in Figures 45-49 through 45-60.

#### 45.2.6 Release Category CFL

Release category CFL represents fission product releases to the environment from containment failure that may occur after 24 hours. Fission products are released from the reactor coolant system to the containment. The containment atmosphere is pressurized with steam from decay heat. Significant aerosol deposition occurs over the long term of the accident. Containment fails from overpressure due to loss of containment cooling. Release category CFL contributes to large release frequency, but is not an early release contributing to LERF.

The fission product releases from an accident class 3BE sequence and containment failure induced by long-term containment pressurization is used to represent release category CFL.

The source term releases for Release Category CFL are presented in Figures 45-61 through 45-72.

#### 45.2.7 Release Category CFV

Release category CFV represents fission product releases to the environment from containment venting, which occurs after 24 hours. Fission products are released to the containment. The

containment atmosphere is pressurized with steam from decay heat. Significant aerosol deposition occurs over the long term of the accident. The operator vents the containment at a pressure well below the failure pressure of the containment. No filtering is assumed. Release category CFV contributes to large release frequency, but is not an early release contributing to LERF.

Release category CFV did not exist for the AP600 PRA (Reference 45-1). The failure frequency for successful operator venting in the containment event tree analysis is unity. Therefore, the frequency of CFV in the AP1000 PRA is zero occurrences per reactor year. No source term is calculated for this release category.

#### 45.3 Direct-Release Sensitivity Case

For release category IC, the leakage from the containment is assumed to pass through the middle annulus of the auxiliary building. This room has restricted leakage to the environment. Thus, the fission products have long residence times. Significant deposition occurs in the middle annulus, attenuating the release of fission products to the environment. A decontamination factor of three is credited for the aerosol fission products because of this deposition.

To account for uncertainty in the probability of the fission products bypassing the middle annulus decontamination effect, the release is assumed, in the IC direct-release sensitivity case, to be released directly to the environment at the design leak rate.

The source term releases for the Direct Release Sensitivity Case are presented in Figures 45-73 through 45-84.

#### 45.4 Summary

The AP1000 release categories and associated source terms over the first 24 and 72 hours after core damage are summarized in Tables 45-1 and 45-2, respectively.

A fission-product release source term (direct) is also developed to address the sensitivity assuming that the IC source term from the containment is released directly to the environment with no holdup or decontamination in the auxiliary building. The sensitivity release fractions also represent source terms for consequence analysis, as discussed in Chapter 49.

#### 45.5 References

- 45-1 GW-GL-022, AP600 Probabilistic Risk Assessment, August 1998.
- 45-2 EPRI Letter to James Wilson, USNRC, dated April 30, 1993, attachment titled, "Passive ALWR Secondary Building Mixing and Leak Rate Monitoring."



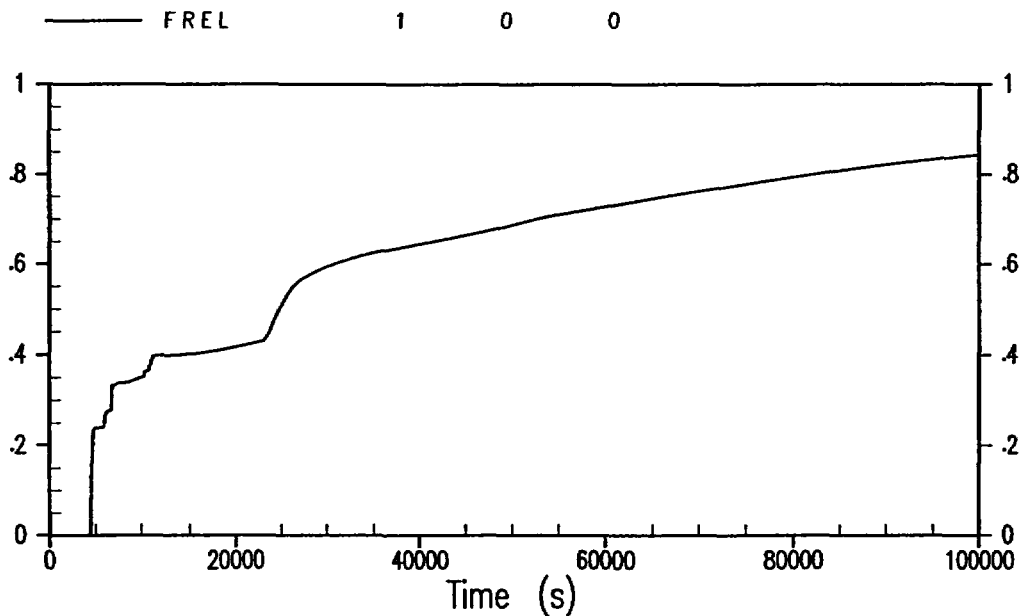


Figure 45-37

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Noble Gases

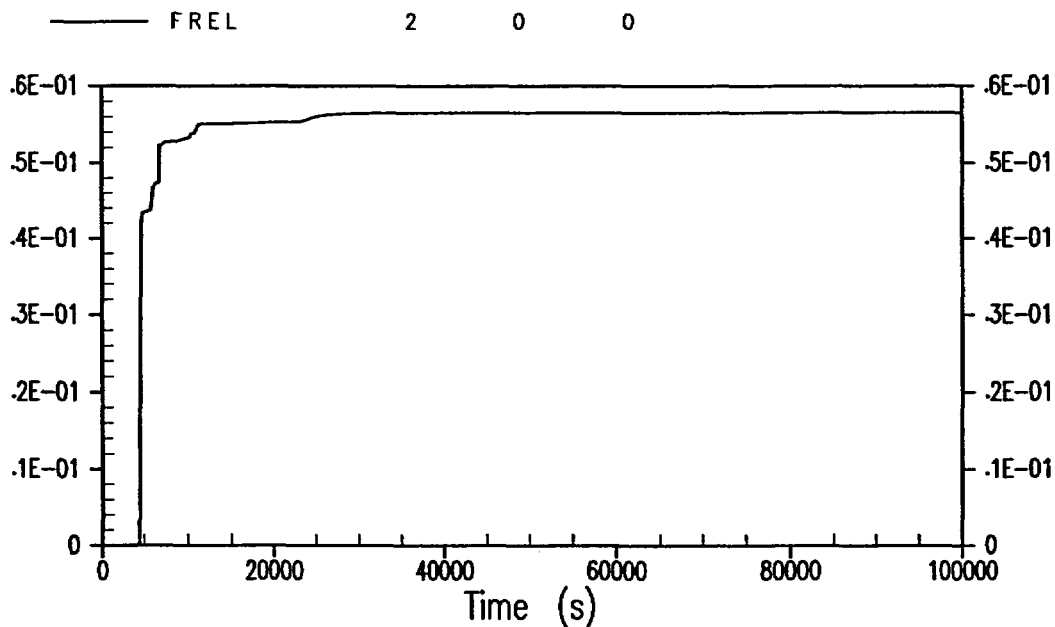


Figure 45-38

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Cesium Iodide

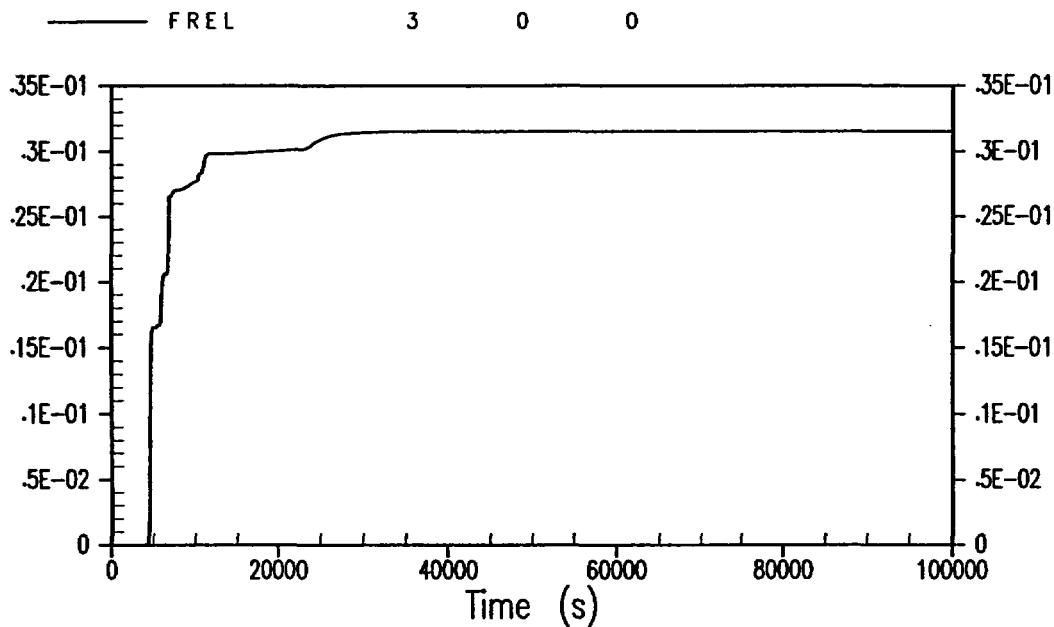


Figure 45-39

Release Category CFE, Case ~~3D4~~ <sup>CFE</sup> – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Tellurium Dioxide

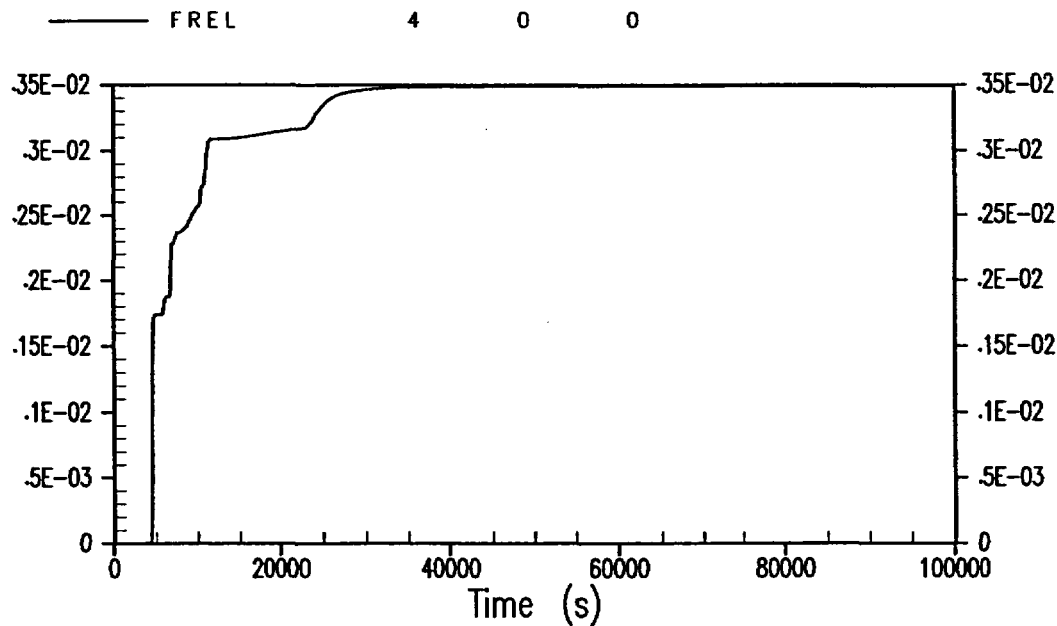


Figure 45-40

Release Category CFE, Case ~~3D4~~ <sup>CFE</sup> – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Strontium Oxide

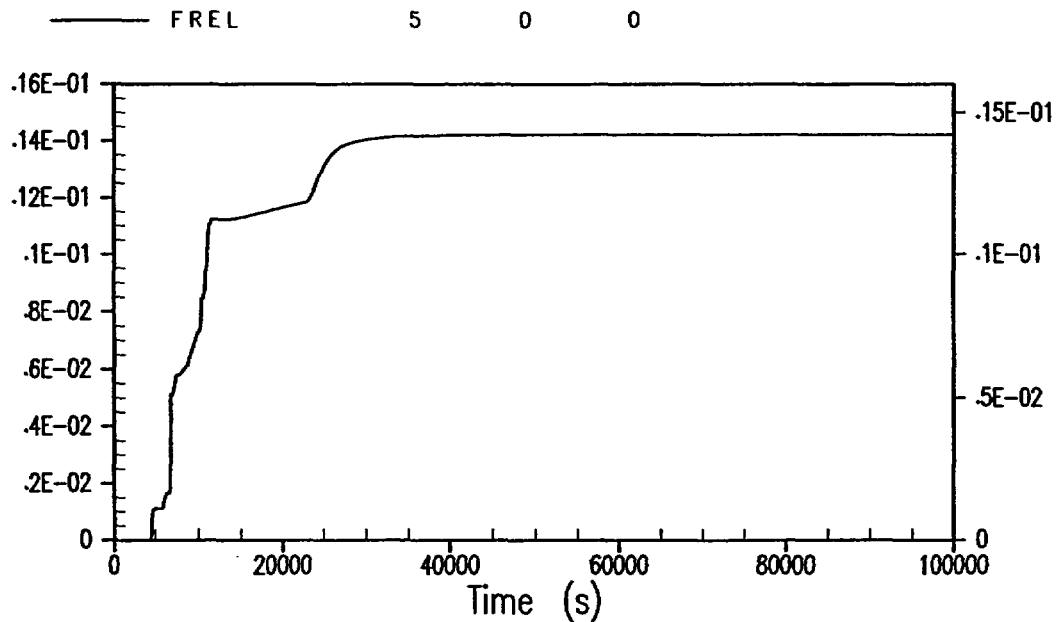


Figure 45-41

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Molybdenum Dioxide

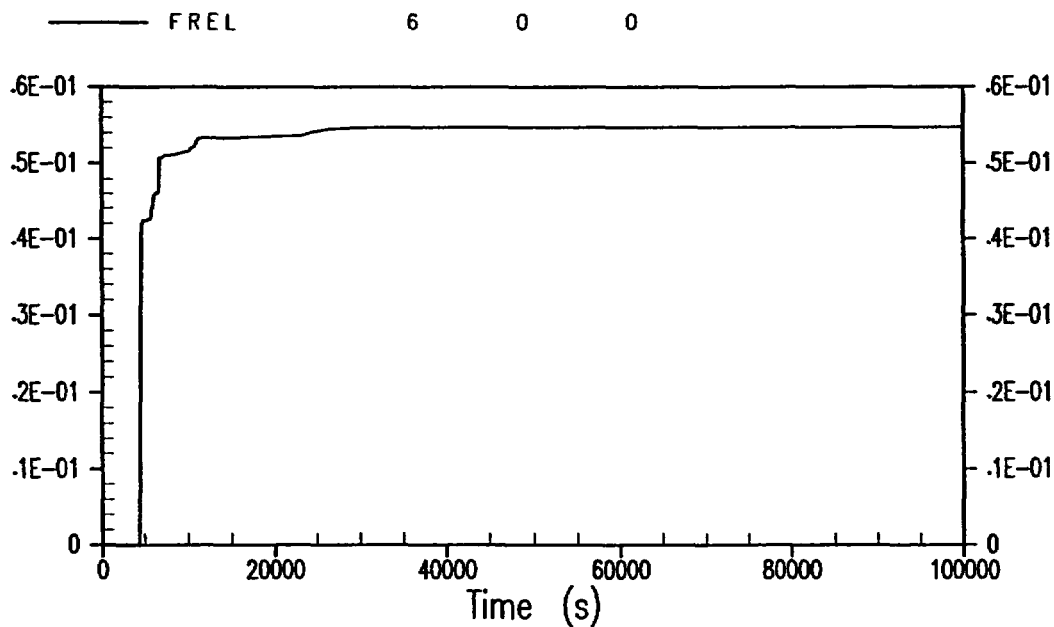


Figure 45-42

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Cesium Hydroxide

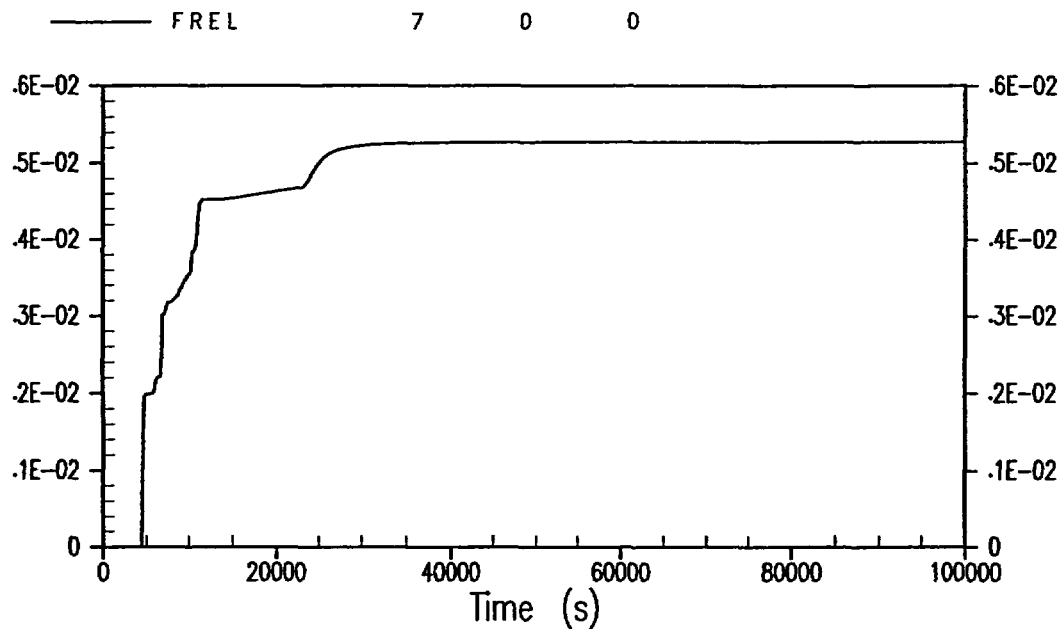


Figure 45-43

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Barium Oxide

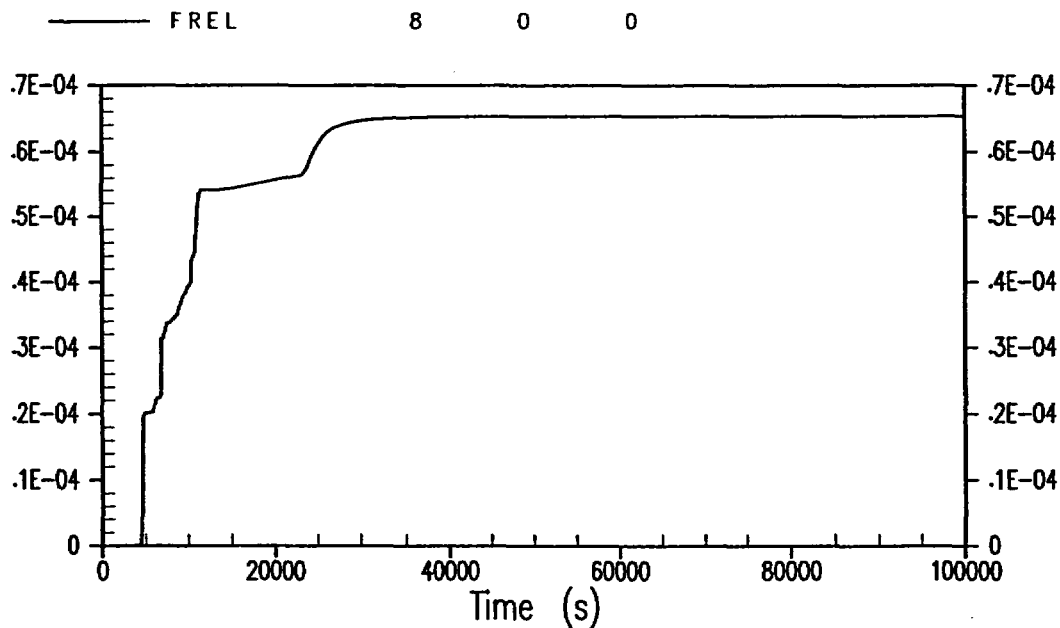


Figure 45-44

CFE  
Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Dylanthanum Trioxide

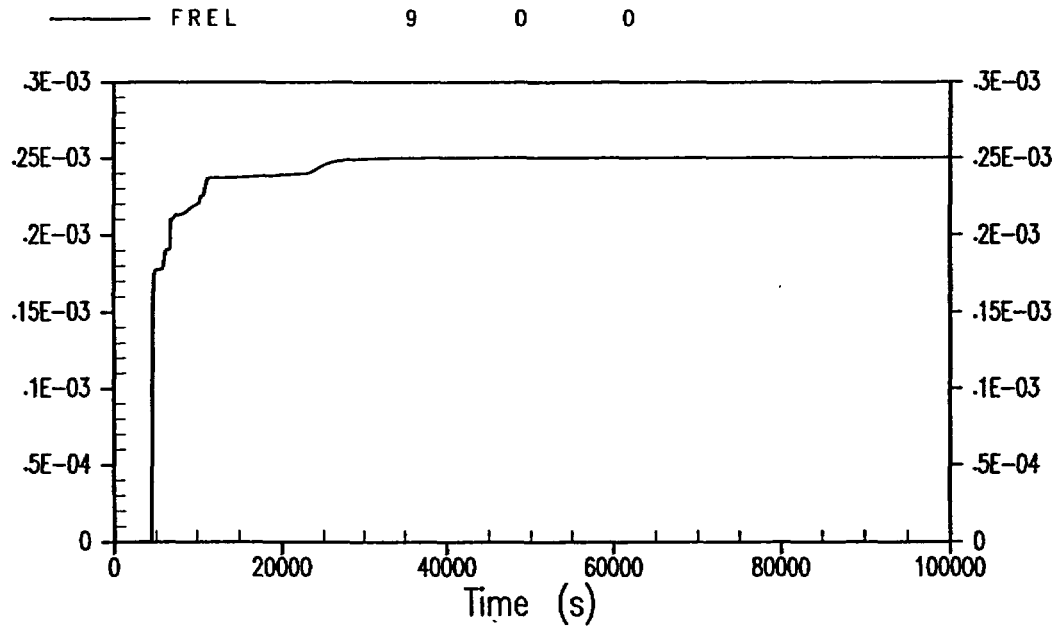


Figure 45-45

CFE  
 Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
 Diffusion Flame: Release Fraction of Cerium Dioxide

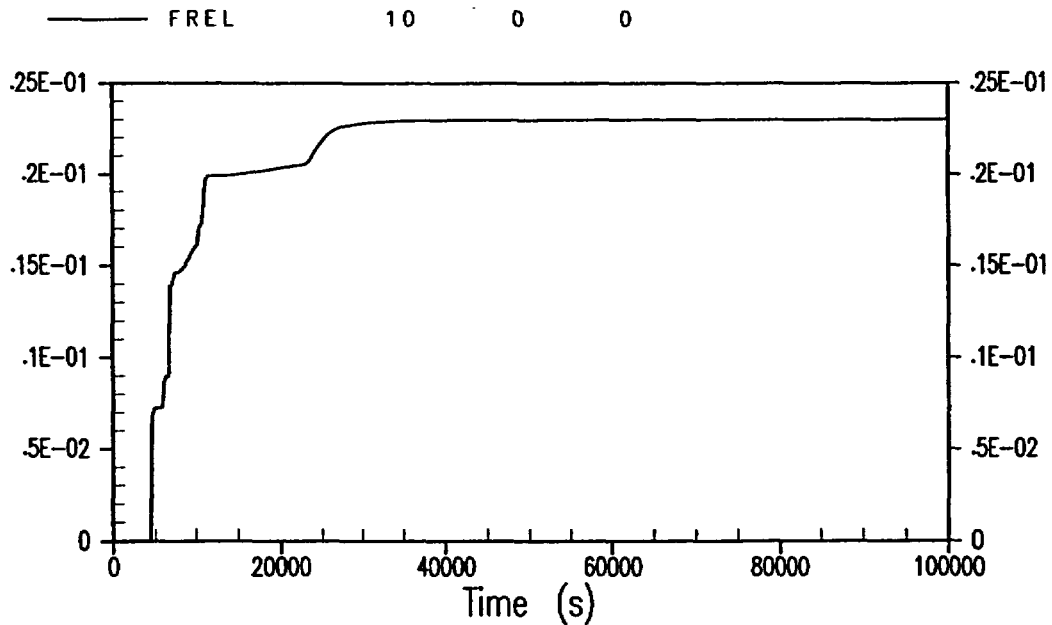


Figure 45-46

CFE  
 Release Category CFE, Case 3D-4 – Spurious ADS-2, Failed CMTs,  
 Diffusion Flame: Release Fraction of Tin

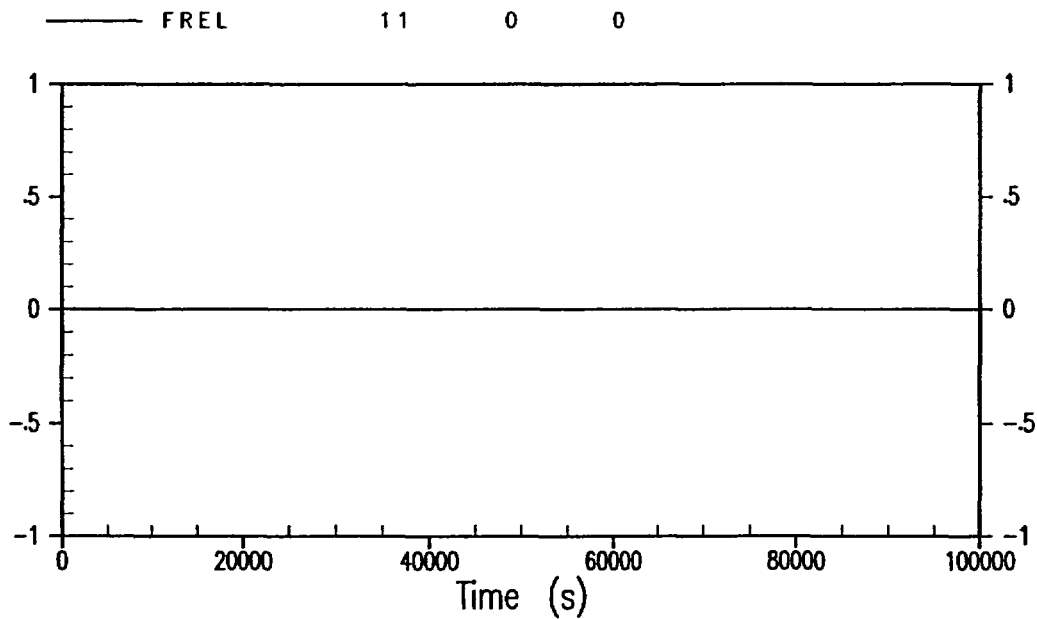


Figure 45-47

Release Category CFE, Case <sup>CFE</sup>3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Tellurium

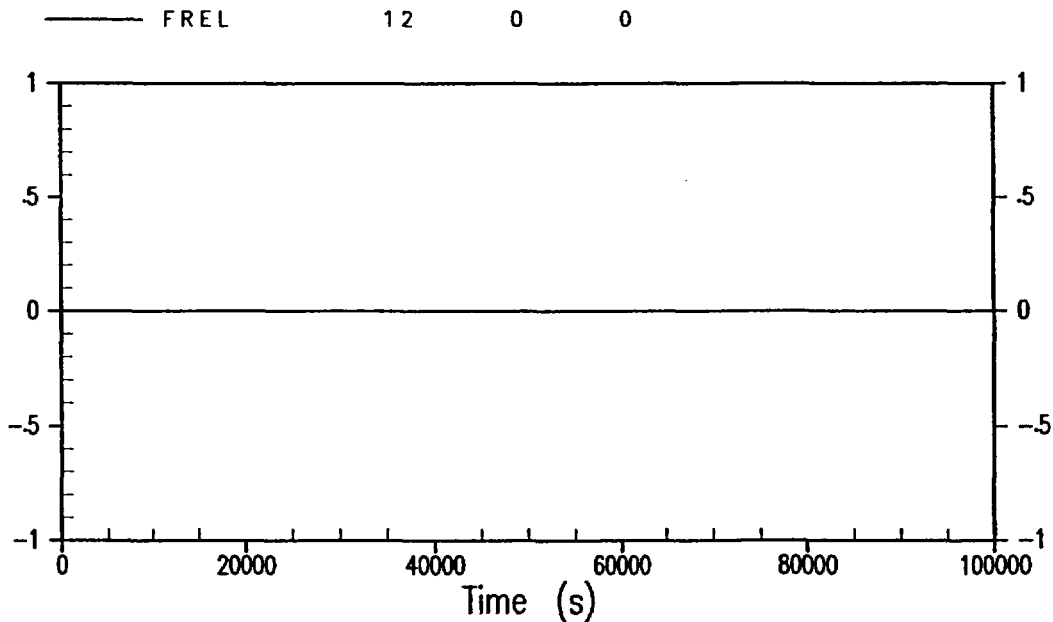


Figure 45-48

Release Category CFE, Case <sup>CFE</sup>3D-4 – Spurious ADS-2, Failed CMTs,  
Diffusion Flame: Release Fraction of Uranium Dioxide

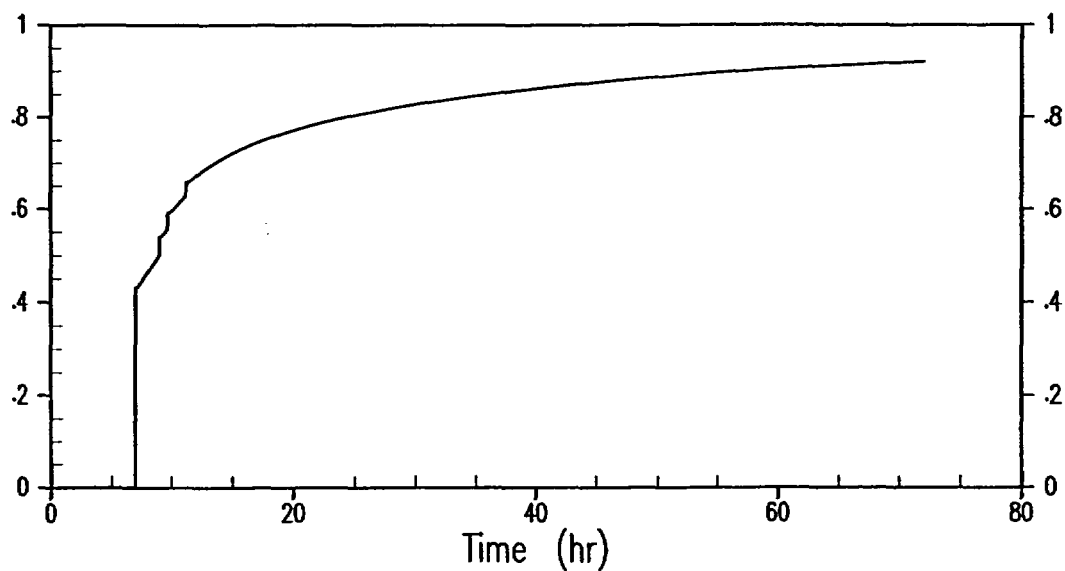


Figure 45-49

CFI  
**Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
 No PXS Flooding: Release Fraction of Noble Gases**

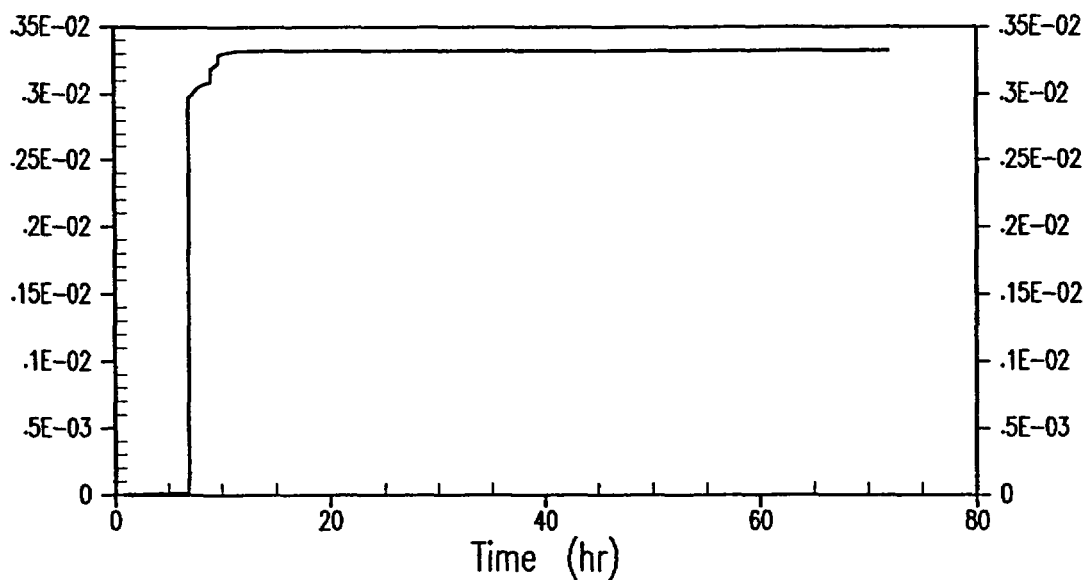


Figure 45-50

CFI  
**Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
 No PXS Flooding: Release Fraction of Cesium Iodide**

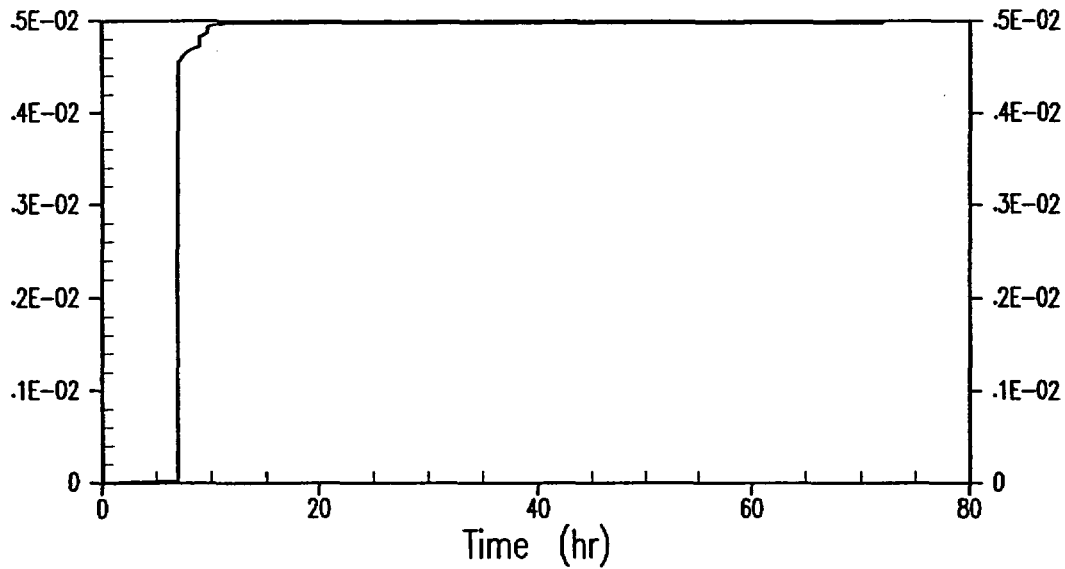


Figure 45-51

CFI  
Release Category CFI, Case 3BE-3 - DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Tellurium Dioxide

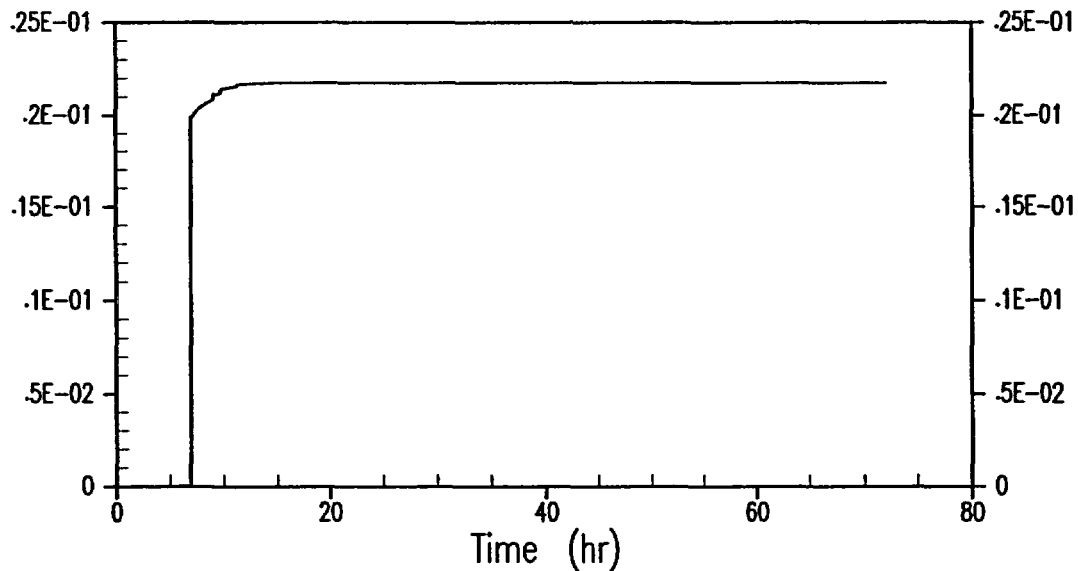


Figure 45-52

CFI  
Release Category CFI, Case 3BE-3 - DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Strontium Oxide



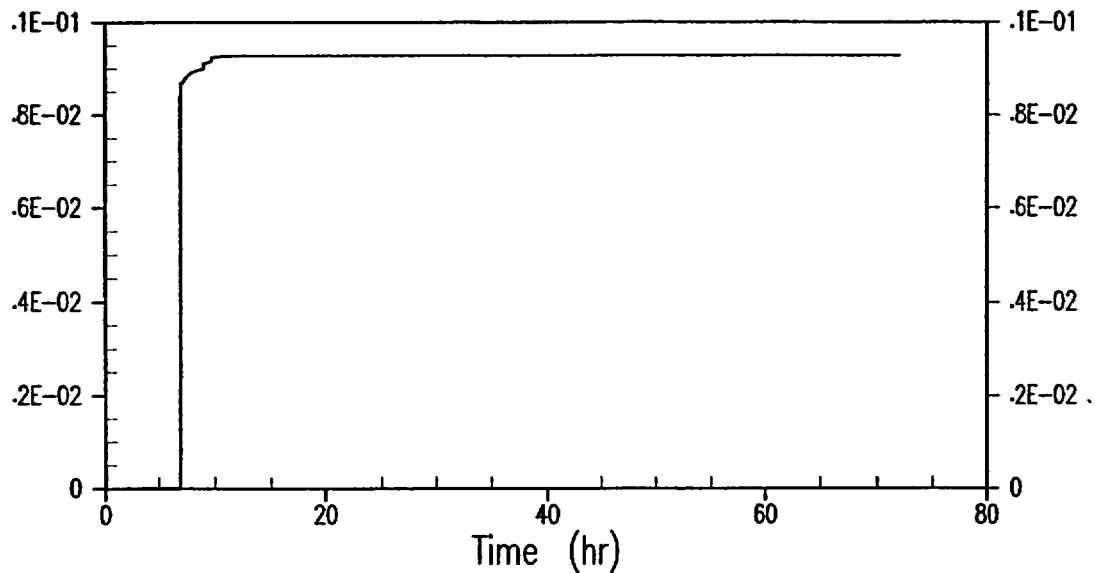


Figure 45-53

CFI  
 Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
 No PXS Flooding: Release Fraction of Molybdenum Dioxide

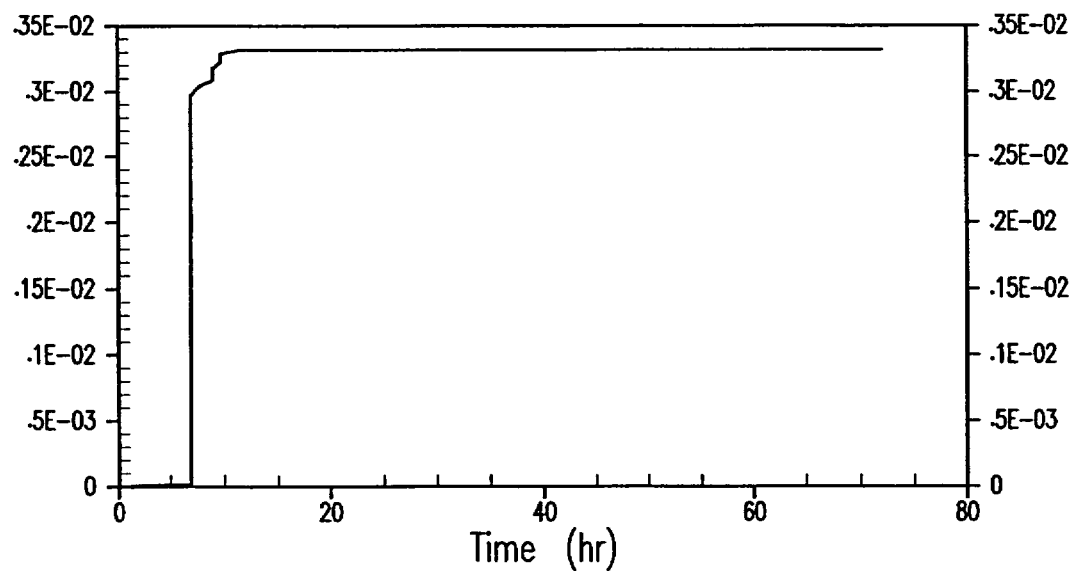


Figure 45-54

CFI  
 Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
 No PXS Flooding: Release Fraction of Cesium Hydroxide

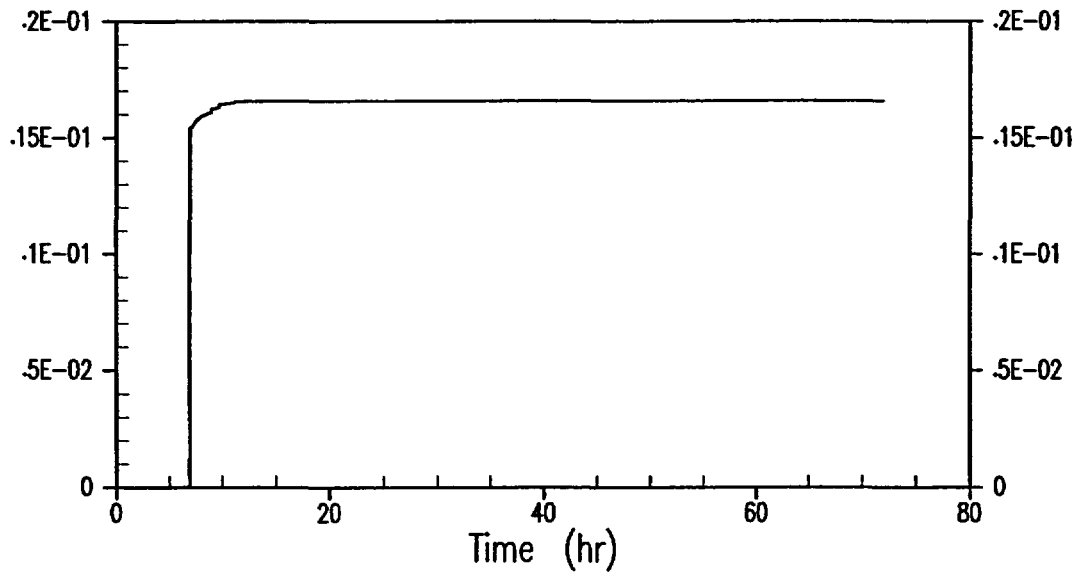


Figure 45-55

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Barium Oxide

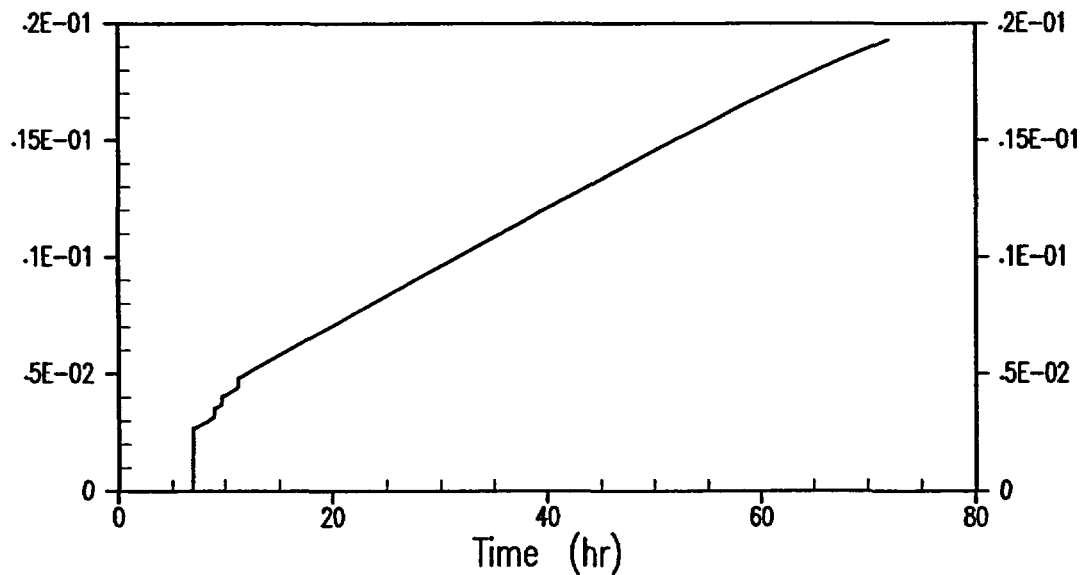


Figure 45-56

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Dlanthanium Trioxide

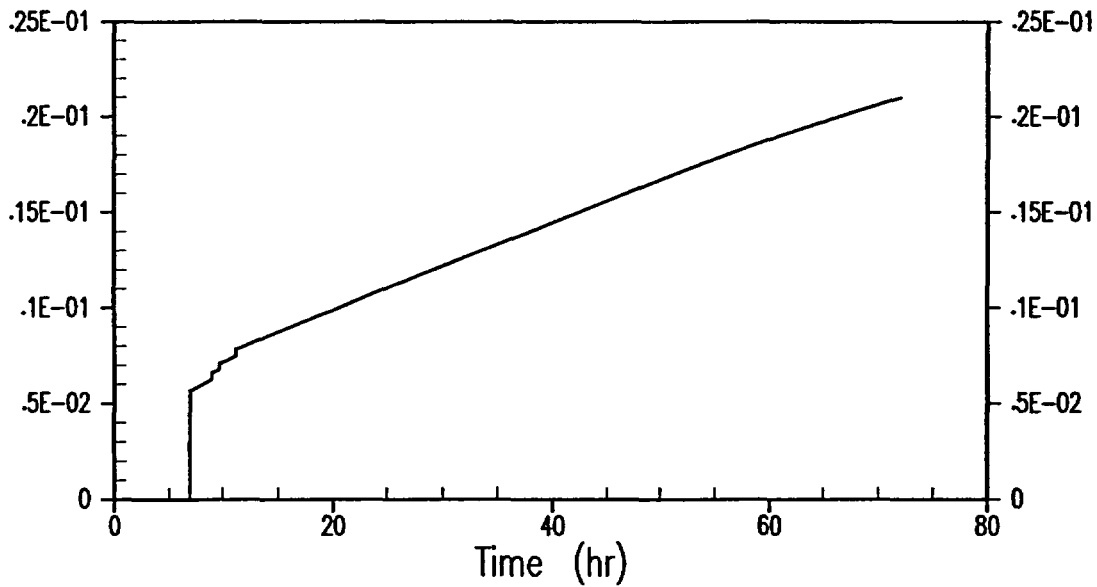


Figure 45-57

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Cerium Dioxide

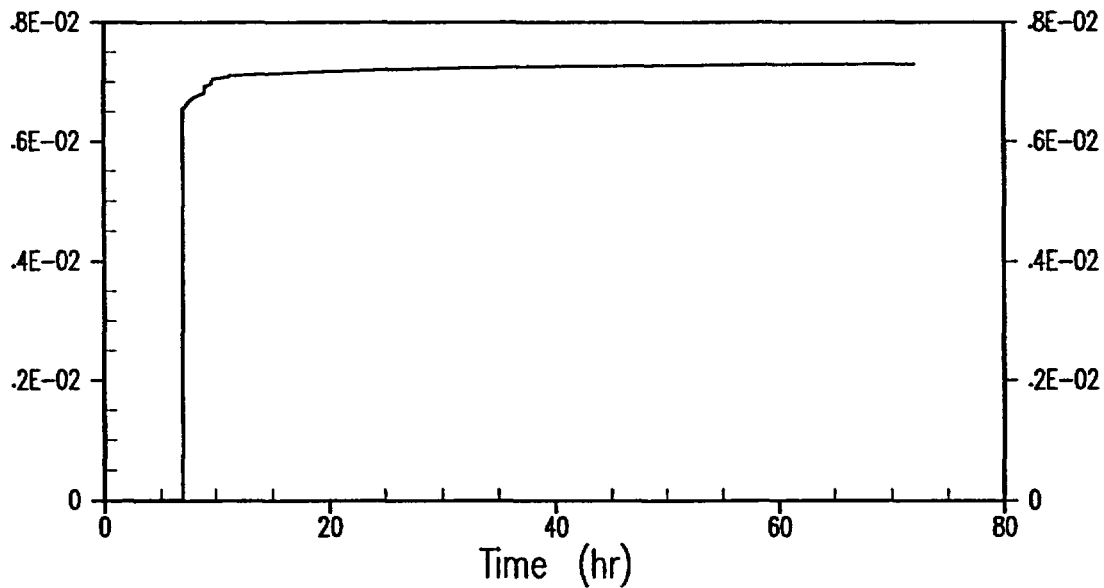


Figure 45-58

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Tin

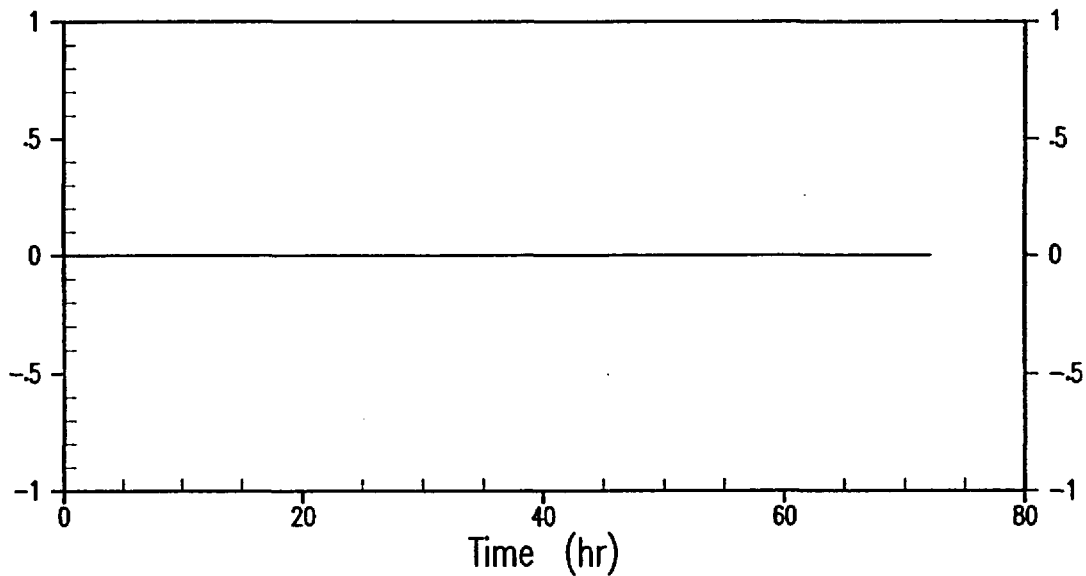


Figure 45-59

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Tellurium

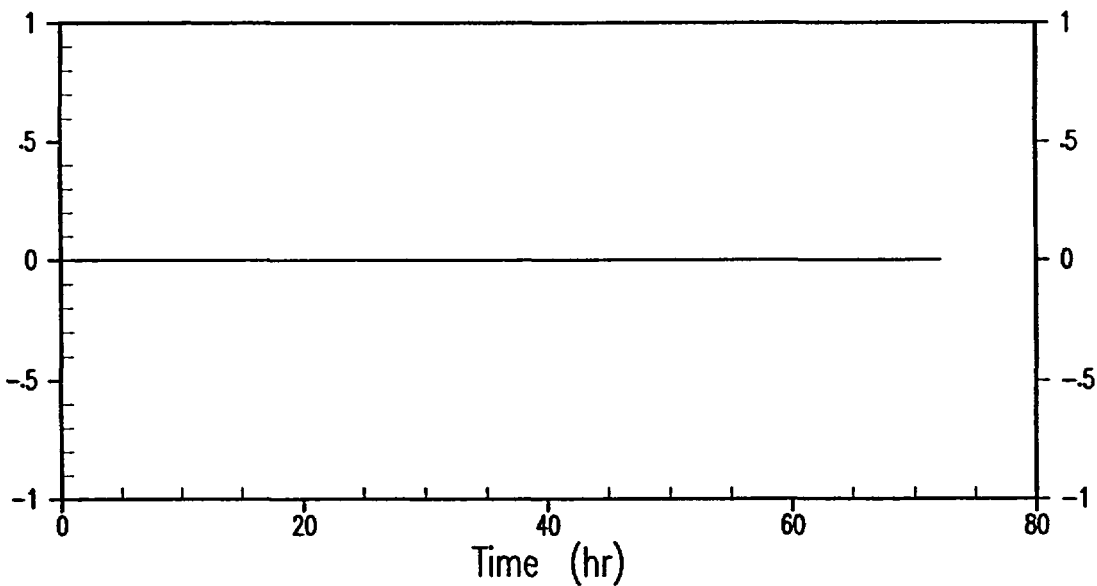


Figure 45-60

CFI  
Release Category CFI, Case 3BE-3 – DVI Line Break, Failed Gravity Injection,  
No PXS Flooding: Release Fraction of Uranium Dioxide

# AP1000 DESIGN CERTIFICATION REVIEW

## Draft Safety Evaluation Report Open Item Response

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**DSER Open Item Number:** 19.2.6-2 (Revision 1)

**Original RAI Number(s):** None

### ***Summary of Issue:***

#### **Buckling of the Two 4.87 m (16 ft) Diameter Equipment Hatch Covers**

The calculated critical buckling pressure for the equipment hatch covers is 1.45 MPa (211 psig) at ambient condition, as discussed in DCD Tier 2 Section 3.8.2.4.2.3. In Section 42.4.3 of the AP1000 PRA, it is shown that a factor of 1.5 was used as a multiplier to the calculated buckling pressure at ambient condition of 38 °C (100 ° F), based on the test head data. Using the multiplier of 1.5 and adjusting for the reduction in material strength due to temperature, the applicant has calculated the median capacity value for the buckling of the two 4.87 m (16 ft) diameter equipment hatch covers as 2.14 MPa (311 psig) at 166 ° C (331 ° F) and 2.05 Mpa (297 psig) at 204 ° C (400 ° F). However, as noted in DCD Tier 2 Section 3.8.2.4.2.2, one of the test results shows a reduction of 0.79 and the other test result shows a factor of 1.0 on the predicted BOSOR-5 value. Therefore, the staff considers that the use of the multiplier of 1.5 is not justified. Consequently, the staff does not agree with the values shown in Tables 42-1 and 42-2 of the PRA. This is Open Item 19.2.6-2.

### ***NRC Follow-On Comments:***

Please clarify the Westinghouse response

#### **Westinghouse Response (Revision 1):**

The critical buckling pressure for the equipment hatch covers discussed in DCD Tier 2 Section 3.8.2.4.2.3 is calculated in accordance with the ASME Code Case N-284, Revision 0 using a formula based on the lower bound of test data. The factor of 1.5 was used as a multiplier to determine a median value. This factor was established conservatively by Westinghouse from review of test data.

During the license review of the AP600 plant the USNRC staff performed a regression analysis on the test data provided by Westinghouse on the bases of the methodology provided in NUREG/CR-4604. They found that the median point at  $M_i$  of 14.5 is higher than 50 percent increment. Therefore, the staff found that the 1.5 multiplier applied to the calculated results was acceptable to establish the best estimate failure pressure (AP600 FSER, Section 19.2.6.3, page 19-193).

BOSOR-5 analysis results were not used to predict the buckling pressure of the equipment hatch covers.

# **AP1000 DESIGN CERTIFICATION REVIEW**

## **Draft Safety Evaluation Report Open Item Response**

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**Design Control Document (DCD) Revision:**

None

**PRA Revision:**

None