Final Precursor Analysis

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

Kewaunee Power Station	• Auxiliary Feedwater Pumps Assumed to Fail from Postulated Loss of Primary Water Source • Auxiliary Feedwater Pumps Postulated to Fall due to Air Ingestion Through Pump Packing • Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Insufficient Net Positive Suction Head • Emergency Diesel Generator Exhaust Ductwork Not Adequately Protected from Potential Tornado Winds & Missiles EDG • Unanalyzed Condition : Design Deficiency - CCW System Inoperable Due to Pump "RunOut" Conditions • Unanalyzed internal flooding condition - inadequate design	
Event Date 2/11/2005 Event Date 3/26/2005 Event Date 4/20/2005 Event Date 3/24/2005 Event Date 3/28/2005 Event Date 3/15/2005	LER 305-2005-002-01 (AFW) LER 305-2005-006-00 (AFW) LER 305-2005-008-01 (AFW) LER 305-2005-005-01 (EDG) LER 305-2005-007-00 (CCW) LER 305-2005-004-01 (Int. Flood) Total windowed importance of 6 LERs **Total without Internal Flood**	ΔCDP = 1.4×10^{-5} ΔCDP = 4×10^{-8} ΔCDP < 9×10^{-7} ΔCDP = 3×10^{-4} ΔCDP = 3E-04 **ΔCDP = 1.4×10^{-5}**

July 11, 2006

Condition Summary

Auxiliary feedwater pump (AFW) plant conditions that are reported in three different LERs in a three-month period are discussed and analyzed as a single plant condition in this document, since they lead to the potential failure of all three AFW pumps.

Two additional LERs, LER 305-2005-005-01 (EDG) and LER 305-2005-007-00 (CCW) are also discussed in Appendices A and B of this document. Finally, the internal flooding LER 305-2005-004-01 importance already calculated in a separate ASP analysis is also windowed with the five LERs analyzed in this report to calculate the total importance.

Condition Description:

1) Auxiliary Feedwater Pumps Assumed to Fail from Postulated Loss of Primary Water Source - Safe Shutdown and Accident Analysis Assumptions Not Assured - Inadequate Design of Pump Protective Equipment. Event Date 2/11/2005. LER 305-2005-002-01.

On 2/11/2005, while the Kewaunee Nuclear Power Plant (KNPP) was operating at full power, plant engineering personnel discovered that the AFW system discharge pressure switches may not operate in time to protect the AFW pumps from damage in the event of a loss of condensate storage tank (CST) water caused by a tornado. During a tornado that causes substantial plant equipment damage and a loss of offsite power, the AFW pumps are required equipment to conduct a safe plant shutdown . Compensatory measures were put in place to protect the pumps in case a tornado watch was declared for the area . These measures allowed continued plant operation . On 2/19/2005, while the plant was operating at full power, during investigative efforts for AFW system operability related to pump protection from a loss of CST water, the potential for a loss of the AFW pumps from a high energy line break (HELB) was discovered. The AFW pumps could be damaged during a feedwater system HELB due to damaged common suction piping . The damaged common piping is postulated to create the same effect on the AFW pumps as the loss of CST inventory. Consequently, the AFW pumps could not be assured to be operable under all postulated design basis HELB scenarios.

As a consequence of the 2/19/2005 discovery, a plant shutdown was completed on 2/20/2005. In both events the scenario that causes the pump failures is also a scenario that requires the AFW pumps to support a required plant shutdown. Also, in both cases, it can be assumed that all available AFW pumps could be affected by the failure.

All three AFW pumps are expected to start on a plant trip as a consequence of low steam generator [SG] level signals that are created. A reactor trip is an expected consequence of the scenarios that are identified as the contributors to the events described Considering the scenarios, main feed HELB and a tornado induced loss of off site power, the need for the AFW pumps is inherently more important. In effect, the consequential loss of AFW under the scenarios described introduces a loss of secondary cooling event.

The significance of a tornado event is reduced by the low probability of occurrence of an initiating tornado of the magnitude assumed. Also, there is a chance that the tornado that could be expected to strike the KNPP site and plant proper will be of substantially lower magnitude such that total CST damage would not occur.

The probability of a HELB occurring that would cause damage to all three AFW pumps is also a low probability event. Although HELBs are required to be assumed to occur, in this instance the HELB would have to occur in the worst case orientation to incur the worst case damage to the common suction piping.

2) Auxiliary Feedwater Pumps Postulated to Fall due to Air Ingestion Through Pump Packing, Event Date 3/26/2005, LER 305-2005-006-00

On March 26, 2005, while the Kewaunee Nuclear Power Plant was in the refueling shutdown mode, plant personnel determined a potential existed for damage to the AFW pumps due to air ingestion through the pump's packing gland. A conservative calculation has shown that during certain main steam line break (MSLB) post-accident conditions the pressure in the pump's inlet chamber can be sub-atmospheric for short periods . During those short sub-atmospheric periods cooling and lubrication of the pump's packing would stop, air could flow through the packing and into the inlet chamber, causing damage to the pump due to air entrainment. Communication with the pump's vendor indicates the pump can handle up to 5% gas by volume without distress . At 20% gas by volume there is a good chance that the pump will lose prime and run gas bound.

Seizure of the rotor would then occur almost immediately."

The AFW pump shafts are sealed with mechanical packing and require a small amount of leak-off water to cool the packing and seal the pump. When the leak-off cooling water is lost, the packing can become damaged due to overheating. Damaged packing can cause an increase in the clearance between the packing and the shaft. If the inlet chamber conditions are sub-atmospheric, air could be drawn into the pump. In the case of KNPP's AFW pumps, air ingestion will potentially air bind then damage the pump.

During operation of the AFW pumps under certain accident conditions, the pressure at the pump suction could go below atmospheric pressure. Consequently, the KNPP system design is potentially vulnerable to the AFW pumps ingesting air. As stated above, the AFW pump can handle up to 5% gas by volume without distress and at 20% gas by volume there is a good chance that the pump will lose prime and run gas bound.

It is not currently known or easily calculated if the gap formed when the packing erodes will restrict air ingestion enough to keep the pump below 20% gas by volume during the period this condition is postulated to exist.

3) Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Insufficient Net Positive Suction Head, Event Date 4/20/2005, LER 305-2005-008-01

During review of design information associated with a planned modification of the AFW system correct previously identified AFW system design deficiencies, it was determined that insufficient NPSH may exist for each of the plant's three AFW pumps following a MSLB event. The insufficient NPSH results, in part, from the excessive flow (runout) condition of the AFW pumps as they supply flow to the depressurized SG.

During a MSLB event, the resultant high flow rates cause a decrease in AFW pump NPSH. When cavitation of the pump occurs, discharge pressure drops rapidly. The motor-driven AFW

pumps were equipped with a low discharge pressure switch that initiated a pump trip at 350 psig. From discussions with the pump vendor and from testing performed, it was determined that, for both the train A and train B motor-driven AFW pumps, there is a high probability that the AFW pump discharge pressure switches would have caused a protective trip of the motor-driven pumps, prior to the pumps being rendered inoperable from damage due to low NPSH. Following action to isolate the faulted SG, the motor-driven AFW pumps could then have been restarted, supplying flow to the intact SG for continued heat removal. After undergoing a protective trip from their discharge pressure switches, sufficient time is available to manually restart the motor-driven AFW pumps for continued heat removal, due to the inherent cooldown that occurs as the faulted SG blows down in a MSLB event.

From discussion with the vendor, it was determined that there is a low probability that one or both of the motor-driven AFW pumps would have been damaged before tripping, rendering them unable to subsequently provide flow to the SGs. For large MSLBs, discharge pressure would be expected to drop rapidly, initiating a pump trip. While severe damage to the pump is unlikely, the vendor estimated a 5% probability that damage might occur that would render the pump unable to be restarted and deliver sufficient flow. For smaller MSLBs, pump discharge pressure may have dropped to a value slightly above the low discharge pressure setpoint. In this case, the pump would have operated for a short time while cavitating before operators took action that reduced flow. For this case, the vendor estimated a 15 to 20% probability of pump damage rendering the pump inoperable.

The turbine-driven AFW pump low discharge pressure switch was set to initiate a pump trip at 100 psig. Due to this low setpoint, it was determined that the switch would likely not have caused a protective trip of the pump in time to prevent pump damage. Consequently, in responding to a postulated MSLB, the turbine-driven pump would have been rendered inoperable due to low NPSH.

The cause of the occurrence is an original system design error. Previous calculations and testing that were performed for AFW system response to a MSLB event were focused on ensuring that adequate AFW flow would be provided by the turbine-driven AFW pump without due consideration of all suction head parameter concerns.

Conditional duration: Since the condition existed for a long time, the maximum time of one year is used for the duration in a conditional assessment.

Recovery opportunity: Recovery is modeled whenever applicable; especially for the plant condition for AFW pumps.

Analysis Results

Analysis results are summarized in Table A.

Table A. Summary of Condition Importances Leading to Windowed Sum

LER	Type of Event	Delta CDP	Total Importance for LER	Windowed Total Importance
LER 305-2005-002-01 (AFW)	SLB	1.60E-06		
LER 305-2005-006-00 (AFW)	SBO	1.20E-05		
LER 305-2005-008-01 (AFW)	Seismic	2.10E-07		
	Tornado	6.70E-07		
Total AFW-related)			1.45E-05	
LER 305-2005-005-01 (EDG)	Tornado + LOOP		4.00E-08	
LER 305-2005-007-00 (CCW)	Any initiating event		9.00E-07	
LER 305-2005-004-01 (Int. Flood)	Internal flooding		3.00E-04	
Total windowed importance of 6 LERs				3.15E-04

I. AFW LERs

Four different initiating events that may lead to increased risk due to this plant condition are modeled as discussed below.

1. Steam Line Break (SLB) Events

This event is modeled by Using the SLB event tree of Figure 1, with the initiating event frequency of 3.3E-04/year. First the base case CDF is quantified. Then the *GENERATE* option of the SAPHIRE software is used to quantify the CDF of the *CURRENT* case when all three AFW pumps are assumed failed. Table 1 shows the SLB sequence CDF and the total SLB CDF for the base and the current cases. Table 2 shows the cutsets of the current case. Table 5 contains the basic events changed in the change sets to get the current case. The calculated CDFs are as follows:

CDF(base) = 8.62E-10 /year

CDF(current) = 8.06E-06/year

CDF (with AFW recovery) = the same as CDF(base)

It is assumed that 20% of the time, all three AFW pumps will be catastrophically failed by the condition and can not be recovered. In the remaining 80% of the time the pumps are recoverable. The CDF of the plant condition then can be written as follows:

CDF(plant condition) = 0.2 * CDF(current) + 0.8 * CDF(with AFW recovery)

CDF(plant condition) = 1.61E-06 /year.

Condition Importance: ΔCDP = [CDF(plant condition) – CDF(base)] * 1 year.

ΔCDP(SLB) = 1.61E-06.

2. Station Blackout (SBO) Events

This event is modeled by Using the LOOP event tree of Figure 2, with the initiating event frequency of 3.59E-02/year. First the base case CDF is quantified. Then the *GENERATE* option of the SAPHIRE software is used to quantify the CDF of the *CURRENT* case when all three AFW pumps are assumed failed. Table 3 shows the LOOP sequences 18-X-X (the SBO sequences) and their CDFs and the total SBO CDF for the base and the current cases. Table 4 shows the cutsets of the current case. Table 5 contains the basic events changed in the change sets to get the current case. The calculated CDFs are as follows:

CDF(base) = 4.20E-06 /year

CDF(current) = 4.38E-05 /year

CDF (with TDP recovery) = the same as CDF(base)

It is assumed that 20% of the time, the TDP will be catastrophically failed by the condition and can not be recovered. In the remaining 80% of the time the TDP is recoverable. The CDF of the plant condition then can be written as follows:

CDF(plant condition) = 0.2 * CDF(current) + 0.8 * CDF(with TDP recovery)

CDF(plant condition) = 1.21E-05 /year.

Condition Importance: ΔCDP = [CDF(plant condition) – CDF(base)] * 1 year.

ΔCDP(SBO) = 1.21E-05.

3. Seismic Events

The seismic model is discussed in Appendix C. Four cases are studied as shown in Table C-1. Case IV is used. Assuming the base case for seismic is negligible, the condition importance is

ΔCDP(seismic) = 2.1E-07.

4. Tornado Events

The likelihood of having a tornado with wind speeds that would damage the CSTs is calculated to be

IE-TOR = 6.7E-07/year

By the licensee. The licensee CDF estimate is 4E-08/year.

This estimate is used to calculate the condition importance from tornado events as

ΔCDP(tornado) = 4 E-08.

The condition importance is calculated as the sum of the importances of these events.

ΔCDP(total-AFW) = 1.4 E-05.

II. LER 305-2005-005-01 (EDG)

The condition importance is calculated in Appendix A as

ΔCDP(EDG) = 4 E-08.

III. LER 305-2005-007-00 (CCW)

The condition importance is calculated in Appendix B as

ΔCDP(CCW) = 9 E-07.

IV. LER 305-2005-004-01 (Int. Flood)

The condition importance for this LER is calculated in a separate ASP analysis as

ΔCDP (CCW) = 3 E-04.

V. Total Condition Importance of Windowed Events

The total condition importance from all six LERs discussed in this package can be estimated as the sum of each condition importance, since they apply to different initiating events.

The total windowed delta CDP for six LERs is calculated as

ΔCDP(Six LERs) = 3 E-04.

- **Importance**

  The parameter of interest in this evaluation is the measure of the incremental change between the conditional probability of core damage for the period in which the condition existed and the nominal core damage probability obtained with the equipment availability modeled in the base case SPAR model.

  The risk significance of these conditions with a duration of 8760 hours was determined by subtracting the baseline core damage probability (point estimate) from the conditional core damage probability (point estimate), as summarized in the previous section.

- **Dominant Sequences**

  Dominant sequences for the newly introduced SLB event tree are discussed below. The SBO sequences are given in Table 4.

  The SLB sequences for plant condition CDP calculation are reported in Tables 1 and 1a, and are defined in Figure 1 by the SLB event tree.

  Failure of AFW pumps directs the operators to feed and bleed action (since MFW is also assumed nonrecoverable, due to the nature of the events considered). Thus, the following two sequences become dominant , especially due to failure of operator actions:

  Large steamline break event occurs;
  Reactor trips;
  SI signal is generated;
  AFW is actuated and fails;
  HP injection starts;

MFW recovery is not feasible;
Operators fail to implement feed and bleed;

Large steamline break event occurs;
Reactor trips;
SI signal is generated;
AFW is actuated and fails;
HP injection starts;
MFW recovery is not feasible;
Operators implement feed and bleed;
RWST is depleted;
Operator action of switchover to sump recirculation fails;

The following two failure combinations (cutsets) represent the major contributors to the above sequences:

1	LARGE STEAM LINE BREAK OCCURS (IE-SLB)	3.30E-04
	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING (HPI-XHE-XM-FB)	2.00E-02

Core damage occurs = 6.6E-06

2	IE-SLB LARGE STEAM LINE BREAK OCCURS IE-SLB)	3.30E-04
	(Feed and bleed cooling is successful)	(~1.0)
	OPERATOR FAILS TO INITIATE HPR (HPR-XHE-XM)	2.00E-03

Core damage occurs = 6.6E-07

- **Results Tables**

  - The sequences are shown in Tables 1 and 1a.
  - The sequence definitions are shown in Figure 1.
  - The top cutsets are shown in Table 2.

SBO results are in tables 4 and 5.

Modeling Assumptions

- **Assessment summary**

This event was modeled as a condition assessment for 8760 hours. The AFW pumps are not protected from failure due to air ingestion during tornado or seismic events; as well as from failure during potential runout conditions (large steamline break).

An analysis (covering all three AFW-related pump LERs) is performed, assuming a large steamline or feedline break would fail all three AFW pumps; but only 20% of the time, the failure is nonrecoverable. Additional two LERs that can be windowed with the three AFW-related LERs are also analyzed in Appendices A and B.

- **Key Modeling Assumptions**

All three AFW pumps are assumed to be failed by any one of the issues involved; a non-recovery factor of 0.2 is used, as mentioned in both the licensee and previous NRC analyses on the same condition.

SLB initiating event tree already created for the ASP analysis of McGuire LER 2005-002 event is used for Kewaunee. This event tree addresses the event tree nodes required for success in a SLB event for a PWR. Kewaunee-specific system failure models (fault trees) are used in the SLB event tree.

SLB, SBO, seismic, and tornado events are considered, consistent with the licensee and other NRC analyses for the same condition. Since the SLB event tree is newly introduced into the SPAr model for this condition, it is discussed in more detail here. The existing SBO model is used, as summarized elsewhere. Seismic event analysis is given in Appendix C. The tornado contribution is deemed to be negligible and licensee analysis results are adopted.

SLB Event:

Base Case:

The base is defined as a large SLB event. The frequency of such an event is estimated below.

Plant Condition Cases:

Plant condition is defined as the deficiency in AFW pump configuration that would lead to failure of all three AFW pumps if a large HELB event occurs.

Table 3 provides the change sets used in the SPAR model to run base and condition cases .

- **SPAR model used in the analysis**

Kewaunee SPAR model version 3.31, run by SAPHIRE 7.26 software. SLB event tree and three fault trees are imported from the McGuire SPAR model and are incorporated into the Kewaunee SPAR model..

- **Unique system and operational considerations**

A SLB event tree is imported from the McGuire SPAR model. The event tree picture is given by Figure 1. This event tree introduces one new initiating event (IE-SLB), and three new fault trees. Each new fault tree has a single basic event, as discussed in the next sections.

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

A new event tree named SLB is introduced.

Three new fault trees named ISGTR, MSI, and HPI-STH are introduced. These fault trees are shown in Figures 2, 3, and 4.

- **Initiating event probability changes**

For the SLB event tree, a frequency is assigned for a large SLB, as discussed below:

IE-SLB = 3.3E-04/year.

This frequency is calculated with zero large HELB events (those that will rapidly reduce the faulted SG pressure to atmospheric pressure, before the MSIVs are closed) observed in 1520 power operation years for the fleet of domestic PWRs (taken from Kewaunee internal flooding LER-2005-004-00 ASP analysis). Non-informative prior is used to calculate the frequency as:

IE-SLB = (0 +0.5) / 1520 = 3.3 E-04/year.

It may be argued that, since Kewaunee has less than the average number of steam loops in the domestic PWR plant pool, its frequency may be lower.

Also note that the frequency of any size SLB or feedline break is

IE-SLB = 1.1E-02/yr (from NUREG/CR-5750; categories K1+K3)

Thus, the probability of large SLB, given any SLB is the ratio 3.3E-04/1.1E-2 = 0.03.

- **Basic event probability changes**

  Three new basic events are introduced, one in each of the new fault trees. These basic events are shown in Figures 2, 3, and 4 and they are taken from the McGuire SLB model. These values are deemed to be generic for PWRs, thus applicable to Kewaunee.

A probability of 20% non-recovery is also used in calculation of the condition importance.

Sensitivity / Uncertainty Analyses

The major contributor to plant condition uncertainty is the nonrecovery probability of 0.2 used for AFW pumps. If this probability is increased to 1.0 (no recovery, the event importance associated with the three AFW LERs will increase about a factor of five.

When all six LERs are windowed, the importance is dominated by the internal flooding condition which is quantified in a separate ASP analysis. The sum of condition importances from other five LERs do not affect the first significant figure of the total windowed importance.

Other Windowed Events

Two other events that are windowed with this AFW pump plant condition are discussed in Appendices A and B.

Note that the internal flooding ASP analysis for LER 2005-004 can also be windowed with the five LERs mentioned in this ASP analysis. Since the ΔCDP of the internal flooding condition is much higher than the ones analyzed in the current package, the conclusions and the insights obtained would not be changed: these five LERs and the internal flooding LER address different initiating events. Thus, their condition importances are additive, but would not “pile up” to increase the importance beyond linearly.

References

1. Licensee Event Report 305/05-002, Revision 1, Auxiliary Feedwater Pumps Assumed to Fail from Postulated Loss of Primary Water Source - Safe Shutdown and Accident Analysis Assumptions Not Assured - Inadequate Design of Pump Protective Equipment at Kewaunee Power station, dated January 30, 2006 (ADAMS Accession No. ML060410107).

2. Licensee Event Report 305/005-005, Revision 1, Emergency Diesel Generator Exhaust Ductwork Not Adequately Protected from Potential Tornado Winds & Missiles, dated September 29, 2005 (ADAMS Accession No. ML052790505).

3. Licensee Event Report 305/05-006, Revision 0, Auxiliary Feedwater Pumps Postulated to Fall due to Air Ingestion Through Pump Packing at kewaunee Power station at kewaunee Power station, dated May 25, 2005 (ADAMS Accession No. ML051530312).

4. Licensee Event Report 305/05-007, revision 0, Unanalyzed Condition : Design Deficiency - Component Cooling Water System Inoperable Due to Pump "Run Out" Conditions at kewaunee Power station, dated May 27, 2005 (ADAMS Accession No. ML051540040).

5. Licensee Event Report 305/05-008, Revision 1, Turbine-Driven Auxiliary Feedwater Pump Inoperable Due to Insufficient Net Positive Suction Head at Kewaunee Power station, dated November 9, 2005 (ADAMS Accession No. ML053210186).

6. Licensee event Report 305/05-004, Revision 0, Safe Shutdown Potentially Challenged By Unanalyzed Internal Flooding Events and Inadequate Design at Kewanuee Power station, dated May 16, 2005 (ADAMS Accession No. ML051440302). (This event is analyzed in a separate ASP package).

7. Licensee event Report 369/05-002, Revision 1,Main Steam Isolation Valve Inoperable Due To Internal Binding at at McGuire Nuclear Station, dated January 23. 2006 (ADAMS Accession No. ML060380514)

8 KEWAUNEE SPAR-EE Model: KEWA-EE-312, August 2005 Revision 1.
Incorporation of External Events into SPAR Models - A Demonstration with Kewaunee Model. Unpublished report/model, US NRC, RES / OERA.

Table 1. Dominant Sequences

Event tree	Sequence	Plant Condition Freq Per Year	Base Freq Per Year	Sequence Importance	Failure
SLB	08	7.12E-06	8.09E-11	7.12E-06	feed and bleed
SLB	07	9.32E-07	3.72E-12	9.32E-07	sump recirculation
SLB	09-31	2.92E-09	0.00E+00	2.92E-09	induced SGTR
SLB	09-30	5.49E-10	0.00E+00	5.49E-10	induced SGTR
SLB	10-11	4.12E-10	0.00E+00	4.12E-10	ATWS
	TOTALS =	8.06E-06	8.46E-11	**8.06E-06**	

Note: See SLB event tree in Figure 1 for sequence definitions.

List of all event tree sequences, in the order they appear in Figure 1 are shwon in Table 1a

Table 1a. Large SLB Sequence Results

Event tree	Sequence	Curr Freq Per Year	Base Freq Per Year	Difference	Curr Cnt	Base Cnt	End State
SLB	04	0.00E+00	6.99E-11	-6.99E-11	1	3	CD
SLB	05	0.00E+00	4.69E-10	-4.69E-10	1	26	CD
SLB	07	9.32E-07	3.72E-12	9.32E-07	609	2	CD
SLB	08	7.12E-06	8.09E-11	7.12E-06	69	12	CD
SLB	09-04	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-06	6.60E-12	6.60E-12	0.00E+00	2	2	CD
SLB	09-10	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-12	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-14	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-17	6.61E-11	6.61E-11	0.00E+00	10	10	CD
SLB	09-19	1.39E-10	1.39E-10	0.00E+00	6	6	CD
SLB	09-21	1.02E-11	1.02E-11	0.00E+00	3	3	CD
SLB	09-22	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-23	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-25	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-27	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-28	0.00E+00	0.00E+00	0.00E+00	0	0	CD
SLB	09-30	5.49E-10	0.00E+00	5.49E-10	42	0	CD
SLB	09-31	2.92E-09	0.00E+00	2.92E-09	24	0	CD
SLB	10-04	0.00E+00	0.00E+00	0.00E+00	1	0	CD
SLB	10-06	0.00E+00	0.00E+00	0.00E+00	1	0	CD
SLB	10-08	0.00E+00	0.00E+00	0.00E+00	1	0	CD
SLB	10-09	0.00E+00	0.00E+00	0.00E+00	1	0	CD
SLB	10-10	0.00E+00	7.99E-12	-7.99E-12	1	1	CD
SLB	10-11	4.12E-10	0.00E+00	4.12E-10	4	0	CD
SLB	10-12	5.59E-12	5.59E-12	0.00E+00	1	1	CD
SLB	11	3.99E-12	3.99E-12	0.00E+00	1	1	CD
	TOTALS =	8.06E-06	8.62E-10	8.06E-06	778	67	

Figure 1. Steam Line Break Event Tree

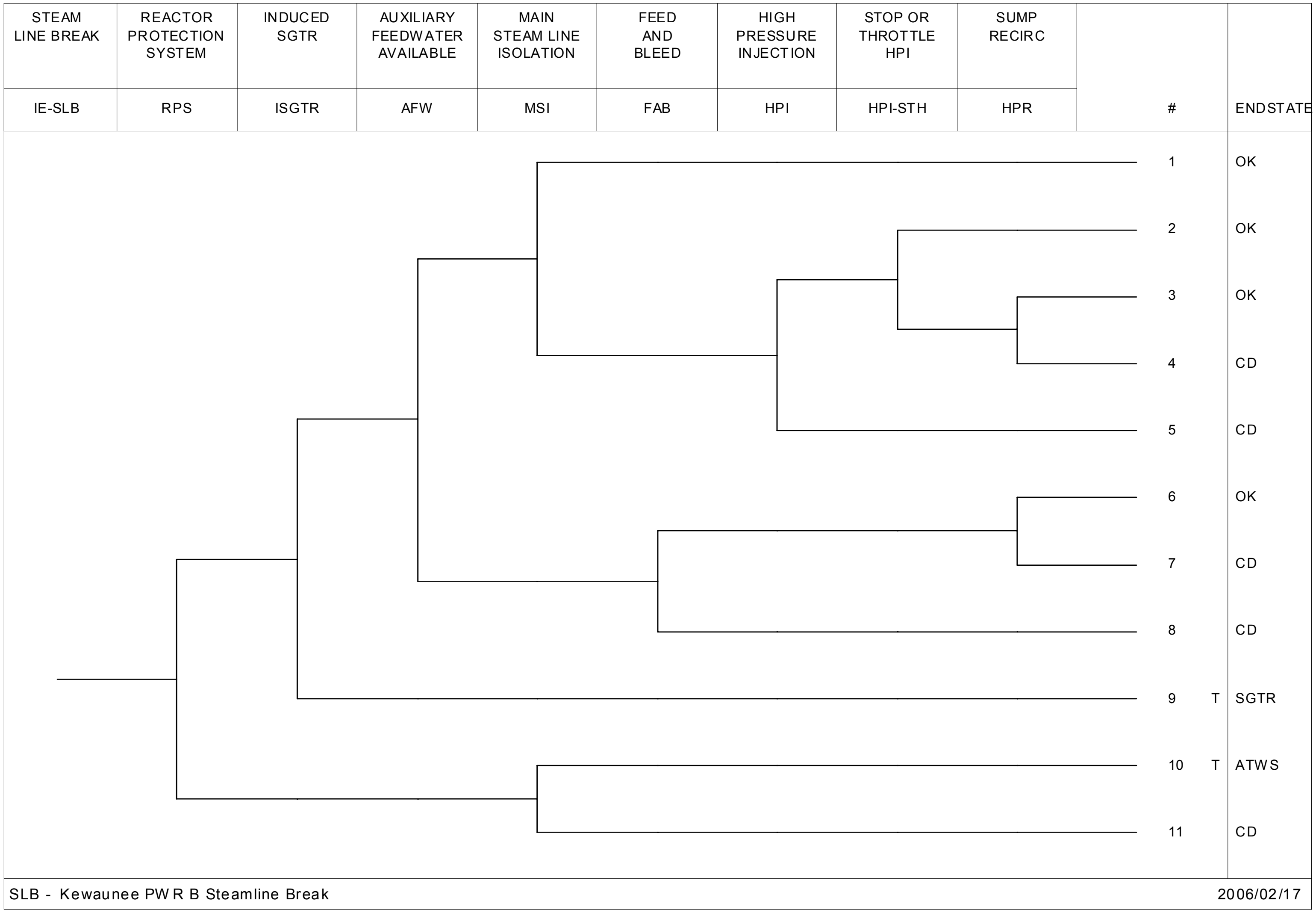

Figure 2. HPI-STH Fault Tree

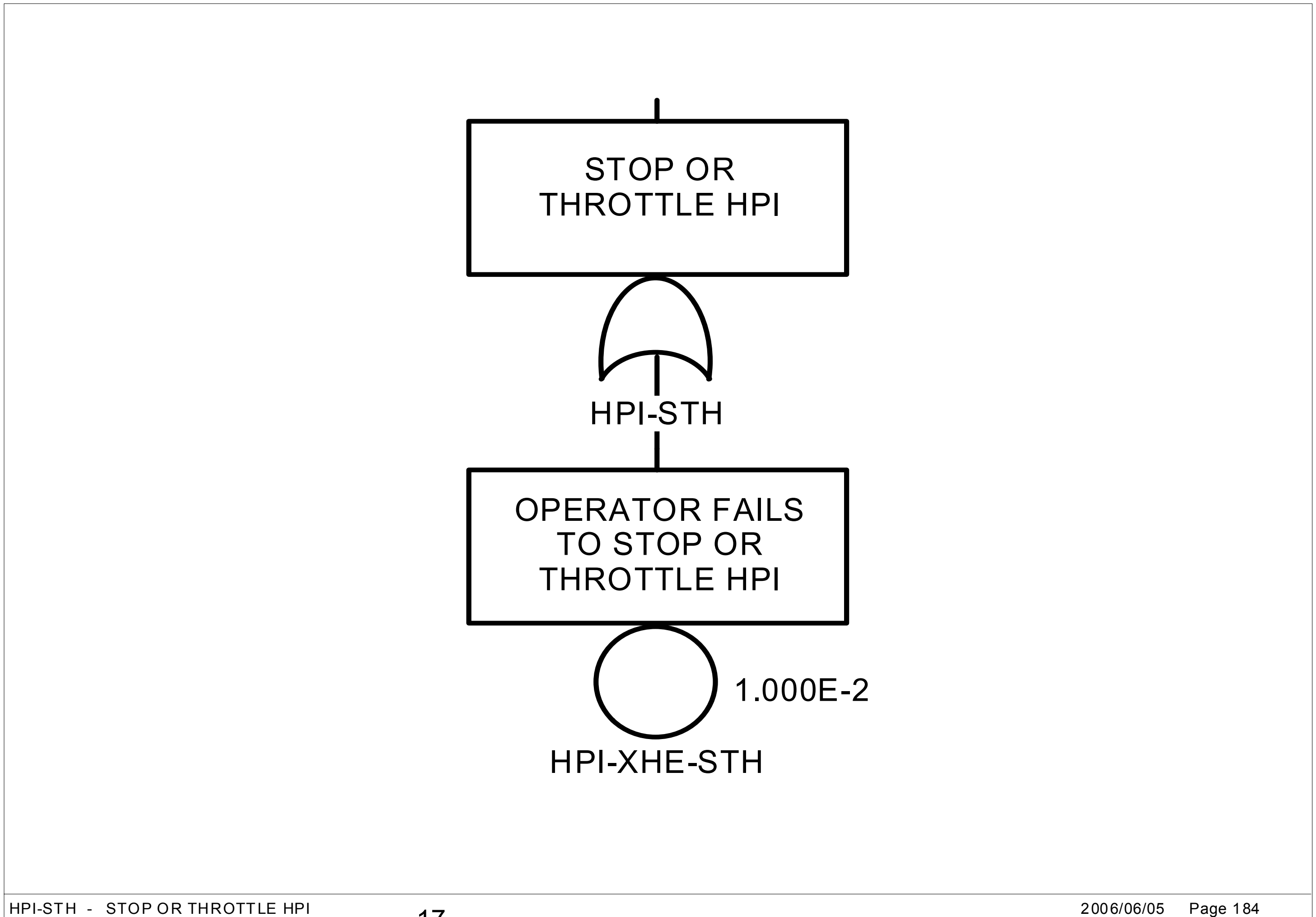

Figure 3. ISGTR Fault Tree

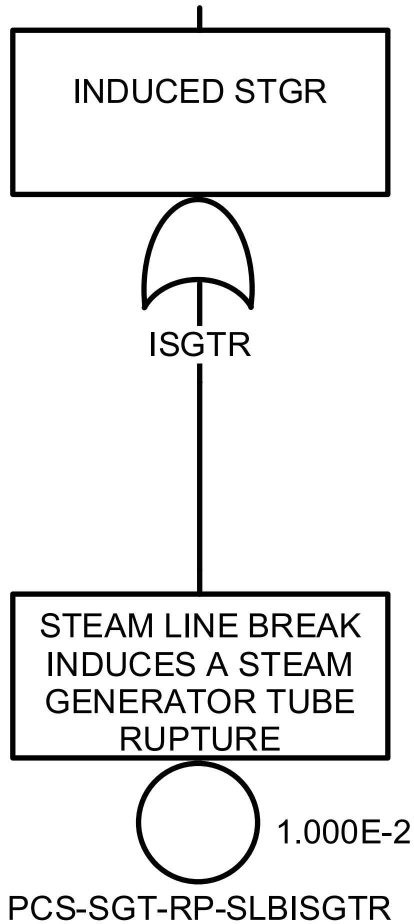

Figure 4. MSI Fault Tree

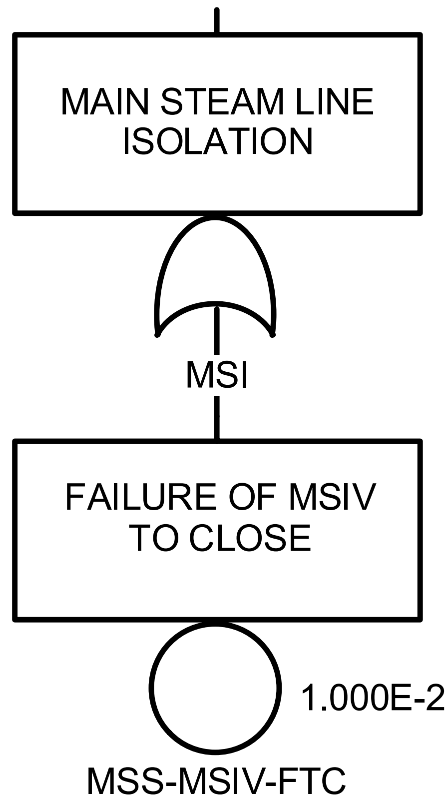

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Table 2. Top Cutsets for the Plant Condition Case

	% Total	CDF	Basic Event	Description	Event Prob.
1	82.12	6.60E-06	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.00E-02
2	90.33	6.60E-07	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPR-XHE-XM	OPERATOR FAILS TO INITIATE HPR	2.00E-03
3	93.2	2.31E-07	IE-SLB	STEAM LINE BREAK	3.30E-04
			PPR-SRV-CC-PR2B	PORV 2B FAILS TO OPEN ON DEMAND	7.00E-04
4	96.07	2.31E-07	IE-SLB	STEAM LINE BREAK	3.30E-04
			PPR-SRV-CC-PR2A	PORV 2A FAILS TO OPEN ON DEMAND	7.00E-04
5	96.35	2.23E-08	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-CF-STRT	HPI PUMP COMMON CAUSE FAILURES TO START	6.77E-05
6	96.63	2.23E-08	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-CF-STRT	RHR PUMP COMMON CAUSE FAILURES TO START	6.77E-05
7	96.84	1.65E-08	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPR-SMP-PG-SMP	FAILURE OF SUMP	5.00E-05
8	97.04	1.57E-08	IE-SLB	STEAM LINE BREAK	3.30E-04
			PPR-SRV-CF-PORVS	CCF OF PORVs TO OPEN	4.76E-05
9	97.15	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CF-350A1B	CCF OF SUMP ISOLATION MOVs 350A AND 351B TO OPEN	2.61E-05
10	97.26	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CF-350AB	CCF OF SUMP ISOLATION MOVs 350A AND 350B TO OPEN	2.61E-05
11	97.37	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CF-351AB	CCF OF SUMP ISOLATION MOVs 351A AND 351B TO OPEN	2.61E-05
12	97.48	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			SWS-MOV-CF-1300AB	CCF OF CCW HTXs SWS MOVs 1300 & B	2.61E-05
13	97.59	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CF-351A0B	CCF OF SUMP ISOLATION MOVs 351A AND 350B TO OPEN	2.61E-05
14	97.7	8.61E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MOV-CF-299AB	RHR ISOLATION RHR-299A&B TO SI TRAINS FAIL TO OPEN	2.61E-05
15	97.75	4.37E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-CF-RUN	HPI PUMP COMMON CAUSE FAILURES TO run	1.32E-05
16	97.8	4.37E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-CF-RUN	RHR PUMP COMMON CAUSE FAILURES TO RUN	1.32E-05

	% Total	CDF	Basic Event	Description	Event Prob.
17	97.84	3.40E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPR-MOV-CF-208209	CCF OF RWST MINFLOW MOVs	1.03E-05
18	97.88	3.39E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			ABV-ACX-CF-STRT	CCF OF AUX BLDG BSMT COOLING UNITS TO START	1.03E-05
19	97.92	3.35E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			CCW-HTX-CF-ALL	COMMON CAUSE FAILURE OF CCW HEAT EXCHANGERS	1.01E-05
20	97.96	2.97E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1A	HPI MDP 1A FAILS TO START	1.50E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
21	98	2.97E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-FS-1A	RHR MDP 1A FAILS TO START	1.50E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
22	98.04	2.97E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1B	HPI MDP 1B FAILS TO START	1.50E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
23	98.08	2.97E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-FS-1B	RHR MDP 1B FAILS TO START	1.50E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
24	98.11	2.48E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1A	HPI MDP 1A FAILS TO START	1.50E-03
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
25	98.14	2.48E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1B	HPI MDP 1B FAILS TO START	1.50E-03
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
26	98.17	2.48E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-MDP-FS-1B	RHR MDP 1B FAILS TO START	1.50E-03
27	98.2	2.48E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-MDP-FS-1A	RHR MDP 1A FAILS TO START	1.50E-03
28	98.22	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			RHR-MOV-CC-299A	RHR ISOLATION RHR-299A TO SI TRAIN A FAILS TO OPEN	1.00E-03
29	98.24	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03

	% Total	CDF	Basic Event	Description	Event Prob.
			RHR-XHE-XR-HX1A	OPERATOR FAILS TO RESTORE RHR HTX 1A FROM T&M	1.00E-03
30	98.26	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			RHR-MOV-CC-299B	RHR ISOLATION RHR-299B TO SI TRAIN B FAILS TO OPEN	1.00E-03
31	98.28	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			RHR-XHE-XR-HX1B	OPERATOR FAILS TO RESTORE RHR HTX 1B FROM T&M	1.00E-03
32	98.3	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-XHE-XR-1A	OP FAILS TO RESTORE HPI MDP 1A AFTER T&M	1.00E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
33	98.32	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-XHE-XR-1B	OP FAILS TO RESTORE HPI MDP 1B	1.00E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
34	98.34	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			RHR-XHE-XR-1A	OP FAILS TO RESTORE RHR MDP 1A	1.00E-03
35	98.36	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			RHR-XHE-XR-1B	OP FAILS TO RESTORE RHR MDP 1B	1.00E-03
36	98.38	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			SWS-MOV-CC-1300A	CCW HTX ISOLATION SWS MOV 1300A FAILS TO OPEN	1.00E-03
37	98.4	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
			SWS-MOV-CC-1300B	CCW HTX B ISOLATION SWS MOV 1300B FAILS TO OPEN	1.00E-03
38	98.42	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CC-SI350A	SUMP ISOLATION MOV 350A TO LPR MDP 1A FAILS TO OPEN	1.00E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
39	98.44	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CC-SI351A	SUMP ISOLATION MOV 351A TO LPR MDP 1A FAILS TO OPEN	1.00E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03

	% Total	CDF	Basic Event	Description	Event Prob.
40	98.46	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MOV-OO-SI5A	RWST HPI ISOLATION MOV 5A FAILS TO CLOSE	1.00E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
41	98.48	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-OO-SI300A	RWST ISOLATION MOV 300A FAILS TO CLOSE	1.00E-03
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
42	98.5	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-OO-SI300B	RWST ISOLATION MOV 300B FAILS TO CLOSE	1.00E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
43	98.52	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CC-SI350B	SUMP ISOLATION MOV 350B TO LPR MDP 1B FAILS TO OPEN	1.00E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
44	98.54	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			LPR-MOV-CC-SI351B	SUMP ISOLATION MOV 351B TO LPR MDP 1B FAILS TO OPEN	1.00E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
45	98.56	1.98E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MOV-OO-SI5B	RWST HPI ISOLATION MOV 5B FAILS TO CLOSE	1.00E-03
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
46	98.58	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-MOV-CC-299A	RHR ISOLATION RHR-299A TO SI TRAIN A FAILS TO OPEN	1.00E-03
47	98.6	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-XHE-XR-HX1A	OPERATOR FAILS TO RESTORE RHR HTX 1A FROM T&M	1.00E-03
48	98.62	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-MOV-CC-299B	RHR ISOLATION RHR-299B TO SI TRAIN B FAILS TO OPEN	1.00E-03
49	98.64	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03

	% Total	CDF	Basic Event	Description	Event Prob.
			RHR-XHE-XR-HX1B	OPERATOR FAILS TO RESTORE RHR HTX 1B FROM T&M	1.00E-03
50	98.66	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-OO-SI300A	RWST ISOLATION MOV 300A FAILS TO CLOSE	1.00E-03
51	98.68	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			HPI-XHE-XR-1B	OP FAILS TO RESTORE HPI MDP 1B	1.00E-03
52	98.7	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-CC-SI350A	SUMP ISOLATION MOV 350A TO LPR MDP 1A FAILS TO OPEN	1.00E-03
53	98.72	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-CC-SI351A	SUMP ISOLATION MOV 351A TO LPR MDP 1A FAILS TO OPEN	1.00E-03
54	98.74	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			HPI-XHE-XR-1A	OP FAILS TO RESTORE HPI MDP 1A AFTER T&M	1.00E-03
55	98.76	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-XHE-XR-1A	OP FAILS TO RESTORE RHR MDP 1A	1.00E-03
56	98.78	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-CC-SI350B	SUMP ISOLATION MOV 350B TO LPR MDP 1B FAILS TO OPEN	1.00E-03
57	98.8	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-CC-SI351B	SUMP ISOLATION MOV 351B TO LPR MDP 1B FAILS TO OPEN	1.00E-03
58	98.82	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			LPR-MOV-OO-SI300B	RWST ISOLATION MOV 300B FAILS TO CLOSE	1.00E-03
59	98.84	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03

	% Total	CDF	Basic Event	Description	Event Prob.
			HPI-MOV-OO-SI5A	RWST HPI ISOLATION MOV 5A FAILS TO CLOSE	1.00E-03
60	98.86	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			HPI-MOV-OO-SI5B	RWST HPI ISOLATION MOV 5B FAILS TO CLOSE	1.00E-03
61	98.88	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			RHR-XHE-XR-1B	OP FAILS TO RESTORE RHR MDP 1B	1.00E-03
62	98.9	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			SWS-MOV-CC-1300A	CCW HTX ISOLATION SWS MOV 1300A FAILS TO OPEN	1.00E-03
63	98.92	1.65E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-TM-1A	HPI MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
			SWS-MOV-CC-1300B	CCW HTX B ISOLATION SWS MOV 1300B FAILS TO OPEN	1.00E-03
64	98.94	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			DCP-BDC-LP-BRA102	FAILURE OF 125VDC BUS BRA-102	4.80E-06
65	98.96	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			DCP-BDC-LP-BRB104	FAILURE OF 125VDC BUS BRB-104	4.80E-06
66	98.98	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			DCP-BDC-LP-BRA104	FAILURE OF 125VDC BUS BRA-104	4.80E-06
67	99	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			DCP-BDC-LP-BRB102	FAILURE OF 125VDC BUS BRB-102	4.80E-06
68	99.02	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-CKV-CF-SI12AB	CCF OF HPI/HPR DISCHARGE CHECK VAVLES SI-12A & B INTO COLD LEGS	4.78E-06
69	99.04	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-CKV-CF-13AB	CCF OF HPI/HPR DISCHARGE CHECK VAVLES SI-13A & B INTO COLD LEGS	4.78E-06
70	99.06	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-CKV-CF-SI6AB	CCF OF HPI MDP DISCHARGE CHECK VALVES SI-6A & B	4.78E-06
71	99.08	1.58E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-CKV-CF-RHR5AB	CCF OF RHR MDPs DISCHARGE CHECK RHR-5A & 5B VALVES	4.78E-06
72	99.1	1.32E-09	IE-SLB	STEAM LINE BREAK	3.30E-04

	% Total	CDF	Basic Event	Description	Event Prob.
			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.00E-02
			MFW-XHE-XL-SITRIP	OPERATOR FAILS TO RECOVER MFW (SI SIGNAL)	4.00E-02
			PCS-SGT-RP-SLBISGTR	STEAM LINE BREAK INDUCES A STEAM GENERATOR TUBE RUPTURE	1.00E-02
			SGA-FAULTED	STEAM GENERATOR A FAULTED	5.00E-01
73	99.12	1.32E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.00E-02
			MFW-XHE-XL-SITRIP	OPERATOR FAILS TO RECOVER MFW (SI SIGNAL)	4.00E-02
			PCS-SGT-RP-SLBISGTR	STEAM LINE BREAK INDUCES A STEAM GENERATOR TUBE RUPTURE	1.00E-02
			SGB-FAULTED	STEAM GENERATOR B FAULTED	5.00E-01
74	99.14	1.24E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1B	HPI MDP 1B FAILS TO START	1.50E-03
			RHR-HTX-TM-1A	RHR HEAT EXCHANGER 1A UNAVAILABLE DUE TO T&M	2.50E-03
75	99.16	1.24E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FS-1A	HPI MDP 1A FAILS TO START	1.50E-03
			RHR-HTX-TM-1B	RHR HEAT EXCHANGER 1B UNAVAILABLE DUE TO T&M	2.50E-03
76	99.18	1.24E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-HTX-TM-1A	RHR HEAT EXCHANGER 1A UNAVAILABLE DUE TO T&M	2.50E-03
			RHR-MDP-FS-1B	RHR MDP 1B FAILS TO START	1.50E-03
77	99.2	1.24E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-HTX-TM-1B	RHR HEAT EXCHANGER 1B UNAVAILABLE DUE TO T&M	2.50E-03
			RHR-MDP-FS-1A	RHR MDP 1A FAILS TO START	1.50E-03
78	99.21	1.02E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FR-1A	HPI MDP 1A FAILS TO RUN	5.15E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
79	99.22	1.02E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-FR-1A	RHR MDP 1A FAILS TO RUN	5.15E-04
			RHR-MDP-TM-1B	RHR MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
80	99.23	1.02E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FR-1B	HPI MDP 1B FAILS TO RUN	5.15E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
81	99.24	1.02E-09	IE-SLB	STEAM LINE BREAK	3.30E-04
			RHR-MDP-FR-1B	RHR MDP 1B FAILS TO RUN	5.15E-04
			RHR-MDP-TM-1A	RHR MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	6.00E-03
82	99.25	1.02E-09	IE-SLB	STEAM LINE BREAK	3.30E-04

	% Total	CDF	Basic Event	Description	Event Prob.
			CCW-MDP-CF-1ABRUN	CCF OF CCW MDP'S TO RUN (2)	3.08E-06
83	99.26	8.50E-10	IE-SLB	STEAM LINE BREAK	3.30E-04
			HPI-MDP-FR-1A	HPI MDP 1A FAILS TO RUN	5.15E-04
			HPI-MDP-TM-1B	HPI MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	5.00E-03
Sum	**99.26**	**7.98E-06**			

Table 3. Change Sets Used to Quantify the Plant Condition and Base Cases

Change Set for Plant Condition : MSLB - NO AFW

Event	Calc. Type	Description
		Condition Assessment
AFW-MDP-FR-1A	T	AFW MDP 1A FAILS TO RUN
AFW-MDP-FR-1B	T	AFW MDP 1B FAILS TO RUN
AFW-MDP-FS-1A	T	AFW MDP 1A FAILS TO START
AFW-MDP-FS-1B	T	AFW MDP 1B FAILS TO START
AFW-MDP-TM-1A	T	AFW MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE
AFW-MDP-TM-1B	T	AFW MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE
AFW-TDP-FR-1C	T	AFW TDP 1C FAILS TO RUN
AFW-TDP-FS-1C	T	AFW TDP 1C FAILS TO START
AFW-TDP-TM-1C	T	AFW TDP 1C UNAVAILABLE DUE TO TEST AND MAINTENANCE
IE-ISL-HPI	F	ISLOCA IE 2-CKV HPI interface
IE-ISL-LPI	F	ISLOCA IE 2-CKV LPI interface
IE-ISL-RHR	F	ISLOCA IE 2-MOV RHR interface
IE-LLOCA	F	LARGE LOCA
IE-LOAC5	F	LOSS OF AC BUS 5
IE-LOAC6	F	LOSS OF AC BUS 6
IE-LOCCW	F	LOSS OF COMPONENT COOLING WATER
IE-LODCA	F	LOSS OF DC POWER BRA-104
IE-LODCB	F	LOSS OF DC POWER BRB-104
IE-LOIA	F	LOSS OF INSTRUMENT AIR
IE-LOMFW	F	Loss of Main Feedwater
IE-LOOP	F	LOSS OF OFFSITE POWER
IE-LOSWS	F	LOSS OF SERVICE WATER SYSTEM
IE-MLOCA	F	MEDIUM LOCA
IE-RXVRUPT	F	REACTOR VESSEL RUPTURE INITIATING EVENT
IE-SGTR	F	SGTR INITIATING EVENT
IE-SLOCA	F	SMALL LOCA
IE-TRANS	F	TRANSIENT

Change Set for the Base Case

Event	Calc. Type	Description
IE-ISL-HPI	F	ISLOCA IE 2-CKV HPI interface
IE-ISL-LPI	F	ISLOCA IE 2-CKV LPI interface
IE-ISL-RHR	F	ISLOCA IE 2-MOV RHR interface
IE-LLOCA	F	LARGE LOCA
IE-LOAC5	F	LOSS OF AC BUS 5
IE-LOAC6	F	LOSS OF AC BUS 6
IE-LOCCW	F	LOSS OF COMPONENT COOLING WATER
IE-LODCA	F	LOSS OF DC POWER BRA-104
IE-LODCB	F	LOSS OF DC POWER BRB-104
IE-LOIA	F	LOSS OF INSTRUMENT AIR
IE-LOMFW	F	Loss of Main Feedwater
IE-LOOP	F	LOSS OF OFFSITE POWER
IE-LOSWS	F	LOSS OF SERVICE WATER SYSTEM
IE-MLOCA	F	MEDIUM LOCA
IE-RXVRUPT	F	REACTOR VESSEL RUPTURE INITIATING EVENT
IE-SGTR	F	SGTR INITIATING EVENT
IE-SLOCA	F	SMALL LOCA
IE-TRANS	F	TRANSIENT

Figure 5. LOOP Event Tree

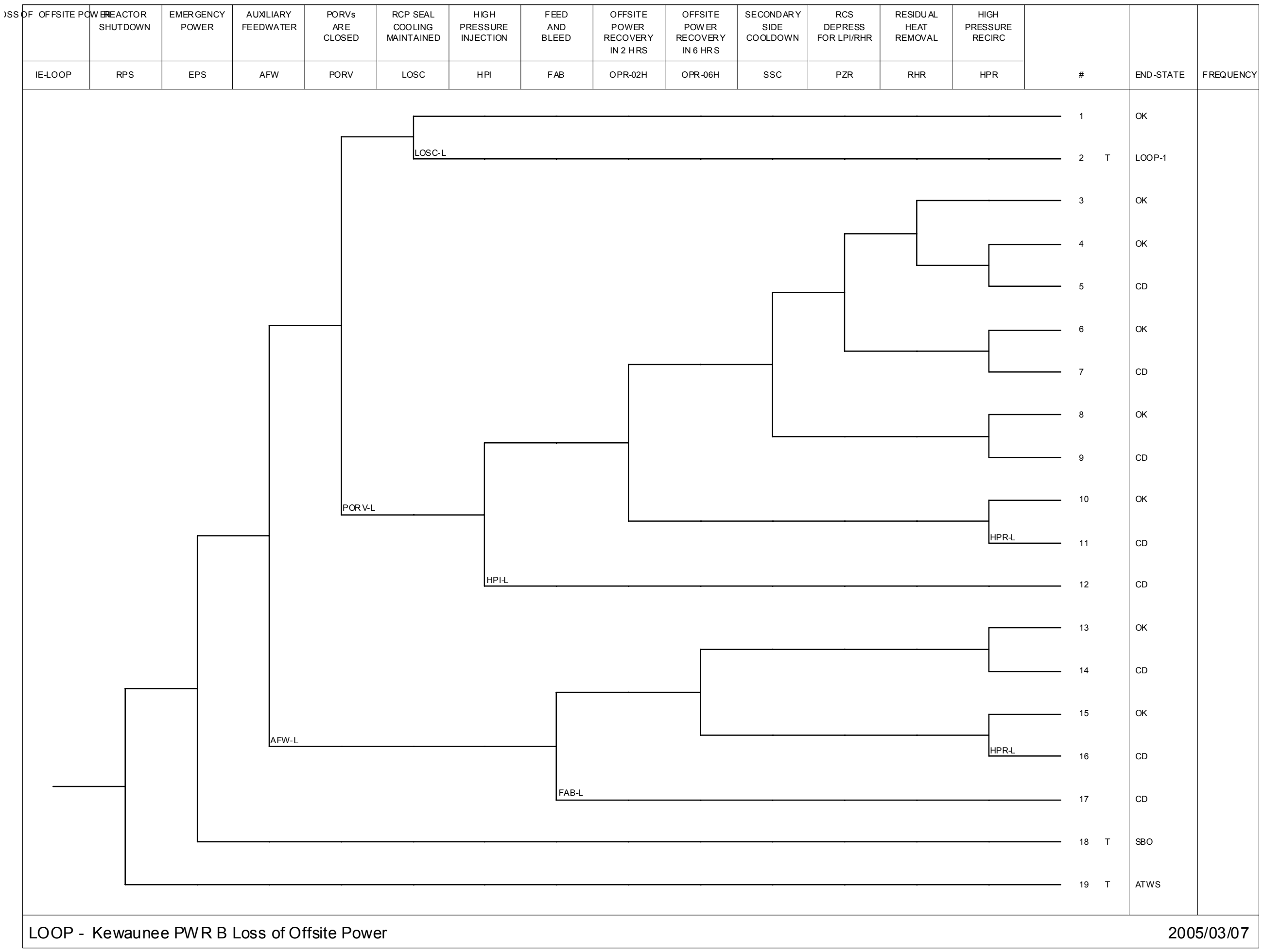


Table 4. SBO Sequences

Event tree	Sequence	Curr Freq Per Year	Base Freq Per Year	Difference	Number of Cutsets (current case)	Number of Cutsets (base case)
LOOP	18-74	4.26E-05	1.03E-06	4.15E-05	537	2163
LOOP	18-72-3	1.11E-06	3.33E-08	1.08E-06	1548	1190
LOOP	18-72-2	1.31E-07	2.23E-09	1.28E-07	4749	319
LOOP	18-46	0.00E+00	4.94E-10	-4.94E-10	1	78
LOOP	18-52	0.00E+00	2.23E-10	-2.23E-10	1	45
LOOP	18-49	0.00E+00	1.20E-09	-1.20E-09	1	82
LOOP	18-47-3	0.00E+00	6.31E-12	-6.31E-12	1	1
LOOP	18-47-2	0.00E+00	7.74E-12	-7.74E-12	1	4
LOOP	18-44-3	0.00E+00	1.10E-12	-1.10E-12	1	1
LOOP	18-43	0.00E+00	2.46E-09	-2.46E-09	1	119
LOOP	18-41-3	0.00E+00	1.26E-11	-1.26E-11	1	1
LOOP	18-41-2	0.00E+00	2.02E-11	-2.02E-11	1	8
LOOP	18-40	0.00E+00	6.01E-11	-6.01E-11	1	17
LOOP	18-38-3	0.00E+00	1.45E-12	-1.45E-12	1	1
LOOP	18-36	0.00E+00	1.15E-10	-1.15E-10	1	28
LOOP	18-65	0.00E+00	3.32E-11	-3.32E-11	1	8
LOOP	18-71	0.00E+00	9.44E-08	-9.44E-08	1	402
LOOP	18-69-3	0.00E+00	8.73E-11	-8.73E-11	1	4
LOOP	18-69-2	0.00E+00	1.68E-10	-1.68E-10	1	40
LOOP	18-68	0.00E+00	1.06E-12	-1.06E-12	1	1
LOOP	18-62	0.00E+00	3.70E-12	-3.70E-12	1	2
LOOP	18-59	0.00E+00	4.06E-11	-4.06E-11	1	10
LOOP	18-04	0.00E+00	2.25E-07	-2.25E-07	1	967
LOOP	18-12-2	0.00E+00	6.94E-10	-6.94E-10	1	98
LOOP	18-08-8	0.00E+00	1.36E-12	-1.36E-12	1	1
LOOP	18-15-2	0.00E+00	4.22E-10	-4.22E-10	1	62
LOOP	18-14	0.00E+00	2.68E-09	-2.68E-09	1	218
LOOP	18-12-7	0.00E+00	1.04E-10	-1.04E-10	1	5
LOOP	18-17	0.00E+00	1.97E-08	-1.97E-08	1	180
LOOP	18-10	0.00E+00	2.14E-07	-2.14E-07	1	945
LOOP	18-08-7	0.00E+00	1.92E-09	-1.92E-09	1	12
LOOP	18-08-2	0.00E+00	1.46E-08	-1.46E-08	1	590
LOOP	18-07	0.00E+00	2.49E-06	-2.49E-06	1	360
LOOP	18-05-3	0.00E+00	1.50E-08	-1.50E-08	1	303
LOOP	18-15-3	0.00E+00	1.82E-10	-1.82E-10	1	4
LOOP	18-25-3	0.00E+00	1.61E-11	-1.61E-11	1	1
LOOP	18-25-2	0.00E+00	2.57E-11	-2.57E-11	1	8
LOOP	18-33	0.00E+00	4.93E-10	-4.93E-10	1	53
LOOP	18-31-3	0.00E+00	8.03E-12	-8.03E-12	1	1
LOOP	18-31-2	0.00E+00	9.86E-12	-9.86E-12	1	4
LOOP	18-30	0.00E+00	2.67E-10	-2.67E-10	1	52

LOOP	18-28-3	0.00E+00	1.26E-12	-1.26E-12	1	1
LOOP	18-27	0.00E+00	1.02E-09	-1.02E-09	1	77
LOOP	18-18-2	0.00E+00	9.73E-11	-9.73E-11	1	27
LOOP	18-05-2	0.00E+00	4.22E-08	-4.22E-08	1	2243
LOOP	18-24	0.00E+00	2.85E-11	-2.85E-11	1	10
LOOP	18-22-3	0.00E+00	1.50E-12	-1.50E-12	1	1
LOOP	18-20	0.00E+00	7.12E-09	-7.12E-09	1	314
LOOP	18-18-7	0.00E+00	1.78E-11	-1.78E-11	1	3
	Sum =	4.38E-05	4.20E-06	3.96E-05	6880	11064

Table 5. SBO CDF Cutsets

Cut No.	% Total	CDF	Basic Event	Description	Event Prob.
1	19.22	8.42E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-CF-RUN	COMMON CAUSE FAILURE OF DIESEL GENERATORS TO RUN	5.73E-04
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
2	33.57	6.29E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
3	39.82	2.74E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
4	46.07	2.74E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
5	49.58	1.54E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-CF-STRT	COMMON CAUSE FAILURE OF DIESEL GENERATORS TO START	1.05E-04
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
6	53.05	1.52E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-FAN-CF-DGFS	CCF OF DGN HVAC FANS TO START	1.04E-04
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
7	56.52	1.52E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02

			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
8	59.99	1.52E-06	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
9	61.72	7.60E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-FAN-FS-DGB	DIESEL GENERATOR B HVAC FAN ROOM B FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
10	63.45	7.60E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-FAN-FS-DGA	DIESEL GENERATOR A HVAC FAN ROOM A FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
11	64.96	6.61E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
12	66.47	6.61E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01

			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
13	67.86	6.08E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-FAN-TM-DGA	DGN 1A HVAC FAN ROOM A UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
14	69.25	6.08E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-FAN-TM-DGB	DGN 1B HVAC FAN ROOM B UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
15	70.29	4.56E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-601	CIRCUIT BREAKER I-503 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
16	71.33	4.56E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-610	CIRCUIT BREAKER I-610 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
17	72.37	4.56E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-503	CIRCUIT BREAKER I-503 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
18	73.41	4.56E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-511	CIRCUIT BREAKER I-511 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01

			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
19	74.45	4.56E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-501	CIRCUIT BREAKER I-501 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
20	75.37	4.03E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-AOV-CF-301AB	CCF OF SWS MOVS 301A&B TO DGN 1A TO OPEN	2.75E-05
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
21	76.21	3.67E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
22	76.96	3.31E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-FAN-FS-DGB	DIESEL GENERATOR B HVAC FAN ROOM B FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
23	77.71	3.31E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-FAN-FS-DGA	DIESEL GENERATOR A HVAC FAN ROOM A FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
24	78.4	3.04E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01

			EPS-XHE-XR-DGAF	OPERATOR FAILS TO RESTORE DGN 1A FAN ROOM A AFTER T&M	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
25	79.09	3.04E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-1A	OP FAILS TO RESTORE DIESEL GENERATOR 1A	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
26	79.78	3.04E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-DGBF	OPERATOR FAILS TO RESTORE DGN 1B FAN ROOM B AFTER T&M	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
27	80.47	3.04E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-1B	OP FAILS TO RESTORE DIESEL GENERATOR 1B	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
28	81.09	2.74E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-AOV-CC-301B	SWS ISOLATION MOV 301B TO DGN 1B FAILS TO OPEN	9.00E-04
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
29	81.71	2.74E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-AOV-CC-301A	SWS ISOLATION MOV 301A TO DGN 1A FAILS TO OPEN	9.00E-04
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
30	82.31	2.65E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03

			EPS-FAN-TM-DGA	DGN 1A HVAC FAN ROOM A UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
31	82.91	2.65E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-FAN-TM-DGB	DGN 1B HVAC FAN ROOM B UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
32	83.36	1.98E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-601	CIRCUIT BREAKER I-503 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
33	83.81	1.98E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-610	CIRCUIT BREAKER I-610 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
34	84.26	1.98E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-503	CIRCUIT BREAKER I-503 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
35	84.71	1.98E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-511	CIRCUIT BREAKER I-511 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03

			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
36	85.16	1.98E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-501	CIRCUIT BREAKER I-501 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
37	85.6	1.93E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-CF-RUN	COMMON CAUSE FAILURE OF DIESEL GENERATORS TO RUN	5.73E-04
			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.00E-02
			/OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	4.70E-01
38	86.02	1.84E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-FAN-FS-DGB	DIESEL GENERATOR B HVAC FAN ROOM B FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
39	86.44	1.84E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-FAN-FS-DGA	DIESEL GENERATOR A HVAC FAN ROOM A FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
40	86.78	1.47E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-FAN-TM-DGA	DGN 1A HVAC FAN ROOM A UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
41	87.12	1.47E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02

			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-FAN-TM-DGB	DGN 1B HVAC FAN ROOM B UNAVAILABLE DUE TO T&M	2.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
42	87.45	1.44E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-FR-1A	DIESEL GENERATOR 1A FAILS TO RUN	2.07E-02
			EPS-DGN-FR-1B	DIESEL GENERATOR 1B FAILS TO RUN	2.07E-02
			HPI-XHE-XM-FB	OPERATOR FAILS TO INITIATE FEED AND BLEED COOLING	2.00E-02
			/OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	4.70E-01
43	87.75	1.32E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-DGAF	OPERATOR FAILS TO RESTORE DGN 1A FAN ROOM A AFTER T&M	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
44	88.05	1.32E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-1A	OP FAILS TO RESTORE DIESEL GENERATOR 1A	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
45	88.35	1.32E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			EPS-XHE-XR-DGBF	OPERATOR FAILS TO RESTORE DGN 1B FAN ROOM B AFTER T&M	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
46	88.65	1.32E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01

			EPS-XHE-XR-1B	OP FAILS TO RESTORE DIESEL GENERATOR 1B	1.00E-03
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
47	88.93	1.21E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-FAN-CF-DGFR	CCF OF DGN HVAC FANS TO RUN	8.23E-06
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
48	89.2	1.19E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-AOV-CC-301B	SWS ISOLATION MOV 301B TO DGN 1B FAILS TO OPEN	9.00E-04
			EPS-DGN-TM-1A	DIESEL GENERATOR 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
49	89.47	1.19E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-AOV-CC-301A	SWS ISOLATION MOV 301A TO DGN 1A FAILS TO OPEN	9.00E-04
			EPS-DGN-TM-1B	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE	9.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
50	89.72	1.10E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-601	CIRCUIT BREAKER I-503 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
51	89.97	1.10E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-610	CIRCUIT BREAKER I-610 TO BUS 1-6 FAILS TO OPEN	1.50E-03
			EPS-DGN-FS-1A	DIESEL GENERATOR 1A FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
52	90.22	1.10E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02

			ACP-CRB-CC-503	CIRCUIT BREAKER I-503 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
53	90.47	1.10E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-511	CIRCUIT BREAKER I-511 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
54	90.72	1.10E-07	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			ACP-CRB-CC-501	CIRCUIT BREAKER I-501 TO BUS 1-5 FAILS TO OPEN	1.50E-03
			EPS-DGN-FS-1B	DIESEL GENERATOR 1B FAILS TO START	5.00E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01
55	90.93	9.19E-08	IE-LOOP	LOSS OF OFFSITE POWER	3.59E-02
			EPS-FAN-FS-DGA	DIESEL GENERATOR A HVAC FAN ROOM A FAILS TO START	2.50E-03
			EPS-FAN-FS-DGB	DIESEL GENERATOR B HVAC FAN ROOM B FAILS TO START	2.50E-03
			EPS-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER EMERGENCY DIESEL IN 1 HOUR	7.72E-01
			OEP-XHE-XL-NR01H	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR	5.30E-01

Table 6. Change Set for SBO Current Case

Event	Calc. Type	Description
Change/Flag Set : LOOP-NO-AFW LOOP without AFW		
AFW-MDP-FR-1A	T	AFW MDP 1A FAILS TO RUN
AFW-MDP-FR-1B	T	AFW MDP 1B FAILS TO RUN
AFW-MDP-FS-1A	T	AFW MDP 1A FAILS TO START
AFW-MDP-FS-1B	T	AFW MDP 1B FAILS TO START
AFW-MDP-TM-1A	T	AFW MDP 1A UNAVAILABLE DUE TO TEST AND MAINTENANCE
AFW-MDP-TM-1B	T	AFW MDP 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE
AFW-TDP-FR-1C	T	AFW TDP 1C FAILS TO RUN
AFW-TDP-FS-1C	T	AFW TDP 1C FAILS TO START
AFW-TDP-TM-1C	T	AFW TDP 1C UNAVAILABLE DUE TO TEST AND MAINTENANCE
IE-ISL-HPI	F	ISLOCA IE 2-CKV HPI interface
IE-ISL-LPI	F	ISLOCA IE 2-CKV LPI interface
IE-ISL-RHR	F	ISLOCA IE 2-MOV RHR interface
IE-LLOCA	F	LARGE LOCA
IE-LOAC5	F	LOSS OF AC BUS 5
IE-LOAC6	F	LOSS OF AC BUS 6
IE-LOCCW	F	LOSS OF COMPONENT COOLING WATER
IE-LODCA	F	LOSS OF DC POWER BRA-104
IE-LODCB	F	LOSS OF DC POWER BRB-104
IE-LOIA	F	LOSS OF INSTRUMENT AIR
IE-LOMFW	F	Loss of Main Feedwater
IE-LOSWS	F	LOSS OF SERVICE WATER SYSTEM
IE-MLOCA	F	MEDIUM LOCA
IE-RXVRUPT	F	REACTOR VESSEL RUPTURE INITIATING EVENT
IE-SGTR	F	SGTR INITIATING EVENT
IE-SLB	F	STEAM LINE BREAK
IE-SLOCA	F	SMALL LOCA
IE-TRANS	F	TRANSIENT

Appendix A. Windowed Condition LER 305-2005-005-01

LER 305-2005-005-01 Emergency Diesel Generator Exhaust Ductwork Not Adequately Protected from Potential Tornado Winds & Missiles EDG

Condition Description:

On March 24, 2005, with unit in the refueling shutdown condition, a walk-down was being conducted in the Kewaunee Power Station (KPS) Turbine Building, as part of an evaluation of the Turbine Building response to design basis tornado winds. Sections of sheet metal panel siding on the Turbine Building are designed to blow out / blow in due to tornado wind loading, as given in Updated Safety Analysis Report (USAR) Appendix B.

However, loss of this siding would expose the Class 3 portion of the A and B Emergency Diesel Generator (EDG) exhaust ductwork to tornado wind loads. The response of the sheet metal panels would be that the ductwork could be subjected to full design basis tornado force. Exposure to tornado winds would likely result in deformation of the ductwork for each EDG. On April 19, 2005, during the evaluation to determine a resolution to the tornado wind EDG ductwork deformation problem, it was determined that the EDG exhaust ductwork was also susceptible to turbine and tornado missiles. Appendix B of the USAR evaluates turbine and tornado missiles for Class 1 portion of the EDG. It does not address how the Class 3 structures and components associated with the EDG could impact its operation if impacted by a missile. Deformation of the EDG exhaust ducts could result in some reduction of EDG capacity, due to postulated increase in exhaust backpressure. The apparent cause relative to this condition is the original design of the plant, which did not take these effects into account. Design Change Request DCR-3582 was completed and it reinforced the guides for the EDG exhaust ducts and reinforced the existing structural steel to carry the guide loads. A probabilistic evaluation of tornado missiles, utilizing the TORMIS computer program, was performed. An evaluation of the effects of turbine missiles on the 'B' EDG exhaust duct was also performed.

Licensee performed a probabilistic evaluation of tornado missiles:

The TORMIS computer program develops the probability of tornado missiles striking the modeled plant structures and other targets, using probability techniques. The NRC, in a Safety Evaluation Report dated October 26, 1983, concluded that TORMIS is an acceptable approach for demonstrating compliance with 10 CFR 50 Appendix A General Design Criteria 2, regarding 50 Appendix A General Design Criteria 2, regarding protection of safety-related plant features from the effects of tornado and high wind generated missiles.

The results of the TORMIS evaluation show the damage probability per year for the EDG exhaust vents is 4.09E-07. This probability is less than 1 E-06 per year. Per NUREG 0800, NRC Standard Review Plan, Section 3.5.1.4 – Missiles Generated by Natural Phenomena, and its associated Regulatory Guides, if the probability of a damaging missile strike is less than 1 E-06 per year, then it can be considered not credible.

The results of evaluation showed the 'B' EDG exhaust duct has sufficient turbine missile protection based on the criteria of NUREG 0800, Section 3.5.1.3. KPS has demonstrated turbine disc integrity, the turbine overspeed protection has redundancy and has been evaluated to show that it minimizes the potential for missile generation due to an overspeed condition, and a redundant EDG is available.

Analysis:

This plant condition is modeled as a severe tornado event that would cause LOOP and also fail one EDG (EDG-B).

The initiating event frequency of the severe tornado event that will damage EDG-B is calculated by the licensee as 4.1E-07/yr. For the purposes of this analysis, it is assumed that this value is optimistic by a factor of ten. Thus, the following initiating event frequency is used;

IE-TOR = 4.1E-06/yr.

Probability of EDG-B failure given IE-TOR = 1.0

Probability of LOOP given IE-TOR occurs = 1.0.

It is also postulated that the EDG-B can not be repaired, and the offsite power can not be recovered in 24 hours.

CCDP(given LOOP occurs and EDG-B fails) = 8.676E-03 (calculated from SPAR; using change set in Table A-1.)

Base line CDP for this event with EDG-B available is assumed to be negligible (conservative assumption).

ΔCDP = Plant condition importance for a 8760-hour exposure time
= CDP of plant condition

ΔCDP = 4.1E-06 * 8.676E-03 = **4 E-08.**

Conclusion: Since ΔCDP is considerably less than the ASP acceptance criteria of 1.0E-06, this LER need not be kept in the ASP data base.

Table A-1. Change set used for CCDP calculation

Change Set for 2005-005-01 Tornado with LOOP + loss of EDG B - CDP

Event	Calc. Type or Probability	Description
		Tornado with LOOP + loss of EDG B - CDP
EPS-DGN-TM-1B	T	DIESEL GENERATOR 1B UNAVAILABLE DUE TO TEST AND MAINTENANCE
EPS-XHE-XR-1B	T	OP FAILS TO RESTORE DIESEL GENERATOR 1B
IE-ISL-HPI	F	ISLOCA IE 2-CKV HPI interface
IE-ISL-LPI	F	ISLOCA IE 2-CKV LPI interface
IE-ISL-RHR	F	ISLOCA IE 2-MOV RHR interface
IE-LLOCA	F	LARGE LOCA
IE-LOAC5	F	LOSS OF AC BUS 5
IE-LOAC6	F	LOSS OF AC BUS 6
IE-LOCCW	F	LOSS OF COMPONENT COOLING WATER
IE-LODCA	F	LOSS OF DC POWER BRA-104
IE-LODCB	F	LOSS OF DC POWER BRB-104
IE-LOIA	F	LOSS OF INSTRUMENT AIR
IE-LOMFW	F	Loss of Main Feedwater
IE-LOOP	1.0	LOSS OF OFFSITE POWER
IE-LOSWS	F	LOSS OF SERVICE WATER SYSTEM
IE-MLOCA	F	MEDIUM LOCA
IE-RXVRUPT	F	REACTOR VESSEL RUPTURE INITIATING EVENT
IE-SGTR	F	SGTR INITIATING EVENT
IE-SLB	F	STEAM LINE BREAK
IE-SLOCA	F	SMALL LOCA
IE-TRANS	F	TRANSIENT
OEP-XHE-XL-NR01H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 1 HOUR
OEP-XHE-XL-NR02H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 2 HOURS
OEP-XHE-XL-NR03H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 3 HOURS
OEP-XHE-XL-NR04H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 4 HOURS
OEP-XHE-XL-NR05H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 5 HOURS
OEP-XHE-XL-NR06H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 6 HOURS
OEP-XHE-XL-NR07H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 7 HOURS
OEP-XHE-XL-NR08H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 8 HOURS
OEP-XHE-XL-NR09H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 9 HOURS
OEP-XHE-XL-NR10H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 10 HOURS
OEP-XHE-XL-NR10H2	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 10 HOURS (GIVEN FAILURE AT 2)
OEP-XHE-XL-NR10H4	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 10 HOURS (GIVEN FAILURE AT 4)
OEP-XHE-XL-NR11H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 11 HOURS
OEP-XHE-XL-NR12H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 12 HOURS
OEP-XHE-XL-NR13H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 13 HOURS
OEP-XHE-XL-NR14H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 14 HOURS
OEP-XHE-XL-NR150M	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 2.5 HOURS
OEP-XHE-XL-NR15H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 15 HOURS
OEP-XHE-XL-NR16H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 16 HOURS
OEP-XHE-XL-NR17H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 17 HOURS

Event	**Calc. Type or Probability**	**Description**
OEP-XHE-XL-NR18H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 18 HOURS
OEP-XHE-XL-NR19H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 19 HOURS
OEP-XHE-XL-NR20H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 20 HOURS
OEP-XHE-XL-NR21H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 21 HOURS
OEP-XHE-XL-NR22H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 22 HOURS
OEP-XHE-XL-NR23H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 23 HOURS
OEP-XHE-XL-NR24H	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 24 HOURS
OEP-XHE-XL-NR30M	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 30 MINUTES
OEP-XHE-XL-NR90M	T	OPERATOR FAILS TO RECOVER OFFSITE POWER IN 90 MINUTES

Appendix B. Windowed Condition LER 305-2005-007-00

LER 305-2005-007-00 Unanalyzed Condition : Design Deficiency - CCW System Inoperable Due to Pump "RunOut" Conditions

Condition Description:

On March 28, 2005 with the plant in Refueling Shutdown Mode, a past operability concern was identified with the plant's Component Cooling Water (CCW) System . Specifically, on January 23, 2002, plant personnel identified a potential "run out" concern with the CCW pumps. The condition assumed CCW being aligned to both Residual Heat Removal (RHR) heat exchangers and both CCW pumps running . If a loss of power caused the loss of one CCW train and the associated train's isolation valve to the RHR heat exchanger could not be closed, there would be a potential concern with pump "run out" and pump damage for the CCW pump that continued to run.

The pump "run-out" concern was determined to be an original plant design issue and was initially resolved by isolating the non-safeguards loads on the CCW system and installing a valve position limiter on a non-critical CCW system flow control valve.

Isolation of the non-safeguards loads on the CCW system and the installation of the valve position limiter on a non-critical CCW system flow control valve were completed approximately 49.75 hours from the time the potential concern was identified . The valve position limiter that was installed was proven effective upon the completion of special operating procedures which verified by testing that a single CCW pump would not experience "run-out" flow conditions when all CCW safeguards loads, including both trains of RHR heat exchangers were supplied by a single CCW pump.

Analysis:

This plant condition is modeled as follows for an 8760 hour exposure time:

- Any random event occurs during a year;
- Both CCW trains are assumed operational at the same time (conservative assumption);
- One CCW train fails to run (2* 2.413E-03; used CCW-1-TR-SS fault tree))
- Operator fails to close isolation valve for the failed CCW train (HEP = 0.1; screening value).
- Second running CCW pump fails due to runout (probability = 1)
- plant CDF from any one of the random initiating events when both CCW pumps fail (1.873E-03; calculated by SPAR using a change set).

The failure of a CCW train is modeled by using the fault tree named CCW-1-TR-FAILS-SS (see Figure B-1). This fault tree is made by copying and trimming the existing CCW-A fault tree. The fault tree quantification gives 2.413E-03 and each running train can fail by the same probability;

thus a factor of 2 is used.

The closure of the isolation valve for the failed CCW train is assumed to be an operator action. A screening value of 0.1 is used for the operator to diagnose that one of the two running CCW pumps failed and that the operator closes the isolation valve before the second running pump fails.

CDF(given both CCW pumps fail during any random event during a year) = 1.873E-03 (calculated from SPAR; using change set in Table B-1; 43811 cutsets).

Base line CDP for this event with second CCW pump not subject to runout failure mode is assumed to be negligible (conservative assumption).

ΔCDP = Plant condition importance for a 8760-hour exposure time
= CDP of plant condition

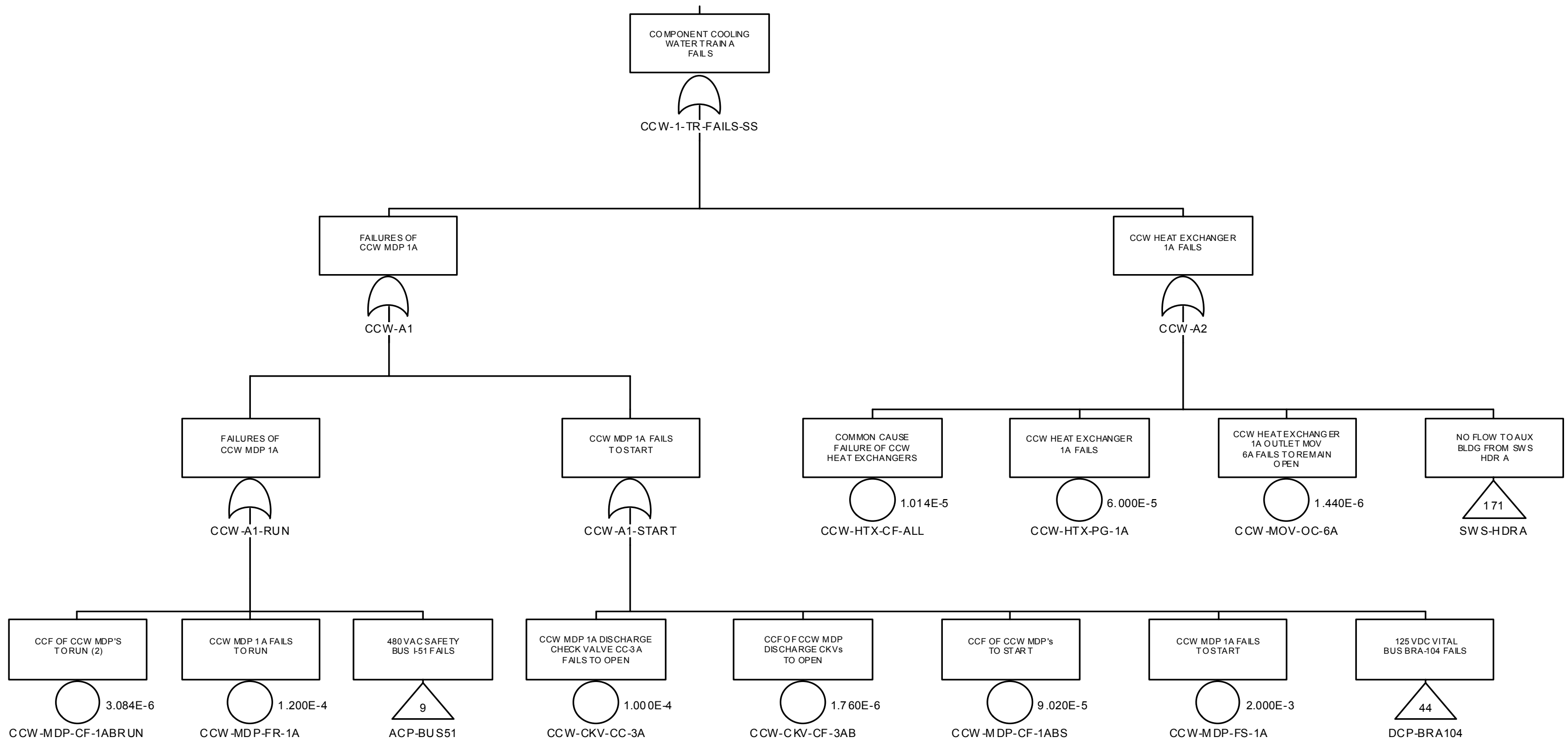
ΔCDP = (2 * 2.413E-03) *(0.1) * (1.873E-03) = **9 E-07.**

Conclusion: The bounding CCDP is below but very close to the ASP acceptance threshold of 1E-06. However, there are conservatisms in the analysis, such as both CCW pumps running in all events, the screening HEP value, and ignoring the base CDP. Thus, a best estimate plant condition may be expected to be lower than the calculated bounding value. Since the ΔCDP is less than the ASP acceptance criteria of 1.0E-06, this LER need not be kept in the ASP data base.

Interaction with other windowed events: The other windowed events, such as the ones related to AFW pumps and the one for internal flooding are dominated by failure of operator actions, with some residual contribution from component failures. Thus, superimposing this CCW condition on the other plant conditions would make very small impact on the overall importance, other than an additive manner.

Normally, both CCW trains are not expected to run during normal power operation. Thus, this condition is not deemed to be a significant contributor to the initiating event frequency of total loss of CCW system.

Figure B-1 Fault Tree CCW-1-TR- FAILS-SS



CCW-1-TR-FAILS-SS - COMPONENT COOLING WATER TRAIN A FAILS 2006/06/05 Page 182

Table B-1 Change Set for Calculating CDF When CCW Fails

Change Set used in 2005-007-00 Condition with both CCW pumps failed

Event	Calc. Type	Description
CCW-MDP-CF-1ABRUN	T	CCF OF CCW MDP'S TO RUN (2)
CCW-MDP-CF-1ABS	T	CCF OF CCW MDP's TO START
CCW-MDP-FR-1A	T	CCW MDP 1A FAILS TO RUN
CCW-MDP-FR-1B	T	CCW MDP 1B FAILS TO RUN
CCW-MDP-FS-1A	T	CCW MDP 1A FAILS TO START
CCW-MDP-FS-1B	T	CCW MDP 1B FAILS TO START
CCW-MDP-TM-1A	T	CCW MDP 1A UNAVAILABLE DUE TO T&M
CCW-MDP-TM-1B	T	CCW MDP 1B UNAVAILABLE DUE TO T&M

Appendix C. Seismic Model and Calculations

Modeling Assumptions:

1 AFW pump failures. Two cases are considered:

i) All three AFW pumps fail non-recoverably if CST fails due to a seismic event
ii) Two MDPs fail with a probability of 0.2; TDP fails, if CST fails due to a seismic event.

2 Failure of AFW forces operators to implement feed and bleed (F/B), and eventually switchover to sump recirculation (REC). Failure of these functions are dominated by the operator errors.

Two cases are considered:

i) HEPs are the same as internal events (0.02 + 0.002 = 0.022).
ii) HEPs are higher by a factor of 2 and 4, respectively, in seismic bins 2 and 3.

3 CST HCLPF is low: it is assumed to be the same as the ceramic insulators. However, its failures in each seismic bin are considered to be independent of ceramic insulators.

4. Three seismic bins, already defined in the KEWA-EE-312 are used. The initiating event frequencies of these bins are:

EQK-BIN-1	0.05-0.3 g	2.84E-04/year
EQK-BIN-2	0.3-0.5 g	1.26E-05/year
EQK-BIN-3	> 0.5 g	7.21E-06/year
	Total =	3.04E-04/year

5. The failure probability of CST due to a seismic event in each bin is given as :

EQK-BIN-1	0.05-0.3 g	2.77E-02
EQK-BIN-2	0.3-0.5 g	5.72E-01
EQK-BIN-3	> 0.5 g	8.99E-01

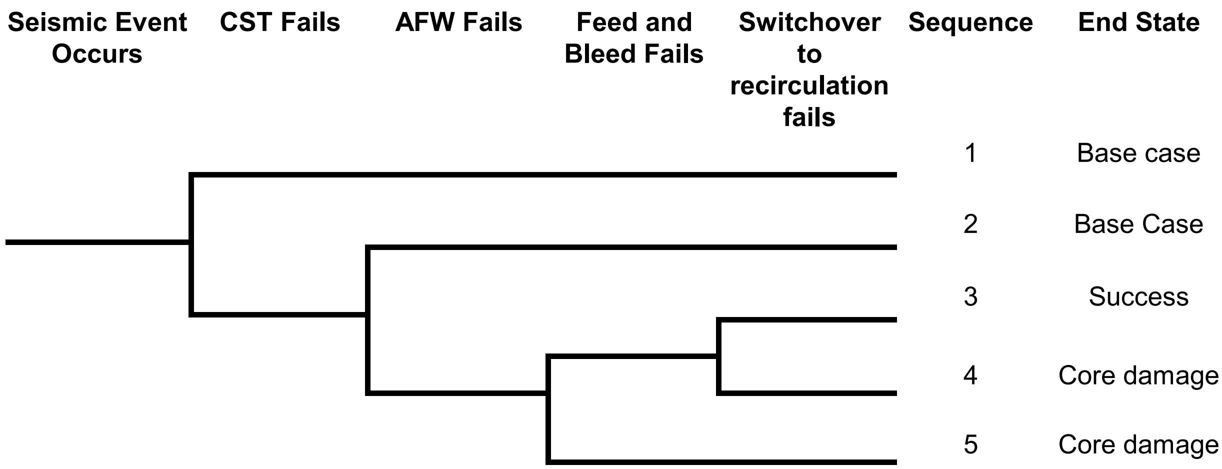
These failure probabilities are based on the HCLPF value assumed in 3.

An event tree model, using the dominant sequences idnetified in the base case is constructed and is given in Figure C-1. This even tree model identifies sequences 4 and 5 as the core damage sequences for the plant condition case. This model applies to each seismic event bin modeled in the KEWA-EE-321 model (Reference 5).

An example of CDF quantification is given in Figure C-1a for case 1 for EQK-BIN-1.

The CDF for four cases are calculated as shown in Table C-1. The four cases are also defined in Table C-1.

Figure C-1 Event Tree Model Depicting CDF calculation for Plant Condition



Sum of sequence 4 and 5 is calculated in Table 1 for each seismic bin.

For example, for case 1 for bin 1, the calculation is as follows:

Figure C-1a.

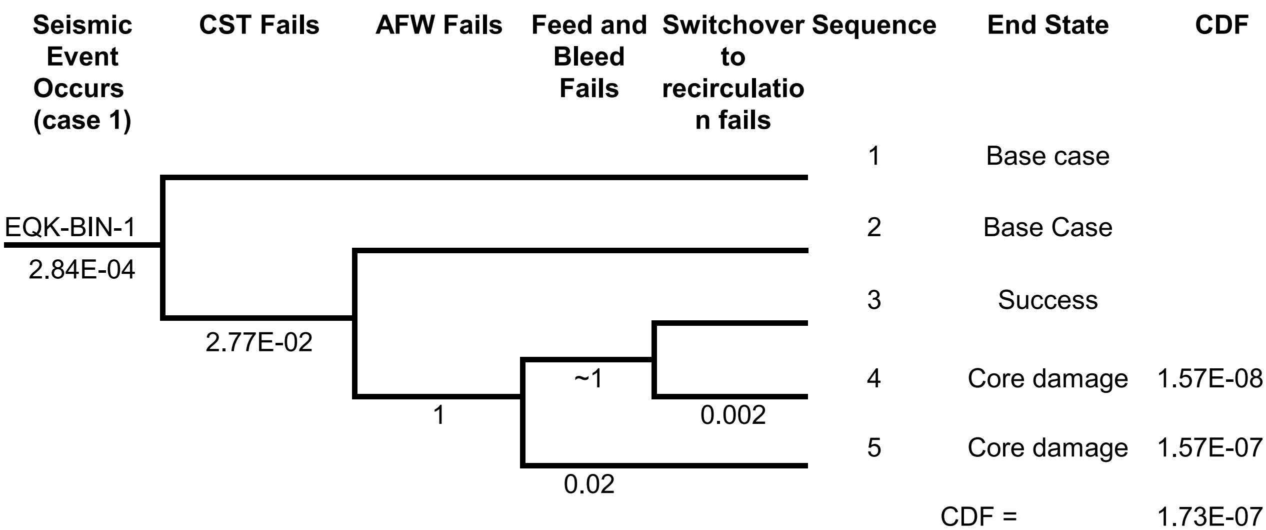


Table 1 Calculation of Seismic Contribution to AFW Plant Condition

Case I. All three AFW pumps fail, if CST fails. F/B and REC HEPs are the same as internal events

Seismic Scenario		SE Occurs	CST Fails	AFW Fails	F/B or REC Fail	CDF
EQK-BIN-1	0.05-0.3 g	2.84E-04	2.77E-02	1	2.20E-02	1.73E-07
EQK-BIN-2	0.3-0.5 g	1.26E-05	5.72E-01	1	2.20E-02	1.58E-07
EQK-BIN-3	> 0.5 g	7.21E-06	8.99E-01	1	2.20E-02	1.43E-07
	Sum =	3.04E-04				4.74E-07

Case II. All three AFW pumps fail, if CST fails. F/B and REC HEPs are larger for seismic bins 2 and 3.

Seismic Scenario		SE Occurs	CST Fails	AFW Fails	F/B or REC Fail	CDF
EQK-BIN-1	0.05-0.3 g	2.84E-04	2.77E-02	1	2.20E-02	1.73E-07
EQK-BIN-2	0.3-0.5 g	1.26E-05	5.72E-01	1	4.40E-02	3.17E-07
EQK-BIN-3	> 0.5 g	7.21E-06	8.99E-01	1	8.80E-02	5.71E-07
	Sum =	3.04E-04				1.06E-06

Case III. MDPs fail with 0.2 probability, if CST fails. F/B and REC HEPs are the same as internal events

Seismic Scenario		SE Occurs	CST Fails	AFW Fails	F/B or REC Fail	CDF
EQK-BIN-1	0.05-0.3 g	2.84E-04	2.77E-02	0.2	2.20E-02	3.46E-08
EQK-BIN-2	0.3-0.5 g	1.26E-05	5.72E-01	0.2	2.20E-02	3.17E-08
EQK-BIN-3	> 0.5 g	7.21E-06	8.99E-01	0.2	2.20E-02	2.85E-08
	Sum =	3.04E-04				9.48E-08

Case IV. MDPs fail with 0.2 probability, if CST fails. F/B and REC HEPs are larger for seismic bins 2 and 3.

Seismic Scenario		SE Occurs	CST Fails	AFW Fails	F/B or REC Fail	CDF
EQK-BIN-1	0.05-0.3 g	2.84E-04	2.77E-02	0.2	2.20E-02	3.46E-08
EQK-BIN-2	0.3-0.5 g	1.26E-05	5.72E-01	0.2	4.40E-02	6.33E-08
EQK-BIN-3	> 0.5 g	7.21E-06	8.99E-01	0.2	8.80E-02	1.14E-07
	Sum =	3.04E-04				2.12E-07