

# Final Precursor Analysis

Accident Sequence Precursor Program ---Office of Nuclear Regulatory Research

Millstone 3	Inadvertent Reactor Trip and Safety Injection	
Event Date: 4/17/2005	LER 423-2005-002	CCDP <sup>1</sup> = 7.6E-06

May 31, 2006

## Event Summary

### *Description.*

On April 17, 2005 at 0829, during normal 100% power operating conditions the solid state protection system (SSPS) generated an "A" Train SSPS Steam Line Pressure Low SI/MSI signal that tripped the reactor, closed the main steam isolation valves (MSIVs), and started the "A" train of the emergency core cooling system (ECCS). Following the trip, all control rods inserted and the auxiliary feedwater system actuated automatically as expected, however the turbine driven auxiliary feedwater pump (TDP) tripped on startup. Immediately following the trip, control room operators entered the emergency operating procedure network, manually initiated "B" safety injection (SI) actuation so as to have a two-train SI actuation, and continued to place the plant in a stable condition. Later into the event at 0844, operators also manually initiated "B" main steam isolation (MSI) actuation.

At 0840, reactor coolant system (RCS) pressure reached 2350 psia and both pressurizer power operated relief valves (PORVs) began cycling as designed. The pressurizer safety valves remained closed throughout the event. Safety injection was terminated at 0913. After performing their safety function, both PORVs leaked, however the leakage did not exceed the 10 gpm Technical Specification limit. Leakage was conservatively estimated to be 5 .3 gpm with the plant at 2250 psia. Additionally, a field observation at 0858 reported RCS leakage from two charging system valves (3CHS\*V661 and 3CHS\*MV8511 B) into the auxiliary building. Valve 3CHS\*MV8511 B leakage was terminated when the valve was closed at 0905 and valve 3CHS\*V661 was isolated at 1032. The leakage was determined to have commenced at 0830 and initial leakage was estimated to be approximately 60 gpm.

Regarding secondary side plant response, following the reactor trip, approximately 8 seconds after the TDP began feeding the steam generators (SGs), the TDP trip throttle valve closed . This resulted in isolating steam to the pump turbine which then began to coast down. Subsequent manual restart of the TDP pump occurred at 1019. The two motor driven AFW pumps provided flow to the SGs throughout the event.

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<sup>1</sup> For the initiating event assessment, the parameter of interest is the measure of the conditional core damage probability (CCDP). This is the value obtained when calculating the probability of core damage for an initiating event with subsequent failure of one or more components following the initiating event.

Within one hour of event initiation, plant parameters were stabilized and ECCS systems were stopped and placed in a standby condition. The event was terminated at 1905.

## Analysis Results

The event importance is calculated to be  $7.6\text{E-}06$ . Based on sensitivity analyses, upper and lower bounds of the event importance may be  $1.6\text{E-}05$  and  $2\text{E-}06$ . The upper bound uses TDP not recovered with a pessimistic SI termination HEP (0.01); the lower bound assumes TDP recovery and a very low SI termination HEP (0.0001).

## Model

- **Assessment summary**

This event was modeled as an initiating event analysis, with a weighted average combination of TRANS and SLOCA (pressurizer PORV or SRV), depending on the success of the operators to terminate the SI or not.

- **Key Modeling Assumptions**

The following key assumptions are made:

1. AFW TDP is unavailable during the event. A sensitivity analysis with a recovered pump is also made.
2. If the operators terminate the SI injection, the event is modeled as a transient.
3. If the operators fail to terminate the SI injection, the event is modeled as a small LOCA (pressurizer PORV or SRV).

- **SPAR model used in the analysis**

Millstone 3 SPAR model 3.21.

- **Unique system and operational considerations**

None

- **Modifications to event tree and fault tree models**

None of the SPAR model fault trees and event trees are changed.

An event tree logic is generated and used to define the weighted average combination

of TRANS and SLOCA, based on the operator action to terminate the SI. This event tree is given in Figure 1.

- **Initiating event probability changes**

None.

- **Basic event probability changes**

**HPR-XHE-XM-RECIRC:** Operator fails to start high pressure recirculation.

The HEP value for this basic event is 5E-03 in the SPAR model. As pointed out by the reviewer of this document, this HEP value is very conservative for this type of small LOCA where a long time period passes before RWST is depleted. Moreover, the switchover to sump recirculation is a semi-automatic action. The plant-specific value calculated by the licensee for this operator action is 1.1E-04 and it is deemed to be a more accurate estimate of the HEP. Thus, it is used for the base case calculations.

The following two event tree nodes are introduced in Figure 1:

**OP-TERM:** Operators terminate SI. The time window for this is taken as hours, rather than minutes, which provides ample time to diagnose.

Failure of OP-TERM is driven by diagnosis; extra time and high stress are postulated and the HEP is estimated as 2E-03. Sensitivity analyses with higher and lower HEPs are also made.

**CCDP:** conditional core damage probability, given TRANS or SLOCA without TDP occurs. SPAR models are quantified to calculate these CCDPs; CCDPs with TDP available (recovered) are also calculated. The results are summarized as follows:

	CCDP with TDP	CCDP without TDP
TRANS	1.9E-06	5.4E-06
SLOCA	1.1E-03	1.1E-03

## Calculations

Table 1 summarizes the results of the eight CCDP calculations made using GEM. These CCDPs are later used in Figures 1 through 4 to estimate event importance for the base case

and various sensitivities. Figure 1 shows the calculations for the base case. Additional sensitivity analyses are made, as shown in Figures 2, 3 and 4. Based on these calculations, the event importance is estimated as 7.6E-06, with upper and lower bound estimates of 1.6 E-05 and 2 E-06.

The upper bound estimate is taken from Figure 2 with TDP not recovered, coupled with a pessimistic SI termination HEP (0.01).

The lower bound is taken from Figure 2 given TDP recovery and a very low SI termination HEP (0.0001).

## **Conclusion**

The event importance is calculated to be 7.6E-06. Since this value is greater than that of the acceptance threshold for ASP program, this event should be retained in the ASP data base.

## **References**

1. Licensee Event Report LER 423-2005-002, issued 6/16/2005
2. NRC Memorandum dated April 20, 2005: Special Team Inspection Charter - Millstone Unit 3 NGS.

**Table 1. Input**

Transient and Small LOCA CCDPs are calculated for 4 cases, using Millstone 3 SPAR\_3.21 Model. Gem files for base case (Case 1) are attached.

**Case 1 AFW TDP fails; HEP for HPR is set to 1.1E-04.**

<b>GEM Run</b>	<b>CCDP</b>
TRANS-TDP-LIC	5.40E-06
SLOCA-TDP-LIC	1.10E-03

**Case 2 AFW TDP is recovered; HEP for HPR is set to 1.1E-04.**

<b>GEM Run</b>	<b>CCDP</b>
TRANS-TDP-LIC	1.90E-06
SLOCA-TDP-LIC	1.10E-03

**Case 3 AFW TDP fails; HEP for HPR is set to 5 E-03.**

<b>GEM Run</b>	<b>CCDP</b>
TRANS-TDP-LIC	5.60E-06
SLOCA-TDP-LIC	6.00E-03

**Case 4 AFW TDP is recovered; HEP for HPR is set to 5 E-03.**

<b>GEM Run</b>	<b>CCDP</b>
TRANS-TDP-LIC	1.90E-06
SLOCA-TDP-LIC	6.00E-03

HEPs for Operator terminates SI (OP-TERM) are taken as:

high	1.00E-02
base	2.00E-03
low	1.00E-04

The CCDPs and OP-TERM are used in the next set of event tree models to estimate the event CCDP for four cases.

Figure 1 Base Case Calculation (case 1)

Reactor trip with SI occurs	Operators Terminate SI	CCDP due to TRANSIENT or SLOCA		low OP-TERM	Base OP- TERM	High OP- TERM
1	OP-TERM	CCDP				
	TRANS		1	OK		
			2	CD	5.4E-06	5.39E-06
		5.4E-06	3	OK		5.35E-06
	SLOCA		4	CD	1.1E-07	2.20E-06
		1.1E-03				1.10E-05
			Sum =		5.5E-06	7.6E-06
						1.6E-05

Case 1 AFW TDP fails; HEP for HPR is set to 1.1E-04.

GEM Run	CCDP
TRANS-TDP-LIC	5.40E-06
SLOCA-TDP-LIC	1.10E-03

HEPs for Operator terminates SI (OP-TERM) are taken as:

	OP-TERM	1 - OP-TERM
high	1.00E-02	9.90E-01
base	2.00E-03	9.98E-01
low	1.00E-04	1.00E+00

Figure 2 Case 2 Calculation

Reactor trip with SI occurs	Operators Terminate SI	CCDP due to TRANSIENT or SLOCA		low OP-TERM	Base OP- TERM	High OP- TERM
1	OP-TERM	CCDP				
	TRANS		1	OK		
			2	CD	1.9E-06	1.90E-06
		1.9E-06	3	OK		1.88E-06
	SLOCA		4	CD	1.1E-07	2.20E-06
		1.1E-03				1.10E-05
			Sum =	2.0E-06	<b>4.1E-06</b>	1.3E-05

Case 2 AFW TDP is recovered; HEP for HPR is set to 1.1E-04.

GEM Run	CCDP
TRANS-TDP-LIC	1.90E-06
SLOCA-TDP-LIC	1.10E-03

HEPs for Operator terminates SI (OP-TERM) are taken as:

	OP-TERM	1 - OP-TERM
high	1.00E-02	9.90E-01
base	2.00E-03	9.98E-01
low	1.00E-04	1.00E+00

Figure 3 Case 3 Calculation

Reactor trip with SI occurs	Operators Terminate SI	CCDP due to TRANSIENT or SLOCA		low OP-TERM	Base OP- TERM	High OP- TERM
1	OP-TERM	CCDP				
	TRANS		1	OK		
			2	CD	5.6E-06	5.59E-06
		5.6E-06	3	OK		
	SLOCA		4	CD	6.0E-07	1.20E-05
		6.0E-03				6.00E-05
			Sum =		6.2E-06	1.8E-05
						6.6E-05

Case 3 AFW TDP fails; HEP for HPR is set to 5 E-03.

GEM Run	CCDP
TRANS-TDP-LIC	5.60E-06
SLOCA-TDP-LIC	6.00E-03

HEPs for Operator terminates SI (OP-TERM) are taken as:

	OP-TERM	1 - OP-TERM
high	1.00E-02	9.90E-01
base	2.00E-03	9.98E-01
low	1.00E-04	1.00E+00



Figure 4 Case 4 Calculation

Reactor trip with SI occurs	Operators Terminate SI	CCDP due to TRANSIENT or SLOCA		low OP-TERM	Base OP- TERM	High OP- TERM
1	OP-TERM	CCDP				
	TRANS		1	OK		
		1.9E-06	2	CD	1.9E-06	1.88E-06
	SLOCA		3	OK		
		6.0E-03	4	CD	6.0E-07	1.20E-05
Sum =				2.5E-06	<b>1.4E-05</b>	6.2E-05

Case 4 AFW TDP is recovered; HEP for HPR is set to 5 E-03.

GEM Run	CCDP
TRANS-TDP-LIC	1.90E-06
SLOCA-TDP-LIC	6.00E-03

HEPs for Operator terminates SI (OP-TERM) are taken as:

	OP-TERM	1 - OP-TERM
high	1.00E-02	9.90E-01
base	2.00E-03	9.98E-01
low	1.00E-04	1.00E+00

**Attachment A: GEM Outputs**

GEM output files for the base case (case 1):

1. TRANS without TDP
2. SLOCA without TDP

## I N I T I A T I N G   E V E N T   A S S E S S M E N T

Fam : MIL3\_3  
 User : INEEL  
 Ev ID: TRANS-TDP-LIC  
 Desc : Transient CCDP with licensee HEP for HPR - no TDP

Code Ver : 7:26  
 Model Ver : 2005/10/28  
 Init Event: IE-TRANS  
 Total CCDP: 5.4E-006

BASIC EVENT CHANGES				
Event Name	Description	Base Prob	Curr Prob	Type
AFW-TDP-TM-P2	FEED PUMP P2 IS IN TEST OR M	5.0E-003	1.0E+000	TRUE
HPR-XHE-XM-RECIRC	OPERATOR FAILS TO START HIGH	5.0E-003	1.1E-004	
IE-LLOCA	LARGE LOSS OF COOLANT ACCIDE	5.0E-006	+0.0E+000	
IE-LOCCW	LOSS OF COMPONENT COOLING WA	4.0E-004	+0.0E+000	
IE-LOCHS	LOSS ODF CONDENSER HEAT SINK	9.0E-002	+0.0E+000	
IE-LODCA	LOSS OF DC BUS 301-A INITIAT	1.3E-003	+0.0E+000	
IE-LODCB	LOSS OF DC BUS 301-B INITIAT	1.3E-003	+0.0E+000	
IE-LOMFW	LOSS OF MAIN FEEDWATER INITI	1.0E-001	+0.0E+000	
IE-LOOP	LOSS OF OFFSITE POWER	3.6E-002	+0.0E+000	
IE-LOSWS	LOSS OF SERVICE WATER	4.0E-004	+0.0E+000	
IE-MLOCA	MEDIUM LOSS OF COOLANT ACCI	4.0E-005	+0.0E+000	
IE-RHR-CLDIS-V	RHR COLD LEG DISCHARGE ISLO	+0.0E+000	+0.0E+000	
IE-RHR-HLDIS-V	RHR HOT LEG DISCHARGE ISLOCA	+0.0E+000	+0.0E+000	
IE-RHR-SUC-V	RHR SUCTION LINE ISLOCA EVEN	+0.0E+000	+0.0E+000	
IE-SGTR	STEAM GENERATOR TUBE RUPTURE	4.0E-003	+0.0E+000	
IE-SI-CLDIS-V	SI COLD LEG DISCHARGE ISLOC	+0.0E+000	+0.0E+000	
IE-SI-HLDIS-V	SI HOT LEG DISCHARGE ISLOCA	+0.0E+000	+0.0E+000	
IE-SLOCA	SMALL LOSS OF COOLANT ACCIDE	4.0E-004	+0.0E+000	
IE-TRANS	TRANSIENT	7.0E-001	1.0E+000	

## SEQUENCE PROBABILITIES

Truncation : Cumulative : 100.0% Individual : 1.0%

Event Tree Name	Sequence Name	CCDP	%Cont
TRANS	18	3.7E-006	
TRANS	02-02-12	7.9E-007	
TRANS	02-02-10	5.5E-007	
TRANS	19-08	1.0E-007	
TRANS	19-18	9.2E-008	

## SEQUENCE LOGIC

Event Tree	Sequence Name	Logic
TRANS	18	/RPS FAB
		AFW

TRANS	02-02-12	/RPS /PORV /RCPT /BP1 HPI	/AFW LOSC /RSD BP2 SSC1
TRANS	02-02-10	/RPS /PORV /RCPT /BP1 HPI /PZR1	/AFW LOSC /RSD BP2 /SSC1 LPI
TRANS	19-08	RPS /MFW	/RCSPRESS BORATION
TRANS	19-18	RPS	RCSPRESS

Fault Tree Name	Description
AFW	AUXILIARY FEEDWATER
BORATION	MILLSTONE 3 EMERGENCY BORATION FOR ATWS
BP1	RCP SEAL STAGE 1 INTEGRITY
BP2	RCP SEAL STAGE 2 INTEGRITY
FAB	FEED AND BLEED
HPI	HIGH PRESSURE INJECTION
LOSC	LOSS OF ALL SEAL COOLING
LPI	LOW PRESSURE INJECTION
MFW	MILLSTONE 3 MAIN FEEDWATER FAULT TREE
PORV	PORVs ARE CLOSED
PZR1	RCS DEPRESS FOR LPI/RHR
RCPT	REACTOR COOLANT PUMP TRIP
RCSPRESS	FAILURE TO LIMIT RCS PRESSURE TO <3200 PSI
RPS	REACTOR TRIP
RSD	RAPID SECONDARY DEPRESS
SSC1	RCS COOLDOWN (POST-LOCA)

## SEQUENCE CUT SETS

Truncation: Cumulative: 100.0% Individual: 1.0%

Event Tree: TRANS  
Sequence: 18

CCDP: 3.7E-006

CCDP	% Cut Set	Cut Set Events
2.0E-006	53.53	HPI-XHE-XM-FB      AFW-MDP-CF-START
1.5E-007	4.05	HPI-XHE-XM-FB      AFW-MDP-FS-1A
		AFW-MDP-TM-1B

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1.5E-007	4.05	HPI-XHE-XM-FB	AFW-MDP-TM-1A
		AFW-MDP-FS-1B	
1.2E-007	3.17	HPI-XHE-XM-FB	AFW-MDP-CF-RUN
9.0E-008	2.43	HPI-XHE-XM-FB	AFW-AOV-CC-F083
		AFW-MDP-TM-1A	
9.0E-008	2.43	HPI-XHE-XM-FB	AFW-AOV-CC-F085
		AFW-MDP-TM-1B	
6.9E-008	1.87	PPR-SRV-CC-PRV2	AFW-MDP-CF-START
6.9E-008	1.87	AFW-MDP-CF-START	PPR-SRV-CC-PRV1
5.2E-008	1.39	HPI-XHE-XM-FB	AFW-MDP-TM-1A
		AFW-MDP-FR-1B	
5.2E-008	1.39	HPI-XHE-XM-FB	AFW-MDP-FR-1A
		AFW-MDP-TM-1B	
4.8E-008	1.30	HPI-XHE-XM-FB	AFW-TNK-FC-DWST
4.8E-008	1.30	HPI-XHE-XM-FB	AFW-TNK-FC-CST
4.5E-008	1.21	HPI-XHE-XM-FB	AFW-MDP-FS-1A
		AFW-MDP-FS-1B	
4.0E-008	1.08	HPI-XHE-XM-FB	AFW-PMP-FR-P1B
		AFW-MDP-TM-1A	
4.0E-008	1.08	AFW-PMP-FR-P1A	HPI-XHE-XM-FB
		AFW-MDP-TM-1B	

Event Tree: TRANS  
Sequence: 02-02-12

CCDP: 7.9E-007

CCDP	% Cut Set	Cut Set Events
3.1E-007	38.89	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABS /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3AOP-P3BSTBY
3.1E-007	38.89	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABS /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3BOP-P3ASTBY
2.5E-008	3.11	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-PND-CF-23AB /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3BOP-P3ASTBY
2.5E-008	3.11	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-PND-CF-23AB /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3AOP-P3BSTBY
2.4E-008	3.09	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABR /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3BOP-P3ASTBY
2.4E-008	3.09	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABR /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2 CVC-P3AOP-P3BSTBY
1.9E-008	2.35	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-FS-2A SWS-FAN-FS-2B
		/RCS-MDP-LK-BP1 RCS-MDP-LK-BP2
		CVC-P3BOP-P3ASTBY
1.9E-008	2.35	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-FS-2A SWS-FAN-FS-2B
		/RCS-MDP-LK-BP1 RCS-MDP-LK-BP2

1.2E-008	1.56	CVC-P3AOP-P3BSTBY CVC-XHE-XM-ACOOOL SWS-FAN-CF-HVY2ABS	SWS-XHE-XL-VENT /RCS-MDP-LK-BP1
1.2E-008	1.56	RCS-MDP-LK-BP2 CVC-XHE-XM-ACOOOL SWS-FAN-CF-HVY2ABS	CVC-P3BOP-P3ASTBY SWS-XHE-XL-VENT /RCS-MDP-LK-BP1
		RCS-MDP-LK-BP2	CVC-P3AOP-P3BSTBY

Event Tree: TRANS  
Sequence: 02-02-10

CCDP: 5.5E-007

CCDP	% Cut Set	Cut Set Events
2.2E-007	38.90	CVC-XHE-XM-ACOOOL /SSC1 /RCS-MDP-LK-BP1 CVC-P3AOP-P3BSTBY
		NOTSUMMER SWS-FAN-CF-HVY2ABS RCS-MDP-LK-BP2
2.2E-007	38.90	CVC-XHE-XM-ACOOOL /SSC1 /RCS-MDP-LK-BP1 CVC-P3BOP-P3ASTBY
		NOTSUMMER SWS-FAN-CF-HVY2ABS RCS-MDP-LK-BP2
1.7E-008	3.11	CVC-XHE-XM-ACOOOL SWS-PND-CF-23AB /RCS-MDP-LK-BP1 CVC-P3AOP-P3BSTBY
		NOTSUMMER /SSC1 RCS-MDP-LK-BP2
1.7E-008	3.11	CVC-XHE-XM-ACOOOL SWS-PND-CF-23AB /RCS-MDP-LK-BP1 CVC-P3BOP-P3ASTBY
		NOTSUMMER /SSC1 RCS-MDP-LK-BP2
1.7E-008	3.09	CVC-XHE-XM-ACOOOL SWS-FAN-CF-HVY2ABR /RCS-MDP-LK-BP1 CVC-P3AOP-P3BSTBY
		NOTSUMMER /SSC1 RCS-MDP-LK-BP2
1.7E-008	3.09	CVC-XHE-XM-ACOOOL SWS-FAN-CF-HVY2ABR /RCS-MDP-LK-BP1 CVC-P3BOP-P3ASTBY
		NOTSUMMER /SSC1 RCS-MDP-LK-BP2
1.3E-008	2.35	CVC-XHE-XM-ACOOOL /SSC1 SWS-FAN-FS-2B RCS-MDP-LK-BP2
		NOTSUMMER SWS-FAN-FS-2A /RCS-MDP-LK-BP1 CVC-P3AOP-P3BSTBY
1.3E-008	2.35	CVC-XHE-XM-ACOOOL /SSC1 SWS-FAN-FS-2B RCS-MDP-LK-BP2
		NOTSUMMER SWS-FAN-FS-2A /RCS-MDP-LK-BP1 CVC-P3BOP-P3ASTBY
8.6E-009	1.56	CVC-XHE-XM-ACOOOL /SSC1 /RCS-MDP-LK-BP1 CVC-P3AOP-P3BSTBY
		SWS-XHE-XL-VENT SWS-FAN-CF-HVY2ABS RCS-MDP-LK-BP2
8.6E-009	1.56	CVC-XHE-XM-ACOOOL /SSC1 /RCS-MDP-LK-BP1
		SWS-XHE-XL-VENT SWS-FAN-CF-HVY2ABS RCS-MDP-LK-BP2

## CVC-P3BOP-P3ASTBY

Event Tree: TRANS  
Sequence: 19-08

CCDP: 1.0E-007

CCDP	% Cut Set	Cut Set Events
3.2E-008	30.88	CVC-XHE-XM-BOR RPS-BME-CF-RTBAB
2.7E-008	25.76	RPS-XHE-XE-NSGNL CVC-XHE-XM-BOR
		RPS-CBI-CF-60F8 /RPS-CCP-TM-CHA
2.4E-008	23.21	CVC-XHE-XM-BOR RPS-ROD-CF-RCCAS
1.8E-008	17.46	RPS-CCX-CF-60F8 RPS-XHE-XE-NSGNL
		CVC-XHE-XM-BOR /RPS-CCP-TM-CHA
2.1E-009	1.99	CVC-XHE-XM-BOR RPS-UVL-CF-UVDAB
		RPS-XHE-XE-SIGNL

Event Tree: TRANS  
Sequence: 19-18

CCDP: 9.2E-008

CCDP	% Cut Set	Cut Set Events
2.0E-008	22.09	RPS-BME-CF-RTBAB RCS-PHN-MODPOOR
		RCS-PHN-PL
1.7E-008	18.43	RPS-XHE-XE-NSGNL RCS-PHN-MODPOOR
		RCS-PHN-PL RPS-CBI-CF-60F8
		/RPS-CCP-TM-CHA
1.5E-008	16.61	RCS-PHN-MODPOOR RCS-PHN-PL
		RPS-ROD-CF-RCCAS
1.2E-008	12.49	RPS-CCX-CF-60F8 RPS-XHE-XE-NSGNL
		RCS-PHN-MODPOOR RCS-PHN-PL
		/RPS-CCP-TM-CHA
1.9E-009	2.10	RPS-BME-CF-RTBAB PPR-SRV-CC-SRV3
1.9E-009	2.10	RPS-BME-CF-RTBAB PPR-SRV-CC-SRV2
1.9E-009	2.10	RPS-BME-CF-RTBAB PPR-SRV-CC-SRV1
1.6E-009	1.76	RPS-XHE-XE-NSGNL RPS-CBI-CF-60F8
		/RPS-CCP-TM-CHA PPR-SRV-CC-SRV3
1.6E-009	1.76	RPS-XHE-XE-NSGNL RPS-CBI-CF-60F8
		/RPS-CCP-TM-CHA PPR-SRV-CC-SRV1
1.6E-009	1.76	RPS-XHE-XE-NSGNL RPS-CBI-CF-60F8
		/RPS-CCP-TM-CHA PPR-SRV-CC-SRV2
1.5E-009	1.58	RPS-ROD-CF-RCCAS PPR-SRV-CC-SRV2
1.5E-009	1.58	RPS-ROD-CF-RCCAS PPR-SRV-CC-SRV3
1.5E-009	1.58	RPS-ROD-CF-RCCAS PPR-SRV-CC-SRV1
1.3E-009	1.43	RCS-PHN-MODPOOR RCS-PHN-PL
		RPS-UVL-CF-UVDAB RPS-XHE-XE-SIGNL
1.1E-009	1.23	RPS-BME-CF-RTBAB PPR-SRV-CC-PRV2
1.1E-009	1.23	RPS-BME-CF-RTBAB PPR-SRV-CC-PRV1
1.1E-009	1.19	RPS-CCX-CF-60F8 RPS-XHE-XE-NSGNL
		/RPS-CCP-TM-CHA PPR-SRV-CC-SRV1
1.1E-009	1.19	RPS-CCX-CF-60F8 RPS-XHE-XE-NSGNL
		/RPS-CCP-TM-CHA PPR-SRV-CC-SRV2
1.1E-009	1.19	RPS-CCX-CF-60F8 RPS-XHE-XE-NSGNL

9.4E-010	1.02	/RPS-CCP-TM-CHA	PPR-SRV-CC-SRV3
		RPS-XHE-XE-NSGNL	RPS-CBI-CF-6OF8
9.4E-010	1.02	/RPS-CCP-TM-CHA	PPR-SRV-CC-PRV1
		RPS-XHE-XE-NSGNL	RPS-CBI-CF-6OF8
		/RPS-CCP-TM-CHA	PPR-SRV-CC-PRV2

## BASIC EVENTS (Cut Sets Only)

Event Name	Description	Curr Prob
AFW-AOV-CC-F083	CST ISOLATION VALVE 83 FAILS TO OPEN	9.0E-004
AFW-AOV-CC-F085	CST ISOLATION VALVE 85 FAILS TO OPEN	9.0E-004
AFW-MDP-CF-RUN	AFW MDP FAILS TO RUN	5.9E-006
AFW-MDP-CF-START	CCF OF AFW MDPS TO START	9.9E-005
AFW-MDP-FR-1A	AFW MOTOR-DRIVEN PUMP FAILS TO RUN	5.2E-004
AFW-MDP-FR-1B	AFW MOTOR-DRIVEN PUMP FAILS TO RUN	5.2E-004
AFW-MDP-FS-1A	AFW MOTOR-DRIVEN PUMP 1A FAILS TO START	1.5E-003
AFW-MDP-FS-1B	AFW MOTOR-DRIVEN PUMP 1B FAILS TO START	1.5E-003
AFW-MDP-TM-1A	AFW MDP UNAVAILABLE DUE TO TEST AND MAINTENAN	5.0E-003
AFW-MDP-TM-1B	AFW MDP UNAVAILABLE DUE TO TEST AND MAINTENAN	5.0E-003
AFW-PMP-FR-P1A	AFW PUMPS FAIL TO RUN (EXCLUDING DRIVER)	4.0E-004
AFW-PMP-FR-P1B	AFW PUMPS FAIL TO RUN (EXCLUDING DRIVER)	4.0E-004
AFW-TNK-FC-CST	CST OR PUMP SUCTION PATH IS UNAVAILABLE	2.4E-006
AFW-TNK-FC-DWST	DWST OR PUMP SUCTION PATH IS UNAVAILABLE	2.4E-006
CVC-P3AOP-P3BSTBY	CHARGING PUMP 3A IN OPERATION WHILE PUMP 3B I	5.0E-001
CVC-P3BOP-P3ASTBY	CHARGING PUMP 3B IN OPERATION WHILE PUMP 3A I	5.0E-001
CVC-XHE-XM-ACOO	OPERATOR FAILS TO ESTABLISH ALTERNATE PUMP CO	4.0E-002
CVC-XHE-XM-BOR	OPERATOR FAILS TO INITIATE EMERGENCY BORATION	2.0E-002
HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COO	2.0E-002
NOTSUMMER	NOT SUMMER TIME OPERATION	7.5E-001
PPR-SRV-CC-PRV1	PORV 1 FAILS TO OPEN ON DEMAND	7.0E-004
PPR-SRV-CC-PRV2	PORV 2 FAILS TO OPEN ON DEMAND	7.0E-004
PPR-SRV-CC-SRV1	SAFETY RELIEF VALVE 1 FAILS TO OPEN ON HIGH P	1.2E-003
PPR-SRV-CC-SRV2	SAFETY RELIEF VALVE 1 FAILS TO OPEN ON HIGH P	1.2E-003
PPR-SRV-CC-SRV3	SAFETY RELIEF VALVE 1 FAILS TO OPEN ON HIGH P	1.2E-003
RCS-MDP-LK-BP1	RCP SEAL STAGE 1 INTEGRITY (BINDING/POPPING O	1.3E-002
RCS-MDP-LK-BP2	RCP SEAL STAGE 2 INTEGRITY (BINDING/POPPING O	2.0E-001
RCS-PHN-MODPOOR	MODERATOR TEMP COEFFICIENT NOT ENOUGH NEGATIV	1.4E-002
RCS-PHN-PL	POWER AT HIGH LEVEL	9.0E-001
RPS-BME-CF-RTBAB	CCF OF RTB-A AND RTB-B (MECHANICAL)	1.6E-006
RPS-CBI-CF-6OF8	CCF 6 BISTABLES IN 3 OF 4 CHANNELS	2.7E-006
RPS-CCP-TM-CHA	CH-A IN T&M	5.0E-003
RPS-CCX-CF-6OF8	CCF 6 ANALOG PROCESS LOGIC MODULES IN 3 OF 4	1.8E-006
RPS-ROD-CF-RCCAS	CCF 10 OR MORE RCCAS FAIL TO DROP	1.2E-006
RPS-UVL-CF-UVDA	CCF UV DRIVERS TRAINS A AND B (2 OF 2)	1.0E-005
RPS-XHE-XE-NSGNL	OPERATOR FAILS TO RESPOND WITH NO RPS SIGNAL	5.0E-001
RPS-XHE-XE-SIGNL	OPERATOR FAILS TO RESPOND WITH RPS SIGNAL PRE	1.0E-002
SSC1	RCS COOLDOWN (POST-LOCA)	3.0E-001
SWS-FAN-CF-HVY2ABR	CCF OF SWS VENTILLATION FANS TO RUN	8.2E-006
SWS-FAN-CF-HVY2ABS	CCF OF SWS VENTILLATION FANS TO START	1.0E-004
SWS-FAN-FS-2A	SWS FAN HVY-2A FAILS TO START	2.5E-003



**LER 423-2005-002**

Event Name	Description	Curr Prob
SWS-FAN-FS-2B	SWS FAN HVY-2B FAILS TO START	2.5E-003
SWS-PND-CF-23AB	CCF O SWS VENTILLATION AODS TO OPEN	8.3E-006
SWS-XHE-XL-VENT	OPERATOR FAILS TO PROVIDE ALTERNATE VENTILATI	3.0E-002

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## I N I T I A T I N G   E V E N T   A S S E S S M E N T

Fam : MIL3\_3  
 User : INEEL  
 Ev ID: SLOCA-TDP-LIC  
 Desc : SLOCA CCDP with licensee HEP for HPR - no TDP

Code Ver : 7:26  
 Model Ver : 2005/10/28  
 Init Event: IE-SLOCA  
 Total CCDP: 1.1E-003

BASIC EVENT CHANGES				
Event Name	Description	Base Prob	Curr Prob	Type
AFW-TDP-TM-P2	FEED PUMP P2 IS IN TEST OR M	5.0E-003	1.0E+000	TRUE
HPR-XHE-XM-RECIRC	OPERATOR FAILS TO START HIGH	5.0E-003	1.1E-004	
IE-LLOCA	LARGE LOSS OF COOLANT ACCIDE	5.0E-006	+0.0E+000	
IE-LOCCW	LOSS OF COMPONENT COOLING WA	4.0E-004	+0.0E+000	
IE-LOCHS	LOSS ODF CONDENSER HEAT SINK	9.0E-002	+0.0E+000	
IE-LODCA	LOSS OF DC BUS 301-A INITIAT	1.3E-003	+0.0E+000	
IE-LODCB	LOSS OF DC BUS 301-B INITIAT	1.3E-003	+0.0E+000	
IE-LOMFV	LOSS OF MAIN FEEDWATER INITI	1.0E-001	+0.0E+000	
IE-LOOP	LOSS OF OFFSITE POWER	3.6E-002	+0.0E+000	
IE-LOSWS	LOSS OF SERVICE WATER	4.0E-004	+0.0E+000	
IE-MLOCA	MEDIUM LOSS OF COOLANT ACCI	4.0E-005	+0.0E+000	
IE-RHR-CLDIS-V	RHR COLD LEG DISCHARGE ISLO	+0.0E+000	+0.0E+000	
IE-RHR-HLDIS-V	RHR HOT LEG DISCHARGE ISLOCA	+0.0E+000	+0.0E+000	
IE-RHR-SUC-V	RHR SUCTION LINE ISLOCA EVEN	+0.0E+000	+0.0E+000	
IE-SGTR	STEAM GENERATOR TUBE RUPTURE	4.0E-003	+0.0E+000	
IE-SI-CLDIS-V	SI COLD LEG DISCHARGE ISLOC	+0.0E+000	+0.0E+000	
IE-SI-HLDIS-V	SI HOT LEG DISCHARGE ISLOCA	+0.0E+000	+0.0E+000	
IE-SLOCA	SMALL LOSS OF COOLANT ACCIDE	4.0E-004	1.0E+000	
IE-TRANS	TRANSIENT	7.0E-001	+0.0E+000	

## SEQUENCE PROBABILITIES

Truncation : Cumulative : 100.0% Individual : 0.0%

Event Tree Name	Sequence Name	CCDP	%Cont
SLOCA	03	1.1E-003	
SLOCA	07	5.6E-005	
SLOCA	12	7.7E-006	
SLOCA	10	5.4E-006	
SLOCA	22	5.2E-006	
SLOCA	21	3.7E-006	
SLOCA	05	2.8E-006	
SLOCA	16	4.5E-007	
SLOCA	15	2.8E-007	
SLOCA	11	2.2E-007	
SLOCA	20	6.2E-008	
SLOCA	18	5.6E-009	

SLOCA		09		2.9E-011
SEQUENCE LOGIC				
Event Tree	Sequence Name	Logic		
SLOCA	03	/RPS /HPI /PZR HPR	/AFW /SSC RHR	
SLOCA	07	/RPS /HPI HPR	/AFW SSC	
SLOCA	12	/RPS HPI	/AFW SSC1	
SLOCA	10	/RPS HPI /PZR1	/AFW /SSC1 LPI	
SLOCA	22	RPS		
SLOCA	21	/RPS FAB	AFW	
SLOCA	05	/RPS /HPI PZR	/AFW /SSC HPR	
SLOCA	16	/RPS /FAB /SSC	AFW /SSCR PZR	
SLOCA	15	/RPS /FAB /SSC RHR	AFW /SSCR /PZR HPR	
SLOCA	11	/RPS HPI PZR1	/AFW /SSC1	
SLOCA	20	/RPS /FAB HPR	AFW SSCR	
SLOCA	18	/RPS /FAB SSC	AFW /SSCR HPR	
SLOCA	09	/RPS	/AFW	

HPI	/SSC1
/PZR1	/LPI
LPR	

Fault Tree Name	Description
AFW	AUXILIARY FEEDWATER
FAB	FEED AND BLEED
HPI	HIGH PRESSURE INJECTION
HPR	HIGH PRESSURE RECIRC
LPI	LOW PRESSURE INJECTION
LPR	LOW PRESSURE RECIRC
PZR	RCS DEPRESS FOR LPI/RHR
PZR1	RCS DEPRESS FOR LPI/RHR
RHR	RESIDUAL HEAT REMOVAL
RPS	REACTOR TRIP
SSC	SECONDARY SIDE COOLING
SSC1	RCS COOLDOWN (POST-LOCA)
SSCR	SECONDARY SIDE COOLING RECOVERY

## SEQUENCE CUT SETS

Truncation: Cumulative: 100.0% Individual: 1.0%

Event Tree: SLOCA  
Sequence: 03

CCDP: 1.1E-003

CCDP	% Cut Set	Cut Set Events
2.8E-004	26.56	LPI-ICC-FC-MINFLO
2.0E-004	18.97	RHR-XVM-CO-V43
1.1E-004	10.43	HPR-XHE-XM-RECIRC
7.8E-005	7.36	NOTSUMMER
4.1E-005	3.87	CVC-MOV-CF-MINFL
2.7E-005	2.58	RSS-MOV-CF-LPSI
2.6E-005	2.48	LPI-MOV-CF-8804AB
2.5E-005	2.37	RSS-MDP-TM-P1A
		RSS-XHE-XM-P1C
		SWS-FAN-CF-HVY2ABS
		RSS-MDP-TM-P1B
		RSS-XHE-XM-P1D

Event Tree: SLOCA  
Sequence: 07

CCDP: 5.6E-005

CCDP	% Cut Set	Cut Set Events
5.5E-005	98.01	SSC-XHE-XM-CDOWN
		HPR-XHE-XM-RECIRC1

Event Tree: SLOCA  
Sequence: 12

CCDP: 7.7E-006

CCDP	% Cut Set	Cut Set Events
2.4E-006	31.21	HPI-TNK-FC-RWST
1.6E-006	20.19	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABS CVC-P3BOP-P3ASTBY
1.6E-006	20.19	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABS CVC-P3AOP-P3BSTBY
2.1E-007	2.68	CVC-XHE-XM-ACOOOL SWS-MOV-CF-50AB
		CVC-P3BOP-P3ASTBY
2.1E-007	2.68	CVC-XHE-XM-ACOOOL SWS-MOV-CF-71AB
		CVC-P3BOP-P3ASTBY
2.1E-007	2.68	CVC-XHE-XM-ACOOOL SWS-MOV-CF-50AB
		CVC-P3AOP-P3BSTBY
2.1E-007	2.68	CVC-XHE-XM-ACOOOL SWS-MOV-CF-71AB
		CVC-P3AOP-P3BSTBY
1.2E-007	1.61	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-PND-CF-23AB CVC-P3AOP-P3BSTBY
1.2E-007	1.61	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-PND-CF-23AB CVC-P3BOP-P3ASTBY
1.2E-007	1.60	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABR CVC-P3AOP-P3BSTBY
1.2E-007	1.60	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-CF-HVY2ABR CVC-P3BOP-P3ASTBY
9.6E-008	1.25	ACP-BAC-LP-34C CVC-XHE-XM-ACOOOL
		CVC-P3BOP-P3ASTBY
9.6E-008	1.25	ACP-BAC-LP-34C CVC-XHE-XM-ACOOOL
		CVC-P3AOP-P3BSTBY
9.4E-008	1.22	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-FS-2A SWS-FAN-FS-2B
		CVC-P3AOP-P3BSTBY
9.4E-008	1.22	CVC-XHE-XM-ACOOOL NOTSUMMER
		SWS-FAN-FS-2A SWS-FAN-FS-2B
		CVC-P3BOP-P3ASTBY

Event Tree: SLOCA  
Sequence: 10

CCDP: 5.4E-006

CCDP	% Cut Set	Cut Set Events
1.7E-006	31.40	HPI-TNK-FC-RWST /SSC1
1.1E-006	20.31	CVC-XHE-XM-ACOOOL NOTSUMMER
		/SSC1 SWS-FAN-CF-HVY2ABS
		CVC-P3BOP-P3ASTBY
1.1E-006	20.31	CVC-XHE-XM-ACOOOL NOTSUMMER
		/SSC1 SWS-FAN-CF-HVY2ABS
		CVC-P3AOP-P3BSTBY
1.4E-007	2.69	CVC-XHE-XM-ACOOOL SWS-MOV-CF-50AB
		/SSC1 CVC-P3BOP-P3ASTBY

1.4E-007	2.69	CVC-XHE-XM-ACOOOL	SWS-MOV-CF-71AB
1.4E-007	2.69	/SSC1	CVC-P3BOP-P3ASTBY
1.4E-007	2.69	CVC-XHE-XM-ACOOOL	SWS-MOV-CF-50AB
1.4E-007	2.69	/SSC1	CVC-P3AOP-P3BSTBY
1.4E-007	2.69	CVC-XHE-XM-ACOOOL	SWS-MOV-CF-71AB
8.7E-008	1.62	/SSC1	CVC-P3AOP-P3BSTBY
8.7E-008	1.62	CVC-XHE-XM-ACOOOL	NOTSUMMER
8.7E-008	1.62	SWS-PND-CF-23AB	/SSC1
8.7E-008	1.62	CVC-P3BOP-P3ASTBY	NOTSUMMER
8.7E-008	1.62	CVC-XHE-XM-ACOOOL	/SSC1
8.6E-008	1.61	SWS-PND-CF-23AB	NOTSUMMER
8.6E-008	1.61	CVC-P3AOP-P3BSTBY	/SSC1
8.6E-008	1.61	CVC-XHE-XM-ACOOOL	NOTSUMMER
8.6E-008	1.61	SWS-FAN-CF-HVY2ABR	/SSC1
8.6E-008	1.61	CVC-P3BOP-P3ASTBY	NOTSUMMER
8.6E-008	1.61	CVC-XHE-XM-ACOOOL	/SSC1
8.6E-008	1.61	SWS-FAN-CF-HVY2ABR	NOTSUMMER
8.6E-008	1.61	CVC-P3AOP-P3BSTBY	/SSC1
6.7E-008	1.26	ACP-BAC-LP-34C	CVC-XHE-XM-ACOOOL
6.7E-008	1.26	/SSC1	CVC-P3BOP-P3ASTBY
6.7E-008	1.26	ACP-BAC-LP-34C	CVC-XHE-XM-ACOOOL
6.7E-008	1.26	/SSC1	CVC-P3AOP-P3BSTBY
6.6E-008	1.23	CVC-XHE-XM-ACOOOL	NOTSUMMER
6.6E-008	1.23	/SSC1	SWS-FAN-FS-2A
6.6E-008	1.23	SWS-FAN-FS-2B	CVC-P3BOP-P3ASTBY
6.6E-008	1.23	CVC-XHE-XM-ACOOOL	NOTSUMMER
6.6E-008	1.23	/SSC1	SWS-FAN-FS-2A
6.6E-008	1.23	SWS-FAN-FS-2B	CVC-P3AOP-P3BSTBY

Event Tree: SLOCA  
Sequence: 22

CCDP: 5.2E-006

CCDP	% Cut Set	Cut Set Events	
1.6E-006	30.88	RPS-BME-CF-RTBAB	
1.3E-006	25.76	RPS-XHE-XE-NSGNL	RPS-CBI-CF-60F8
		/RPS-CCP-TM-CHA	
1.2E-006	23.21	RPS-ROD-CF-RCCAS	
9.1E-007	17.46	RPS-CCX-CF-60F8	RPS-XHE-XE-NSGNL
		/RPS-CCP-TM-CHA	
1.0E-007	1.99	RPS-UVL-CF-UVDAB	RPS-XHE-XE-SIGNL

Event Tree: SLOCA  
Sequence: 21

CCDP: 3.7E-006

CCDP	% Cut Set	Cut Set Events	
2.0E-006	53.50	HPI-XHE-XM-FB	AFW-MDP-CF-START
1.5E-007	4.05	HPI-XHE-XM-FB	AFW-MDP-TM-1A
		AFW-MDP-FS-1B	
1.5E-007	4.05	HPI-XHE-XM-FB	AFW-MDP-FS-1A
		AFW-MDP-TM-1B	

1.2E-007	3.17	HPI-XHE-XM-FB	AFW-MDP-CF-RUN
9.0E-008	2.43	HPI-XHE-XM-FB	AFW-AOV-CC-F083
		AFW-MDP-TM-1A	
9.0E-008	2.43	HPI-XHE-XM-FB	AFW-AOV-CC-F085
		AFW-MDP-TM-1B	
6.9E-008	1.87	AFW-MDP-CF-START	PPR-SRV-CC-PRV1
6.9E-008	1.87	PPR-SRV-CC-PRV2	AFW-MDP-CF-START
5.2E-008	1.39	HPI-XHE-XM-FB	AFW-MDP-TM-1A
		AFW-MDP-FR-1B	
5.2E-008	1.39	HPI-XHE-XM-FB	AFW-MDP-FR-1A
		AFW-MDP-TM-1B	
4.8E-008	1.30	HPI-XHE-XM-FB	AFW-TNK-FC-CST
4.8E-008	1.30	HPI-XHE-XM-FB	AFW-TNK-FC-DWST
4.5E-008	1.21	HPI-XHE-XM-FB	AFW-MDP-FS-1A
		AFW-MDP-FS-1B	
4.0E-008	1.08	HPI-XHE-XM-FB	AFW-PMP-FR-P1B
		AFW-MDP-TM-1A	
4.0E-008	1.08	AFW-PMP-FR-P1A	HPI-XHE-XM-FB
		AFW-MDP-TM-1B	

Event Tree: SLOCA  
Sequence: 05

CCDP: 2.8E-006

CCDP	% Cut Set	Cut Set Events
2.8E-007	10.03	LPI-ICC-FC-MINFLO RCS-XHE-RCSDEP
2.2E-007	8.03	LPI-ICC-FC-MINFLO RCS-SOV-CC-AUXSPRAY
2.2E-007	8.03	LPI-ICC-FC-MINFLO RCS-SOV-CC-SPRAY
2.0E-007	7.17	RCS-XHE-RCSDEP RHR-XVM-CO-V43
1.6E-007	5.73	RCS-SOV-CC-AUXSPRAY RHR-XVM-CO-V43
1.6E-007	5.73	RCS-SOV-CC-SPRAY RHR-XVM-CO-V43
1.1E-007	3.94	RCS-XHE-RCSDEP HPR-XHE-XM-RECIRC
8.8E-008	3.15	RCS-SOV-CC-AUXSPRAY HPR-XHE-XM-RECIRC
8.8E-008	3.15	RCS-SOV-CC-SPRAY HPR-XHE-XM-RECIRC
7.8E-008	2.78	NOTSUMMER RCS-XHE-RCSDEP
		SWS-FAN-CF-HVY2ABS
6.2E-008	2.22	NOTSUMMER RCS-SOV-CC-SPRAY
		SWS-FAN-CF-HVY2ABS
6.2E-008	2.22	NOTSUMMER RCS-SOV-CC-AUXSPRAY
		SWS-FAN-CF-HVY2ABS
4.1E-008	1.46	RCS-XHE-RCSDEP CVC-MOV-CF-MINFL
3.3E-008	1.17	RCS-SOV-CC-AUXSPRAY CVC-MOV-CF-MINFL
3.3E-008	1.17	RCS-SOV-CC-SPRAY CVC-MOV-CF-MINFL

Event Tree: SLOCA  
Sequence: 16

CCDP: 4.5E-007

CCDP	% Cut Set	Cut Set Events
9.9E-008	22.18	AFW-MDP-CF-START RCS-XHE-RCSDEP
7.9E-008	17.74	AFW-MDP-CF-START RCS-SOV-CC-SPRAY
7.9E-008	17.74	AFW-MDP-CF-START RCS-SOV-CC-AUXSPRAY

7.5E-009	1.68	AFW-MDP-FS-1A	AFW-MDP-TM-1B
		RCS-XHE-RCSDEP	
7.5E-009	1.68	AFW-MDP-TM-1A	AFW-MDP-FS-1B
		RCS-XHE-RCSDEP	
6.0E-009	1.34	AFW-MDP-FS-1A	AFW-MDP-TM-1B
		RCS-SOV-CC-AUXSPRAY	
6.0E-009	1.34	AFW-MDP-TM-1A	AFW-MDP-FS-1B
		RCS-SOV-CC-AUXSPRAY	
6.0E-009	1.34	AFW-MDP-TM-1A	AFW-MDP-FS-1B
		RCS-SOV-CC-SPRAY	
6.0E-009	1.34	AFW-MDP-FS-1A	AFW-MDP-TM-1B
		RCS-SOV-CC-SPRAY	
5.9E-009	1.31	AFW-MDP-CF-RUN	RCS-XHE-RCSDEP
4.7E-009	1.06	PPR-SRV-CF-PORVS	AFW-MDP-CF-START
4.7E-009	1.05	AFW-MDP-CF-RUN	RCS-SOV-CC-SPRAY
4.7E-009	1.05	AFW-MDP-CF-RUN	RCS-SOV-CC-AUXSPRAY
4.5E-009	1.01	AFW-AOV-CC-F085	AFW-MDP-TM-1B
		RCS-XHE-RCSDEP	
4.5E-009	1.01	AFW-AOV-CC-F083	AFW-MDP-TM-1A
		RCS-XHE-RCSDEP	

Event Tree: SLOCA  
Sequence: 15

CCDP: 2.8E-007

CCDP	% Cut Set	Cut Set Events	
2.8E-008	9.94	LPI-ICC-FC-MINFLO	AFW-MDP-CF-START
2.4E-008	8.59	ACP-BAC-LP-34C	AFW-MDP-TM-1B
2.0E-008	7.10	AFW-MDP-CF-START	RHR-XVM-CO-V43
1.2E-008	4.29	ACP-BAC-LP-34D	ESF-FAN-FS-5A
1.2E-008	4.29	ACP-BAC-LP-34D	ESF-FAN-FS-6A
1.1E-008	3.90	AFW-MDP-CF-START	HPR-XHE-XM-RECIRC
7.7E-009	2.75	AFW-MDP-CF-START	NOTSUMMER
		SWS-FAN-CF-HVY2ABS	
7.2E-009	2.58	ACP-BAC-LP-34C	AFW-MDP-FS-1B
4.3E-009	1.55	ACP-BAC-LP-34C	AFW-AOV-CC-F083
4.0E-009	1.45	AFW-MDP-CF-START	CVC-MOV-CF-MINFL

Event Tree: SLOCA  
Sequence: 11

CCDP: 2.2E-007

CCDP	% Cut Set	Cut Set Events	
6.7E-008	30.01	RCS-XHE-RCSDEP1	HPI-TNK-FC-RWST
		/SSC1	
4.4E-008	19.41	RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOOOL
		NOTSUMMER	/SSC1
		SWS-FAN-CF-HVY2ABS	CVC-P3BOP-P3ASTBY
4.4E-008	19.41	RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOOOL
		NOTSUMMER	/SSC1
		SWS-FAN-CF-HVY2ABS	CVC-P3AOP-P3BSTBY
5.8E-009	2.58	RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOOOL



		SWS-MOV-CF-50AB	/SSC1
5.8E-009	2.58	CVC-P3AOP-P3BSTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		SWS-MOV-CF-71AB	/SSC1
5.8E-009	2.58	CVC-P3AOP-P3BSTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		SWS-MOV-CF-71AB	/SSC1
5.8E-009	2.58	CVC-P3BOP-P3ASTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		SWS-MOV-CF-50AB	/SSC1
3.5E-009	1.55	CVC-P3BOP-P3ASTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	SWS-PND-CF-23AB
3.5E-009	1.55	/SSC1	CVC-P3BOP-P3ASTBY
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	SWS-PND-CF-23AB
3.5E-009	1.54	/SSC1	CVC-P3AOP-P3BSTBY
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	SWS-FAN-CF-HVY2ABR
3.5E-009	1.54	/SSC1	CVC-P3BOP-P3ASTBY
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	SWS-FAN-CF-HVY2ABR
2.7E-009	1.20	/SSC1	CVC-P3AOP-P3BSTBY
		ACP-BAC-LP-34C	RCS-XHE-RCSDEP1
		CVC-XHE-XM-ACOO	/SSC1
2.7E-009	1.20	CVC-P3AOP-P3BSTBY	
		ACP-BAC-LP-34C	RCS-XHE-RCSDEP1
		CVC-XHE-XM-ACOO	/SSC1
2.6E-009	1.17	CVC-P3BOP-P3ASTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	/SSC1
		SWS-FAN-FS-2A	SWS-FAN-FS-2B
2.6E-009	1.17	CVC-P3AOP-P3BSTBY	
		RCS-XHE-RCSDEP1	CVC-XHE-XM-ACOO
		NOTSUMMER	/SSC1
		SWS-FAN-FS-2A	SWS-FAN-FS-2B
		CVC-P3BOP-P3ASTBY	

Event Tree: SLOCA  
Sequence: 20

CCDP: 6.2E-008

CCDP	% Cut Set	Cut Set Events
5.6E-009	9.00	PCS-XHE-XO-SEC LPI-ICC-FC-MINFLO
4.8E-009	7.78	AFW-MDP-CF-START PCS-XHE-XO-SEC
4.0E-009	6.43	ACP-BAC-LP-34C AFW-MDP-TM-1B
2.4E-009	3.89	PCS-XHE-XO-SEC AFW-MDP-CF-START
2.4E-009	3.89	RHR-XVM-CO-V43 PCS-XHE-XO-SEC
		ACP-BAC-LP-34D ESF-FAN-FS-6A
		ACP-BAC-LP-34D PCS-XHE-XO-SEC

2.4E-009	3.89	ESF-FAN-FS-5A ACP-BAC-LP-34C AFW-MDP-TM-1B	PPR-SRV-OO-WTR1
2.2E-009	3.54	PCS-XHE-XO-SEC HPR-XHE-XM-RECIRC	AFW-MDP-CF-START
1.5E-009	2.49	PCS-XHE-XO-SEC NOTSUMMER	AFW-MDP-CF-START SWS-FAN-CF-HVY2ABS
1.4E-009	2.33	ACP-BAC-LP-34C AFW-MDP-FS-1B	PCS-XHE-XO-SEC
1.2E-009	1.94	ACP-BAC-LP-34D ESF-FAN-FS-5A	PPR-SRV-OO-WTR2
1.2E-009	1.94	ACP-BAC-LP-34D ESF-FAN-FS-6A	PPR-SRV-OO-WTR2
8.6E-010	1.40	ACP-BAC-LP-34C AFW-AOV-CC-F083	PCS-XHE-XO-SEC
8.1E-010	1.31	PCS-XHE-XO-SEC CVC-MOV-CF-MINFL	AFW-MDP-CF-START
7.2E-010	1.17	ACP-BAC-LP-34C AFW-MDP-FS-1B	PPR-SRV-OO-WTR1

Event Tree: SLOCA  
Sequence: 18

CCDP: 5.6E-009

CCDP	% Cut Set	Cut Set Events
5.4E-009	97.26	SSC-XHE-XM-CDOWN HPR-XHE-XM-RECIRC1

Event Tree: SLOCA  
Sequence: 09

CCDP: 2.9E-011

CCDP	% Cut Set	Cut Set Events
4.7E-012	16.08	CVC-CKV-CC-DISCH HPI-MDP-CF-START
1.8E-012	5.94	SWS-MOV-OO-50A RSS-MDP-TM-P1B
1.8E-012	5.94	/SSC1 CVC-CKV-CC-DISCH SWS-MOV-OO-71A
1.8E-012	5.94	/SSC1 SWS-MOV-OO-50A RSS-MDP-TM-P1B RSS-XHE-XM-P1D HPI-MDP-TM-P1B
1.8E-012	5.94	CCE-MDP-TM-P1B CVC-XHE-XM-ACOOOL RSS-XHE-XM-P1D HPI-MDP-TM-P1B
1.8E-012	5.94	SWS-MOV-OO-50A CVC-MDP-TM-P3B RSS-XHE-XM-P1D

1.8E-012	5.94	HPI-MDP-TM-P1B RSS-MDP-TM-P1B CVC-XHE-XM-ACOO	CVC-P3AOP-P3BSTBY CVC-MDP-TM-P3B SWS-MOV-OO-71A
1.8E-012	5.94	RSS-XHE-XM-P1D HPI-MDP-TM-P1B CVC-CKV-CC-DISCH SWS-MOV-OO-50B	/SSC1 CVC-P3AOP-P3BSTBY RSS-MDP-TM-P1A RSS-XHE-XM-P1C
1.8E-012	5.94	/SSC1 CVC-CKV-CC-DISCH SWS-MOV-OO-71B	HPI-MDP-TM-P1A RSS-MDP-TM-P1A RSS-XHE-XM-P1C
1.8E-012	5.94	/SSC1 RSS-MDP-TM-P1A SWS-MOV-OO-50B	HPI-MDP-TM-P1A CVC-XHE-XM-ACOO
1.8E-012	5.94	/SSC1 CVC-P3BOP-P3ASTBY RSS-MDP-TM-P1A SWS-MOV-OO-71B	RSS-XHE-XM-P1C HPI-MDP-TM-P1A CCE-MDP-TM-P1A
1.8E-012	5.94	/SSC1 CVC-P3BOP-P3ASTBY RSS-MDP-TM-P1A SWS-MOV-OO-50B	CVC-XHE-XM-ACOO RSS-XHE-XM-P1C HPI-MDP-TM-P1A
1.8E-012	5.94	/SSC1 CVC-MDP-TM-P3A RSS-MDP-TM-P1A SWS-MOV-OO-71B	CCE-MDP-TM-P1A CVC-XHE-XM-ACOO RSS-XHE-XM-P1C
1.8E-012	5.94	/SSC1 CVC-MDP-TM-P3A RSS-MDP-TM-P1A SWS-MOV-OO-71B	HPI-MDP-TM-P1A CVC-P3BOP-P3ASTBY CVC-XHE-XM-ACOO
1.2E-012	4.20	CVC-MOV-CF-SUCT HPI-MDP-CF-START	RSS-XHE-XM-P1C HPI-MDP-TM-P1A CVC-P3BOP-P3ASTBY
1.2E-012	4.20	CVC-MOV-CF-VCT HPI-MDP-CF-START	/SSC1 LPR-XHE-XM-ERROR
1.2E-012	4.20	/SSC1 HPI-MDP-CF-START	/SSC1 LPR-XHE-XM-ERROR CVC-MOV-CF-DISCH LPR-XHE-XM-ERROR

## BASIC EVENTS (Cut Sets Only)

Event Name	Description	Curr Prob
ACP-BAC-LP-34C	4160 VAC BUS 34C FAILS	4.8E-006
ACP-BAC-LP-34D	4160 VAC BUS 34D FAILS	4.8E-006
AFW-AOV-CC-F083	CST ISOLATION VALVE 83 FAILS TO OPEN	9.0E-004
AFW-AOV-CC-F085	CST ISOLATION VALVE 85 FAILS TO OPEN	9.0E-004
AFW-MDP-CF-RUN	AFW MDP FAILS TO RUN	5.9E-006
AFW-MDP-CF-START	CCF OF AFW MDPS TO START	9.9E-005
AFW-MDP-FR-1A	AFW MOTOR-DRIVEN PUMP FAILS TO RUN	5.2E-004
AFW-MDP-FR-1B	AFW MOTOR-DRIVEN PUMP FAILS TO RUN	5.2E-004
AFW-MDP-FS-1A	AFW MOTOR-DRIVEN PUMP 1A FAILS TO START	1.5E-003
AFW-MDP-FS-1B	AFW MOTOR-DRIVEN PUMP 1B FAILS TO START	1.5E-003
AFW-MDP-TM-1A	AFW MDP UNAVAILABLE DUE TO TEST AND MAINTENAN	5.0E-003
AFW-MDP-TM-1B	AFW MDP UNAVAILABLE DUE TO TEST AND MAINTENAN	5.0E-003
AFW-PMP-FR-P1A	AFW PUMPS FAIL TO RUN (EXCLUDING DRIVER)	4.0E-004

Event Name	Description	Curr Prob
AFW-PMP-FR-P1B	AFW PUMPS FAIL TO RUN (EXCLUDING DRIVER)	4.0E-004
AFW-TNK-FC-CST	CST OR PUMP SUCTION PATH IS UNAVAILABLE	2.4E-006
AFW-TNK-FC-DWST	DWST OR PUMP SUCTION PATH IS UNAVAILABLE	2.4E-006
CCE-MDP-TM-P1A	CCE MDP P1A UNAVAILABLE DUE TO TEST AND MAINT	5.0E-003
CCE-MDP-TM-P1B	CCE MDP P1B UNAVAILABLE DUE TO TEST AND MAINT	5.0E-003
CVC-CKV-CC-DISCH	CHARGING DISCHARGE CKV 8815 FAILS TO OPEN	1.0E-004
CVC-MDP-TM-P3A	PUMP P3A IS IN TEST OR MAINTENANCE	5.0E-003
CVC-MDP-TM-P3B	PUMP P3B IS IN TEST OR MAINTENANCE	5.0E-003
CVC-MOV-CF-DISCH	COMMON CAUSE FAILURE OF DISCHARGE MOV	2.6E-005
CVC-MOV-CF-MINFL	CCF OF CVC/RWST MINFLOW VALVES TO CLOSE 8511A	4.1E-005
CVC-MOV-CF-SUCT	CCF OF CVC SUCTION MOV CV112D/E	2.6E-005
CVC-MOV-CF-VCT	COMMON CAUSE FAILURE OF VCT MOV	2.6E-005
CVC-P3AOP-P3BSTBY	CHARGING PUMP 3A IN OPERATION WHILE PUMP 3B I	5.0E-001
CVC-P3BOP-P3ASTBY	CHARGING PUMP 3B IN OPERATION WHILE PUMP 3A I	5.0E-001
CVC-XHE-XM-ACCOOL	OPERATOR FAILS TO ESTABLISH ALTERNATE PUMP CO	4.0E-002
ESF-FAN-FS-5A	AFW SUPPLY FAN 5A FAILS TO START	2.5E-003
ESF-FAN-FS-6A	AFW EXHAUST FAN 6A FAILS TO START	2.5E-003
HPI-MDP-CF-START	HPI PUMPS FAIL FROM COMMON CAUSE TO START	6.8E-005
HPI-MDP-TM-P1A	HPI PUMP TRAIN P1A IS IN TEST OR MAINTENANCE	5.0E-003
HPI-MDP-TM-P1B	HPI PUMP TRAIN P1B IS IN TEST OR MAINTENANCE	5.0E-003
HPI-TNK-FC-RWST	RWST IS UNAVAILABLE	2.4E-006
HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COO	2.0E-002
HPR-XHE-XM-RECIRC	OPERATOR FAILS TO START HIGH PRESSURE RECIRC	1.1E-004
HPR-XHE-XM-RECIRC1	OPERATOR FAILS TO START HIGH PRESSURE RECIRC	5.5E-002
LPI-ICC-FC-MINFLO	MINFLOW VALVE 8511A,B OR 8512A,B INTERLOCKS F	2.8E-004
LPI-MOV-CF-8804AB	LPSI TO SI VALVES 8804A,B FAIL FROM COMMON CA	2.6E-005
LPR-XHE-XM-ERROR	OPERATOR FAILS TO INITIATE LOW PRESSURE RECIR	1.0E-003
NOTSUMMER	NOT SUMMER TIME OPERATION	7.5E-001
PCS-XHE-XO-SEC	OPERATOR FAILS TO ESTABLISH SECONDARY COOLING	2.0E-001
PPR-SRV-CC-PRV1	PORV 1 FAILS TO OPEN ON DEMAND	7.0E-004
PPR-SRV-CC-PRV2	PORV 2 FAILS TO OPEN ON DEMAND	7.0E-004
PPR-SRV-CF-PORVS	CCF OF PORVS TO OPEN	4.8E-005
PPR-SRV-OO-WTR1	PORV 1 FAILS TO RECLOSE AFTER PASSING WATER	1.0E-001
PPR-SRV-OO-WTR2	PORV 2 FAILS TO RECLOSE AFTER PASSING WATER	1.0E-001
RCS-SOV-CC-AUXSPRAY	PRESSURIZER AUX SPRAY VALVE FAILS TO OPEN	8.0E-004
RCS-SOV-CC-SPRAY	PRESSURIZER SPRAY VALVE FAILS TO OPEN	8.0E-004
RCS-XHE-RCSDEP	OPERATOR FAILS TO DEPRESSURIZE THE RCS	1.0E-003
RCS-XHE-RCSDEP1	OPERATOR FAILS TO RAPIDLY DEPRESSURIZE THE RC	4.0E-002
RHR-XVM-CO-V43	RHR MANUAL VALVE V43 MISALIGNED OPEN (PSA PRO	2.0E-004
RPS-BME-CF-RTBAB	CCF OF RTB-A AND RTB-B (MECHANICAL)	1.6E-006
RPS-CBI-CF-60F8	CCF 6 BISTABLES IN 3 OF 4 CHANNELS	2.7E-006
RPS-CCP-TM-CHA	CH-A IN T&M	5.0E-003
RPS-CCX-CF-60F8	CCF 6 ANALOG PROCESS LOGIC MODULES IN 3 OF 4	1.8E-006
RPS-ROD-CF-RCCAS	CCF 10 OR MORE RCCAS FAIL TO DROP	1.2E-006
RPS-UVL-CF-UVDAB	CCF UV DRIVERS TRAINS A AND B (2 OF 2)	1.0E-005
RPS-XHE-XE-NSGNL	OPERATOR FAILS TO RESPOND WITH NO RPS SIGNAL	5.0E-001
RPS-XHE-XE-SIGNL	OPERATOR FAILS TO RESPOND WITH RPS SIGNAL PRE	1.0E-002
RSS-MDP-TM-P1A	RSS MDP P1A UNAVAILABLE DUE TO TEST AND MAINT	5.0E-003
RSS-MDP-TM-P1B	RSS MDP P1B UNAVAILABLE DUE TO TEST AND MAINT	5.0E-003
RSS-MOV-CF-LPSI	LPSI ISOLATION VALVES FAIL FROM COMMON CAUSE	2.7E-005

Event Name	Description	Curr Prob
RSS-XHE-XM-P1C	OPERATOR FAILS TO ALIGN RSS P1C FOR RECIRCULA	1.0E+000
RSS-XHE-XM-P1D	OPERATOR FAILS TO ALIGN RSS P1D FOR RECIRCULA	1.0E+000
SSC-XHE-XM-CDOWN	OPERATOR FAILS TO INITIATE RCS COOLDOWN USING	1.0E-003
SSC1	RCS COOLDOWN (POST-LOCA)	3.0E-001
SWS-FAN-CF-HVY2ABR	CCF OF SWS VENTILLATION FANS TO RUN	8.2E-006
SWS-FAN-CF-HVY2ABS	CCF OF SWS VENTILLATION FANS TO START	1.0E-004
SWS-FAN-FS-2A	SWS FAN HVY-2A FAILS TO START	2.5E-003
SWS-FAN-FS-2B	SWS FAN HVY-2B FAILS TO START	2.5E-003
SWS-MOV-CF-50AB	CCW ISOLATION VLVS FAIL FROM COMMON CAUSE TO	1.0E-005
SWS-MOV-CF-71AB	TBCCW ISOLATION VLVS FAIL FROM COMMON CAUSE T	1.0E-005
SWS-MOV-OO-50A	COMPONENT COOLING WATER ISOLATION VLV FAILS T	1.0E-003
SWS-MOV-OO-50B	COMPONENT COOLING WATER ISOLATION VLV FAILS T	1.0E-003
SWS-MOV-OO-71A	TBCCW ISOLATION VALVE FAILS TO CLOSE	1.0E-003
SWS-MOV-OO-71B	TBCCW ISOLATION VALVE FAILS TO CLOSE	1.0E-003
SWS-PND-CF-23AB	CCF O SWS VENTILLATION AODS TO OPEN	8.3E-006