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REVISION 2 CHANGE ROADMAP

Section	Page No.	Type of Change[1]
AP1000 Document Cover Sheet		Editorial
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T of C	i through c	Editorial
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6	6-17	720.026 (R1)
6	6-28	720.024 (R1)
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6	6-37 through 6-39	720.024 (R1)
6	6-41	720.024 (R1)
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6	6-69	720.029 (R1)
24	24-17	720.046 (R1)
24	24-22 and 24-23	720.046 (R1)
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30	30-26a through 30-28	720.029 (R1)
35	35-28	720.043 (R1)
43	43-9 and 43-9a	720.039 (R2)
43	43-9b	Editorial
43	43-10a	720.039 (R2)
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50	50-1	
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54	54-1 through 54-131	720.038 (R2)

REVISION 2 CHANGE ROADMAP (Cont.)

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56	56-9	Editorial
56	56-17 and 56-18	Editorial
56	56-20	Editorial
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56	56-38a through 56-38k	720.038 (R1)
56	56-38l	Editorial
56	56-47 through 56-49	Editorial
56	56-51	Editorial
56	56-54 and 56-55	720.038 (R1)
57	57-14 and 57-15	280.011 (R1)
57	57-15a and 57-15b	Editorial
59	59-23 and 59-23a	720.038 (R1)
59	59-23b	Editorial
59	59-34	720.038 (R1)
59	59-72	720.038 (R1)
Appendix A	A-12	Editorial
Appendix A	A-24 through A-26	440.014 (R1)
Appendix A	A-26a	440.014 (R1) 720.024 (R1)
Appendix A	A-26b	Editorial
Appendix A	A-27	720.012 (R1)
Appendix A	A-31	720.012 (R1)
Appendix A	A-33	720.010 (R1)
Appendix A	A-33a and A-33b	Editorial
Appendix A	A-44	Editorial
Appendix A	A-57 through A-61	720.012 (R1)
Appendix A	A-63	720.012 (R1)
Appendix A	A-66	720.012 (R1)
Appendix A	A-103a through A-103b	440.014 (R1)
Appendix A	A-103c and A-103d	720.012 (R1)
Appendix A	A-151 and A-152	720.013 (R1)
Appendix A	A-165 and A-166	720.013 (R1)

REVISION 2 CHANGE ROADMAP (Cont.)

Section	Page No.	Type of Change[1]
Appendix D	D-13 and D-14	720.080 (R1)
Appendix D	D-35 and D-36	720.080 (R1)

1. Changes incorporated as a result of Westinghouse responses to NRC Request for Additional Information (RAI) identified by RAI number.

Table 35-5 (Sheet 3 of 3)

SUMMARY OF CONTAINMENT EVENT TREE SUCCESS CRITERIA

Top Event Name	Event Case Name	Success Criteria	Manual Actions	Dependencies and Modeled Actuation	Mission Time	Basis
IG	VLH – containment hydrogen control	Sufficient number of igniters operate to limit hydrogen concentration in containment	Credit for manual actuation only [operator action: VLN-MAN01]	None	24 hours	Ch. 16
DF	Louvered IRWST vents closed or ADS-4 open to vent hydrogen away from shell	2 of 4 ADS-4 lines open to vent H_2 away from shell	None	None	Release duration	Ch. 41
DTE	Phenomenological event – accident class-dependent scalar value	DDT does not occur during hydrogen release to containment	None	None	Release duration	Ch. 41
DFG	Phenomenological event – accident class-dependent scalar value	Containment not failed by overpressure, shell not failed by overtemperature	None	None	24 hours	Ch. 41
DTI	Phenomenological event – accident class-dependent scalar value	DDT does not occur during burn	None	None	24 hours	Ch. 41

Table 35-6

SUMMARY OF OPERATOR ACTIONS CREDITED ON CONTAINMENT EVENT TREE

Top Event	Description of Operator Error	Event ID	Cue(s)	Time Window
DP	Failure to recognize need for post-core-uncovery RCS depress during small LOCA or transient with loss of PRHR	LPM-REC01	core-exit T/C > 1200°F (ERG AFR.C-1)	30 minutes
	Failure to complete ADS as recovery from failure of automatic actuation or manual actuation after core damage	ADN-REC01	core-exit T/C > 1200°F (ERG AFR.C-1)	30 minutes
IS	Failure to recognize need and failure to isolate the containment, given core damage following an accident	CIC-MAN01	high containment pressure, high containment temperature, high containment radiation (ERG E-0)	50 minutes
IR	Failure to recognize need and failure to open recirculation valves to flood reactor cavity after core damage	REN-MAN03	core-exit temperature > 1200°F (ERG AFR.C-1)	5 minutes
PC	Failure to recognize need and failure to open PCS water valves to drain cooling water on containment shell	PCN-MAN01	high containment pressure (ERG E-0)	18 hours
VNT	Failure to recognize need and failure to open containment vent to reduce containment pressure	VNT-MAN01	high containment pressure (SAMG)	60 minutes
IG	Failure to recognize need and failure to actuate hydrogen control system, given core damage following an accident	VLN-MAN01	core-exit T/C > 1200°F (ERG AFR.C-1)	15 minutes

From this sensitivity analysis results, it is concluded that the LRF is not sensitive to the VLH failure as long is this failure probability is 0.1 or less. On the other hand, the LRF is sensitive to the failure of VLH (e.g. when no credit is taken for VLH).

43.6.5 Lesser Reliability for PCS

In this sensitivity analysis, the PCS failure probability is assigned a value of 0.001 for all PDSs. The LRF becomes 1.97 E-08/year.

From this sensitivity analysis results, it is concluded that the LRF is not sensitive to the PCS failure as long is this failure probability is 0.001 or less. On the other hand, the LRF is sensitive to the failure of PCS (e.g., when no credit is taken for PCS).

43.6.6 No Credit for Depressurization for High Pressure PDS

Set DP(fail) = 1.0 for all HP PDS: 1A, 1AP, 3A, 6.

This is the same as the node importance calculated in 44.5.1. The LRF is 2.91 E-08/year.

43.6.7 Set PDS-3C Vessel Failure Probability to 1.0

Set VF(fail) = 1.0 for PDS-3C.

This is the same as the node importance calculated in 44.5.1. The LRF is 2.85 E-08/year.

43.6.8 Set 3D and 1AP Diffusion Flame and Detonation Failure Probability to 1.0

Set DF(fail) = 1.0 for PDS-3D and 1AP.

Set DTE(fail) = 1.0 for PDS-3D and 1AP.

In this case, the LRF becomes 7.66 E-08/year.

43.7 Other Importance and Sensitivity Analyses

In this section, the initiating event importances are calculated and reported. Also, a sensitivity analysis is made for the case when standby nonsafety systems are unavailable.

43.7.1 Initiating Event Importances

In order to calculate the initiating event importances, first more LRF cutsets need to be collected to have accurate results. For this purpose, dominant cutsets from additional dominant sequences are collected. In this process, some of the split fractions assigned to PDS-6 are more accurately calculated. This caused the LRF frequency to reduce slightly to 1.91E-08/year. The initiating event importances thus calculated are reported in Table 43-11. ATWS, SGTR, SPADS, and SI-LB initiating events lead the list of contributors to LRF, with a total contribution of 56 percent.

Since the base case LRF was already calculated to be 1.95E-08/yr and reported in various places, it will be retained as the value of record.

43.7.2 Sensitivity to Standby Systems

This sensitivity case is analogous to the similar case for CDF, reported in Section 50 to support RTNSS. A sensitivity study is performed to estimate the LRF increase when no credit is taken for nonsafety standby systems. This study removes (assumes to fail) the hydrogen ignitors in addition to the CVS, SFS, RNS, DAS, and DGs. The calculation is done by setting the standby system components to failure in the plant LRF cutsets. The LRF increases from 1.9E-8/year to 5.2E-6/year. This LRF frequency is still in the 10-6 range and is small.

Table 43-12 provides the top LRF cutsets for this sensitivity case. An examination of the top cutsets shows that they contain CCF of PMS software or cards in slow developing initiating events, such as TRANS and LSP. These LRF precursor sequences can be recovered from by credible operator actions. This considerably decreases the LRF. However, such recovery credit is not taken at this time.

43.7.3 Sensitivity to Standby Systems With Credit for Manual DAS

This sensitivity case is similar to the previous case reported above. A sensitivity study is performed to estimate the LRF increase when no credit is taken for nonsafety standby systems, but manual DAS is retained. This study removes (assumes to fail) the hydrogen ignitors in addition to the CVS, SFS, RNS, automatic DAS, and DGs. The calculation is done by setting the standby system components to failure in the plant LRF cutsets. The LRF increases from 1.9E-8/year to 3.9E-7/year. This LRF frequency is in the 10-7 range and is small. This case is intended to show the benefit of putting administrative controls on manual DAS. Table 43-13 provides the top LRF cutsets for this sensitivity case.

43.8 Conclusions and Insights

From the results of the containment event tree quantification and sensitivity analyses, the following conclusions and insights related to AP1000 LRF can be derived:

1. The containment effectiveness for AP1000 is over 90 percent, which provides an order of magnitude decrease from CDF to LRF. Since this results already includes CDF sequences that directly bypass the containment, the containment effectiveness for remaining sequences is actually much better. For example, for five (3BE,3BL,3BR,3C,3D) of the nine accident classes studied, the containment effectiveness ranges from 90 percent to 99.8 percent.

2. The containment effectiveness is lowest for the 3A accident class where the reactor coolant system (RCS) pressure is high after core damage. The post-core-damage depressurization for this class proves to be ineffective since failure of the automatic

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depressurization systems (ADS) by common cause failures leading to core damage also causes failure of post-core-damage depressurization.

3. Based on detailed analysis, the containment effectiveness for accident class 6, mainly steam generator tube rupture (SGTR) events, is 56.9 percent, due to those sequences where the RCS pressure is low after the postulated core damage. In such sequences, the fission products can be retained in the pressure vessel, shielded by the water in the faulted steam generator. A sensitivity analysis where all accident class 6 events are assigned to LRF shows that the plant containment effectiveness drops slightly to 89.7 percent (from 91.9 percent). Thus, the LRF results are not very sensitive to the treatment of the SGTR events for LRF.

4. A frequency of 1.0E-08/year has been assigned to the vessel failure initiating event (accident class 3C). In 90 percent of these events, the vessel is assumed to undergo failures that will be above the beltline: in which case the molten core could be cooled and containment would not be challenged. In the remaining 10 percent of the cases, the failure is assumed to be below the pressure vessel beltline, whereby the molten core would drop into the containment. In this case, it is conservatively assumed that the containment would fail. A sensitivity analysis is made whereby 100 percent of the failures would be below the beltline. The result shows that the containment effectiveness drops to 88.2 percent. This change is not significant, and the assumptions behind the case are very conservative.

5. The LRF results are sensitive to failure of hydrogen igniters. If no credit is taken for hydrogen igniters, the containment effectiveness drops to 74 percent.

6. However, LRF is not very sensitive to the reliability of hydrogen igniters; if IG reliability is assumed to be degraded (0.1) across the board for all accident classes, the containment effectiveness becomes 90.5 percent, which is an insignificant change from the base case.

7. For accident classes 3D and 1AP, if the large hydrogen releases through the in-containment refueling water storage tank (IRWST) is conservatively assumed to cause containment failure, the containment effectiveness drops to 84.5 percent. The LRF increases to 7.58 E-08/year. The increase is about a factor of 4 of the base. Such an increase is significant. This sensitivity analysis addresses the uncertainties in hydrogen mixing model for the case where the hydrogen is released into the IRWST and comes out from the IRWST vents above the operating deck.

8. The LRF is dominated (53.9 percent) by containment failures or bypasses due to SGTR, and unmitigated high-RCS-pressure core damage sequences, classified as BP. The remaining containment failures are dominated by an early containment failure due to reactor cavity flooding failure.

9. The LRF is not very sensitive to the reliability of PCS. If PCS reliability is assumed to be 0.001 across the board for all accident classes, the LRF becomes 1.97E-08, which is an insignificant change from the base case.

10. If no credit is taken for standby non-safety systems (the case for the RTNSS), the plant LRF becomes 5.2E-06/yr. This LRF frequency is still in the 10-6 range and is small. If credit for manual DAS is introduced in this case, the LRF becomes 3.9E-07/yr, which shows the benefit obtained from manual DAS.

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Table 43-10

CET EVENT TREE NODE IMPORTANCES

CET NODE	LRF (per year)	Containment Failure Prob	Containment Effectiveness	Node Failed in Following PDS
BASE LRF	1.95E-08	8.1%	91.9%	N/A
DP RCS Depressurization	2.91E-08	12.1%	87.9%	1A, 1AP, 3A, and 6 set to 1.0.
IS Containment Isolation	2.41E-07	100.0%	0.0%	all PDS set to 1.0
IR Cavity Flooding	1.58E-07	65.6%	34.4%	3BE, 3D, 6 set to 1.0
RFL Core Reflooding	1.91E-08	7.9%	92.1%	3BE set to 1.0
VF Vessel Failure	2.85E-08	11.8%	88.2%	3C set to 1.0
PC PCS Failure	2.41E-07	100.0%	0.0%	all PDS set to 1.0
IG Hydrogen Igniter Failure	6.28E-08	26.0%	74.0%	all PDS set to 1.0
DF Diffusion Flame	1.41E-07	58.3%	41.7%	3D and 1AP set to 1.0; 3BE set to 0.8535 (85% of 3BE are SI-LB events where DF may exist. Diffusion flame does not apply to other PDS.
DTE Early DDT	2.16E-08	9.0%	91.0%	all PDS set to 1.0
DFG Hydrogen Deflagration	2.17E-08	9.0%	91.0%	all PDS set to 1.0
DTI Intermediate DDT	2.17E-08	9.0%	91.0%	all PDS set to 1.0

Table 43-11

CONTRIBUTION OF INITIATING EVENTS TO LARGE RELEASE

	Initiating Event Category	Percentage Contribution to LRF	LRF Contribution	Initiating Event Frequency
1	IEV-ATWS	17.11	3.27E-09	4.81E-01
2	IEV-SGTR	15.87	3.04E-09	3.88E-03
3	IEV-SPADS	13.14	2.51E-09	5.40E-05
4	IEV-SI-LB	9.82	1.88E-09	2.12E-04
5	IEV-TRANS	7.49	1.43E-09	1.40E+00
6	IEV-SLOCA	5.94	1.14E-09	5.00E-04
7	IEV-RV-RP	5.37	1.03E-09	1.00E-08
8	IEV-MLOCA	4.71	9.02E-10	4.36E-04
9	IEV-ATW-T	3.72	7.12E-10	1.17E+00
10	IEV-LCOND	2.73	5.22E-10	1.12E-01
11	IEV-LOSP	2.46	4.70E-10	1.20E-01
12	IEV-LMFW	1.98	3.80E-10	3.35E-01
13	IEV-LLOCA	1.65	3.16E-10	5.00E-06
14	IEV-RCSLK	1.53	2.93E-10	6.20E-03
15	IEV-SLB-V	1.22	2.33E-10	2.39E-03
16	IEV-LMFW1	1.11	2.12E-10	1.92E-01
17	IEV-CMTLB	1.03	1.98E-10	9.31E-05
18	IEV-LCCW	0.72	1.37E-10	1.44E-01
19	IEV-ATW-S	0.53	1.01E-10	1.48E-02
20	IEV-LCAS	0.52	1.00E-10	3.48E-02
21	IEV-POWEX	0.50	9.49E-11	4.50E-03
22	IEV-PRSTR	0.45	8.64E-11	1.34E-04
23	IEV-SLB-U	0.26	4.97E-11	3.72E-04
24	IEV-LRCS	0.08	1.58E-11	1.80E-02
25	IEV-SLB-D	0.05	9.07E-12	5.96E-04
26	IEV-ISLOC	0.00	4.74E-13	5.00E-11
	Totals	100.00	1.91E-08	2.38E+00

Table 43-12 (Sheet 1 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
1	1.68E-06	32.33	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
2	9.24E-07	17.78	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
3	7.24E-07	13.93	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
4	4.02E-07	7.74	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
5	2.30E-07	4.43	LOSS OF MFW TO ONE SG INITIATING EVENT OCCURS	1.92E-01	IEV-LMFW1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
6	1.73E-07	3.33	LOSS OF CCW/SW INITIATING EVENT OCCURS	1.44E-01	IEV-LCCW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
7	1.34E-07	2.58	LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW

Table 43-12 (Sheet 2 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
8	1.01E-07	1.94	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
9	7.44E-08	1.43	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
10	6.82E-08	1.31	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
11	6.01E-08	1.16	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFIL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE OF 4 AOVS TO OPEN	6.20E-05	CCX-AV-LA
			COND. PROB. OF ADN-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	ADN-MAN01C
12	5.34E-08	1.03	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
13	4.27E-08	0.82	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW

Table 43-12 (Sheet 3 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
14	4.07E-08	0.78	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFIL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE TO OPEN OF 4.16 KVAC CIRCUIT BREAK	4.20E-04	RPX-CB-GO
			COND. PROB. OF AND-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	AND-MAN01C
			LATE ADS RECOVERY BY OPERATOR ACTION	1.00E-01	PDS6-MANADS
15	3.34E-08	0.64	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
16	3.00E-08	0.58	ATWS PRECURSOR WITH NO MFW INITIATING EVENT OCCURS	4.81E-01	IEV-ATWS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
17	2.63E-08	0.51	MAIN STEAM LINE STUCK-OPEN SV INITIATING EVENT OCCURS	2.39E-03	IEV-SLB-V
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
18	2.59E-08	0.5	LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			ANY SECOND. SIDE RELIEF VALVE FAILS TO CLOSE (2 SV + PORV)	2.10E-02	OTH-SLSOV1
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
19	2.16E-08	0.42	LOSS OF RSC FLOW INITIATING EVENT OCCURS	1.80E-02	IEV-LRCS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW

Table 43-12 (Sheet 4 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
20	2.06E-08	0.4	MAIN STEAM LINE STUCK-OPEN SV INITIATING EVENT OCCURS	2.39E-03	IEV-SLB-V
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
21	2.03E-08	0.39	LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			ANY SECOND. SIDE RELIEF VALVE FAILS TO CLOSE (2 SV + PORV)	2.10E-02	OTH-SLSOV1
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
22	1.08E-08	0.21	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSU	4.78E-04	CCX-TRNSM
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			LATE ADS ACTUATION BY OPERATOR ACTION	5.00E-02	AND-REC01
23	1.08E-08	0.21	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSU	4.78E-04	CCX-TRNSM
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			OPERATOR FAILS TO RECOGNIZE NEED FOR RCS DEPR. AFTER CORE DAMAGE	5.00E-02	LPM-REC01
24	9.14E-09	0.18	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG

Table 43-12 (Sheet 5 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
25	7.44E-09	0.14	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
26	7.36E-09	0.14	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSU	4.78E-04	CCX-TRNSM
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
27	6.56E-09	0.13	STEAM LINE BREAK DOWNSTREAM OF MSIV INITIATING EVENT OCCURS	5.96E-04	IEV-SLB-D
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
28	6.22E-09	0.12	CONTAINMENT FAILURE DUE TO DIFFUSION FLAME	1.70E-02	OTH-DF
			RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
29	6.15E-09	0.12	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			CCF OF SAFETY PT LT CONTINUOUSLY INTERFACING HIGH PRESSURE	4.78E-04	CCX-XMTR
			CCF OF RTD LEVEL TRANSMITTERS	3.84E-05	CMX-VS-FA
30	6.00E-09	0.12	SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP

Table 43-12 (Sheet 6 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
31	5.77E-09	0.11	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSU	4.78E-04	CCX-TRNSM
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
32	5.71E-09	0.11	ATWS PRECURSOR WITH NO MFW INITIATING EVENT OCCURS	4.81E-01	IEV-ATWS
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			CCF OF SAFETY PT LT CONTINUOUSLY INTERFACING HIGH PRESSURE	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PZR LEVEL SENSORS	4.78E-04	CCX-XMTR195
33	5.50E-09	0.11	SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
34	5.40E-09	0.1	CORE POWER EXCURSION INITIATING EVENT OCCURS	4.50E-03	IEV-POWEX
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
35	5.23E-09	0.1	MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
36	5.14E-09	0.1	STEAM LINE BREAK DOWNSTREAM OF MSIV INITIATING EVENT OCCURS	5.96E-04	IEV-SLB-D
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM

Table 43-12 (Sheet 7 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
37	4.95E-09	0.1	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFIL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE OF 4 CHECK VALVES TO OPEN	5.10E-05	CMX-CV-GO
			COND. PROB. OF AND-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	AND-MAN01C
			LATE ADS RECOVERY BY OPERATOR ACTION	1.00E-01	PDS6-MANADS
38	4.92E-09	0.09	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			COMMON CAUSE FAILURE TO OPEN OF 4.16 KVAC CIRCUIT BREAK	4.20E-04	RPX-CB-GO
			OPER. FAILS TO FULFIL MANUAL ACTUATION OF ADS	3.02E-03	AND-MAN01
39	4.80E-09	0.09	MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
40	4.66E-09	0.09	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
41	4.31E-09	0.08	SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
42	3.83E-09	0.07	LOSS OF COMPRESSED AIR INITIATING EVENT OCCURS	3.48E-02	IEV-LCAS
			ANY SECOND. SIDE RELIEF VALVE FAILS TO CLOSE (1 SV)	1.00E-02	OTH-SLSOV2
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW

Table 43-12 (Sheet 8 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
43	3.76E-09	0.07	MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
44	3.49E-09	0.07	SUCCESS OF CORE REFLOODING	7.33E-01	SUC-RFL
			NO CONTAINMENT FAILURE FROM HYDROGEN DETONATION	7.55E-01	SUC-DTE
			CONTAINMENT FAILURE DUE TO HYDROGEN DEFLAG.-TO-DETON. TRANSITION	1.24E-01	OTH-DTI-1
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG
45	3.39E-09	0.07	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
46	3.16E-09	0.06	CONTAINMENT FAILURE FROM DIFFUSION FLAME	1.70E-02	OTH-DF
			RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			DUE TO CCF OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
47	3.00E-09	0.06	LOSS OF COMPRESSED AIR INITIATING EVENT OCCURS	3.48E-02	IEV-LCAS
			ANY SECOND. SIDE RELIEF VALVE FAILS TO CLOSE (1 SV)	1.00E-02	OTH-SLSOV2
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM

Table 43-12 (Sheet 9 of 9)

LRF SENSITIVITY CASE – NON CREDIT FOR STANDBY NON-SAFETY SYSTEMS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Basic Event Identifier
48	2.96E-09	0.06	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
49	2.87E-09	0.06	MAIN STEAM LINE STUCK-OPEN SV INITIATING EVENT OCCURS	2.39E-03	IEV-SLB-V
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
50	2.69E-09	0.05	SUCCESS OF CORE REFLOODING	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF 4 GRAVITY INJECTION CVs	3.00E-05	IWX-CV-AO

Table 43-13 (Sheet 1 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
1	7.44E-08	19.12	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
2	2.06E-08	5.29	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFILL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE TO OPEN OF 4.16 KVAC CIRCUIT BREAKERS	4.20E-04	RPX-CB-GO
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			COND. PROB. OF AND-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	AND-MAN01C
			LATE ADS RECOVERY BY OPERATOR ACTION	1.00E-01	PDS6-MANADS
3	1.95E-08	5.01	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
4	1.68E-08	4.32	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS

Table 43-13 (Sheet 2 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
5	1.58E-08	4.06	ATWS PRECURSOR WITH NO MFW INITIATING EVENT OCCURS	4.81E-01	IEV-ATWS
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			COND. PROB. OF ATW-MAN04 (OPER. FAILS TO TRIP REACTOR)	5.26E-01	ATW-MAN04C
6	1.07E-08	2.75	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
7	9.24E-09	2.37	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF PMS ESF OUTPUT LOGIC SOFTWARE	1.10E-05	CCX-PMXMOD1-SW
8	9.14E-09	2.35	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG

Table 43-13 (Sheet 3 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
9	8.40E-09	2.16	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
10	7.24E-09	1.86	LOSS OF OFFSITE POWER INITIATING EVENT OCCURS	1.20E-01	IEV-LOSP
			FAILURE TO RECOVER OFFSITE AC POWER IN 30 MINUTES	7.00E-01	OTH-R05
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
			CCF OF EPO BOARDS IN PMS	8.62E-06	CCX-EP-SAM
11	6.22E-09	1.6	CONTAINMENT FAILURE DUE TO DIFFUSION FLAME	1.70E-02	OTH-DF
			RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
12	6.00E-09	1.54	SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP

Table 43-13 (Sheet 4 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
13	5.49E-09	1.41	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSURE	4.78E-04	CCX-TRNSM
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			OPERATOR FAILS TO ACTUATE ADS AFTER CORE DAMAGE	5.00E-02	LPM-REC01
14	5.49E-09	1.41	TRANSIENT WITH MFW INITIATING EVENT OCCURS	1.40E+00	IEV-TRANS
			CCF NON-SAFETY TRANSMITTERS INTERFACING SYSTEM PRESSURE	4.78E-04	CCX-TRNSM
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			OPERATOR FAILS TO ACTUATE ADS AFTER CORE DAMAGE	5.00E-02	ADN-REC01
15	5.23E-09	1.34	MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF STRAINERS IN IRWST TANK	1.20E-05	IWX-FL-GP
16	4.66E-09	1.2	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS

Table 43-13 (Sheet 5 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
17	4.02E-09	1.03	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
18	3.49E-09	0.9	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			NO CONTAINMENT FAILURE FROM HYDROGEN DETONATION	7.55E-01	SUC-DTE
			OTH-DTI-1	1.24E-01	OTH-DTI-1
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG
19	3.39E-09	0.87	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
20	3.16E-09	0.81	CONTAINMENT FAILURE DUE TO DIFFUSION FLAME	1.70E-02	OTH-DF
			RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			DUE TO CCF OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA

Table 43-13 (Sheet 6 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
21	3.04E-09	0.78	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFIL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE OF 4 AOVS TO OPEN	6.20E-05	CCX-AV-LA
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			COND. PROB. OF ADN-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	ADN-MAN01C
			PDS6-MANADS	1.00E-01	PDS6-MANADS
22	3.01E-09	0.77	ATWS PRECURSOR WITH NO MFW INITIATING EVENT OCCURS	4.81E-01	IEV-ATWS
			OPERATOR FAILS TO MANUALLY TRIP REACTOR VIA PMS	5.20E-02	ATW-MAN03
			CCF OF SAFETY PT LT CONTINUOUSLY INTERFACING HIGH PRESSURE	4.78E-04	CCX-XMTR
			COMMON CAUSE FAILURE OF PZR LEVEL SENSORS	4.78E-04	CCX-XMTR195
			COND. PROB. OF ATW-MAN04 (OPER. FAILS TO TRIP REACTOR)	5.26E-01	ATW-MAN04C
23	2.96E-09	0.76	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2

Table 43-13 (Sheet 7 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
24	2.69E-09	0.69	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF 4 GRAVITY INJECTION CVs	3.00E-05	IWX-CV-AO
25	2.67E-09	0.69	LOSS OF MFW TO ONE SG INITIATING EVENT OCCURS	1.92E-01	IEV-LMFW1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
26	2.50E-09	0.64	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			OPERATOR FAILS TO FULFIL MANUAL ACTUATION OF ADS	5.00E-01	ADF-MAN01
			COMMON CAUSE FAILURE OF 4 CHECK VALVES TO OPEN	5.10E-05	CMX-CV-GO
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			COND. PROB. OF ADN-MAN01(OPER. FAILS TO ACT. ADS)	5.00E-01	ADN-MAN01C
			LATE ADS RECOVERY BY OPERATOR ACTION	1.00E-01	PDS6-MANADS
27	2.49E-09	0.64	STEAM GENERATOR TUBE RUPTURE INITIATING EVENT OCCURS	3.88E-03	IEV-SGTR
			COMMON CAUSE FAILURE TO OPEN OF 4.16 KVAC CIRCUIT BREAKERS	4.20E-04	RPX-CB-GO
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			OPER. FAILS TO FULFIL MANUAL ACTUATION OF ADS	3.02E-03	ADN-MAN01

Table 43-13 (Sheet 8 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
28	2.35E-09	0.6	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF 4 GRAVITY INJECTION CVs	3.00E-05	IWX-CV-AO
29	2.33E-09	0.6	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			CCF OF 4 GRAVITY INJECTION & 2 RECIRCULATION SQUIB VALVES	2.60E-05	IWX-EV-SA
30	2.30E-09	0.59	LOSS OF MFW TO ONE SG INITIATING EVENT OCCURS	1.92E-01	IEV-LMFW1
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
31	2.04E-09	0.52	CORE REFLOODING IS SUCCESSFUL	7.33E-01	SUC-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	2.45E-01	OTH-DTE
			MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			CCF OF 4 GRAVITY INJECTION & 2 RECIRCULATION SQUIB VALVES	2.60E-05	IWX-EV-SA

Table 43-13 (Sheet 9 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
32	2.00E-09	0.51	LOSS OF CCW/SW INITIATING EVENT OCCURS	1.44E-01	IEV-LCCW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
33	1.73E-09	0.44	LOSS OF CCW/SW INITIATING EVENT OCCURS	1.44E-01	IEV-LCCW
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
34	1.73E-09	0.44	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			SMALL LOCA INITIATING EVENT OCCURS	5.00E-04	IEV-SLOCA
			DUE TO CCF OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
35	1.71E-09	0.44	SUC-CFE	9.00E-01	SUC-CFE
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.90E-01	OTH-DTE-2R
			REACTOR VESSEL RUPTURE INITIATING EVENT OCCURS	1.00E-08	IEV-RV-RP
36	1.66E-09	0.43	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.90E-01	OTH-DTE-2R
			LARGE LOCA INITIATING EVENT OCCURS	5.00E-06	IEV-LLOCA
			CHECK VALVE 028A FAILS TO OPEN	1.75E-03	ACACV028GO

Table 43-13 (Sheet 10 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob	Percent	Basic Event Name	Event Prob.	Identifier
37	1.66E-09	0.43	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.90E-01	OTH-DTE-2R
			LARGE LOCA INITIATING EVENT OCCURS	5.00E-06	IEV-LLOCA
			CHECK VALVE 029B FAILS TO OPEN	1.75E-03	ACBCV029GO
38	1.66E-09	0.43	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.90E-01	OTH-DTE-2R
			LARGE LOCA INITIATING EVENT OCCURS	5.00E-06	IEV-LLOCA
			CHECK VALVE 028B FAILS TO OPEN	1.75E-03	ACBCV028GO
39	1.66E-09	0.43	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.90E-01	OTH-DTE-2R
			LARGE LOCA INITIATING EVENT OCCURS	5.00E-06	IEV-LLOCA
			CHECK VALVE 029A FAILS TO OPEN	1.75E-03	ACACV029GO
40	1.61E-09	0.41	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
			CCF OF RECIRC MOVs TO OPEN	4.40E-03	IWX-MV-GO
41	1.59E-09	0.41	CORE REFLOODING FAILS	2.67E-01	OTH-RFL
			CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.17E-01	OTH-DTE-4
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			IWRST DISCHARGE LINE "A" STRAINER PLUGGED	2.40E-04	IWA-PLUG

Table 43-13 (Sheet 11 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
42	1.56E-09	0.4	LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS ACT.	1.16E-02	REC-MANDAS
43	1.50E-09	0.39	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			MEDIUM LOCA INITIATING EVENT OCCURS	4.36E-04	IEV-MLOCA
			DUE TO CCF OF 4TH STAGE ADS SQUIB VALVES TO OPERATE	3.00E-05	ADX-EV-SA
44	1.48E-09	0.38	RCS LEAK INITIATING EVENT OCCURS	6.20E-03	IEV-RCSLK
			MAIN GEN. BKR ES 01 FAILS TO OPEN [# 12]	5.08E-03	EC0MOD01
			COMMON CAUSE FAILURE OF THE BATTERIES IDSA-DB-1A/1B	4.70E-05	CCX-BY-PN
45	1.44E-09	0.37	CONTAINMENT FAILS DUE HYDROGEN DETONATION	1.15E-01	OTH-DTE-3D
			SAFETY INJECTION LINE BREAK INITIATING EVENT OCCURS	2.12E-04	IEV-SI-LB
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
46	1.41E-09	0.36	MAIN STEAM LINE STUCK-OPEN SV INITIATING EVENT OCCURS	2.39E-03	IEV-SLB-V
			CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2

Table 43-13 (Sheet 12 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
47	1.39E-09	0.36	CONSEQUENTIAL SGTR OCCURS	1.00E-02	OTH-SGTR
			LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			ANY SECOND. SIDE RELIEF VALVE FAILS TO CLOSE (2 SV + PORV)	2.10E-02	OTH-SLSOV1
			CCF OF 2 SQUIB VALVES TO OPERATE	5.90E-05	ADX-EV-SA2
48	1.34E-09	0.34	LOSS OF CONDENSER INITIATING EVENT OCCURS	1.12E-01	IEV-LCOND
			SOFTWARE CCF OF ALL CARDS	1.20E-06	CCX-SFTW
			FAILURE OF MANUAL DAS REACTOR TRIP HARDWARE	1.00E-02	MDAS
49	1.31E-09	0.34	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			CCF OF SAFETY PT LT CONTINUOUSLY INTERFACING HIGH PRESSURE	4.78E-04	CCX-XMTR
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			OPERATOR FAILS TO ACTUATE ADS AFTER CORE DAMAGE	5.00E-02	ADN-REC01

Table 43-13 (Sheet 13 of 13)

LRF CUTSETS FOR THE CASE – SENSITIVITY TO STANDBY SYSTEMS WITH CREDIT FOR MANUAL DAS

Number	Cutset Prob.	Percent	Basic Event Name	Event Prob.	Identifier
50	1.31E-09	0.34	LOSS OF MAIN FEEDWATER INITIATING EVENT OCCURS	3.35E-01	IEV-LMFW
			CCF OF SAFETY PT LT CONTINUOUSLY INTERFACING HIGH PRESSURE	4.78E-04	CCX-XMTR
			COND. PROB. OF REC-MANDAS (FAILURE OF MANUAL DAS ACT.)	5.06E-01	REC-MANDASC
			CCF OF 4 COMBINATIONS OF 3 STAGES #2 AND #3 MOVS	3.24E-04	ADX-MV3-GO
			OPERATOR FAILS TO ACTUATE ADS AFTER CORE DAMAGE	5.00E-02	LPM-REC01

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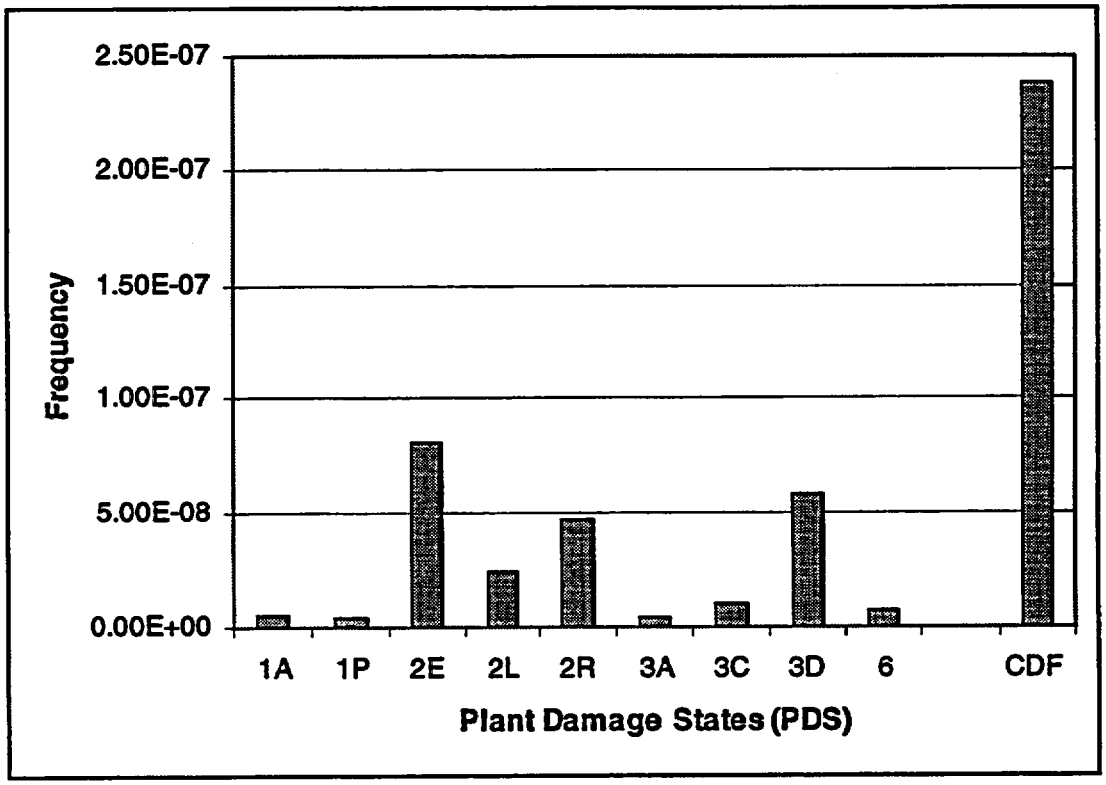

Figure 43-1

Plant Damage State Contributions to CDF

ATTACHMENT 43C

EVALUATION OF OPERATOR ACTIONS

The operator actions pertinent to the CET event tree nodes are listed in Table 43C-1. A comparison with the operator actions modeled in the AP600 PRA indicates that all but one operator action still have the same performance shaping factors and time windows except one, REN-MAN03.

The REN-MAN03 time window is estimated to be shorter for the AP1000 design since higher water levels are needed in the reactor cavity, thus a longer flooding time. To compensate for the shorter time window, the action to open valves has been moved to the first step of Emergency Response Guideline (ERG) AFR.C-1. With this revision it is estimated that the A600 HEP of 3.4E-03 for this operator action is maintained for AP1000. However, two sensitivity analyses are made to study the effect of this operator action HEP being higher, namely 3.4E-02 or 0.1. The operator action affects the IWF fault tree cutsets, and thus the probabilities q2 and q20 calculated for use in the CET. The calculations are stored in sec-44iwf folder.

The results are summarized in the following table:

REN-MAN03 HEP =	3.4E-03	3.4E-02	0.1
Q2	2.671E-09	5.088E-09	1.029E-08
Q20	2.059E-09	3.851E-09	7.712E-09
LRF	1.95E-08	2.62E-08	3.5E-08
Ceff	91.9%	89.1	85.5%

If the REN-MAN03 failure probability was two orders of magnitude higher than the base case, the plant LRF would have been doubled, which shows that the results are somewhat sensitive to this operator action.

Table 43C-1

EVALUATION OF CET-RELATED OPERATOR ACTIONS

SUMMARY OF OPERATOR ACTIONS FOR CONTAINMENT EVENT TREE NODES

Top Event	Description of Operator Error	Event ID	Cue(s)	Time Window	AP600 Tw/Ta/Stress	AP600 HEP/Cond HEP	AP1000 HEP	Comments
DP	Failure to recognize need for post-core-uncovery RCS depress during small LOCA or transient with loss of PRHR	LPM-REC01	core-exit T/C > 1200°F (ERG AFR.C-1)	30 minutes	20/15/H	1.34E-03/ 5.0E-02	1.34E-03/ 5.0E-02	
	Failure to complete ADS as recovery from failure of automatic actuation or manual actuation after core damage	ADN-REC01	core-exit T/C > 1200°F (ERG AFR.C-1)	30 minutes	5/3/H	3.02E-03/ 5.0E-02	3.02E-03/ 5.0E-02	
IS	Failure to recognize need and failure to isolate the containment, given core damage following an accident	CIC-MAN01	high containment pressure, or temperature, or radiation (ERG E-0)	50 minutes	60/30/H	5.71E-03/ N/A	5.71E-03/ N/A	
IR	Failure to recognize need and failure to open recirculation valves to flood reactor cavity after core damage	REN-MAN03	core-exit temperature > 1200°F (ERG AFR.C-1)	5 minutes	20/10/H	3.4E-03/0.15	3.4E-03/0.15	See sensitivity analyses
PC	Failure to recognize need and failure to open PCS water valves to drain cooling water on containment shell	PCN-MAN01	high containment pressure (ERG E-0)	18 hours	300/120/H	1.48E-04/ N/A	1.48E-04/ N/A	
VNT	Failure to recognize need and failure to open containment vent to reduce containment pressure	VNT-MAN01	high containment pressure (SAMG)	60 minutes	N/A		1.0	Not credited
IG	Failure to recognize need and failure to actuate hydrogen control system, given core damage following an accident	VLN-MAN01	core-exit T/C > 1200°F (ERG AFR.C-1)	15 minutes	15/10/H	1.28E-03/0.5	1.28E-03/0.5	
DP	Failure to perform ADS as recovery from failure of automatic actuation or manual actuation in later phases of SGTR event	PDS6-MANADS	Late Recovery	Hours available	0.1		0.1	Screening valve